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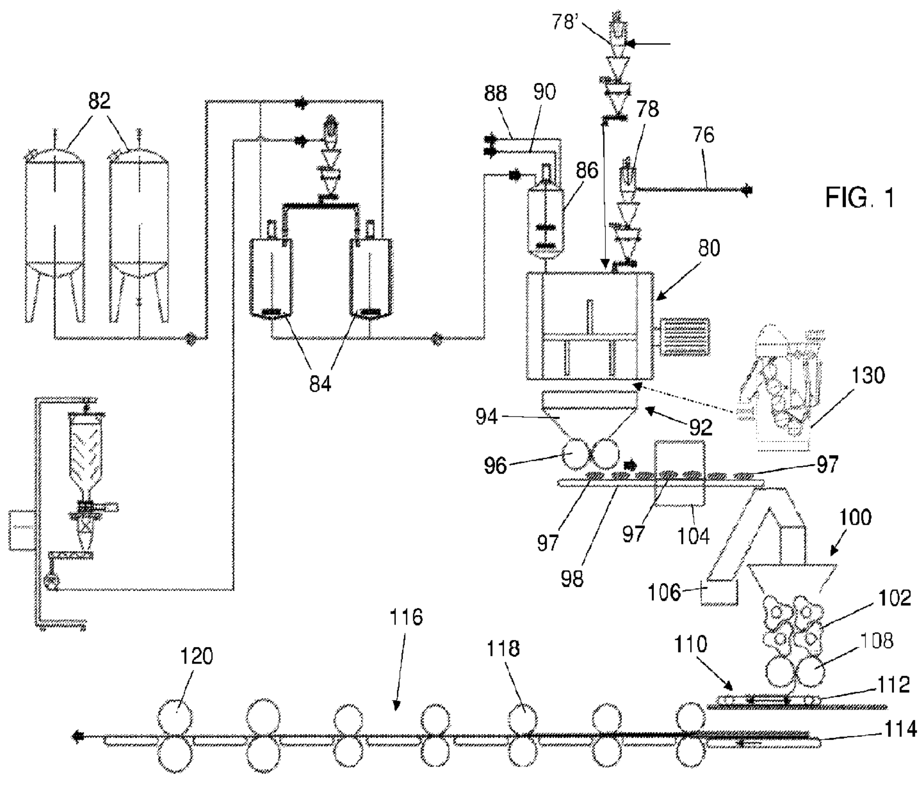

FIG. 1

(57) Abrégé/Abstract:
Method for producing reconstituted tobacco characterized by the fact that: · the solid components of tobacco are ground up to a particle size of about 20 - 220 µm, preferably about 80-180 µm, · the ground product thus obtained is mixed with powdered cellulose water, at least one binding agent and at least one material to form an aerosol until a slurry with a liquid content of about 30-50%, preferably about 35-40% obtained, · said slurry is subjected to a first lamination to obtain a continuous strip with a thickness of about 1-20 mm, preferably about 1-10 mm · the strip already subjected to said first lamination is subjected to a series of further lamination steps, until a strip having considerably constant thickness of about 90 - 280 µm, preferably of about 140-200 µm, · said strip is dried until its liquid content is brought to about 8-15%.

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Abstract:

Method for producing reconstituted tobacco characterized by the fact that: • the solid components of tobacco are ground up to a particle size of about 20 - 220 m, preferably about 80-180 m, • the ground product thus obtained is mixed with powdered cellulose water, at least one binding agent and at least one material to form an aerosol until a slurry with a liquid content of about 30-50%, preferably about 35-40% obtained, • said slurry is subjected to a first lamination to obtain a continuous strip with a thickness of about 1-20 mm, preferably about 1-10 mm • the strip already subjected to said first lamination is subjected to a series of further lamination steps, until a strip having considerably constant thickness of about 90 - 280 m, preferably of about 140-200 m, • said strip is dried until its liquid content is brought to about 8-15%.

METHOD AND PLANT FOR PRODUCING RECONSTITUTED TOBACCO.

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

In general, reconstituted tobacco is obtained with the use of tobacco by-products and processing scraps (ribs, small pieces of leaves, powder, etc.) which, properly ground up to be practically reduced to powder and mixed with water, glycerin 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 in the form of a veil on a steel strip and with this transferred to a drying. Here the evaporation of the liquid fraction of the mixture takes place, so that the solid residue forms a sort of continuous strip of tobacco having approximately the same width as the steel strip. Subsequently, the dried mixture strip is separated from the steel strip and is cut into pieces of various sizes according to the request. These pieces are then transformed into thin filaments which, suitably mixed, are fed to a traditional cigarette packing machine.

Depending on the raw materials used and, in particular, depending on whether shredded tobacco by-products up to a particle size between 20 μm and 220 μm are used, or whether ground tobacco leaves with dimensions between 5 and 10 mm are used, the reconstituted tobacco is distinguished into conventional or unconventional.

WO 2016/050469, WO 2016/050470, WO 2016/050471, WO 25 2016/050472 describe known techniques for the production of reconstituted tobacco, which however require large plants and involve high energy consumption to carry the slurry, which when it is product is rather fluid, to the consistency of a sheet of tobacco. It is sufficient to point out that a drying oven can reach up to 100 m in length.

Another drawback of the known techniques for the production of reconstituted tobacco with the use of by-products consists in the fact that the formation of the sheet starting from the slurry film is rather irregular, since the starting products are not homogeneous and their distribution on the steel is not uniform; it follows that the reconstituted tobacco sheet does not allow it to be reeled or cut regularly.

WO2019/157576 describes a method for the preparation of strips of reconstituted vegetable material in which, between a pre-lamination phase and the final lamination phase, a remixing of the pre-laminated sheet is provided inside a mixer in order to obtain a homogeneous mass from then submit to the final lamination.

WO2020/058814 discloses a method for the preparation of reconstituted tobacco in which the solid components of shredded tobacco are mixed with water, at least one binding agent and at least one material to form an aerosol until a slurry with a liquid content of about 30- 50%, preferably about 35-40%.

WO2016/067226 describes a method a process for preparing reconstituted tobacco comprising: a first drying unit, a grinding unit, a mixing unit for the solid components (i.e. tobacco powder with solid powder of natural binders), a mixing unit for the liquid components (i.e. liquid/nanogel with propylene glycol and glycerin), a unit for mixing the solid mixed components with the liquid mixed components, from one to three lamination units to obtain a 0.15 film -0.3 mm, and a dryer to reduce the moisture content of the film.

The object of the invention is to eliminate these drawbacks and to produce both conventional and non-conventional reconstituted tobacco, with much smaller plants.

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 apparatuses that are partly already available on the market, even if never used in this specific technical sector.

Another object of the invention is to produce reconstituted tobacco in an alternative way 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 by operating at low temperatures and therefore preserving all the aromas of the tobacco.

According to the invention, all these objects and others that will result from the following description are jointly or separately achieved with a method of producing reconstituted tobacco according to claim 1 and with a plant according to claim 23.

In particular, the method according to the invention to produce reconstituted tobacco is characterized by the fact that it includes the carrying out, in sequence, of the following steps:

- the solid components of tobacco are ground up to bring them to a particle size of about 20 - 220 μm, preferably about 80-180 μm,
- the ground product thus obtained is mixed with water, powdered cellulose, at least one binding agent and at least one material to form an aerosol until a slurry is obtained with a liquid content of about 30-50%, preferably about 35-40%,
- said mixture is subjected to a first lamination to obtain a continuous strip with a 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 lamination steps, until a strip having a significantly constant thickness of about 90 - 280 µm, preferably of about 140-200 µm, is obtained,
- said strip is dried until its liquid content is about 8-15%.

The present invention is further clarified hereinafter in some of its preferred embodiments reported for purely illustrative and non-limiting purposes with reference to the attached drawings, in which:

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

Figure 2 shows its feed section if the plant is intended for the production of conventional reconstituted tobacco,

Figure 3 shows its feed section if the plant is intended for production of reconstituted tobacco of unconventional type (HNB),

Figure 4 shows its rib feeding section,

Figure 5 shows a partial scheme of the plant with two distinct lines of pre-treatment of leaves and tobacco ribs,

Figure 6 shows its section for grinding, mixing and storage,

Figure 7 shows a schematic view of it refiner with cylinders,

Figure 8 shows in plan its stratification section in a different embodiment,

Figure 9 schematically shows a hot air dryer thereof, and

Figure 10 schematically shows its hot air dryer in a different embodiment.

As can be seen from the figures, the plant for producing reconstituted tobacco according to the invention comprises several sections designed to operate on the incoming raw materials until they are transformed into a continuous strip of reconstituted tobacco to be sent to the subsequent cigarette packaging operations.

