METHOD AND PLANT FOR BUILDING DIFFERENT TYPES OF GREEN TYRES FOR VEHICLE WHEELS

VERFAHREN UND ANLAGE ZUR HERSTELLUNG VERSCHIEDENEN ARTEN VON ROHREIFEN FÜR FAHRZEUGRÄDER

PROCÉDÉ ET ÉQUIPEMENT POUR LA FABRICATION DE DIFFÉRENTS TYPES DE PNEUS CRUS POUR ROUES DE VÉHICULE

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(56) References cited:
EP-A2- 0 448 407

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Description

[0001] The present invention relates to a method for building different types of green tyres for vehicle wheels. In particular, the present invention relates to a method for building green tyres by using elementary semi-finished products.

[0002] The present invention also relates to a plant for building different types of green green tyres for vehicle wheels, usable for carrying out the above mentioned building process.

[0003] Tyre production cycles envisage that, after a building process wherein the various components of the tyre itself are made and/or assembled in one or more building lines, a moulding and vulcanization process is carried out in a suitable vulcanization line, adapted to define the tyre structure according to desired tread geometry and design.

[0004] A tyre generally comprises a toroidally ring-shaped carcass structure including one or more carcass plies, strengthened with reinforcing cords lying in substantially radial planes (a radial plane contains the rotation axis of the tyre). Each carcass ply has its ends integrally associated with at least one metal reinforcing annular structure, known as bead core, constituting the reinforcing of the beads, i.e. the radially inner ends of the tyre having the function of enabling the assembling of the tyre with a corresponding mounting rim. Placed crown wise to said carcass is a band of elastomeric material, called tread band, within which, at the end of the moulding and vulcanization steps, a raised pattern is formed for ground contact. A reinforcing structure, generally known as belt structure, is arranged between the carcass and the tread band. Such structure usually comprises, in the case of tyres for cars, at least two radially overlapped strips of rubber fabric provided with reinforcing cords, usually of metal, arranged parallel to each other in each strip and crossed with the cords of the adjacent strip, preferably symmetrical to the equatorial plane of the tyre. Preferably, the belt structure further comprises in radially outer position, at least on the ends of the underlying belt strips, also a third layer of textile or metal cords, arranged circumferentially (at 0 degrees).

[0005] Finally, in tyres of the tubeless type, a radially inner layer, called liner, is present which has imperviousness features for ensuring the air-tightness of the tyre itself.

[0006] To the aims of the present invention and in the following claims, by the term "elastomeric material" it is intended a composition comprising at least one elastomeric polymer and at least one reinforcing filler. Preferably, such composition further comprises additives such as crosslinking and/or plasticizing agents. By virtue of the crosslinking agents, such material may be crosslinked by heating, so as to form the final manufactured article.

[0007] In the present context, by the term "green tyre" it is meant a tyre obtained by the building process and not yet vulcanized.

[0008] In the present description and in the following claims, by "elementary semi-finished products" it is meant continuous elongated elements of elastomeric material having at least one textile or metal reinforcing cord therein, and/or strips of elastomeric material generally called "strip-like elements" obtained by cutting said continuous elongated elements to size. Generally, such semi-finished products are laid reciprocally side by side, especially in the case of strip-like elements that for example contribute to forming carcass plies, belt strips, and some types of reinforcements. Preferably, such side by side reciprocal laying takes place on a substantially cylindrical and/or substantially toroidal and/or substantially flat laying surface.

[0009] In the present description, by "technological flexibility" it is meant the possibility of using for each tyre elementary semi-finished products differing by type of elastomeric material or by type of textile cord or metal reinforcing cord.

[0010] To the aims of the present invention and in the following claims, by the term "structural component" of the tyre it is meant any component adapted to carry out a function in the tyre, for example selected among: liner, sub-liner, carcass ply/plies, under-belt insert, belt strips either crossed or at zero degrees, connecting skin coat for the tread band, tread band, bead core, bead filler, reinforcing inserts made of textile or metal or elastomeric material only, abrasion-proof insert, sidewall inserts.

[0011] To the aims of the present invention and in the following claims, the term "size" of the tyre means the set of geometrical features that characterises a tyre, that is, at least tread band width, sidewall height, fitting diameter.

[0012] In the present description and in the following claims, by "type" of tyre it is meant the set of structural features (such as for example one- or two-ply structure, radial or with crossed carcass plies, with or without belt structure, type of belt structure - with crossed belts, zero degrees, crossed belts and zero degrees -, type of tread band with one or more layers etc.), and technological features (such as for example mixture of the various structural components, materials constituting the textile or metal reinforcing cords, type of formation of the reinforcing cords, etcetera).

[0013] EP 0 448 407 discloses a method and a plant for manufacturing tyres having different sizes in a hybrid manner. The plant comprises an automatic green tyre building line comprising three building machines; three corresponding component manufacturing machines for manufacturing various components of the tyres having different sizes corresponding to the rim sizes and tire widths; and three corresponding component supplying machines. Each of the component supplying machines includes three component stocking and feeding devices which store required amounts of the components having different sizes. These components are selected by means of selecting mechanisms in accordance with the
sizes of tires to be built successively. [0014] US 2003/0170336 discloses a plant for producing
tires of different types simultaneously. The plant comprises a plurality of work stations. Each work station comprises one feed device for supplying the basic elements required for the production of the corresponding structural component. The structural components of the tire are prepared essentially at the moment of their deposition, thus making possible to operate without previously stored semi-finished products and to adapt each unit immediately to the type of tire being processed.

[0015] EP 0 776 756 A1 describes an apparatus for manufacturing tires for vehicle wheels having a carcass assembly with an inner layer, at least one carcass ply, two side portions and two beads having a crown structure with at least one belt strip and a tread band layer, wherein at least one carcass manufacturing station and/or a belt manufacturing station is provided with at least two connection devices, which may be controlled independently of one another for the connection with the materials, which are identical in nature, and at least one feeding device for feeding identical components, associated with each connection device.

