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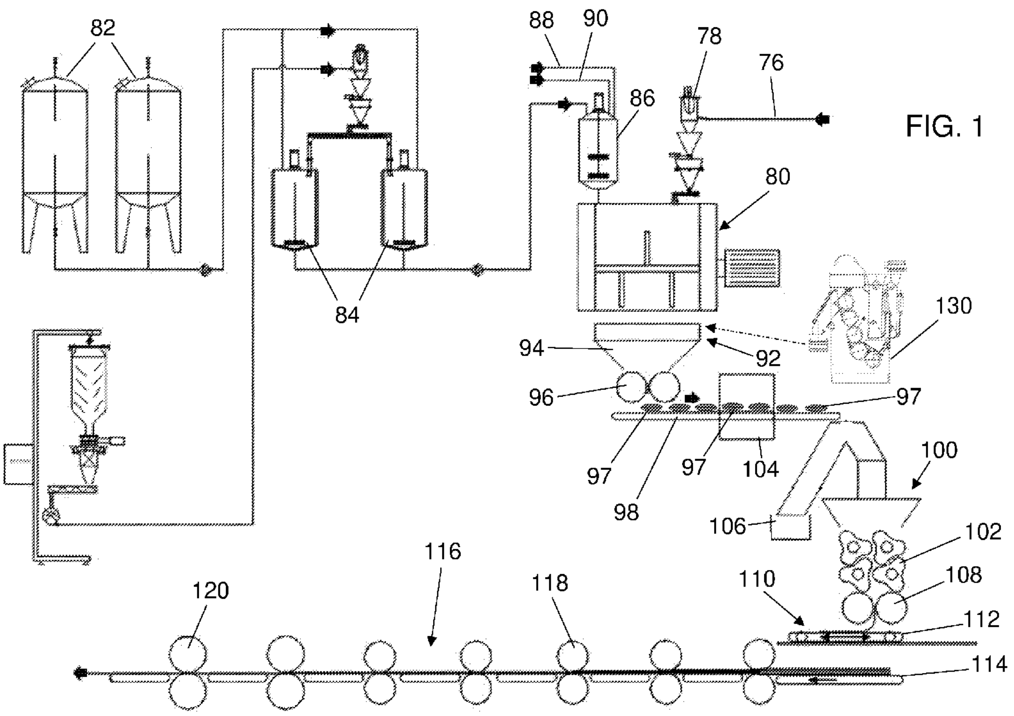


FIG. 1

(57) Abstract: Method for producing reconstituted tobacco characterized in that: -the solid components of tobacco are comminuted to bring them to a particle size of about 20 - 220 µm, preferably about 80-180 µm, -the comminuted product thus obtained is mixed with water, at least one binding agent and at least one material to form an aerosol until a mixture with a liquid content of about 30-50%, preferably about 35-40%, is obtained. -said mixture is subjected to a first lamination in order to obtain a strip of continuous thickness of about 1-20 mm, preferably about 1 -10 mm, -said strip, already subjected to said first lamination, is subjected to a series of further rolling passages, to obtain a strip having a substantially constant thickness of approximately 90 - 280 µm, preferably about 140- 200 µm, -said strip is dried to bring its liquid content to about 8-15 %.

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# METHOD AND PLANT FOR THE PRODUCTION OF RECONSTITUTED TOBACCO.

The present invention relates to a method and a plant for producing reconstituted tobacco, both of the conventional type and of the non-conventional type, the latter also referred to as H N B (Heat Not Burn).

In general, the reconstituted tobacco is obtained by using tobacco by-products and processing waste (ribs, small pieces of leaves, dust, etc.) which, properly shredded until they are practically reduced to powder and mixed with water, glycerine binders and other liquid additives, allow to obtain an extremely fluid mixture (slurry) having a liquid content of about 70% by weight, which is then poured into a veil on a steel belt and with this transferred into a drying oven. Here the evaporation of the liquid fraction of the mixture takes place, so that the solid residue forms a sort of continuous tobacco strip having approximately the same width as the steel belt. Subsequently the strip of dried mixture is separated from the steel belt and is cut into pieces of various sizes depending on the request. These pieces are then transformed into thin filaments which, suitably mixed, are fed to a conventional packaging machine for cigarettes.

Depending on the raw materials used and, in particular, depending on whether tobacco products shredded to a particle size comprised between 50 µm and 120 µm, or chopped tobacco leaves having sizes included between 5 and 10 mm are used, the reconstituted tobacco is distinguished as conventional or unconventional.

WO 2016/050469, WO 2016/050470, WO 2016/050471, WO 2016/050472 describe known techniques of production of reconstituted tobacco, which require plants of considerable size and involve high energy consumption to bring the mixture, which when it is produced is rather fluid, to the consistency of a tobacco sheet. It is sufficient to point out that a drying oven can reach 100 m in length.

Another drawback of the known techniques of production of reconstituted tobacco with the use of the by-products consists in the fact that the formation of the sheet starting from the layer of mixture is rather irregular, since the starting products are not homogeneous and their distribution on the steel belt is not uniform; it follows that the reconstituted tobacco sheet does not allow it to be reeled, nor to be cut regularly.

The object of the invention is to eliminate these drawbacks and to produce reconstituted tobacco of both conventional and unconventional types, with implants of much smaller dimensions.

Another object of the invention is to produce reconstituted tobacco with limited energy consumption.

Another object of the invention is to produce reconstituted tobacco using equipment partly already available on the market, even if never used in this specific technical field.

Another object of the invention is to produce reconstituted tobacco which is alternative to traditional methods.

Another object of the invention is to produce reconstituted tobacco with characteristics suitable for satisfying different market demands.

Another object of the invention is to produce reconstituted tobacco operating at low temperature and thus preserving all the aromas of tobacco.

All of these objects and others which will become apparent from the following description are attained, according to the invention, with a reconstituted tobacco production method according to claim 1 and with a plant according to claim 16.

In particular, the method according to the invention for producing reconstituted tobacco is characterized in that it comprises the carrying out, in sequence, of the following steps:

– the solid components of tobacco are comminuted until they reach a granulometry of about 20 - 220 μm, preferably about 80-180 μm,

- the comminuted product thus obtained is mixed with water, at least one binding agent and at least one material to form an aerosol until a mixture with a liquid content of about 30-50%, preferably about 35-40%, is obtained,
- said mixture is subjected to a first lamination to obtain a continuous strip having a thickness of about 1-20 mm, preferably of about 1-10 mm,
- said strip already subjected to the said first rolling is subjected to a series of further rolling passages, until a strip having a substantially constant thickness of about 90 - 280 μm, preferably about 140-200 μm, is obtained;
- said strip is dried to bring its liquid content to about 8-15%.

The present invention is further clarified hereinafter in some of its preferred embodiments which are given purely by way of a non-limiting example with reference to the accompanying drawings, in which:

Figure 1 shows in a schematic general view a plant for the production of reconstituted tobacco according to the invention,

Figure 2 shows its power supply section in the case that the plant is intended for the production of reconstituted tobacco of the conventional type,

Figure 3 shows its power supply section in the case the plant is intended for the production of reconstituted tobacco of the unconventional (HNB) type,

Figure 4 shows its feeding section of the ribs,

Figure 5 shows its milling mixing and storage sections,

Figure 6 shows in a schematic view its refiner displacements,

Figure 7 shows a plane view of its layering section in a different embodiment,

Figure 8 shows in a schematic view its hot air drier, and

Figure 9 shows in a schematic view its hot air drier in a different embodiment.

As can be seen from the figures, the plant for producing reconstituted tobacco according to the invention comprises several sections arranged in series and aimed at operating on the input raw materials until they are transformed into a continuous strip of reconstituted tobacco to be sent for subsequent packaging operations of the cigarettes.

In particular, the plant according to the invention for the production of reconstituted tobacco comprises:

- a comminution unit of the solid components of tobacco, to bring them to a granulometry of about 20 - 220 µm, preferably of about 80-180 µm; advantageously, said comminution unit comprises a mill 20 (preferably cryogenic) and/or a grinder 24 and/or a hammer mill 54;
- a kneading machine 80 which is fed with metered quantities of comminuted material, with water, with at least one binding agent and with at least one material to form an aerosol; said kneading machine being configured to obtain a mixture with a liquid content of about 30-50%, preferably about 35-40%,
- a first lamination unit 100 for obtaining from said mixture a continuous strip having a thickness of about 1-20 mm, preferably of about 1-10 mm,
- a rolling line 116 located downstream of said first lamination unit 100 to carry said continuous strip to a thickness of about 90-280 µm, preferably about 140-200 µm,
- a drier 122, placed downstream of said rolling line 116, to bring the liquid content of said strip, laminated and coming out from said rolling line 116, to about 8-15%.