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

- a unit for shredding the solid components of tobacco, to bring them to a particle size of about 20 - 220 µm, preferably about 80-180 µm; it
- a mill 20 and/or a grinder 24 and/or a pin mill 54;
- a mixer 80, which is fed with metered quantities of shredded material, with water, with at least one binding agent and with at least one material to form an aerosol, and which is configured to form a mixture with a liquid content of about 30-50 %, preferably about 35-40%,
- a first rolling unit 100 to obtain from said mixture a continuous strip having a thickness of about 1-20 mm, preferably about 1-10 mm,

- a rolling line 116 located downstream of said first rolling unit 100 to bring said continuous strip to a thickness of about 90 - 280 μm, preferably of about 140-200 μm,
- a dryer 122, located downstream of said rolling line 116, to bring the liquid content of said strip, rolled and exiting said rolling line 116, to about 8-15%.

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

Preferably, the plant according to the invention comprises:

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

Conveniently, the preparation and pretreatment section of the starting solid products is different depending on whether the plant is intended to produce reconstituted tobacco of a conventional type (fig. 2) or of an unconventional type (fig. 3). Moreover, advantageously, a section for the preparation and pre-treatment of the tobacco ribs can also be provided (Fig. 4), to be used for the production of both conventional and unconventional reconstituted tobacco.

Advantageously, if the preparation and pre-treatment section is intended to feed a plant for the production of reconstituted tobacco of a conventional type (fig. 2), it comprises a tilter 2 of the cartons containing the tobacco by-products, aimed at overturning their content 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 conveying line 10, a cyclone 12, a conveyor belt 14, equipped with a metal detector 16 for the removal of any metal bodies, and a pneumatic conveying line 18, to the mill 20, preferably of the cryogenic type.

Advantageously, if the preparation and pretreatment section is provided for the preparation of reconstituted tobacco of an unconventional type (fig. 3), it comprises a feeding

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station with a bench 22 for unpacking the bales of tobacco leaves from cartons of about 200 kg, which generally contain them, and the transfer of these to a grinder 24.

Conveniently, 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 outlet of the fine parts is directly connected to the cryogenic mill 20, while the outlet of the remaining parts of the product feeds a traditional twine levering machine 32, which eliminates any twine previously not removed from the bales of tobacco leaves.

The outlet of the twine lever machine 32 feeds a classification chamber 34 for the separation of any heavy foreign bodies from the ground tobacco leaves, which through a pneumatic conveying line 36, a cyclone 38, a conveyor belt 40, equipped with metal detector 42 for the removal of any metal bodies, a weighing system 43 (master scale), and a pneumatic conveying line 44, are transferred to storage and mixing silos 45, from which they can then be transported through another line of pneumatic transport 44', to the cryogenic mill 20. These silos 45 are sized so as to contain the quantities of product necessary to form the batch according to the particular recipe to be prepared.

Advantageously, if the preparation and pre-treatment section is provided for the preparation of the tobacco ribs to be used for the production of both conventional and unconventional reconstituted tobacco (fig. 4), it comprises a tilter 46 of cartons containing the tobacco ribs, a rib feeder 48 to a vibrating conveyor 50, for the separation from these of any heavy bodies, and a pneumatic conveying line 52 for their transfer to a pin mill 54, where they are ground.

The pin mill 54 has its outlet in turn connected, by means of a pneumatic conveying line 56 equipped with cyclone filters 58, to one or more storage silos 60.

The output of the silo or silos 60 is at its connected, by means of a screw conveyor 62, to a weighing system 64 (slave scale), which doses the ground ribs in the percentage required by the particular recipe to be prepared, before sending them through the same pneumatic transport line 44', to the storage and mixing silos 45.

As mentioned, the plant according to the invention also includes the mill 20 (fig. 5), which grinds the various products received until it reaches an average particle size of about 20 - 220 μm, preferably about 80-180 μm.

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

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The pin mill is traditional in itself and comprises within a closed structure a fixed disc and a rotating disc or two counter-rotating discs, provided with facing and partially interpenetrating pins. Being a traditional apparatus in itself, it has been globally indicated with 20 in fig. 5 and 6 but is not shown in its internal construction characteristics or in its operating modes.

Preferably, the pin mill 20 is designed to carry out cryogenic grinding, that is, grinding in the presence of liquid nitrogen.

As stated, in a reconstituted tobacco production plant a cryogenic pin mill 20 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 poor quality products while grinding in the presence of liquid nitrogen allows the physical properties and the chemical and organoleptic characteristics of the products to be preserved.

The amount of liquid nitrogen used in cryogenic grinding processes is a key part to consider when investigating the pros and cons of the process, and can vary depending on the materials being processed. 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 the nitrogen is approximately 2 to 5 sec., which is also the transit time of the product inside the screw that feeds the pin mill. The temperature of the product that leaves the mill 20 is advantageously lower than 10°C, so that the nitrogen vapors, which are released almost instantaneously upon contact with the tobacco to be cooled, go through the entire feeding system of the mill in countercurrent the desired pre-cooling effect. The flow of liquid nitrogen in the pre-cooling system and in the mill is controlled by thermocouples, which make the cryomind process fully automatic.

In summary, the positive factors of cryogenic grinding are:

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

Conveniently, the outlet of the cryogenic pin mill 20 is connected to a fluid bed sieve 70, which has the function of separating the ground product, which comes out of the mill itself and generally has an average particle size of about 20 - 220 μm, preferably of about 80-180 μm, from larger sizes, inevitably present.

Conveniently, the fluidized bed sieve 70 therefore has the function of classifying the product and reintroducing the one with fractions greater than 220 µm into the mill 20, after having separated them from those between 20 µm and 220 µm, which through a pneumatic transport 72 are sent to one or more mixing and storage silos 74.

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

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

The mixer 80 is fed with metered quantities of ground 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 of about 35-40%.

In particular, the values of liquid or humidity, indicated in the present description, are intended to be determined according to the measuring 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, as the percentage ratio between the quantity of water and the total mass of the assembly. Conveniently, these values are obtained using the traditional methods provided in the literature to measure the amount 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, at least one duct for inlet water, a material for the formation of aerosols (for example glycerin) and at least one binding agent (binder) is connected to the mixer 80. Conveniently, one or more inlet ducts can be provided for other additives required by the particular recipe to be prepared.

More particularly, the plant comprises one or more storage tanks 82 for aerosol formation material and one or more premixers 84, into which said material for aerosol formation can be introduced and, preferably, a plurality of additives dosed in the right proportions to form the liquid to be introduced into the mixer 80.

In order to increase the resistance of the sheet of finished product and at the same time to increase the density of the product itself, the invention envisages introducing it into the mixer 80, together with the other components of the mixture, including powdered cellulose. Conveniently, the cellulose powder used is made up of an organic fiber obtained from natural cellulose, and not a compound derived from cellulose. The powdered cellulose thus added preferably has a particle size comprised between 50 and 100 µm and is preferably in a percentage comprised between 2% and 10% by weight with respect to the ground tobacco.

The added powdered cellulose is predominantly or exclusively of natural origin. In particular, the powdered cellulose thus added is not synthetic and is not obtained by chemical treatments.

Conveniently, the powdered cellulose thus added does not have a binding function but the function of lowering the specific weight of the finished product and of reducing the solid components of tobacco, thus reducing the costs of the finished product, since cellulose has a much lower cost than tobacco. Furthermore, the addition of cellulose makes the finished product less brittle by increasing the tensile strength, and therefore it is more easily workable, and this is particularly useful in the case in which a pleated sheet of finished product is to be obtained.

This powdered cellulose, which before its use is contained in bags or big-bags, can be directly introduced into the mixer 80 (fig. 1) and in this case, after being poured into a traditional hopper, it is fed to a cyclone filter 78', which through a continuous dosing system, preferably of the screw type, introduces it in a metered quantity into the mixer 80.

Alternatively, the powdered cellulose can be introduced, again through a cyclone filter 78' and a continuous dosing system, in the pneumatic conveying line 44' which feeds the mixing and storage silos, from which it is then transferred to the mill 20 (fig. 5) through the pneumatic conveying line 44', together with the other components of the mixture, present in the line itself. From the mill 20 the contents of the mixing and storage silos 45 are then transferred, through the conveyor line 76, to the weighing device placed at the inlet of the mixer 80.

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

Preferably, said at least one binder includes at least one of hydroxypropylcellulose, hydroxypropylmethylcellulose, hydroxyethylcellulose, microcrystalline cellulose, methylcellulose, carboxymethylcellulose (CMC), corn starch, potato starch, guar gum, locust bean gum, pectin and alginates (e.g. ammonium alginate and sodium alginate).

Preferably, the binder and the added powdered cellulose are defined by materials different from each other. Conveniently, the powdered cellulose mainly serves to form a three-dimensional framework with a high thickening effect, a pseudoplastic behavior and a good capacity to retain liquids, while the binding agent serves exclusively or mainly to bind together the various components to be mixed.

Advantageously, the outlet of the premixers 84 is connected to an inlet of a hydrator 86, having other inlets connected to a water supply line 88 and to a compressed air supply line 90.

Preferably, the outlet of the mixer 80 feeds the mixture forming unit 92 to obtain a plurality of portions 97, preferably shaped like loaves/loaves and separated from each other. Conveniently, the forming unit 92 comprises a pair of forming cylinders 96, affected by grooves preferably parallel to the axis of the cylinders themselves and intended to pick up the mixture at the inlet and to supply the portions 97 at the outlet. Advantageously, the unit 92 is also configured for roughing the mixture and for this purpose, preferably, comprises a hopper 94 provided with an internal lump breaker and said pair of forming cylinders 96 on the bottom.