[0016] WO 01/32409, in the name of the same Applicant, describes a tire building line provided with working stations, each arranged to make and assemble at least one structural component of the tyre being processed, wherein at least one series of tires is treated at the same time, comprising at least one first and a second type of tires differing from each other, and wherein the tire transfer to the vulcanization line is carried out through robotized arms and according to a transferring rate equal to the transferring rate of the tires to each of said working stations.

[0017] WO 09/040594, in the name of the same Applicant, describes a process for producing tires for vehicle wheels comprising the steps of: a) building a carcass structure of a green tire on a first forming drum; b) building a crown structure of a green tire on at least one second forming drum; c) toroidally shaping said carcass structure assemplaning it to said crown structure in at least one station for shaping and assembling the tire being processed, wherein said assembly and shaping station is synchronised with the building line of the carcass structure and with the building line of the crown structure and wherein each carcass structure is associated with the respective first forming drum whereon it is built until the end of step c) of shaping and assembling the tire being processed; d) moulding and curing the green shaped tire.

[0018] US 2007/0175567 describes an apparatus for building tires comprising a movement system for sequentially moving conveyors along an assembly path; and a plurality of stations for applying components spaced along the path for applying green tyre components to each conveyor, each station comprising: at least one moving conveyor having second positioning structures releasably coupled to first positioning structures, means for feeding a green tyre component, a feeding mechanism for unwinding the green tyre component from the coil and feeding it towards a conveyor arranged at the respective station, and a cutting mechanism for cutting the green tyre component once a selected length has been unwound.

[0019] The methods of the type described in WO 01/32409 are aimed at increasing productivity in manufacturing processes of tires built on a toroidal forming support and using elementary semi-finished products for building by automated, standardised steps, synchronised with each other. However, such methods do not allow obtaining high technological flexibility. In fact, such methods are suitable for producing tyres that differ in limited features, such as dimensions, presence or not of some structural components of the tire - such as one or two carcass plies, reinforcing elements in bead zone -, arrangement of the coils of rubber metal wires forming the bead cores in the bead zone, more or less extended belt layer at zero degrees, presence of layer and sublayer in the tread band.

[0020] The methods of the type illustrated in EP 0 776 756, on the other hand, are technologically more flexible as they allow obtaining tyres from semi-finished products having different features from one another, but they are limited in terms of productivity, for example as the type of tyre to be produced changes, and they require large sized plants for their implementation.

[0021] The processes described in WO 09/040594 are similar to those of the type illustrated in EP 0 776 756 in terms of productivity and more flexible compared to the processes of the type described in WO 01/32409, however also the technological flexibility of such processes is limited. In fact, while such processes allow concurrently producing tyres of different sizes and with different structural components, they require the selection of built structural components starting from a limited number of semi-finished products. In processes of this type, in fact, once the building of tyres with predetermined elementary semi-finished products has started, the production must be stopped in order to change the selected semi-finished products, with consequent production drawbacks.

[0022] Moreover, the Applicant has noted that in the building tyres plants that use elementary semi-finished products of the type illustrated above, the management of a large number of materials and/or semi-finished products causes problems in synchronising the production steps of the various portions of the tyre and thereby problems in the general management of the production plant with negative consequences on productivity.

[0023] The Applicant has thus perceived that in order to build tyres with very different technological requirements from one another, improving the productivity of the processes of the type shown in WO 01/32409, increasing the flexibility of those of the type shown in WO 09/040594, and avoiding production plants of large dimensions and difficult to manage and synchronise like those illustrated in EP 0 776 756, it is necessary to have
building plants and processes that provide for the possibility of selecting an elementary semi-finished product among different elementary semi-finished products at the time of using the semi-finished product without interrupting the building process.

[0024] The Applicant has then perceived that by applying a process for building green tyres that provides for feeding a plurality of elementary semi-finished products in each one of a plurality of work stations, it is possible to obtain a large variety of tyres with a high technological flexibility while keeping productivity high as well.

[0025] The Applicant has then found that with a plant building green tyres comprising at least two stations adapted to build structural components of the tyre by the use of elementary semi-finished products selected among a plurality of semi-finished products fed in each one of the same stations, it is possible to build tyres much different from each other with a high productivity.

[0026] In particular, according to an aspect thereof, the invention relates to a plant for building different types of green tyres for vehicle wheels for each tyre size, according to the invention are defined in the dependent claims 15 to 25. Preferred embodiments of the plant according to the invention are defined in the dependent claims 15 to 25.

[0027] Finally, the Applicant has found that by providing a method that provides for feeding \( n_k \) elementary semi-finished products differing from one another to each k-th work station of m work stations fed by said \( n_k \) elementary semi-finished products, with k ranging from 1 to m, it is possible to obtain \( n_1 \cdot n_2 \cdot n_3 \cdot \ldots \cdot n_m \) that is \( \Pi_{k=1,m} n_k \) different types of green tyres.

[0028] By providing m and each \( n_k \) greater than or equal to two, it is possible to achieve a high technological flexibility.

[0029] In particular, according to an aspect thereof, the invention relates to a method for building different types of green tyres for vehicle wheels for each tyre size, according to claim 1.

[0030] Preferred embodiments of the method according to the invention are defined in the dependent claims 2 to 13.

[0031] The present invention, in at least one of the above aspects thereof, can have at least one of the following preferred features.

[0032] According to a preferred embodiment, the plant of the invention comprises at least one temporary storage unit of elementary semi-finished products.

[0033] Advantageously, the work stations fed by at least one first and one second elementary semi-finished product are four.