Advantageously, the plant 1 also comprises a mixture forming unit 92 for forming a plurality of portions 97 of said mixture; suitably, therefore, the first lamination unit 100 is configured to obtain, from the portions 97 of said mixture, a continuous strip having a thickness of about 1-20 mm, preferably of about 1-10 mm.

Preferably, the plant according to the invention comprises:

- a pre-treatment section of the starting solid products (tobacco leaves, ribs, fragments of leaves, powder, etc.) for the preparation thereof to subsequent grinding treatments,
- a milling and storage section awaiting subsequent mixing with suitable treatment liquids; suitably, said milling section comprises said comminution unit,
- a kneading section of solid and liquid materials to obtain a homogeneous mixture of a rather dense consistency,
- a section for transforming the mixture, and in particular for a plurality of portions of said mixture, in a continuous strip,
- a continuous strip rolling line for its reduction to the desired final thickness,
- a section for drying the laminated strip.

Conveniently, the section for preparing and pre-treating the starting solid products is different depending on whether the implant is intended to produce reconstituted conventional tobacco (fig. 2) or non- conventional type (fig. 3). In addition, advantageously, it may be provided also a section of preparation and pre-treatment of the tobacco ribs (fig. 4), to be used for the production of reconstituted tobacco both conventional type that unconventional type.

Advantageously, in the case in which the preparation and pre-treatment section is intended to supply a plant for the production of reconstituted tobacco of the conventional type (fig. 2), it includes a tilter 2 of cartons containing tobacco products, to overturn their contents on a feeder 4 of a vibrating conveyor 6, which separates any heavy bodies from the product to be treated. The heavy bodies are collected in a suitable container 8, while the product to be treated is transferred, through a pneumatic conveyor line 10, to a cyclone 12, a conveyor belt 14, provided with metal detector 16 for the removal of any metal bodies, and a pneumatic conveying line or 18, to a mill 20, advantageously of the cryogenic type.

Advantageously, in the case in which the preparation and pre-treatment section is provided for the preparation of reconstituted tobacco of an unconventional type (fig. 3), it comprises a feeding station with a counter 22 for unloading the bales of tobacco leaves from cartons of approximately 200 kg, which typically contain them, and the transfer of these to a grinder 24.

Suitably, the output of this grinder 24 is connected, through a pneumatic conveying line 26, to a cyclone 28, in which the transport air is separated from the solid product, which is transferred to a vibrating sieve 30 for the separation of the fine parts from the remaining parts of the product. The output of the fine parts is directly connected with the cryogenic mill 20, while the output of the remaining parts of the product feeds a conventional twine remove machine 32, which provides for eliminating any twine previously not removed from the bales of tobacco leaves.

The exit of the twine remove machine 32 feeds a separation chamber 34 for the separation of any heavy foreign bodies from the ground tobacco leaves, which through a pneumatic conveyor line 36, a cyclone 38, a strip conveyor 40, provided with metal detectors 42 for removing any metal bodies, and a pneumatic conveyor line 44, are transferred to the cryogenic mill 20.

Advantageously, in the case in which the preparation and pre - treatment section is provided for the preparation of the tobacco ribs to be used for the production of reconstituted tobacco of both the conventional and the non-conventional type (Fig. 4), it comprises a tipper 46 for cartons containing the ribs of tobacco, feeder 48 for the ribs to a vibrating conveyor 50, for the separation from these of any heavy bodies, and a pneumatic transport line 52 for their movement to a hammer mill 54, where they are comminuted.

The hammer mill 54 has its output connected, via a pneumatic conveyor line 56 provided with cyclone filters 58, to one or more storage silos 60.

The output of the of the storage silo or silos 60 is in turn connected, by means of a screw conveyor 62, to a metering device 64, which provides for dosing the shredded ribs before sending them to the mill 20, preferably cryogenic, through a pneumatic line of transport 66.

As mentioned above, the plant according to the invention also includes the mill 20 (Fig. 5), which carries out the grinding of various products received to bring them to an average particle size of about 20 - 220 µm, preferably about 80-180 µm.

Various types of mills can be used, although it is more advantageous to use a cryogenic rungs mill, which allows the product to be kept at low process temperatures and therefore to retain tobacco aromas.

The pinned-disk mill is in itself conventional and includes a closed structure with inside a fixed and a rotating disc or two counter-rotating discs, provided with rungs facing and partially interpenetrating each other. Being an apparatus in itself traditional, it has been globally indicated with 20 in fig. 5 but is not shown in its internal construction characteristics or in its operating modes.

Preferably, the rungs mill 20 is predisposed to make a cryogenic grinding, namely a grinding in the presence of liquid nitrogen.

As mentioned, in a plant for the production of reconstituted tobacco, a cryogenic pin mill is somewhat more advantageous than a traditional mill, essentially due to the different ways in which the products to be ground are treated. In fact, grinding at room temperature can lead to obtaining products of poor quality, while grinding in the presence of liquid nitrogen preserves the physical properties and the chemical and organoleptic characteristics of the products.

The amount of liquid nitrogen used in cryogenic grinding processes is a fundamental part to consider when the pros and cons of the process are studied and may vary depending on the materials processed. The liquid nitrogen at a temperature of -175°C is injected onto the product inside the chamber of a screw conveyor 68 which feeds the mill 20 and its residence time in contact with nitrogen is about 2 to 5 sec., which is also the transit time of the product inside the cochlea that feeds the pin mill. The temperature of the product coming out of the mill 20 is advantageously less than 10°C, in a way that the nitrogen vapours, which are released almost instantaneously upon contact with the tobacco to be cooled, travel upstream all of mill feed system, performing the desired pre-cooling effect. The flow of liquid nitrogen in the precooling system and the mill is controlled by thermocouples, that make the cryogenically grinding process fully automatic.

In summary, the positive factors of cryogenic grinding are:

- higher yields,
- better quality of the final product without breaking or tearing the molecular structure,
- reduction of the needed energy,
- better quality of the final product,
- lower amount of waste due to overheating and to oxidation,
- more homogeneous and finer final product,
- lower amount of material to be reprocessed in the grinding system.

Suitably, the output of the rungs cryogenic mill 20 is connected to a fluidized sieve bed 70, which has the function of separating the ground product, which exits from the mill itself and typically has an average particle size of about 20 - 220 µm, preferably about 80-180 µm, from particles of larger sizes, inevitably present.

Suitably, the sieve with a fluidized bed therefore has the function of sorting the product and put back into the cycle in the mill 20 the one with fractions greater than 120 µm, after having them separated from those comprised between 20 µm and 120 µm, that through a line of pneumatic conveying 72 are sent to one or more mixing and storage silos 74.

Advantageously, the output of the of mixing and storage silos 74 feeds, via a pneumatic transport line 76, and a cyclone filter 78, which has the function of breaking down the dusty air and more specifically to separate the dust, which then is recovered and fed back into the cycle, from the air, which can then be ejected.

Conveniently, the output of the cyclone filter 78 feeds, through a continuous dosing system, preferably with a screw, the kneader 80, which can be of various types, for example of a horizontal type with overturning or a vertical spiral type.

The kneading machine 80 is fed with a quantity of minced tobacco, water, at least one binding agent and at least one material to form an aerosol and is configured to obtain a mixture with a liquid content of about 30-50%, preferably by about 35-40%.

In particular, the values of liquid or humidity, indicated in the present description, are intended to be determined according to the measurement system on a wet basis. In particular, the humidity values are defined as the percentage of water contained in the total mass of the corresponding product and, in other words, it is the percentage ratio between the quantity of water and the total mass of the mixture. Suitably, these values are obtained using the traditional methods provided in the literature for measuring the quantity of water in a product, such as those presented in “Tobacco Moisture, Water and Oven Volatiles - A status report of common moisture methods used within the tobacco industry” By Nils Rose ET AL. in "Analytical and bioanalytical chemistry" (1 July 2014, pages 1-16).