Advantageously, at the outlet of the forming unit 92 a conveyor belt 98 is provided for the transfer of the portions 97 to the first rolling unit 100.

Preferably, the first rolling unit 100 comprises a lobe feeder 102 to homogenize the mixture formed by the portions 97.

Advantageously, along the transfer path from the forming unit 92 to the lobe feeder 102, a further metal detector 104 can be provided, having the function of removing any metal parts, which could still be present in the mixture and could damage subsequent processing units. These metal parts are conveyed along a distinct path to the inlet of the lobe feeder 102 and are collected within a suitable container 106.

The lobe feeder 102 comprises a series of lobed feed rollers, between which the portions are made to pass 97 (which come out of the forming rolls 96 of the forming unit 92) so as to be mixed together and homogenized before being pushed between a pair of rolling rolls 108, which are configured to form a continuous strip of thickness about 1-20 mm, preferably about 1-10 mm.

Conveniently, therefore, the lobe feeder 102 causes homogenization of the product which leaves the forming unit 92 and which could have lumps. Advantageously, moreover, the lobe feeder 102 also advances the product to push it into the inlet between the pair of laminating cylinders 108.

Conveniently, therefore, the first laminating unit 100 comprises a homogenization module, preferably defined by the feeder lobe 102, which is positioned immediately upstream with respect to a pre-lamination module which is defined by at least one pair of lamination cylinders 108, which are configured to form a continuous strip with a thickness of approximately 1-20 mm, preferably about 1-10 mm. Advantageously, the strip thus obtained has a greater elasticity.

Conveniently, in a version not shown of the plant, the rolling line 116 can be provided directly downstream of the lobe feeder 102. In particular, in this case, the rolling line receives the single-layer continuous strip having a thickness of about 1-20 mm, preferably of about 1-10 mm, which comes out of the first lamination unit 100 provided in the lobe feeder 102 Advantageously, downstream of the first lamination unit 100 and upstream of the lamination line 116, a layering unit 110 can be provided. Preferably, it is configured to arrange on several layers the single-layer continuous strip, having a thickness of about 1-10 mm, which comes out of the first rolling unit 100, so as to transform it in a multilayer belt with a thickness of about 2-20 mm, which is then sent to the inlet of the rolling line 116.

Preferably, said stratification unit 110 consists of an upstream conveyor belt 112, the which has the function of depositing the product belt on an underlying downstream conveyor belt 114, preferably belonging to the rolling line 116, arranging it so that it is layered on said downstream conveyor belt 114, for example by multiple folding on itself. Preferably, the upstream conveyor belt 112 is elevated with respect to the downstream conveyor belt 114 and is equipped with a continuous forward motion with respect to its support structure, and at the same time with an alternating motion with its support structure, parallel to the its longitudinal axis.

Conveniently, the layering unit 110 feeds the subsequent and underlying rolling line 116, and depending on the type of plant the upstream conveyor belt 112 of the layering unit 110 can be arranged parallel or perpendicular to the rolling line 116. In in particular, if the downstream conveyor belts 114 of the rolling line 116 have a width substantially equal to the width of the product belt that leaves the stratification unit 110, the upstream conveyor belt 112 is arranged parallel to the downstream conveyor belts 114 provided in the rolling line 116 (fig. 1), while if the downstream conveyor belts 114 of the rolling line 116 are wider than the product belt exiting the layering unit 110, it is preferable that the upstream conveyor belt 112 is arranged orthogonally to the downstream conveyor belts 114 provided in the rolling line 116 (fig. 8), so that with its movements can distribute the product strip over the entire useful width of the rolling line 116.

Conveniently, in both cases, the alternating movement of the support structure of the upstream conveyor belt 112 of the layering unit 110 causes a stratification of the product belt, which leaves the first rolling unit 100 on the underlying first downstream conveyor belt 114 of the rolling line 116 and the formation of a stratified belt having a width substantially equal to the useful width of the rolling line itself.

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

Preferably, between each rolling station and the next there is a conveyor belt 114 having a length preferably of about 1.5-2 m, which has the function of allowing the product to rest before it is subjected to the subsequent rolling step.

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

It is advantageously provided that the118 and possibly also the calibrating rolls 120 can be heated, so as to being able to start the drying phase already during lamination. Conveniently, downstream of the rolling line 116 there is a dryer 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 each other. More particularly, the upstream unit 124 is provided for carrying out the first drying phase and is equipped inside with a steel belt or net conveyor belt for transporting the product leaving the rolling line 16; the downstream unit 126 is provided for carrying out the second drying phase and the subsequent cooling phase and is internally equipped with a network conveyor belt.

Furthermore, the dryer 122 is advantageously provided at the inlet and outlet with sensors 128, preferably with infrared rays, which monitor the product along its entire length.

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

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

Preferably, for the production of reconstituted tobacco of an unconventional type instead (fig. 3), the cartons containing the tobacco leaves are placed in the undressing 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 between 5 and 10 mm.

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

Here the separation of the finer parts takes place, which are sent directly to the cryogenic mill 20, from the remaining parts which, after passing through the twine levering machine 32, reach the classification chamber 34. In this, any heavy bodies are separated from the ground leaves, which after being subjected to the control of the metal detector 42 are sent to the cryogenic mill 20.

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

In this case (Fig. 4) the containers with the ribs are placed on the overturning device 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 pin 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 from the transport air, are transferred to the storage silos 60, from which the different types of ribs, coming from different qualities of tobacco, can be picked up and transferred through the screw conveyor 62 to the rib dispenser 64, which doses them according to the particular recipe to be prepared.

The ground and dosed ribs in the correct quantities are transferred through the pneumatic line 66 to the cryogenic mill 20.

Advantageously, regardless of the type of reconstituted tobacco to be produced, and therefore of the type of solid parts of tobacco introduced into the shredding unit, by this last comes a ground product with an average particle size of about 20 - 220 μm, preferably about 80-180 μm. Preferably, the ground product, which comes out of the fluid bed sieve fed by the cryogenic mill 20, has an average particle size of about 20 - 220 μm, preferably of 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 withdrawn according to the needs and transferred to the mixer 80.

In addition to the ground tobacco and the cellulose and in general all the solid products coming from the mixing and storage silos 45, water, at least one binding agent and at least one material to form an aerosol are also introduced. Advantageously, compressed air and other additives can also be introduced, including in particular ground cloves.

Conveniently, the whole is then mixed together to form a slurry having a percentage of liquids (humidity) of about 30-50%, preferably 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, preferably shaped like loaves, come out.

These portions of mixture 97, which come out of the forming unit 92 are suitably transferred to the first rolling unit 100 which is configured to homogenize the mixture and to provide at the outlet a continuous strip with a thickness of about 1-20 mm, preferably of approximately 1-10 mm. This continuous strip, which comes out of the first lamination unit 100, is transferred directly to the lamination line 116 or - by means of the stratification unit 110 - is folded on itself to be thus deposited in the form stratified on the inlet belt 114 of the rolling line 116.

Conveniently, as mentioned, the stratification is obtained by letting the continuous belt fall on the conveyor belt 112, which is made to advance with respect to its support structure, which is moved by alternating motion, so as to arrange the product belt on several layers on said inlet conveyor belt 114. Depending on the plant and the direction of the alternating movement, the support structure of the conveyor belt 112 immediately downstream of the layering unit 110, the product belt is arranged on several layers parallel to the longitudinal direction of the rolling line 116 or orthogonally thereto.

Conveniently, at each passage from one station to another of the rolling line 116, the product strip undergoes a thickness reduction, until it reaches the desired thickness in correspondence with the output calibrating cylinders 120, which has a significantly constant value of about 90 - 280 μm, preferably about 140-200 μm. Advantageously, moreover, at the exit from the rolling line 116 the strip has a liquid content lower than 20% or even 15%, if the laminating cylinders 118 are heated and the removal of the water has already begun during the rolling process.

The web of product leaving 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 air-recirculated, and compared to the dryers traditionally used in reconstituted tobacco production plants it is somewhat more advantageous both in terms of manufacturing complexity and in terms of overall dimensions and in terms of energy consumption. This is because traditional plants treat a very fluid and not very stable product (slurry), unlike the product treated by the plant according to the invention, which is much denser and much more stable. Consequently, while the plants that treat slurry require traditional irradiation and conduction dryers, the plant according to the invention can advantageously use a recirculating air dryer 122 with a network conveyor belt or a combined system of steel conveyor belts for the first drying phase and net conveyor belts for the second drying phase and for the cooling phase. In this way, with the same performance, reduced dimensions are obtained (about 45 m compared to over 100 m of a traditional dryer) and lower energy consumption due to the lower quantity of water to be removed (using about 1000 kg/hour of steam/hour compared to over 5000 kg/hour of steam from a traditional dryer).