[0034] Preferably, the different elementary semi-finished products fed into each of said first and second work stations are two.

[0035] Preferably, each work station fed by said first and second elementary semi-finished products is provided with corresponding feeding units of semi-finished products.

[0036] According to a preferred embodiment, the building plant further comprises an elementary semi-finished products arranging line.

[0037] Advantageously, at least one of said at least one first and one second work station fed by at least one first and one second elementary semi-finished product comprises one among the following work stations:

- first belt application work station provided with devices for applying at least one first belt strip;
- second belt application work station provided with devices for applying a second belt strip in a position radially external to said first belt strip;
- cord application work station provided with devices for applying at least one first layer of textile or metal cords, arranged circumferentially on the radially external belt strip, applied at least at its axially external portions;
- a ply application work station provided with devices for applying at least one first carcass ply.

[0038] The plant preferably further comprises at least one forming drum whereon the tyre is built.

[0039] According to a preferred embodiment, the plant further comprises:

- at least one carcass structure building line on a first forming drum, said carcass structure comprising at least one carcass ply and a pair of annular anchoring structures;
- at least one crown structure building line on a second forming drum, said crown structure comprising at least one belt structure and a tread band.

[0040] At least one assembling and shaping work station of the tyre being processed is also advantageously provided, adapted to shape said carcass structure assembling it at said crown structure so as to obtain a green tyre.

[0041] Preferably, the plant of the invention comprises at least one tread band building work station, provided with at least one application device of said tread band adapted to deposit a continuous elongated element of elastomeric material winding it onto a surface radially external to a forming drum, according to adjacent and/or radially juxtaposed coils.

[0042] Advantageously, said tread band building work station comprises at least two of said application devices, each dispensing a continuous elongated element of elastomeric material different to the other one.

[0043] According to preferred embodiments of the invention, the plant further comprises devices for transferring the tyre being processed from one work station to the next work station.

[0044] Preferably, said transfer devices comprise at
least one robotised arm.

According to preferred embodiments of the method of the invention, the number \( m \) of work stations fed by said \( n_k \) elementary semi-finished products is larger than or equal to \( 3 \).

More preferably, \( m \) is equal to \( 4 \).

According to a preferred embodiment of the method of the invention, the number \( n_k \) of elementary semi-finished products fed into the \( k \)-th station is equal to \( 2 \) in each \( k \)-th work station.

Advantageously, at least one \( n_k \) of a \( k \)-th work station is greater than or equal to \( 3 \).

According to an embodiment of the method of the invention, each elementary semi-finished product fed into a \( k \)-th work station is different from each elementary semi-finished product fed into a different \( k \)-th work station.

Preferably, each elementary semi-finished product fed into a \( k \)-th work station is different from all of the remaining elementary semi-finished products fed into the remaining work stations of \( m \) work stations.

Preferably, the method of the invention further comprises:

- storing elementary semi-finished products, previously arranged, in respective temporary storage units of elementary semi-finished products.

And advantageously, also:

- transferring said elementary semi-finished products, arranged in an elementary semi-finished products arranging line, into the respective temporary storage units.

According to preferred embodiments, the method of the invention further comprises:

- transferring said \( n_k \) elementary semi-finished products from the temporary storage units into corresponding semi-finished product feeding units of the corresponding \( k \)-th work stations.

Preferably, the building of at least one portion of a structural component of the tyre being processed starting from at least one elementary semi-finished product selected from said \( n_k \) elementary semi-finished products fed into the \( k \)-th work station comprises:

- winding at least one continuous elongated element of elastomeric material onto a surface radially external to a forming drum according to adjacent and/or radially juxtaposed coils.

More preferably, said continuous elongated elements are two and are made from different elastomeric materials.

Further features and advantages of invention will appear more clearly from the following description of some preferred examples of building plants, processes and methods according to the invention, made by way of an indicative non-limiting example with reference to the annexed drawings, wherein:

- figure 1 shows a schematic layout of a plant for building green tyres for vehicle wheels wherein the method according to a first embodiment of the present invention is carried out;

- figure 2 shows a schematic layout of a plant for building green tyres for vehicle wheels wherein the method according to a further embodiment of the present invention is carried out.

With reference to figure 1, reference numeral 1 globally indicates a plant for building green tyres for vehicle wheels.

According to the first preferred embodiment shown in figure 1, plant 1 comprises a carcass structure building line 2 and a crown structure building line 3.

The carcass structure building line 2 comprises a plurality of work stations and at least one first forming drum wherein the carcass structure is built; likewise, the crown structure building line 3 comprises a plurality of work stations and at least one second forming drum wherein the crown structure is built.

The carcass structure of the tyre to be built in such plant 1 comprises at least one carcass ply and a pair of annular anchoring structures and the crown structure comprises at least one belt structure and a tread band.

Plant 1 comprises a plurality of assembling and shaping work stations 4 of the tyre being processed which are adapted to shape the carcass structure assembling it to the crown structure so as to obtain a green tyre.

According to the present invention, plant 1 comprises at least one first and one second work station, each fed by at least one first and one second elementary semi-finished product which are different to one another.

The elementary semi-finished products may differ, for example, by type of elastomeric material; density, that is number of cords per unit of width in cross section with respect to the semi-finished product; type of cords: textile, metal, scheme (starting from the elementary filaments).

Such semi-finished products are fed to the respective work stations by means of corresponding feeding units 12.

Therefore, plant 1 comprises at least one first feeding unit 12 of said first elementary semi-finished product and one second feeding unit 12 of said second elementary semi-finished product for each one of the at least two work stations fed by at least one first and one second elementary semi-finished product.

According to the invention, each of said first and second work station is adapted to build at least one por-
tion of a structural component of the tyre being processed starting from at least one elementary semi-finished product selected between said first and second elementary semi-finished products fed into the work station itself.