Preferably, to kneader 80 is headed at least a duct or water inlet, of a material for the formation of aerosols (e.g. glycerine) and at least one binding agent (binder). Conveniently, one or more inlet ducts can be provided for other additives required by the particular recipe to be prepared.

More particularly, the system includes one or more tanks 82 for the storage of material for the formation of aerosols and one or more pre-mixers 84, in which can be entered said material for the formation of aerosols and, preferably, a plurality of additives dosed in the right proportions to form the liquid to be introduced into the mixer 80.

Examples of preferred materials for the formation of the aerosol (and in particular for the formation of a visible aerosol) include polyhydric alcohols (e.g. Glycerol, propylene glycol, triethylene glycol and tetraethylene glycol), aliphatic esters of mono-, di- or poly-carboxylic acids (e.g. Methyl - stearate, dimethyl - dodecandioate and dimethyl - tetradecandioate), as well as mixtures thereof. Suitably, glycerine, propylene glycol, triethylene glycol and tetraethylene glycol can be mixed together to form an aerosol forming material. The aerosol forming material can also be supplied as a portion of the binding agent (e.g., when the binding agent is alginate propylene glycol). Advantageously, suitable combinations of materials for the formation of the aerosol can also be provided.

Preferably, said at least one agent and a binder comprises at least one of hydroxypropyl cellulose, hydroxypropyl methylcellulose, hydroxyethyl cellulose, microcrystalline cellulose, methylcellulose, carboxymethylcellulose (CMC), corn starch, potato starch, guar gum, carob seed flour, pectins and alginates (for example ammonium alginate and sodium alginate).

Advantageously, the output of the pre-mixer the 84 is connected with the input of a hydrator 86, having other inputs connected with a line 88 of water and with a supply line 90 to supply compressed air.

Preferably, the output of the mixer 80 feeds to the forming units 92 the mixture to obtain a plurality of portions 97, preferably conformed to breads/loaves and separated from each other. Suitably, the forming unit 92 includes a pair of forming rollers 96, presenting grooves preferably parallel to the axis of cylinders and configured to pick up the incoming mixture and to output the portions 97. Advantageously, the forming unit 92 is also configured to perform a roughing mixture and for this purpose, preferably, comprises a hopper 94 provided with a break lumps in its interior and of said pair of forming rollers 96 on the bottom.

Advantageously, at the exit from the forming unit 92 a conveyor belt 98 is provided for transferring the portions 97 to the first lamination unit 100.

Preferably, the first lamination unit 100 comprises a lobed feeder 102.

Advantageously, along the transfer path from the forming unit 92 to the lobed feeder 102 may be provided a further metal detector 104, whose function is to remove any metal parts, that may still be present in the mixture and may damage the subsequent processing units. These metal parts are conveyed along a distinctive path to the inlet of the lobed feeder 102 and are collected within a suitable container 106.

The lobed feeder 102 comprises a series of feeding lobed rollers, between which are conveyed the portions 97 (which come from the forming rollers 96 of the forming unit 92) so as to push them between a displaced couple of rolling cylinders 108, which are configured so as to form a continuous strip having a thickness of about 1-20 mm, preferably of about 1-10 mm.

Suitably, in a version not represented of the plant, the rolling line 116 may be provided directly downstream of the lobed feeder 102. In particular, in this case, the rolling line receives the continuous strip input, having thickness of about 1-20 mm, preferably of about 1-10 mm, which exits from the first lamination unit 100 provided in the lobed feeder 102.

Advantageously, downstream of the first lamination unit 100 and upstream of the rolling line 116, a stratification unit 110 can be provided. Preferably, it is configured to lay out the continuous single-layer strip, having a thickness of about 1-10 mm, which comes out of the first lamination unit 100, on several layers, so as to transform it into a multilayer strip having a thickness of about 2-20 mm., which is then sent to the rolling line 116.

Preferably, said stratification unit 110 consists of an upstream conveyor belt 112, which has the function of depositing on a lower downstream conveyor belt 114, preferably belonging to the rolling line 116, the product strip arranging it so that it is stratified on said downstream conveyor belt 114, for example folding it several times on itself. Preferably, the upstream conveyor belt 112 is raised above the downstream conveyor belt 114 and is provided with a continuous advancement movement with respect to its supporting structure, and at the same time with a reciprocating motion with its supporting structure, parallel to the its longitudinal axis.

Suitably, the stratification unit 110 feeds the lower successive rolling line 116 and depending on the type of plant the upstream conveyor belt 112 stratification unit 110 may be arranged parallel or perpendicular to the rolling line 116. In particular, if the downstream conveyor belt 114 of the rolling line 116 have a width substantially equal to the width of the strip of product that exits the stratification unit 110, the upstream conveyor belt 112 is disposed parallel to the downstream conveyor belt 114 provided it the rolling line 116 (fig. 1), while if the downstream conveyor belt 114 of the rolling line 116 are wider than the product that exits the stratification unit 110, it is preferable that the upstream conveyor belt 112 is arranged orthogonally to the downstream conveyor belt 114 provided of the rolling line 116 (fig. 8), so that with its movements can distribute the product strip on the whole useful width of the rolling line 116.

Conveniently, both cases, the reciprocating movement of the structure supporting the upstream conveyor belt 112 stratification unit 110 causes a stratification of the strip of product, which exits from the first lamination unit 100 on the underlying first downstream conveyor belt 114 of the rolling line 116 and the formation of a stratified strip of width substantially equal to the useful width of the rolling line itself.

The rolling line 116 is formed by several lamination stations, each comprising a pair of cylinders 118, which delimit between them an increasingly narrow passage to gradually reduce the strip thickness of the product being processed. In particular, the rolling line 116 is configured to progressively bring the endless strip to a thickness of 90-280 μm, preferably about 140-200 μm.

Preferably, between one laminating station and the next one is placed a downstream conveyor belt 114 having a length of preferably about 1.5-2 m, which has the function to rest the product before it is subjected to the next step of lamination.

Advantageously, the rolling line 116 is then completed with one or more calibration stations, each formed by a pair of calibrating cylinders 120.

It is advantageously provided that the laminating cylinders 118 and possibly also the calibrating cylinders 120 can be heated, so as to be able to start the drying step already during the rolling.

Conveniently, downstream of the rolling line 116 it is provided a drier 122, preferably with air recirculation (Fig. 7), to bring the liquid content of said rolled strip to about 8-15%. Advantageously, the dryer 122 can be divided into two units 124, 126, placed in series with respect to each other. More particularly, the upstream unit 124 is provided to perform the first drying step and it presents in its interior a carrier made steel sheet or of a mesh conveyor belt for the transport of the product that comes out of the rolling line 16; the downstream unit 126 is provided to perform the second drying step and the subsequent cooling step and is provided inside with a mesh conveyor belt.

Moreover, the dryer 122 is advantageously provided at the entrance and exit of sensors 128, preferably with infrared rays, which control the product along its entire length.

The operation of the plant now described for the production of conventional reconstituted tobacco (Fig. 2) is as follows.

Preferably, the containers of tobacco scraps are placed on the tipper 2, which reverses the products on the feeder 4, which transfers them to the vibrating conveyor 6. Here takes place the separation of heavy bodies from the tobacco by-products: the former are collected in the container 8 while the latter are transferred by an air flux along the pneumatic conveying line 10 up to the cyclone 12, which separates the air from solid products and let these fall on the conveyor 14, for their transfer, through the pneumatic line 18, to the cryogenic mill 20.

Preferably, instead, for the production of non-conventional reconstituted tobacco (Fig. 3), the cartons containing the tobacco leaves are placed in the unpacking bench 22, where the individual bales of tobacco leaves are removed from the cartons and sent to the grinder 24, which reduces the leaves themselves to a substantially uniform size of between 5 and 10 mm.

Conveniently, the thus comminuted product is then transferred along the pneumatic conveying line 26 to the cyclone 28, which separates it from the air and makes it fall on the vibrating sieve 30.

Here occurs the separation of the finer parts, which are sent directly to the cryogenic mill 20, from the remaining parts which, after having passed the twine remove machine 32, reach the separation chamber 34. Here takes place the separation of any heavy bodies from the shredded leaves, which after being subjected to the control of the metal detector 42 are sent to the cryogenic mill 20.