Conveniently, at the exit of the dryer 122 the product is ready to be wound in reels or to be cut into threads of predetermined dimensions, to be used for the packaging of cigarettes.

Conveniently, in the method according to the invention, the homogenization of the mixture is carried out mainly or exclusively by means of the lobe feeder 102 and is in any case carried out always and only upstream, preferably immediately upstream of the pre-rolling module, which transforms the homogenized mixture in a continuous strip with a thickness of about 1-20 mm, preferably about 1-10 mm, to be sent in the final rolling line 116.

In particular, once the homogenized mixture has been transformed in a continuous strip with a thickness of about 1-20 mm, preferably about 1-10 mm, the latter is no longer remixed, but is sent in the form of a strip to the rolling line 116 to be thus brought to the desired thickness, which has a significantly constant value of about 90 - 280 μm, preferably of about 140-200 μm. Advantageously, the fact that the rolling line 116 receives a strip at the inlet, and not a deformed mixture, allows to guarantee a constant inlet flow, increasing the accuracy of the thickness of the sheet in the subsequent rolling steps and also allows to reduce the number of laminating cylinders 118 of the same line, thus reducing the cost and the overall dimensions of the plant.

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

The refiner (Fig. 7) comprises inside a closed container a plurality of cylinders 132 arranged in sequence in close proximity to each other, so as to delimit corresponding grinding slots. 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 to 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 higher speed than the lower cylinder, with which it cooperates, so as to subject the mixture to stretching during the passage between the cylinders 132 of each pair and to thus reduce the size of the particles of the mixture itself. In fact, one of the fundamental parameters for the success of the refining process is precisely the different speed of the different cylinders 132, on which the passage of the whole mass of mixture that has passed through the grinding slot depends.

The pressure between the cylinders is hydraulically controlled.

All the cylinders 132 are cooled with cold water which circulates inside each cylinder and in this way contrasts the heat, which develops from the mixture due to the friction due both to the movement of the cylinders and to the rubbing with the product. In this way the temperature of the product mass is reduced until it reaches 25°C.

Thanks to the refiner 130 just described, the friction action, which is exerted on the mixture by the cylinders 132 of the latter, develops a considerable binding action of the cellulose fibers contained in the tobacco and in particular in the ribs of the latter, and this involves the double advantage of developing the aromatic components of the product and eliminating the need to introduce more fiber into the mixture to obtain the required binding effect.

The operation of the plant in this different embodiment provides that the shredded leaves and the shredded ribs coming from the preparation and pre-treatment stations are fed to the cryogenic pin mill 20 in proportionally dosed quantities according to the recipe to be obtained, and are from this leads to a particle size of about 20 - 220 μm, preferably about 80-180 μm.

The product is then transferred in the manner already described into 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 grain size not exceeding 20 μm. In this way, the friction action exerted on the mixture by the cylinders 132 of the refiner 130 develops a considerable binding action of the cellulose fibers contained in the tobacco and in particular in the ribs thereof, and this entails the double advantage of developing, from a on the other hand, the aromatic components of the product and, on the other hand, to eliminate the need to introduce more fiber into the mixture to obtain the required binding effect.

In fig. 1 schematically indicates the position of the refiner 130 between the mixer 80 and the forming unit 92, but the invention also provides that the refiner 130 can be an alternative to the forming unit 92, and in this case the mixture which it leaves the refiner 130 and is transferred directly to the first rolling unit 100, for the continuation of the processing cycle according to the methods already described.

CLAIMS

1. Method for producing reconstituted tobacco characterized by the fact that:

- the solid components of tobacco are ground up to a particle size of about 20 - 220 μm, preferably about 80-180 μm,
- the ground product thus obtained is mixed with powdered cellulose, water, at least one binding agent and at least one material to form an aerosol until a slurry with a liquid content of about 30-50%, preferably about 35-40%obtained,
- said slurry is subjected to a first lamination to obtain a continuous strip with a thickness of about 1-20 mm, preferably about 1-10 mm,
- the strip already subjected to said first lamination is subjected to a series of further lamination steps, until a strip having considerably constant thickness of about 90 - 280 μm, preferably of about 140-200 μm,
- said strip is dried until its liquid content is brought to about 8-15%.

2. Method according to claim 1, characterized in that the dried continuous web is subjected to winding or shredding into threads of predefined dimensions.

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

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

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

6. Method according to one or more of the preceding claims, characterized in that powdered cellulose consisting of an organic fiber obtained from natural cellulose is used.

7. Method according to one or more of the preceding claims, characterized in that said slurry is formed with powdered cellulose having a particle size between 50 and 100 μm.

8. Method according to one or more of the preceding claims, characterized in that said mixture is formed with powdered cellulose in a percentage comprised between 2% and 10% of the weight of the tobacco.

9. Method according to one or more of the preceding claims, characterized in that ground cloves are added to the mixture.

10. Method according to one or more of the preceding claims, characterized in that the ground tobacco components are mixed with powdered cellulose before forming said mixture with them.

11. Method according to one or more of the preceding claims, characterized in that the mixture formed by ground product, powdered cellulose, water, at least one binding agent and at least one material for forming an aerosol is subjected:

- to a roughing step for passage through at least one pair of grooved cylinders (92) and/or
- to a refining step by passage through at least one pair of refining cylinders (132,132') until it reaches a particle size not exceeding 20 μm.

12. Method according to one or more of the preceding claims, characterized in that said mixture is subjected to a homogenization and/or molding step before subjecting it to said first rolling step.

13. Method according to one or more of the preceding claims characterized by the fact that said mixture is subjected to a homogenization and/or shaping phase for its transformation into a continuous strip, with a substantially constant width between 100 and 2000 mm and thickness between 1 and 10 mm, to be then subjected to said first lamination step.

14. Method according to one or more of the preceding claims characterized in that said mixture is subjected to a homogenization and/or molding step for its transformation into a sequence of portions (97) to be then subjected to said first lamination step.

15. Method according to one or more of the preceding claims, characterized by the fact that it carries out said first rolling the mixture with a unit (100) comprising a feeder lobe (102) and at least one pair of rolling cylinders (108).

16. Method according to one or more of the preceding claims characterized in that said first lamination comprises a homogenization step which is carried out before obtaining said continuous strip having a thickness of about 1-20 mm, preferably about 1-10 mm.

17. Method according to one or more of the preceding claims, characterized in that said mixture is subjected in sequence first to a forming step for its transformation into a sequence of portions (97) and subsequently to a homogenizing step of said portions (97) before obtaining from these said continuous strip having a thickness of about 1-20 mm, preferably about 1-10 mm.

18. Method according to one or more of the preceding claims, characterized in that said mixture is homogenized predominantly or exclusively by means of a feeder lobes (102) positioned at the input of at least one pair of rolling cylinders (108).

19. Method according to one or more of the preceding claims, characterized in that a monolayer tape with a thickness of about 1-10 mm is obtained at the outlet of said first lamination.

20. Method according to one or more of the preceding claims, characterized in that, before said series of further lamination steps, said strip, already subjected to said first

lamination, is subjected to stratification until a multilayer strip with a thickness of about 2-20mm is obtained.

21. Method according to one or more of the preceding claims, characterized by the fact that, in said series of further rolling passes, it makes the mixture to rest between a laminating station and the next.

22. Method according to one or more of the preceding claims, characterized by the fact that the lamination is carried out with pairs of cylinders (118) at least partially heated.

23. Method according to one or more of the preceding claims, characterized by the fact that dries said laminated ribbon for passage through a drying air recirculation system (122).

24. Plant for the production of reconstituted tobacco characterized by the fact of comprising:

- a grinding unit (20,24,54) of the solid components of tobacco, to bring them to a particle size of about 20 - 220 μm, preferably about 80 -180 μm,
- a mixer (80) which is fed with metered quantities of shredded material, powdered cellulose, water, at least one binding agent and at least one material to form an aerosol, and which is configured to obtain a mixture with a liquid content of about 30-50%, preferably about 35-40%,
- a first rolling unit (100) to obtain, from said mixture, a continuous strip with a thickness of about 1-20 mm, preferably about 1 -10 mm,
- a rolling line (116) placed downstream of said first rolling unit (100) to bring said continuous strip to a thickness of 90 - 280 μm, preferably about 140-200 μm,
- a dryer (122) to bring the liquid content of said laminated web to around 8-15%.

25. Plant according to the preceding claim, characterized in that said dryer is air-recirculating.

26. Plant according to one or more of the preceding claims, characterized in that said grinding unit comprises a mill (20).

27. Plant according to one or more of the preceding claims characterized in that said grinding unit comprises a cryogenic pin mill.

28. Plant according to one or more of the preceding claims characterized in that it comprises means for feeding cellulose in powder form into said mixer.

29. Plant according to one or more of the preceding claims characterized in that it comprises upstream of said mill (20) at least one silo (45) for mixing and storing the solid material comprising said ground tobacco components and said powdered cellulose.

30. Plant according to one or more of the preceding claims characterized in that it comprises, downstream of said mixer (80) and upstream of said first rolling unit (100), a mixture forming unit (92).