**[0067]** Preferably, the feeding units 12 of elementary semi-finished products comprise semi-finished product dispensing devices.

**[0068]** Plant 1 further comprises temporary storage units 29 of elementary semi-finished products. Such temporary storage units 29 preferably comprise coils of elementary semi-finished products.

**[0069]** In the first embodiment shown in figure 1, there are shown four work stations fed by two elementary semi-finished products by means of the corresponding feeding units 12:

- a first belt application work station 9 provided with devices for applying at least a first belt strip on said second forming drum;
- a second belt application work station 31 provided with devices for applying a second belt strip in a position radially external to said first belt strip;
- a cord application work station 10 provided with devices for applying at least one first layer of textile or metal cords, arranged circumferentially, that is, at zero degrees, on the radially external belt strip, applied at least at its axially external portions;
- a ply application work station 8 provided with devices for applying at least one first carcass ply on said first forming drum.

**[0070]** Such figure 1 also shows a tread band building station 11, provided with at least two devices 30 for applying said tread band. Each of such application devices 30 is adapted to lay a continuous elongated element of elastomeric material by winding it on a surface radially external to the second forming drum, more precisely on the radially outer surface of the belt structure already built, according to adjacent and/or radially juxtaposed coils.

**[0071]** With reference now to figure 2, it is seen that plant 1' comprises anything described before for the first embodiment plus further elements that shall be described hereinafter. In the two figures, same reference numbers correspond to same elements.

**[0072]** Plant 1' comprises a carcass structure building line 2', a crown structure building line 3' and an assembling and shaping work station 4, similar to plant 1 relating to the first embodiment.

**[0073]** The carcass structure building line 2' comprises a plurality of work stations and at least one first forming drum 6 whereon the carcass structure is built; likewise, the crown structure building line 3 comprises a plurality of work stations and at least one second forming drum 7 wherein the crown structure is built.

**[0074]** Plant 1' comprises an elementary semi-finished products arranging line 28 adapted to arrange elementary semi-finished products which are in turn adapted to be fed into the work stations through the feeding units 12.

**[0075]** According to the embodiment shown by way of an example in figure 2, the carcass structure building line 2' of plant 1' further comprises:

- a station for applying a reinforcing fabric 13 provided with devices for applying at least one bead reinforcing fabric on the forming drum;
- a first abrasion-proof application station 14 provided with devices for applying at least a first portion of an abrasion-proof element in a position radially external to said forming drum;
- a liner application station 15 provided with devices for applying a liner layer in a position radially external to the forming drum;
- a sub-liner application station 16 provided with devices for applying an sub-liner layer in a position radially external to said liner;
- a ply application station 8 provided with devices for applying at least a first carcass ply in a position radially external to the sub-liner layer;
- a station for applying first intermediate elements 17 provided with devices for applying a plurality of first intermediate elements at said at least one carcass ply;
- an internal reinforcement application station 18 provided with devices for applying a plurality of internal reinforcements at said first intermediate elements;
- a station for applying annular anchoring structures 19 provided with devices for applying at least one pair of annular anchoring structures to the axially opposite ends of said at least one carcass ply;
- a second abrasion-proof application station 20 provided with devices for applying at least a second portion of the abrasion-proof element;
- a first side wall building station 21 provided with devices for applying at least a first portion of sides of the tyre being processed.

**[0076]** The carcass structure building line 2' of plant 1' may optionally comprise the following work stations not shown in the figures:

- a self-sealing material application station provided with devices for applying a layer of self-sealing material in a position radially external to the sub-liner
layer;

- an external reinforcement application station provided with devices for applying a plurality of external reinforcements at said at least one carcass ply;

- an external ply application station provided with devices for applying an external ply at said at least one carcass ply.

[0077] The crown structure building line 3' of plant 1' comprises:

- an under-belt layer application station 22 provided with devices for applying an under-belt layer on the forming drum;

- a first belt application station 9 provided with devices for applying at least a first belt strip in a position radially external to said forming drum;

- a second belt application station 31 provided with devices for applying a second belt strip in a position radially external to said forming drum;

- a second intermediate elements laying station 23 provided with devices for laying at least one second intermediate element on the first belt strip;

- a belt turning station 24 provided with devices for turning the ends of the first belt strip on the second belt strip;

- a cord application work station 10 provided with devices for applying at least a first layer of cords, arranged circumferentially, that is, at zero degrees, on the radially external belt strip, applied at least at the axially external portions thereof;

- one sub-layer application work station 25 provided with devices for applying at least one sub-layer in a position radially external to the cord layer;

- four tread band building work stations 11, each provided with devices for applying at least one tread band in a position radially external to said sub-layer;

- a second side wall building station 26 provided with devices for building at least a second portion of side walls in a position axially external to the tread band.

[0078] Plant 1' further comprises units 12 for feeding elementary semi-finished products.

[0079] In particular, at each one of the following work stations:

- first belt application station 9;

- second belt application station 31;

- cord application station 10;

plant 1' is provided with two feeding units 12 of two corresponding different elementary semi-finished products fed in each one of said stations.

[0080] At the ply application station 8, on the other hand, plant 1' comprises three feeding units 12 of three corresponding different elementary semi-finished products fed into the same ply application station 8.

[0081] Also plant 1' comprises temporary storage units 29 of elementary semi-finished products. Such temporary storage units 29 of elementary semi-finished products preferably comprise coils of elementary semi-finished products.

[0082] Plant 1' further comprises devices for transferring the tyre being processed from one work station to the next work station.

[0083] In particular, each one of said transfer devices comprises one robotised arm 27.

[0084] Plant 1' also comprises a moulding and curing line 5 of the green tyre built.