Conveniently, to the same cryogenic mill 20 can also be transferred, if the recipe requires it, the shredded tobacco ribs, which can be used for the production of reconstituted tobacco of both conventional and non-conventional type.

In this case (fig. 4) the containers with the ribs are placed on the tilter 46, which feeds the ribs themselves to the vibrating conveyor 50 for the removal of any heavy bodies. The ribs are then transferred through the pneumatic line 52 to the hammer mill 54, which shreds them to reduce them to a size between 5 and 8 mm.

From here the shredded ribs, separated in the cyclones 58 by the conveying air, are transferred to the storage silos 60, from which the different types of ribs, coming from different qualities of tobacco, can be withdrawn and transferred through the screw conveyor 62 to the doser of the ribs 64, which doses them according to the particular recipe to be prepared.

The ribs, shredded and dosed in the correct quantities, are transferred via the pneumatic line transport 66 to the cryogenic mill 20.

Advantageously, independently from the type of reconstituted tobacco to produce, and to the type of solid tobacco parts introduced into the comminution unit, from the latter comes out a ground product with an average particle size of approximately 20 - 220 µm, preferably about 80-180 µm. Preferably, the ground product, which comes out of the sieve with a fluid bed fed by the cryogenic mill 20, has an average particle size of about 20 - 220 µm, preferably about 80-180 µm.

Advantageously, the product thus ground is sent to the mixing and storage silos 60, from which the products can then be taken according to requirements and transferred to the kneading machine 80.

Suitably, in the mixer 80, in addition to the ground tobacco (and preferably the solid products from blending silos and storage 60), also water, at least one binding agent and at least one material to form an aerosol are introduced. Preferably, compressed air and other additives are also added.

Suitably, the whole is then mixed together to form a mixture having a percentage of liquids (humidity) of about 30-50%, preferably of about 35-40%, by weight on a wet basis, i.e. a rather dense consistency.

Preferably, the mixture thus obtained is transferred to the forming unit 92, from which a plurality of portions 97 emerge, preferably shaped like loaves.

Suitably, therefore, the portions 97 of mixture, which emerge from the forming unit 92 are transferred at the first lamination unit 100 which is configured to output a continuous ribbon thickness of about 1-20 mm, preferably about 1-10 mm.

This continuous strip, which comes from the first lamination unit 100, is directly transferred to the rolling line 116 or - by means of the stratification unit

110 - is folded onto itself so as to be deposited in stratified form on the input strip 114 of the rolling line 116.

Suitably, as has been said, the stratification is obtained by dropping the continuous strip on the conveyor belt 112, which is made to advance with respect to its support structure, which moves of reciprocating motion, so as to have more than one layer of the product strip on said downstream conveyor belt 114. Depending on the plant and the direction of the alternating movement of the support structure of the conveyor belt 112 immediately downstream of the stratification unit 110, the product strip can be arranged on several layers parallel to the longitudinal direction of the rolling line 116 or orthogonally to it.

Suitably, during each passage from one station to another of the rolling line 116 the strip of product undergoes a reduction in thickness, up to reach, in correspondence with the displaced output calibrating cylinders 120, the desired thickness, which has a value substantially constant of about 90-280 μm, preferably of about 140-200 μm. Advantageously, moreover, at the exit from the rolling line 116 the strip has a liquid content lower to 20% or even 15%, in case the displaced cylinders 118 are heated and the water is removed already during the rolling process.

The product strip coming out of the rolling line 116 is then subjected to drying in the dryer 122, where its liquid content is brought to about 8-15%.

Preferably, the dryer 122 is in air recirculation, which compared to the driers traditionally used in production systems of reconstituted tobacco is more advantageous in terms of complexity both in terms of encumbrance and in terms of energy consumption. This is because the traditional systems treat a product (mixture) very fluid and little stable, unlike the treated product from the plant according to the invention, which is much denser and much more stable. Consequently, while the systems which treat slurries require traditional irradiation and conduction dryers, the plant according to the invention can advantageously use an air recirculating dryer 122 with a net conveyor or a combined system of steel belt conveyors for the first drying step and mesh strip conveyors for the second drying step and the cooling step. In this way we obtain, with the same performance, reduced size (about 45 m compared to more than 100 m of a traditional drier) and lower energy consumption given the lower amount of water to be removed (using approximately 1000 kg/hour of steam/hour compared to over 5000 kg/hour of steam from a traditional dryer).

Suitably, at the exit of the drier 122 the product is ready to be wound in a reel or to be shredded into strands of the prescribed size, to be used for the packaging of cigarettes.

Conveniently, in case the plant is provided for the production of reconstituted tobacco of the unconventional type, in addition to using the different preparation and treatment section already described, it uses, as an alternative to the forming unit 92 or in addition and upstream of this, a refiner to cylinder refiner 130 which has the task of bringing the solid components of the mixture to a particle size of not more than 20 µm.

The refiner (fig. 6) comprises within a closed container a plurality of cylinders 132 arranged in sequence in narrow closeness between them, so as to delimit the corresponding milling gaps. The lower cylinder 132 is mounted with the axis outside the plane containing the axis of all the other cylinders 132 and functions as a feeder of the mixture which is taken from the bottom of the container and made re rise upwards so as to pass between the lower cylinder and the one immediately above and then to follow among all the others. The various pairs of cylinders 132 between which the mixture passes rotate at different speeds, in the sense that the upper cylinder rotates at a speed greater than the lower cylinder, with which it cooperates, in order to subject the mixture to a stretch during the passing between the cylinders 132 of each pair and thereby reducing the particle size of the mixture itself. One of the fundamental parameters for the success of the refining process is precisely the different speeds of the different cylinders 132, from which depends the passage of the entire mass of the mixture which has passed through the milling gap. The pressure between the cylinders is hydraulically controlled.

All cylinders 132 are cooled with cold water that circulates inside each cylinder and thereby counteracts the heat which is developed from mixing due to friction due to both the movement of the cylinders itself and the rubbing with the product. In this way the temperature of the product is reduced to 25°C.

Thanks to the cylinder refiner 130 now described, the action of friction, which is exerted on the mixture by the cylinders 132 of the former, develops a considerable binding action of the cellulose fibres contained in tobacco and in particular in its ribs, and this generates the double advantage of developing the aromatic components of the product and eliminating the need to introduce other fiber into the mixture to obtain the required bonding effect.

The operation of the plant in this different embodiment requires that the shredded leaves and chopped ribs coming from the preparation and pre-treatment stations are fed to a rungs cryogenic mill 20 in an amount proportionally metered according to the recipe to obtain, and from this are brought to a particle size of about 20 - 220 μm, preferably about 80-180 μm.

The product is then transferred in the manner already described in the mixer 80, in which a product mixture is formed as described above.

The mixture thus obtained is then fed to the cylinder refiner 130, which has the task of bringing the solid components of the mixture to a particle size not exceeding 20 μm. In this way, the action of friction exerted on the mixture by the cylinders 132 of the cylinder refiner 130 develops a considerable binding action of the cellulose fibers contained in the tobacco and in particular in its ribs, and this causes the dual advantage of developing, on one hand, the aromatic components of the product and, on the other hand, eliminating the need to introduce other fibers into the mixture to obtain the required bonding effect.

Fig. 1 schematically indicates the position of the cylinder refiner 130 between the kneading machine 80 and the forming unit 92, but the invention also provides that the cylinder refiner 130 can be an alternative to the forming unit 92, and in this case the mixture which exits from the cylinder refiner 130 is transferred directly to the first lamination unit 100, for the continuation of the processing cycle according to the methods already described.

# CLAIMS

1. Method for producing reconstituted tobacco characterized in that:

   - the solid components of tobacco are comminuted to bring them to a particle size of about 20 - 220 μm, preferably about 80-180 μm,
   - the comminuted product thus obtained is mixed with water, at least one binding agent and at least one material to form an aerosol until a mixture with a liquid content of about 30-50%, preferably about 35-40%, is obtained.
   - said mixture is subjected to a first lamination in order to obtain a strip of continuous thickness of about 1-20 mm, preferably about 1 -10 mm,
   - said strip, already subjected to said first lamination, is subjected to a series of further rolling passages, to obtain a strip having a substantially constant thickness of approximately 90 - 280 μm, preferably about 140-200 μm,
   - said strip is dried to bring its liquid content to about 8-15 %.