31. Plant according to one or more of the preceding claims characterized in that said forming unit (92) is also configured to homogenize the mixture.

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

33. Plant according to one or more of the preceding claims characterized in that said forming unit (92) is configured to divide said mixture into a plurality of portions (97) to be sent to said first rolling unit (100).

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

35. Plant according to one or more of the preceding claims characterized in that the first rolling unit (100) comprises a mixture homogenization module, positioned immediately upstream with respect to a pre-rolling module, which is defined by at least a pair of laminating rolls (108), which are configured to form a continuous strip with a thickness of about 1-20 mm, preferably about 1-10 mm.

36. Plant according to one or more of the preceding claims characterized in that said homogenization module comprises a lobe feeder (102).

37. Plant according to one or more of the preceding claims characterized in that said first rolling unit (100) comprises a lobe feeder (102) and at least one pair of rolling rolls (108).

38. Plant according to one or more of the preceding claims characterized in that it comprises a layering unit (110) downstream of said first rolling unit (100).

39. Plant according to the preceding 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 equipped with continuous movement with respect to one of its support structure, which is provided with alternating movement with respect to an underlying downstream conveyor belt (114), preferably of said rolling line (116).

40. 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 sections of conveyor belt (114) of sufficient length to allow the product belt to rest between a lamination station and the next.

41. 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.

42. 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 drying step is carried out on the product web that leaves the rolling line (116), and a second unit (126), placed in series with

the first, in which a second drying phase is carried out and a subsequent cooling phase of the product web, already partially dried, which comes out of the first unit (124).

43. System according to one or more of the preceding claims, characterized by the fact to use inside said drier with hot air (122) at least one mesh conveyor.

44. Plant according to one or more of the preceding claims characterized in that said hot air dryer (122) is provided inside said first unit (124) with a steel belt or net conveyor belt and inside of said second unit (126) of a network conveyor belt.

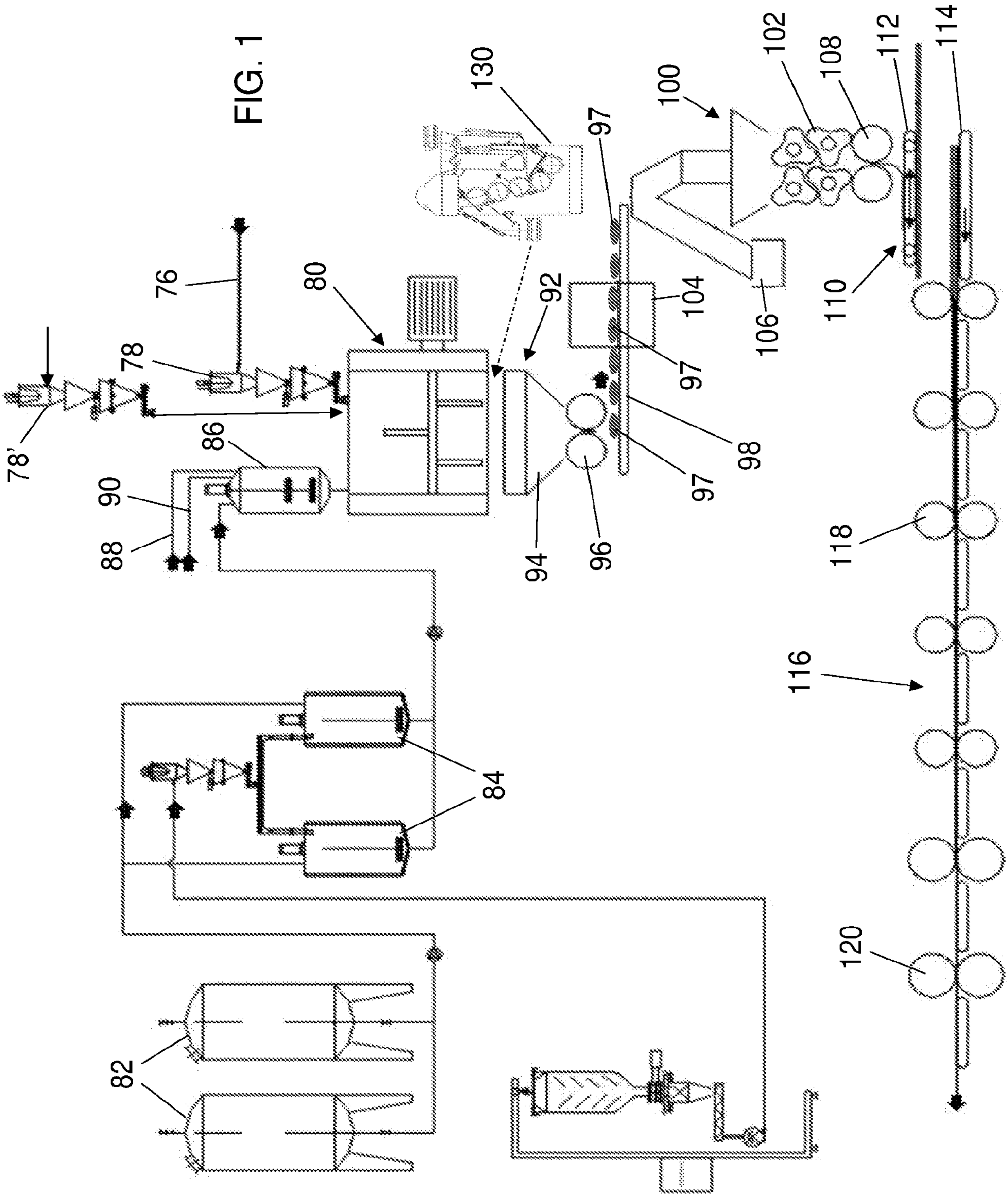
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FIG. 1