[0085] According to alternative embodiments not shown in the figure, it is possible to provide two or more ply application stations, in particular one adapted to apply the first carcass ply and the further stations adapted to apply further carcass plies.

[0086] Further embodiments of the plant of the invention, not shown in the figures, provide a single station for applying one or more belt strips.

[0087] With reference to the building plant 1 illustrated in figure 1, a preferred embodiment of a process for building a tyre shall now be described.

[0088] The carcass structure of a green tyre is built by the use of elementary semi-finished products fed into the work stations of the carcass structure building line 2.

[0089] The carcass structure of the tyre being processed is transferred from one work station to the next one, preferably in the direction indicated by the arrow in figure 1, up to the completion of the same carcass structure.

[0090] During the building of the carcass structure, once the tyre being processed has been transferred into the ply application station 8, which is provided with two feeding units 12 of semi-finished products, it is possible to select one of the two semi-finished products fed therein based on the technological requirements of the tyre to be produced.

Once a first carcass ply has been applied using the selected semi-finished product, it is possible to apply a second ply in a position radially external to the first ply by selecting one of the two semi-finished products fed into the ply application station 8 again, or transfer the tyre into the next work station.

[0091] Once the tyre being processed has been transferred outside the ply application station 8, the latter receives a further tyre being processed for which it is again possible to select one of the two elementary semi-fin-
ished products fed therein, in order to apply at least a first carcass ply, by building a carcass structure equal to or different from the previous one.

[0092] The crown structure of the tyre being processed, in the meantime, is built in the crown structure building line 3 by the use of elementary semi-finished products fed into the work stations of the same crown structure building line 3.

[0093] The crown structure of the tyre being processed is transferred from one work station to the next one, preferably in the direction indicated by the arrow in figure 1, up to the completion of the crown structure.

[0094] During the building of the crown structure, once the latter has been transferred into the first belt application station 9, into the second belt application station 31 and into the cord application station 10, in each one of such stations it is possible to select one of the two elementary semi-finished products fed therein, consequently obtaining different crown structures according to the combination of the selected semi-finished products.

[0095] The crown structures and the carcass structures thus obtained are then assembled in an assembling and shaping station 4 from which different types of built tyres are obtained.

[0096] With reference to the building plant 1' illustrated in figure 2, a second preferred embodiment of a process for building a tyre shall now be described.

[0097] Elementary semi-finished products are arranged in an elementary semi-finished products arranging line 28.

[0098] Such elementary semi-finished products are transferred into corresponding temporary storage units 29 where they remain up to the transfer into corresponding feeding units 12.

[0099] According to the second embodiment, the process provides the arrangement of three feeding units 12 of three corresponding elementary semi-finished products differing from each other, adapted to feed the ply application station 8. The latter is adapted to apply at least one first ply of the tyre being processed starting from at least one of said three elementary semi-finished products.

[0100] The process further provides for arranging two feeding units 12 of two corresponding different elementary semi-finished products, adapted to feed each one among: the first belt application work station 9, the second belt application work station 31 and the cord application work station 10. In this way it is possible to select at least one elementary semi-finished product between the two semi-finished products fed into the corresponding stations for each one of the following process operations:

- applying a first belt strip;
- applying a second belt strip in a position radially external to said first belt strip;
- applying at least one first layer of textile or metal cords, arranged circumferentially in a position radially external to the radially external belt strip, and applied at least at its axially external portions.

[0101] In a preferred case, a carcass structure of a tyre being processed is carried out on a first forming drum 6 in one carcass structure building line 2' by the following process operations:

- applying at least one bead reinforcing fabric in a position radially external to the first forming drum 6;
- applying at least one first portion of an abrasion-proof element in a position radially external to the first forming drum 6;
- applying a liner layer in a position radially external to the forming drum;
- applying an under-liner layer in a position radially external to said liner;
- applying at least one first carcass ply in a position radially external to the under-liner layer using at least one elementary semi-finished product selected among the three elementary semi-finished products fed into the ply application station 8;
- applying a plurality of first intermediate elements at said least one carcass ply;
- applying a plurality of internal reinforcements at said first intermediate elements;
- applying at least one pair of annular anchoring structures to the axially opposite ends of said at least one carcass ply;
- applying at least a second portion of the abrasion-proof element;
- applying at least one first portion of side walls of the tyre being processed.

[0102] According to alternative embodiments, the carcass structure building also comprises at least one of the following process operations:

- applying a layer of self-sealing material;
- applying a plurality of external reinforcements at said at least one carcass ply;
- applying an external ply at said at least one carcass ply.

[0103] In a preferred case, a crown structure of a tyre being processed is carried out on a second forming drum
in a crown structure building line 3' by the following process operations:

- applying an under-belt layer in a position radially external to the second forming drum 7;
- applying at least one first belt strip in a position radially external to the second forming drum 7 using at least one elementary semi-finished product selected between the two elementary semi-finished products fed into the first belt application station 9;
- laying at least a second intermediate element on the first belt strip;
- applying a second belt strip in a position radially external to said first belt strip using at least one elementary semi-finished product selected between the two elementary semi-finished products fed into the second belt application station 31;
- turning the ends of the first belt strip on the second belt strip;
- applying at least one first layer of metal or textile cords, arranged circumferentially in a position radially external to the radially external belt strip, using at least one elementary semi-finished product selected between the two elementary semi-finished products fed into the cord application station 10;
- applying at least one sub-layer on the cord layer;
- applying at least one tread band in a position radially external to said sub-layer;
- applying at least one further tread band in a position radially external to said tread band.

According to such second preferred embodiment of the process, the tread band is built by winding two continuous elongated elements of elastomeric material differing from each other at least by composition, on a surface radially external to the second forming drum 7 according to adjacent and/or radially juxtaposed coils.