2. Method according to claim 1, characterized in that the continuous dried strip is subjected to coiling or shredding in wires of predefined dimensions.

3. Method according to one or more of the preceding claims, characterized in that the solid components of the tobacco are comminuted by grinding.

4. Method according to one or more of the preceding claims, characterized in that the solid components of the tobacco are comminuted with a mill.

5. Method according to one or more of the preceding claims, characterized in that the solid components of the tobacco are crushed with a cryogenic rung mill (20).

6. Method according to one or more of the preceding claims, characterized in that the mixture formed by comminuted product, water, at least one binding agent and at least one material is configured to form an aerosol is subjected to:

   - a roughing step for passage through at least one pair of grooved cylinders (92) and/or

- a refining step by passing it through at least one pair of refining cylinders (132, 132 ') until it is brought to a particle size of not more than 20 μm.

7. Method according to one or more of the preceding claims, characterized in that said mixture is subjected to a homogenization and forming step before being subjected to said first rolling step.

8. Method according to claim 7, characterized in that said mixture is subjected to a homogenization and forming step for its transformation into a continuous strip, of a substantially constant width of between 100 and 2000 mm and a thickness of between 1 and 10 mm, to then be subjected to said first rolling phase.

9. Method according to claim 7, characterized in that said mixture is subjected to a homogenization and forming step for its transformation into a sequence of portions (97) to be then subjected to said first lamination step.

10. Method according to one or more of the preceding claims, characterized in that said first rolling of the mixture is carried out with a unit (100) comprising a lobed feeder (102) and at least a pair of rolling cylinders (108).

11. Method according to one or more of the preceding claims, characterized in that at the output of said first lamination a single-layer strip of a thickness of about 1-10 mm is obtained.

12. Method according to one or more of the preceding claims, characterized in that, before said series of further rolling passages, said strip, already subjected to said first lamination, is subjected to stratification until a multilayer strip having a thickness of about 2 -20 mm is obtained.

13. Method according to one or more of the preceding claims, characterized, in that in said series of further rolling passes, the mixture is made to rest between one lamination station and the next.

14. Method according to one or more of the preceding claims, characterized in that lamination is performed with pairs of cylinders (118) at least partially heated.

15. Method according to one or more of the preceding claims, characterized in that said laminated strip is dried by passage through a recirculating air dryer (122).

16. Plant for the production of reconstituted tobacco characterized in that it includes:

- a comminute unit (20,24,54) of the solid component of tobacco, to bring them to a particle size of about 20 - 220 µm, preferably about 80-180 µm,
- a kneader (80) which is supplied with metered quantities of comminuted material, water, at least one binder agent and at least one material to form an aerosol, and that is configured to obtain a mixture with a liquid content of about 30-50%, preferably about 35-40%,
- a first lamination unit (100) for obtaining, from said mixture, a continuous strip having a thickness of about 1-20 mm, preferably of about 1 -10 mm,
- a rolling line (116) located downstream of said first lamination unit (100) to bring said continuous strip to a thickness of 90 - 280 µm, preferably about 140-200 pm,
- a drier (122) to bring the liquid content of said laminate strip to about 8- 15%.

17. Plant according to the previous claim, characterized in that said dryer is with air recirculation.

18. Plant according to one or more of the preceding claims, characterized in that said shredding unit comprises a mill.

19. Plant according to one or more of the preceding claims, characterized in that said shredding unit comprises a cryogenic rung mill (20).

20. Plant according to one or more of the preceding claims, characterized in that it comprises, downstream of said kneading machine (80) and upstream of said first lamination unit (100), a mixture-forming unit (92).

21. Plant according to one or more of the preceding claims, characterized in that said forming unit (92) is also configured to perform an homogenization of the mixture.

22. Plant according to one or more of the preceding claims, characterized in that said forming unit (92) is configured to transform the mixture into a continuous strip of substantially constant width between 100 and 2000 mm and a thickness of between 1 and 4 mm.

23. Plant according to one or more of the preceding claims, characterized in that said forming unit (92) is configured to subdivide said mixture into a plurality of portions (97) to be started at said first lamination unit (100).

24. Plant according to one or more of the preceding claims, characterized in that the forming unit (92) comprises a roughing machine with at least a pair of forming rollers (96) and/or a cylinder refiner (130).

25. Plant according to one or more of the preceding claims, characterized in that said first lamination unit (100) comprises a lobed feeder (102) and at least a pair of rolling cylinders (108).

26. Plant according to one or more of the preceding claims, characterized in that it comprises a stratification unit (110) downstream of said first lamination unit (100).

27. Plant according to the previous claim characterized in that said stratification unit (110) comprises an upstream conveyor belt (112) which is fed by said first lamination unit (100) and which is provided with continuous movement with respect to a support structure thereof, which is provided with

reciprocating movement with respect to an underlying downstream conveyor belt (114), preferably of said rolling line (116).

28. Plant according to one or more of the preceding claims, characterized in that said rolling line (116) comprises a plurality of rolling stations separated from each other by lengths of conveyor belt (114) of sufficient length to rest the product strip between a station of rolling and the following.

29. Plant according to one or more of the preceding claims, characterized in that at least part of the cylinders (118,120) of said rolling line (116) are heated.

30. Plant according to one or more of the preceding claims, characterized in that said hot-air dryer (122) comprises a first unit (124), in which a first step of drying the product strip which comes out of the rolling line (116), and a second unit (126), placed in series with the first, in which a second drying step is performed and a subsequent step of cooling the product strip, already partially dried, which leaves the first unit (124) are performed.

31. Plant according to claim 30 characterized in that at least one mesh conveyor is used inside said hot air dryer (122).

32. Plant according to the claim 30 and/or 31, characterized in said drier with hot air (122) is provided inside of the said first unit (124) of a steel belt or a mesh belt conveyor and inside said second unit (126) of a mesh belt conveyor.

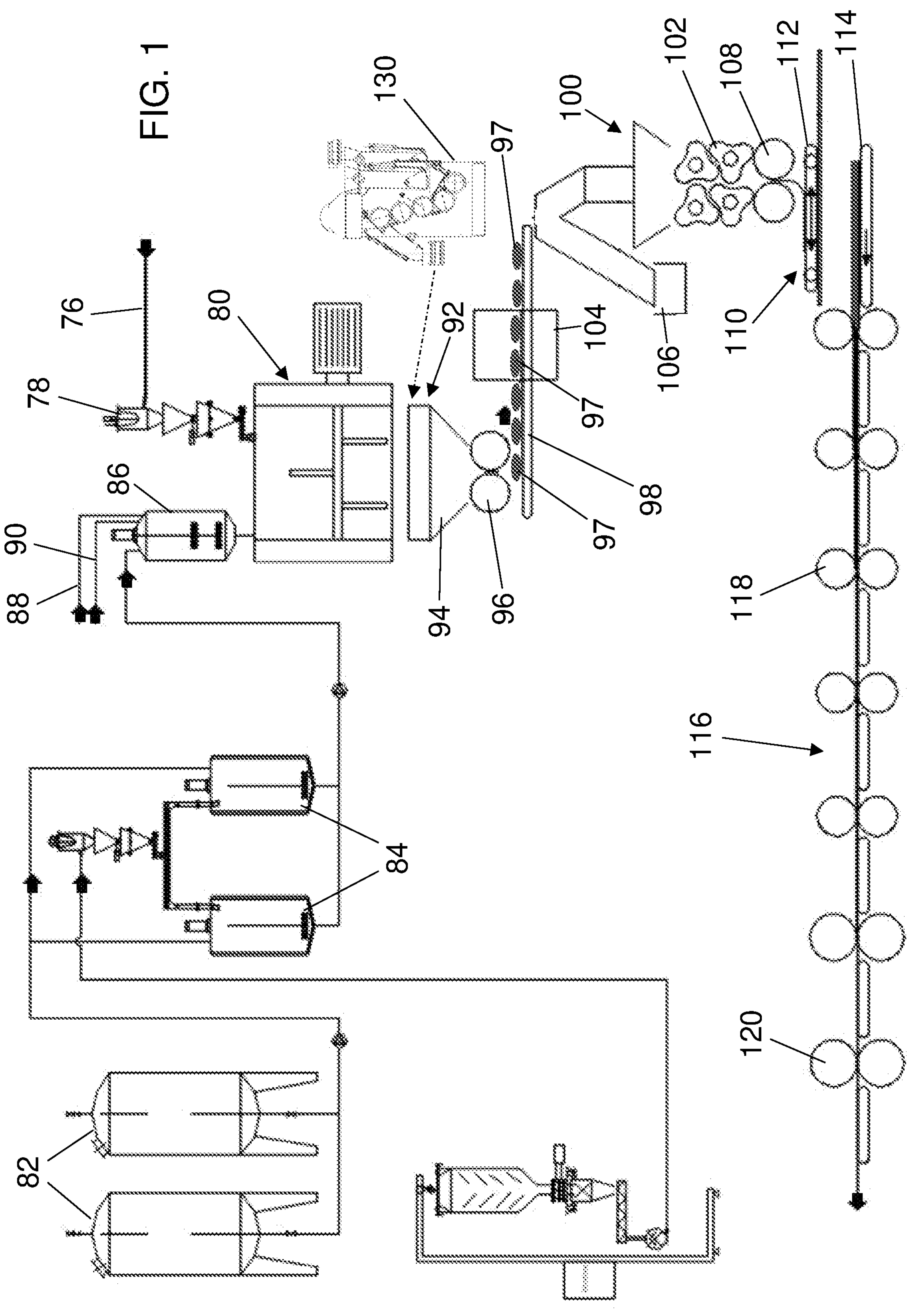
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FIG. 1