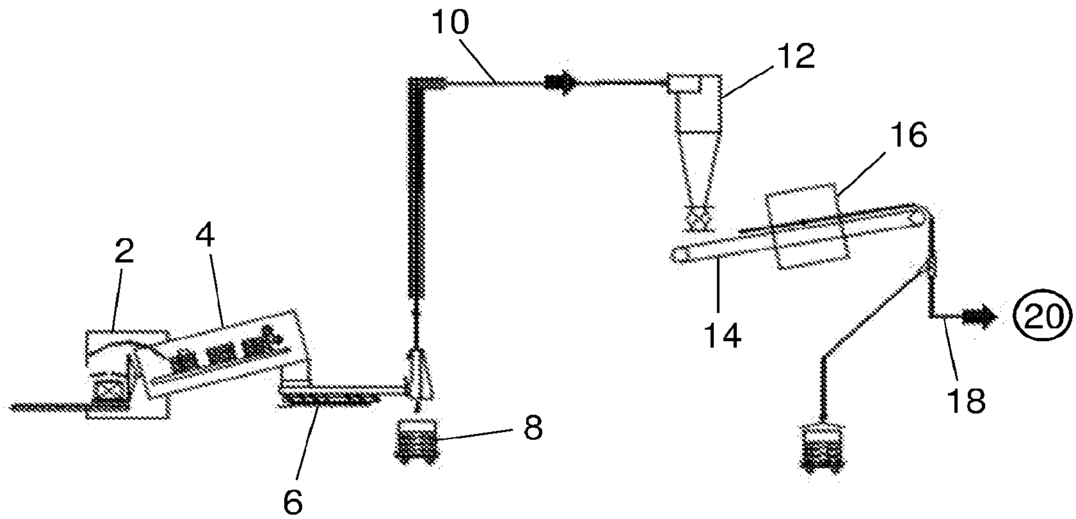


FIG. 2

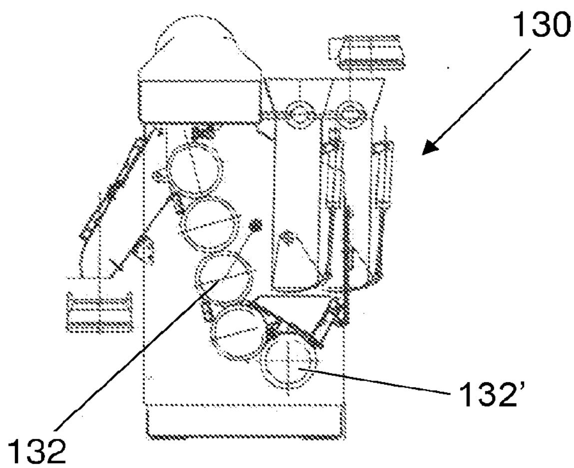


FIG. 7

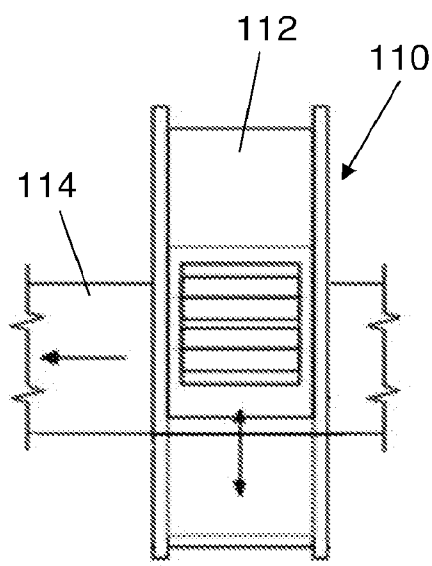


FIG. 8

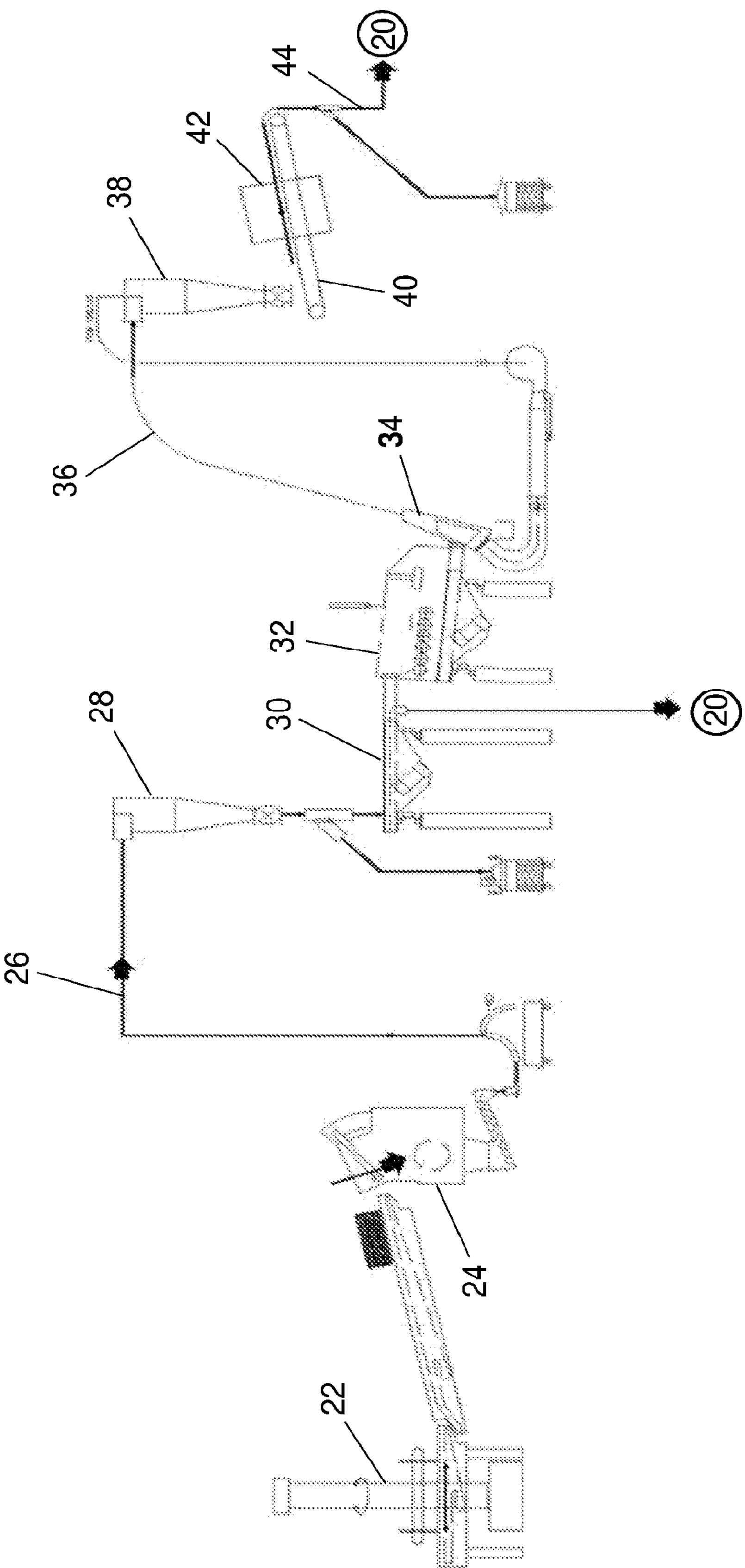