Once the different carcass and crown structures have been built, the process provides for toroidally shaping the carcass structures assembling them to the corresponding crown structures in one assembling and shaping work station 4 of the tyre being processed.

Moreover, according to such embodiment, each carcass structure is associated to the respective first forming drum 6 whereon it is assembled up to the end of the shaping and assembly of the tyre being processed.

The tyres being processed are preferably transferred from one work station to the next work station by means of at least one robotised arm 27.
band, provided with two feeding devices of continuous elongated elements differing from each other (used for building the entire tread band), in the first example shown above we shall get 16x2, that is, 32 types of different tyres, in the second one 24x2, that is, 48.

The building plants 1 and 1’, schematically shown in the figures, therefore allow obtaining different types of green tyres for each tyre size. Of course, the number of tyre types that can be built by the method of the invention, and therefore the flexibility of such method, further increases if we think that they also allow building tyres of a different size.

Within the scope of the above present description and in the following claims, all numerical values indicating amounts, parameters, percentages and so on are always to be deemed as preceded by the term “about”, if not otherwise stated. Moreover, all numerical value ranges include all possible combinations of the maximum and minimum numerical values and all possible intermediate ranges, besides those specifically indicated in the text.

Claims

1. Method for building different types of green tyres for vehicle wheels for each tyre size, through the use of elementary semi-finished products, in a building plant (1; 1’) comprising a plurality of work stations, said method comprising:

- feeding \( n_k \) different elementary semi-finished products into each k-th work station of m work stations of said plurality of work stations, with k ranging from 1 to m, said m work stations being fed by said \( n_k \) elementary semi-finished products;
- building, in each k-th work station of said m work stations, at least one portion of a structural component of the tyre being processed starting from at least one elementary semi-finished product selected from said \( n_k \) elementary semi-finished products fed into the work station itself;

wherein m and each \( n_k \) are integers greater than or equal to 2, \( n_k \) representing the number of different elementary semi-finished products fed into the kth work station of said m work stations.

2. Method according to claim 1, wherein the building of at least one portion of a structural component of the tyre being processed starting from at least one elementary semi-finished product selected from said \( n_k \) elementary semi-finished products fed into the k-th work station comprises:

- winding at least one continuous elongated element of elastomeric material onto a surface radially external to a forming drum according to adjacent and/or radially juxtaposed coils.

3. Method according to claim 2, wherein said continuous elongated elements are two and are made from different elastomeric materials.

4. Method according to any one of claims 1 - 3, wherein each elementary semi-finished product fed into a k-th work station of said m work stations is different from each elementary semi-finished product fed into a different k-th work station of said m work stations.

5. Method according to any one of claims 1 - 4, wherein each elementary semi-finished product fed into a k-th work station of said m work stations is different from all of the remaining elementary semi-finished products fed into the remaining work stations of said m work stations.

6. Method according to any one of claims 1 - 5, wherein m is greater than or equal to 3.

7. Method according to any one of claims 1 - 6, wherein m is equal to 4.

8. Method according to any one of claims 1 - 7, wherein \( n_k \) is equal to 2 in each work station of said m work stations.

9. Method according to any one of claims 1 - 8, wherein at least one \( n_k \) of a work station of said m work stations is greater than or equal to 3.

10. Method according to any one of claims 1 - 9, further comprising:

- storing elementary semi-finished products, previously arranged, in respective temporary storage units (29) of elementary semi-finished products.

11. Method according to claim 10, further comprising:

- transferring said elementary semi-finished products, arranged in an elementary semi-finished products arranging line (28), into the respective temporary storage units (29).

12. Method according to claim 10 or 11, further comprising:

- transferring said \( n_k \) elementary semi-finished products from the temporary storage units (29) into corresponding semi-finished product feeding units (12) of said m work station.

13. Method according to any one of claims 1 - 12, where-
in said step of building in each k-th work station of said m work stations at least one portion of a structural component of the tyre being processed is performed by selecting at least one of said first and second elementary semi-finished products based on the type of green tyres being processed.

14. Plant (1; 1') for building different types of green tyres for vehicle wheels for each tyre size, through the use of elementary semi-finished products fed into a plurality of work stations belonging to said plant, said plant comprising:
- at least one first and one second work station of said plurality of work stations, each fed by at least one first and one second elementary semi-finished product which are different to one another;
- at least one first feeding unit (12) of said first elementary semi-finished product and one second feeding unit (12) of said second elementary semi-finished product for each of said at least one first and one second work station fed by said at least one first and one second elementary semi-finished product; wherein:
  - each of said first and second work station is adapted to build at least one portion of a structural component of the tyre being processed starting from at least one elementary semi-finished product selected between said first and second elementary semi-finished products fed into the work station itself.

15. Plant according to claim 14, comprising at least one temporary storage unit (29) of elementary semi-finished products.

16. Plant according to any one of claims 14 - 15, further comprising an elementary semi-finished products arranging line (28).

17. Plant according to any one of claims 14 - 16, wherein at least one of said at least one first and one second work station fed by at least one first and one second elementary semi-finished product comprises one of the following work stations:
- first belt application work station (9) provided with devices for applying at least one first belt strip;
- second belt application work station (31) provided with devices for applying a second belt strip in a position radially external to said first belt strip;
- cord application work station (10) provided with devices for applying at least one first layer of textile or metal cords, arranged circumferentially on the radially external belt strip, applied at least at its axially external portions;
- a ply application work station (8) provided with devices for applying at least one first carcass ply.

18. Plant according to any one of claims 14 - 17, further comprising:
- at least one carcass structure building line (2; 2') on a first forming drum (6), said carcass structure comprising at least one carcass ply and a pair of annular anchoring structures;
- at least one crown structure building line (3; 3') on a second forming drum (7), said crown structure comprising at least one belt structure and a tread band.