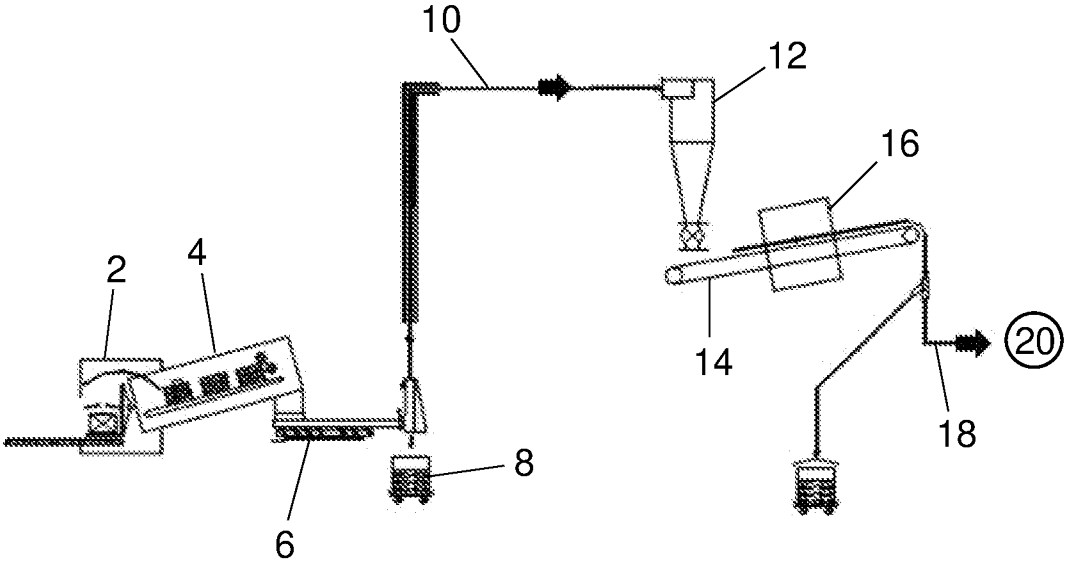



FIG. 2

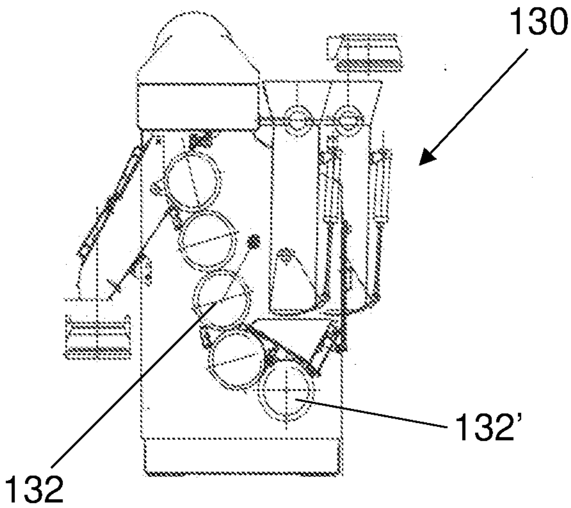



FIG. 6

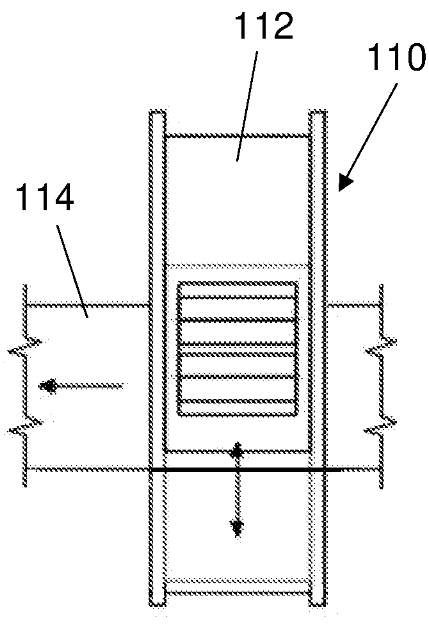



FIG. 7