FIG. 3

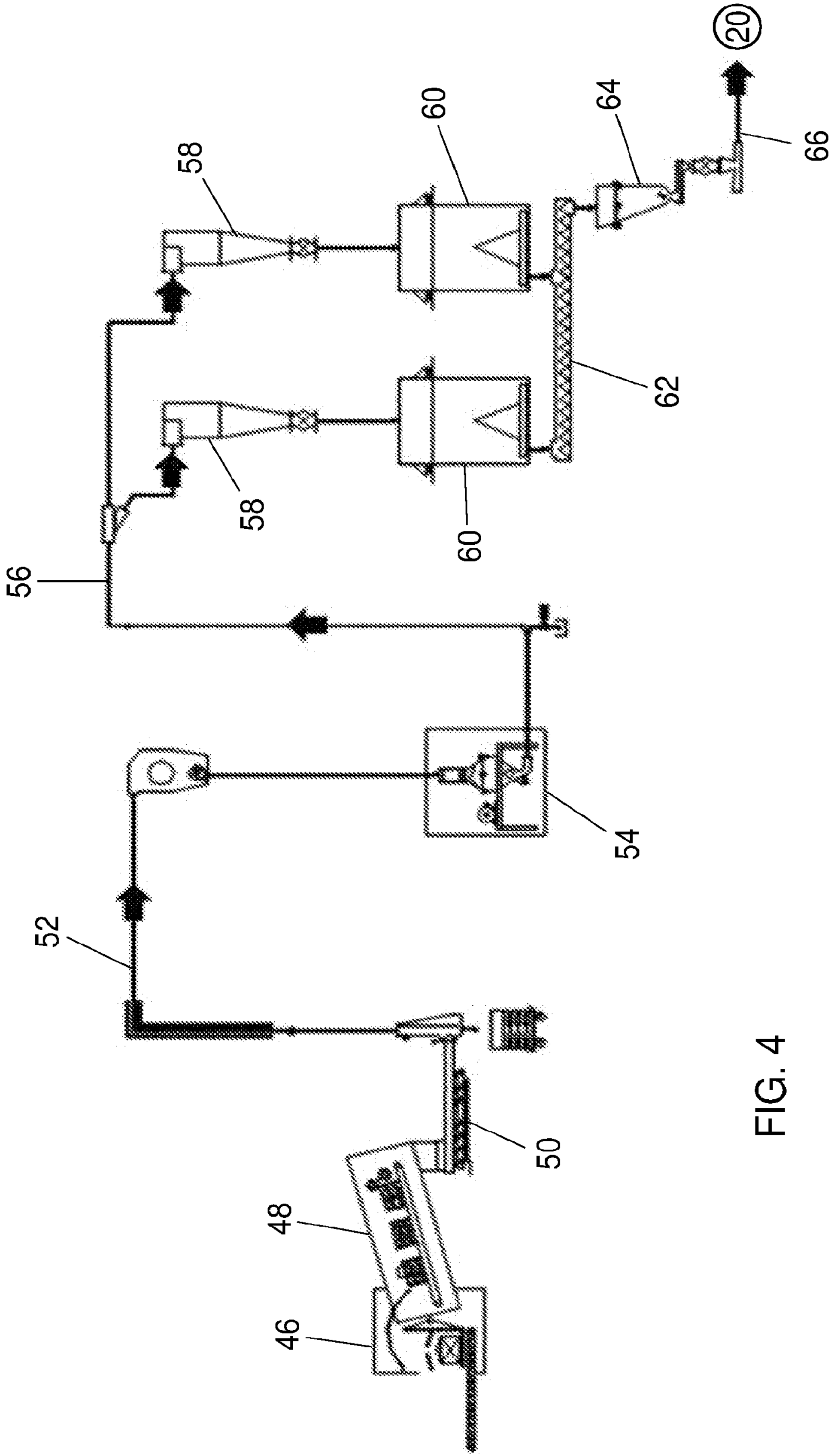


FIG. 4

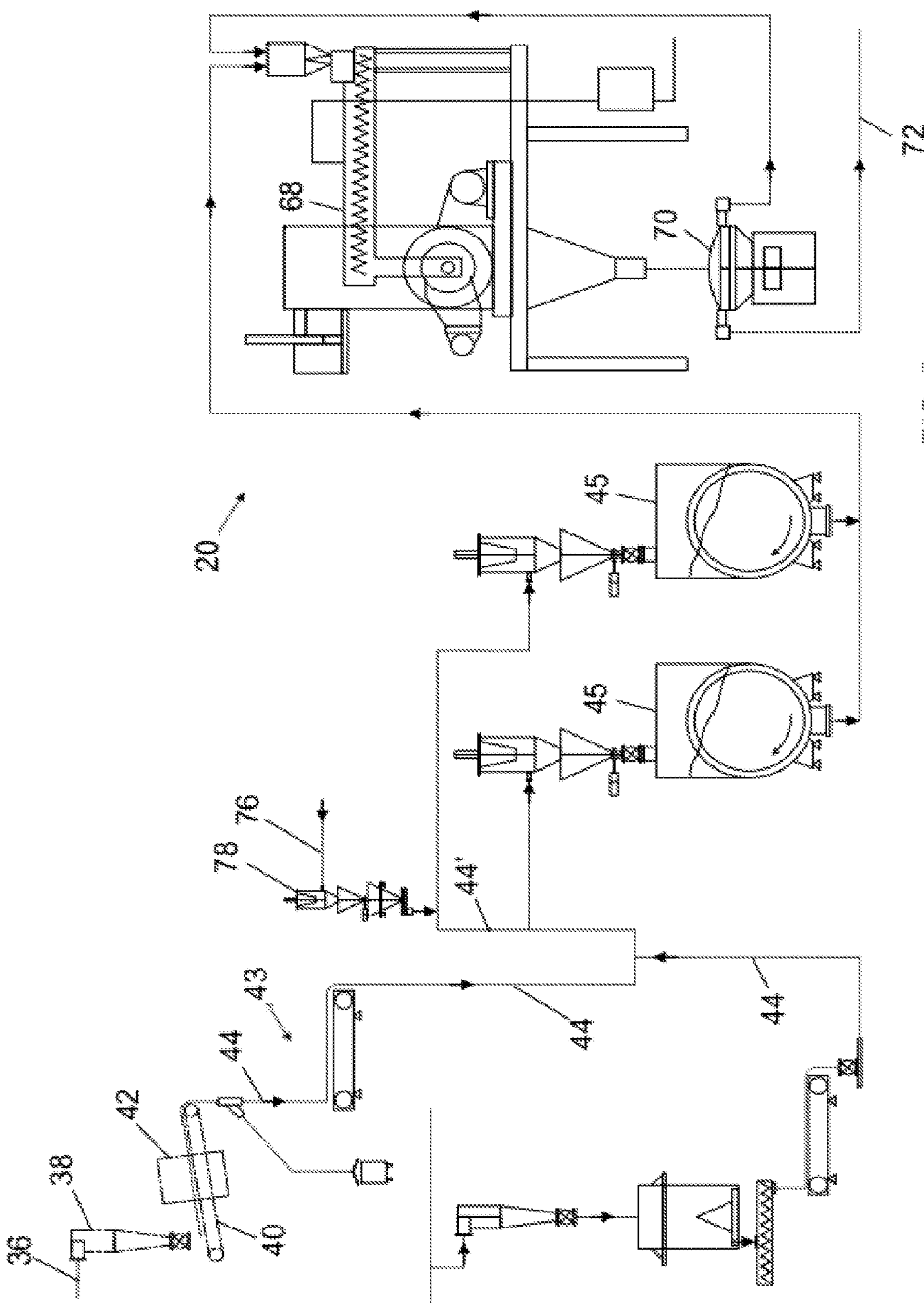


FIG. 5

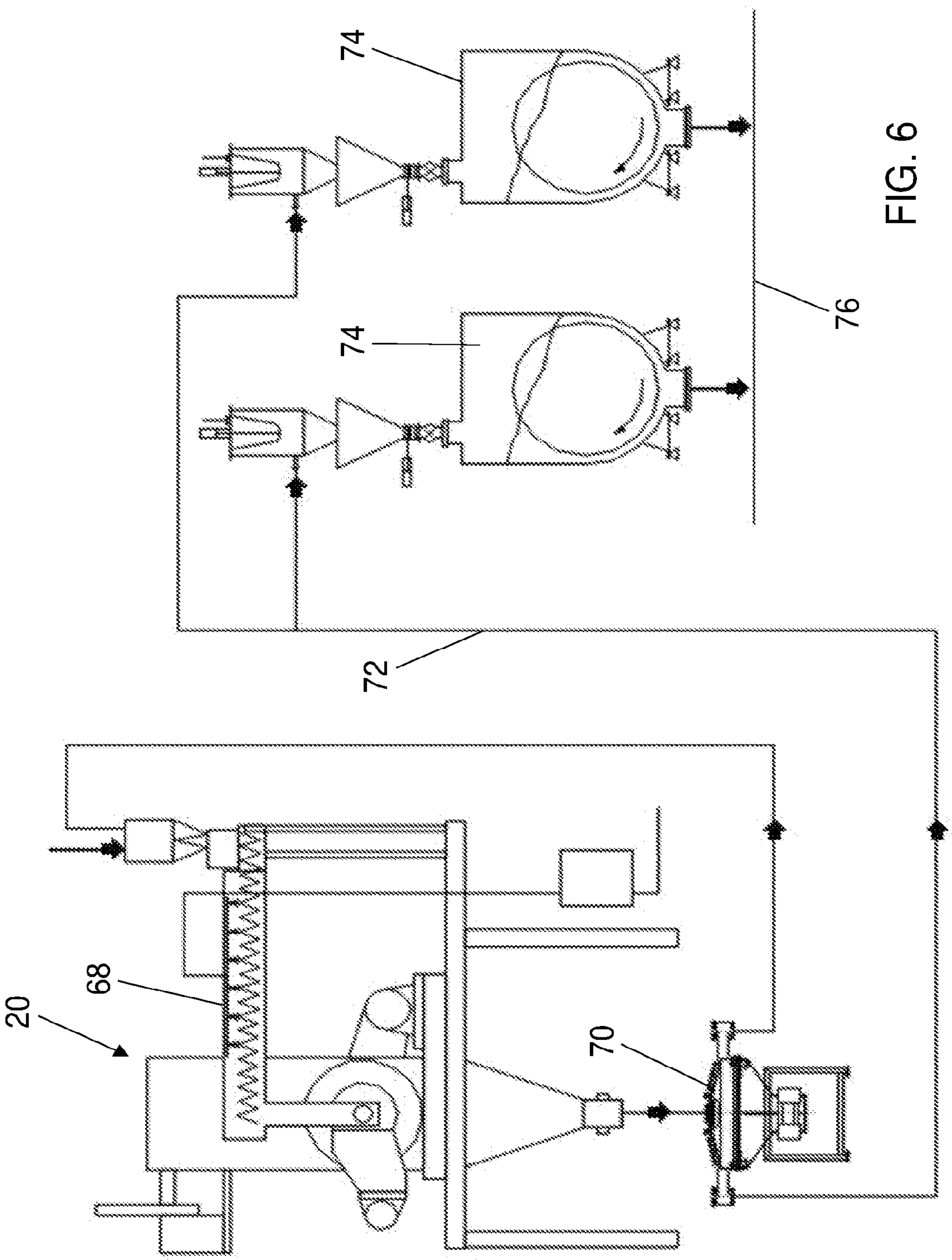
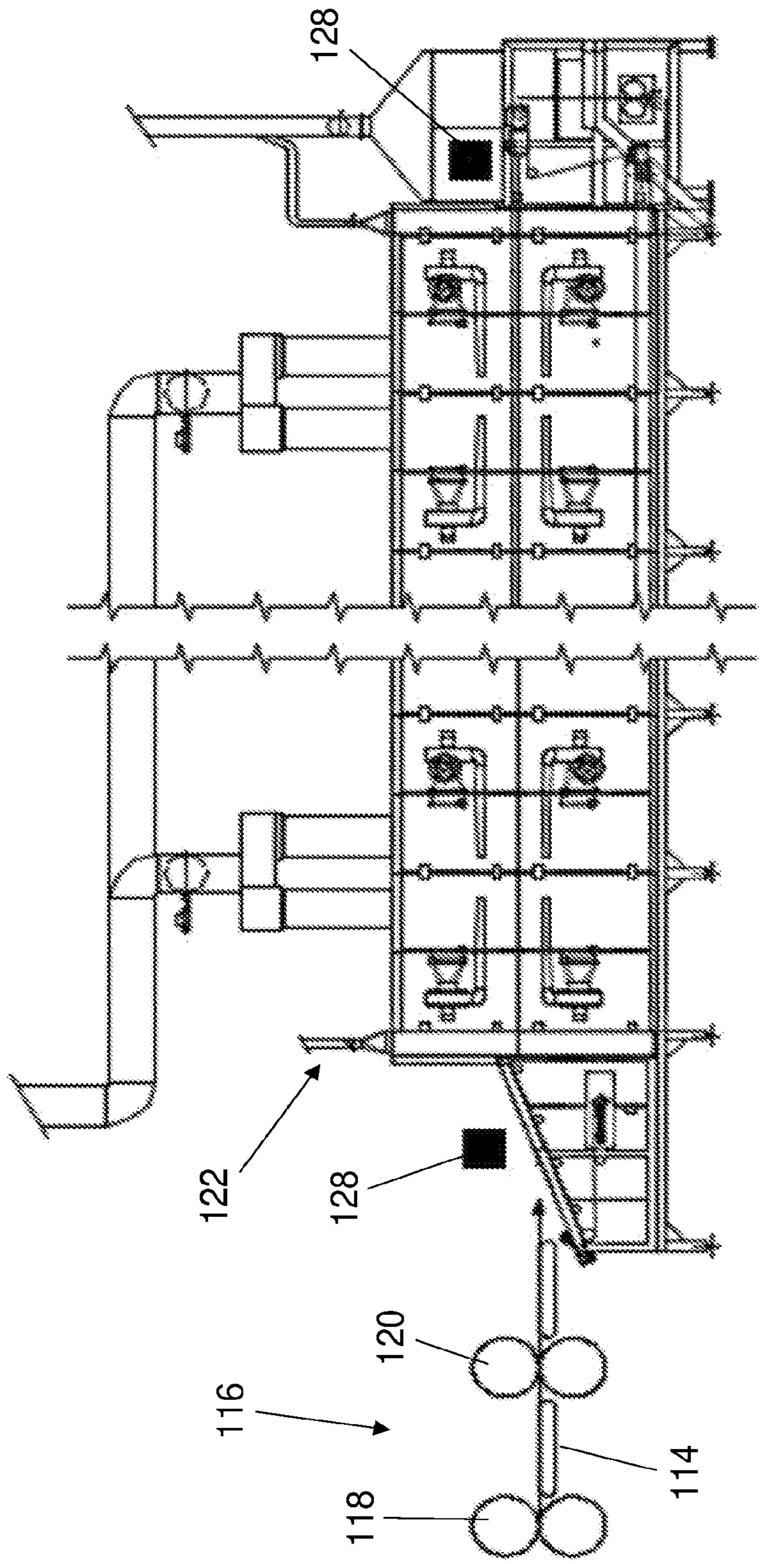