19. Plant according to claim 18, further comprising:
- at least one assembling and shaping work station (4; 4') of the tyre being processed adapted to shape said carcass structure by assembling it at said crown structure so as to obtain a green tyre.

20. Plant according to any one of claims 14 - 19, further comprising at least one work station of the following type:
- at least one tread band building work station (11), provided with at least one application device (30) of said tread band adapted to depose a continuous elongated element of elastomeric material by winding it onto a surface radially external to a forming drum, according to adjacent and/or radially juxtaposed coils.

21. Plant according to claim 20, wherein said tread band building work station (11) comprises at least two of said application devices (30), each dispensing a continuous elongated element of elastomeric material different to the other one.

22. Plant according to any one of claims 14 - 21, further comprising devices for transferring the tyre being processed from one work station to the next work station.

23. Plant according to claim 22, wherein said transfer devices comprise at least one robotised arm (27).

24. Plant according to any one of claims 14 - 23, wherein said at least one first and one second elementary semi-finished products comprise elongated elements of elastomeric material having at least one textile or metal reinforcing cord therein, and/or strips of elastomeric material obtained by cutting said elongated elements to size.
25. Plant according to any one of claims 14 - 24, wherein said at least one first and one second elementary semi-finished products are different to one another by type of elastomeric material, by density of cords and/or by type of cord.

Patentansprüche

1. Verfahren zur Herstellung unterschiedlicher Arten von Rohreifen für Fahrzeugräder für jede Reifengröße, durch Verwendung von halbfertigen Ausgangsprodukten, in einer Fertigungsanlage (1; 1') umfassend eine Vielzahl von Arbeitsstationen, wobei das Verfahren die Schritte umfasst:

- Zuführen von \( n_k \) unterschiedlichen halbfertigen Ausgangsprodukten in jede k-te Arbeitsstation von m Arbeitsstationen der Vielzahl von Arbeitsstationen, wobei k von 1 bis m reicht, wobei die \( m \) Arbeitsstationen mit den \( n_k \) halbfertigen Ausgangsprodukten beschickt werden;
- Herstellen, in jeder k-ten Arbeitsstation der \( m \) Arbeitsstationen, zumindest eines Abschnittes einer strukturellen Komponente des aktuell bearbeiteten Reifens ausgehend von zumindest einem halbfertigen Ausgangsprodukt ausgewählt aus den \( n_k \) halbfertigen Ausgangsprodukten, die in die Arbeitsstation selbst zugeführt wurden;

wobei \( m \) und jedes \( n_k \) ganze Zahlen größer oder gleich 2 sind, wobei \( n_k \) die Anzahl unterschiedlicher halbfertiger Ausgangsprodukte darstellt, die in die k-te Arbeitsstation der \( m \) Arbeitsstationen zugeführt wurden.

2. Verfahren nach Anspruch 1, wobei das Herstellen zumindest eines Abschnittes einer strukturellen Komponente des aktuell bearbeiteten Reifens ausgehend von zumindest einem halbfertigen Ausgangsprodukt ausgewählt aus den \( n_k \) halbfertigen Ausgangsprodukten, die in die Arbeitsstation selbst zugeführt wurden, den Schritt umfasst:

- Aufwickeln zumindest eines durchgehenden länglichen Elements aus Elastomermaterial auf eine Oberfläche radial außerhalb einer Formungstrommel in Übereinstimmung mit benachbarten und/oder radial nebeneinander liegenden Wicklungen.

3. Verfahren nach Anspruch 2, wobei die durchgehenden länglichen Elemente zwei sind und aus unterschiedlichen Elastomermaterialien hergestellt sind.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei jedes halbfertige Ausgangsprodukt, das in eine k-te Arbeitsstation der \( m \) Arbeitsstationen zugeführt wird, sich von jedem halbfertigen Ausgangsprodukt unterscheidet, das in eine unterschiedliche k-te Arbeitsstation der \( m \) Arbeitsstationen zugeführt wird.

5. Verfahren nach einem der Ansprüche 1 bis 4, wobei jedes halbfertige Ausgangsprodukt, das in eine k-te Arbeitsstation der \( m \) Arbeitsstationen zugeführt wird, sich von allen übrigen halbfertigen Ausgangsprodukten unterscheidet, die in die übrigen Arbeitsstationen der \( m \) Arbeitsstationen zugeführt werden.

6. Verfahren nach einem der Ansprüche 1 bis 5, wobei \( m \) größer oder gleich 3 ist.

7. Verfahren nach einem der Ansprüche 1 bis 6, wobei \( m \) gleich 4 ist.

8. Verfahren nach einem der Ansprüche 1 bis 7, wobei \( n_k \) in jeder Arbeitsstation der \( m \) Arbeitsstationen gleich 2 ist.

9. Verfahren nach einem der Ansprüche 1 bis 8, wobei zumindest ein \( n_k \) einer Arbeitsstation der \( m \) Arbeitsstationen größer oder gleich 3 ist.

10. Verfahren nach einem der Ansprüche 1 bis 9, weiters umfassend den Schritt:

- Speichern halbfertiger Ausgangsprodukte, die zuvor angeordnet wurden, in jeweiligen temporären Speichereinheiten (29) für halbfertige Ausgangsprodukte.

11. Verfahren nach Anspruch 10, weiters umfassend den Schritt:

- Überführen der halbfertigen Ausgangsprodukte, die in einer Anordnungslinie (28) für halbfertige Ausgangsprodukte angeordnet wurden, in die jeweiligen temporären Speichereinheiten (29).

12. Verfahren nach Anspruch 10 oder 11, des Weiteren umfassend den Schritt:

- Überführen der \( n_k \) halbfertigen Ausgangsprodukte von den temporären Speichereinheiten (29) in entsprechende Beschickungseinheiten (12) für halbfertige Ausgangsprodukte der \( m \) Arbeitsstation.