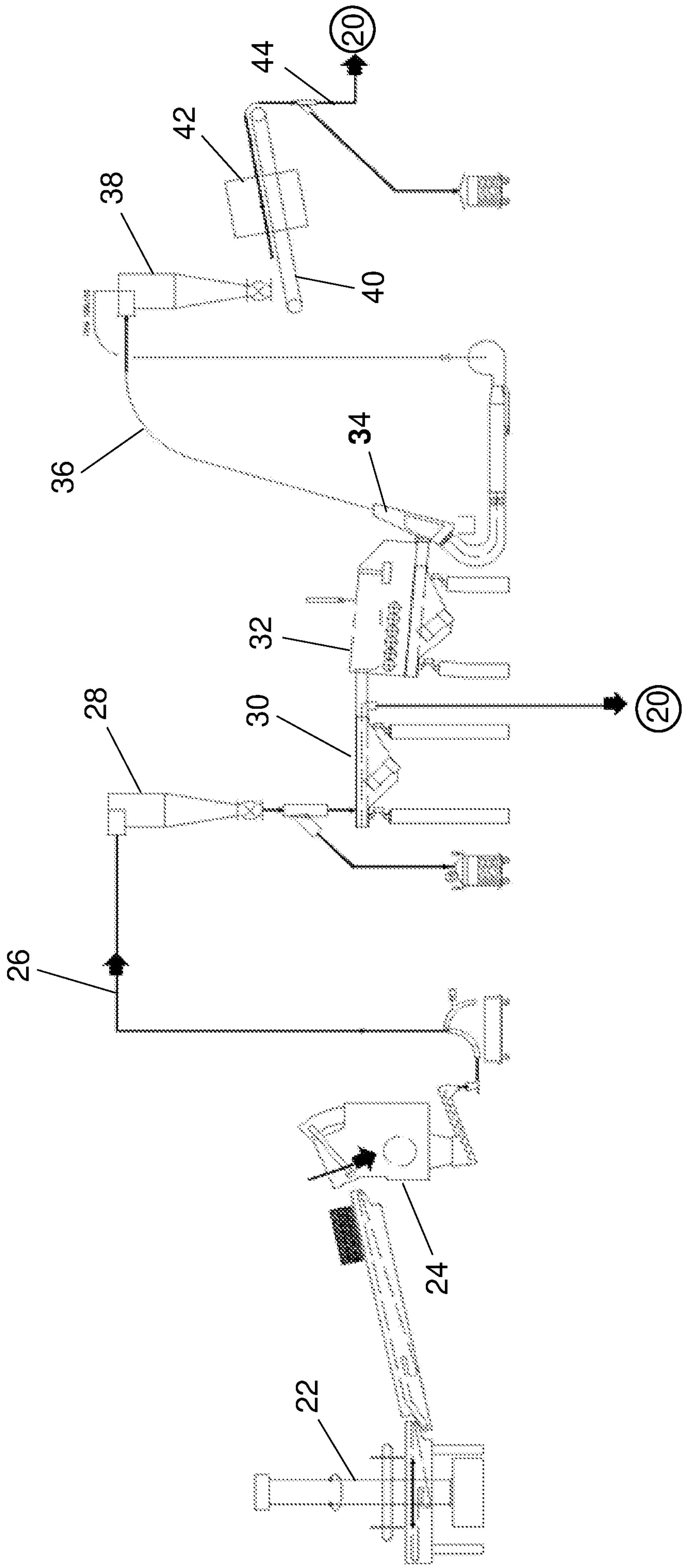



FIG. 3

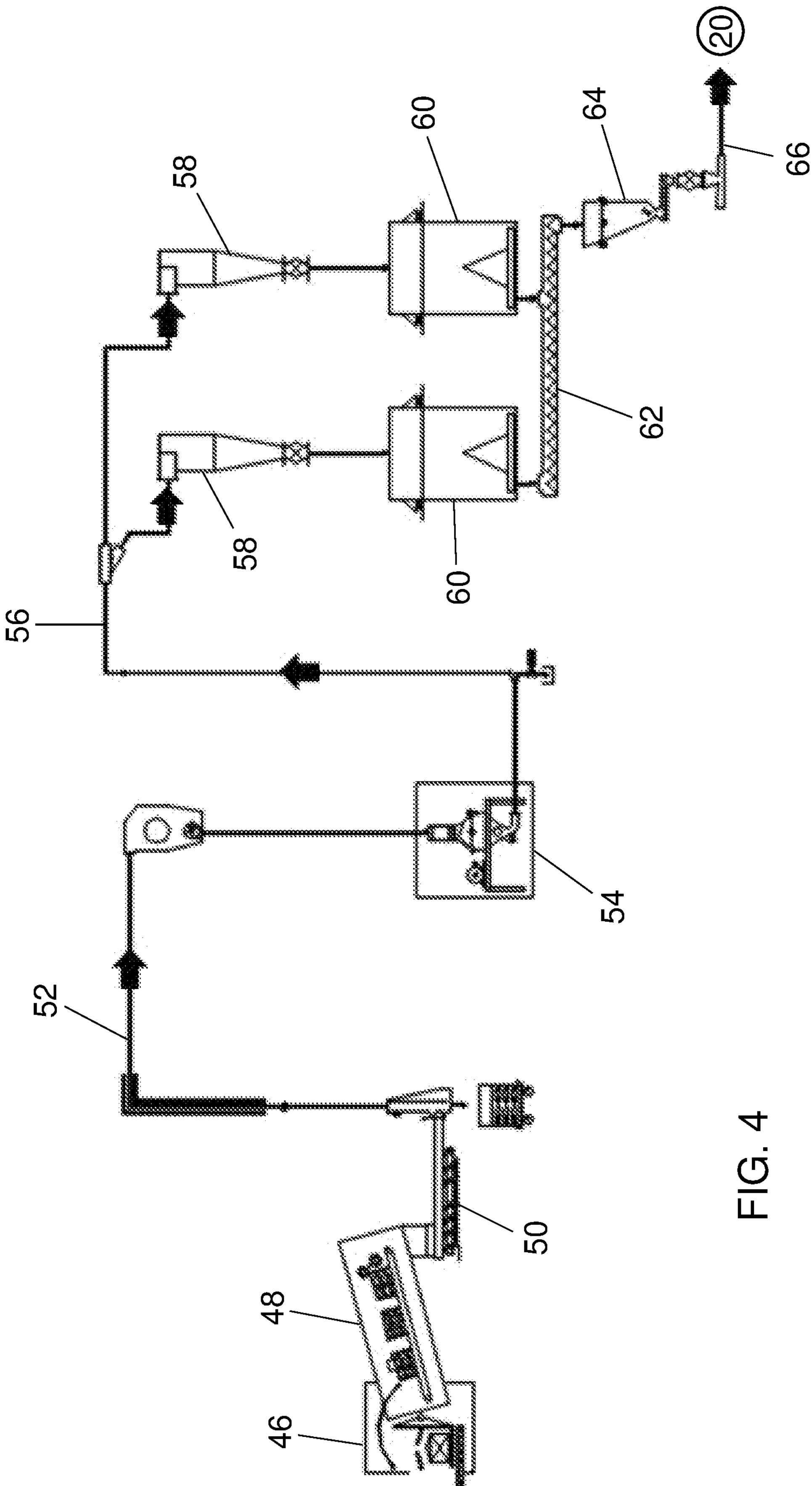



FIG. 4

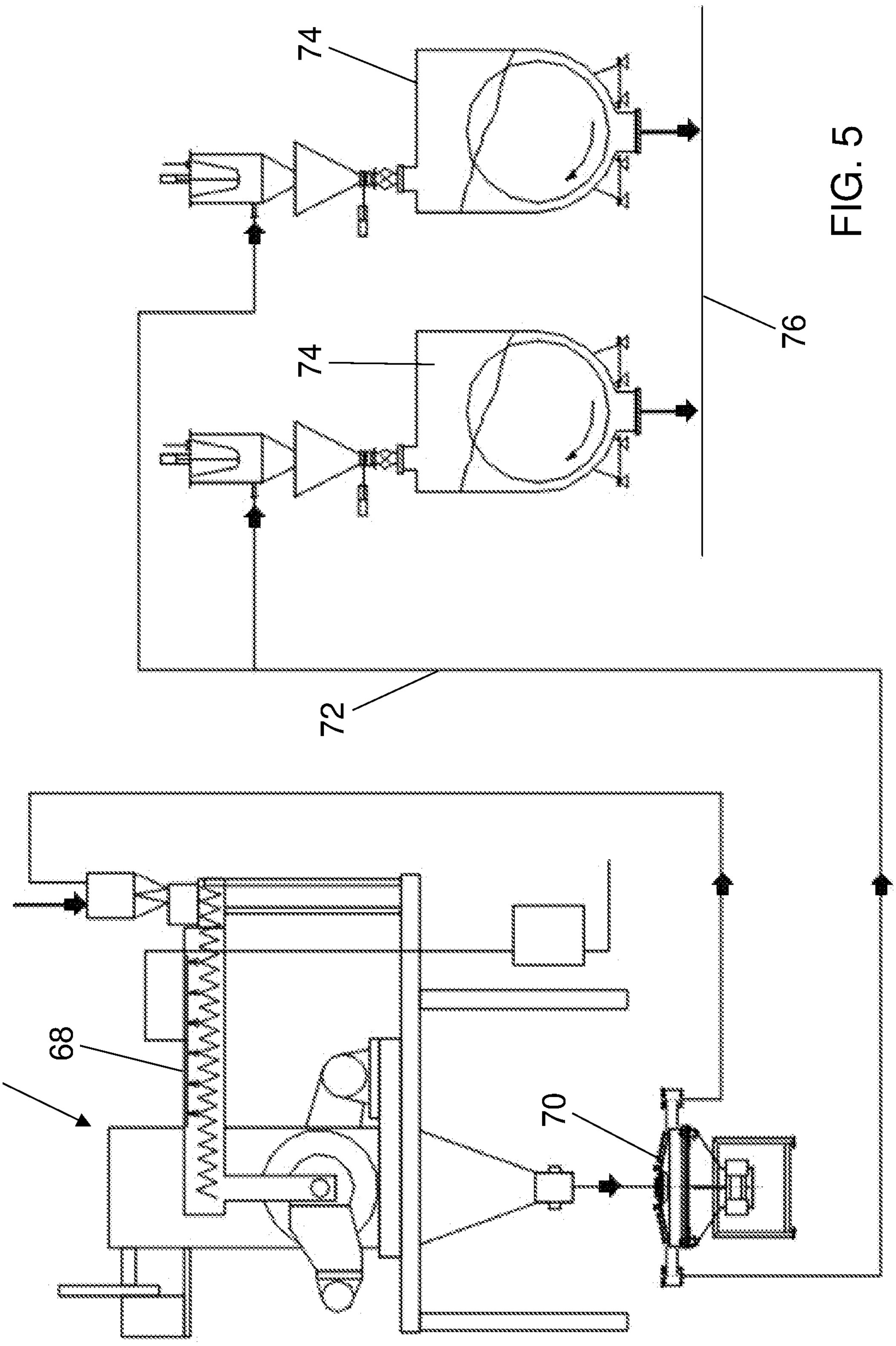
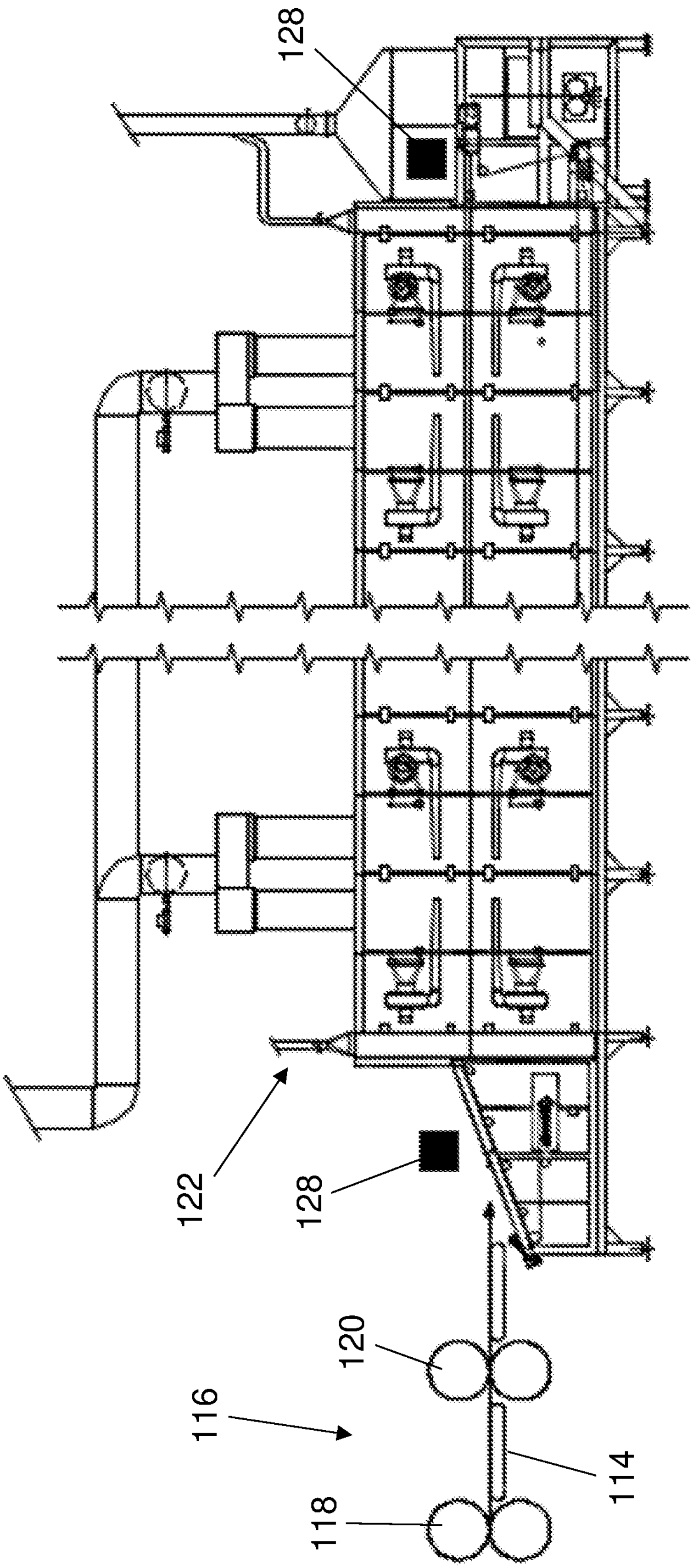