FIG. 6

FIG. 9



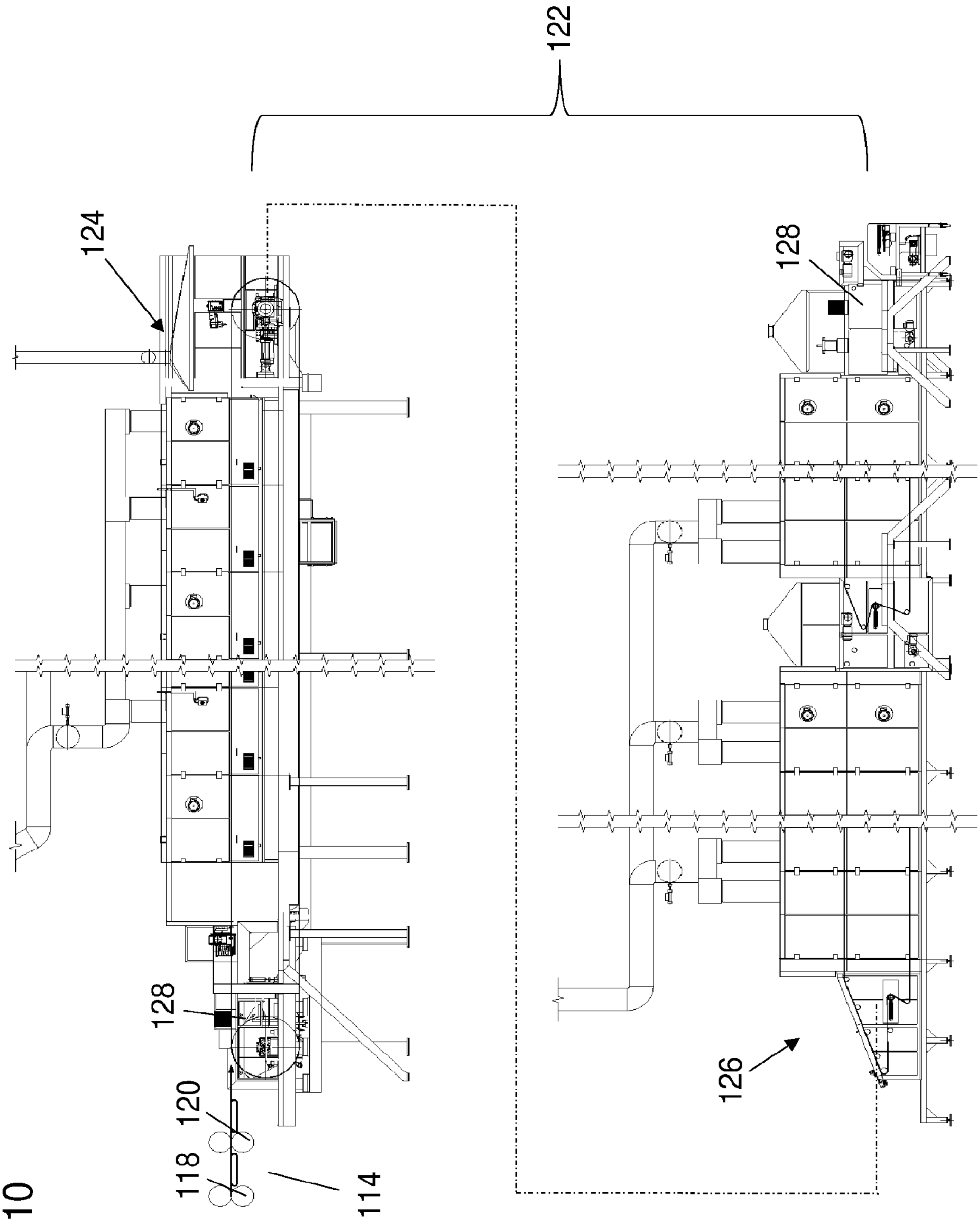


FIG. 10

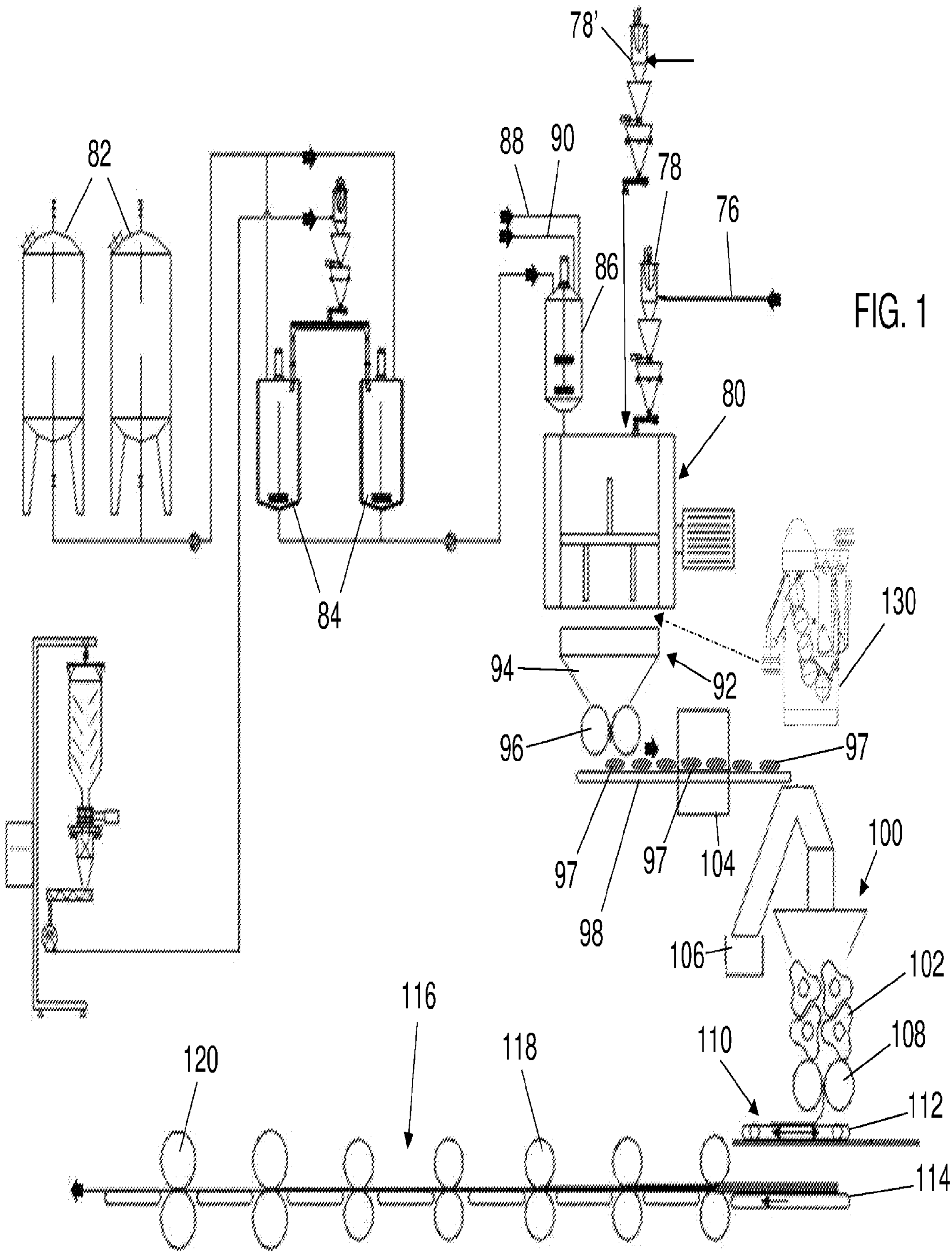

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FIG. 1