FIG. 5

FIG. 8



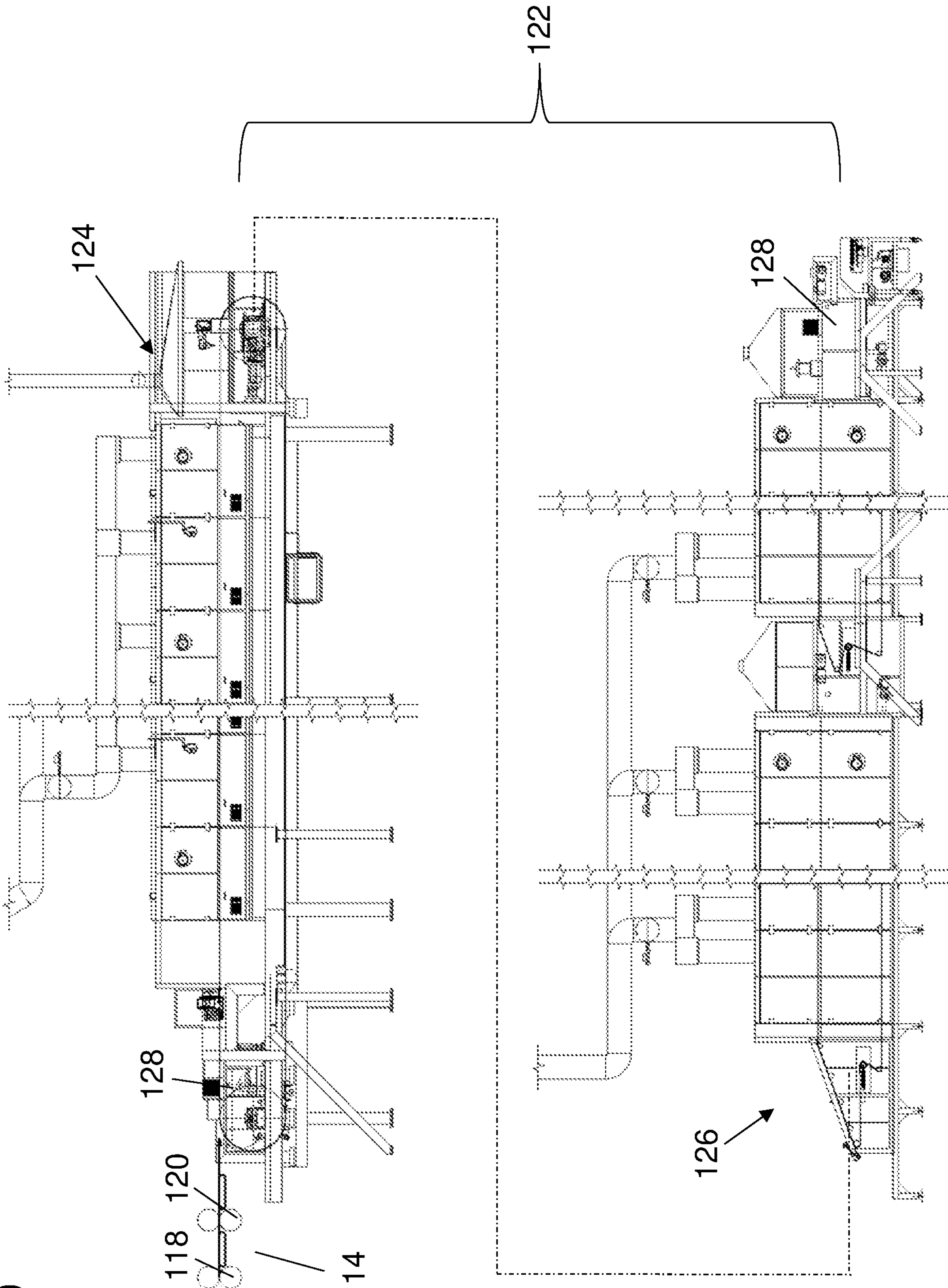



FIG. 9

# INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/057713

**A. CLASSIFICATION OF SUBJECT MATTER**
INV. A24B3/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
A24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | EP 3 075 266 A1 (PT GUDANG GARAM TBK [ID]) 5 October 2016 (2016-10-05) | 16-32 |
| A | paragraph [0124] - paragraph [0126] | 1-15 |
| | ----- | |
| X | WO 2016/067226 A1 (RECON INC [BR]) 6 May 2016 (2016-05-06) | 16-32 |
| A | page 4, line 1 - line 23 | 1-15 |
| | ----- | |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 3 December 2019 | 13/12/2019 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Cardan, Cosmin |

# INTERNATIONAL SEARCH REPORT

**Information on patent family members**

International application No
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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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| | | EP 3075268 A1 | 05-10-2016 |
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