13. Verfahren nach einem der Ansprüche 1 bis 12, wobei der Schritt des Herstellens zumindest eines Abschnittes einer strukturellen Komponente des aktuell bearbeiteten Reifens in jeder k-ten Arbeitsstation von der \( m \) Arbeitsstationen ausgeführt wird, indem zumindest eines der ersten und zweiten halbfertigen
Ausgangsprodukte auf der Grundlage des Typs von Rohreifen, der verarbeitet wird, ausgewählt wird.

14. Anlage (1; 1') zur Herstellung unterschiedlicher Arten von Rohreifen für Fahrzeugräder für jede Reifengröße, durch Verwendung von halbfertigen Ausgangsprodukten, die in eine Vielzahl von Arbeitsstationen zugeführt werden, die der Anlage zugeordnet sind, wobei die Anlage umfasst:

- zumindest eine erste und eine zweite Arbeitsstation der Vielzahl von Arbeitsstationen, wobei jede mit zumindest einem ersten und einem zweiten halbfertigen Ausgangsprodukt beschickt wird, die sich von einander unterscheiden;
- zumindest eine erste Beschickungseinheit (12) für das erste halbfertige Ausgangsprodukt und eine zweite Beschickungseinheit (12) für das zweite halbfertige Ausgangsprodukt für jede der zumindest einen ersten und einen zweiten Arbeitsstation, welche jeweils mit zumindest einem ersten und einem zweiten halbfertigen Ausgangsprodukt beschickt werden; wobei:
  - jede der ersten und zweiten Arbeitsstation geeignet ist, zumindest einen Abschnitt einer strukturellen Komponente des aktuell bearbeiteten Reifens aus dem ersten und dem zweiten halbfertigen Ausgangsprodukt herzustellen, die in die Arbeitsstation selbst zugeführt werden.

15. Anlage nach Anspruch 14, umfassend zumindest eine temporäre Speichereinheit (29) für halbfertige Ausgangsprodukte.


17. Anlage nach einem der Ansprüche 14 bis 16, wobei zumindest eine der zumindest einen ersten und einen zweiten Arbeitsstation, welche mit zumindest einem ersten und einem zweiten halbfertigen Ausgangsprodukt beschickt werden, eine aus den folgenden Arbeitsstationen umfasst:

- eine erste Arbeitsstation (9) zur Gürtelanbringung, die mit Einrichtungen zum Anbringen zumindest eines ersten Gürtelstreifens versehen ist;
- eine zweite Arbeitsstation (31) zur Gürtelanbringung, die mit Einrichtungen zum Anbringen eines zweiten Gürtelstreifens in einer Position radial außerhalb des ersten Gürtelstreifens versehen ist,
- eine Arbeitsstation (10) zur Drahtanbringung,
- die mit Einrichtungen zur Anbringung zumindest einer ersten Schicht aus Textil- oder Metalldrähten versehen ist, die in Umfangsrichtung an dem radial äußeren Gürtelstreifen angeordnet und zumindest an dessen axial äußeren Abschnitten angebracht wird,
- eine Arbeitsstation (8) zur Lagenanbringung, die mit Einrichtungen zum Anbringen zumindest einer ersten Karkassenlage versehen ist.

18. Anlage nach einem der Ansprüche 14 bis 17, des Weiteren umfassend:

- zumindest eine Karkassenstruktur-Fertigungsleitung (2; 2') an einer ersten Formungstemmel (6), wobei die Karkassenstruktur zumindest eine Karkassenlage und ein Paar ringförmiger Verankerungsstrukturen umfasst;
- zumindest eine Zenithstruktur-Fertigungsleitung (3; 3') an einer zweiten Formungstemmel (7), wobei die Zenithstruktur zumindest eine Gürtelstruktur und einen Laufflächenring umfasst.

19. Anlage nach Anspruch 18, des Weiteren umfassend:

- zumindest eine Montage- und Formgebung-Arbeitsstation (4; 4') für den aktuell bearbeiteten Reifen, die geeignet ist, die Karkassenstruktur zu formen, indem sie diese an einer Zenithstruktur montiert, um so einen Rohreifen zu erhalten.

20. Anlage nach einem der Ansprüche 14 bis 19, des Weiteren umfassend zumindest eine Arbeitsstation des folgenden Typs:

- zumindest eine Arbeitsstation (11) zur Fertigung eines Laufflächenringes, die mit zumindest einer Einrichtung (30) zur Aufbringung des Laufflächenrings versehen ist, die geeignet ist, ein durchgehendes längliches Element aus Elastomermaterial durch Aufwickeln auf eine Oberfläche radial außerhalb auf eine Formungstemmel in Übereinstimmung mit benachbarten und/oder radial nebeneinander liegenden Wicklungen abzulegen.

21. Anlage nach Anspruch 20, wobei die Arbeitsstation (11) zur Fertigung eines Laufflächenrings zumindest zwei der Anbringvorrichtungen (30) umfasst, die jeweils ein durchgehendes längliches Element aus einem unterschiedlichen Elastomermaterial als die jeweils andere ausgeben.

23. Anlage nach Anspruch 22, wobei die Übertragungseinrichtungen zumindest einen Roboterarm (27) umfassen.

24. Anlage nach einem der Ansprüche 14 bis 23, wobei das zumindest eine erste und eine zweite halbfertige Ausgangsprodukt längliche Elemente aus Elastomermaterial mit zumindest einem Textil- oder Metalverstärkungsdraht darin und/oder Streifen aus Elastomermaterial umfassen, die durch Ablängen der länglichen Elemente erhalten werden.

25. Anlage nach einem der Ansprüche 14 bis 24, wobei das zumindest eine erste und eine zweite halbfertige Ausgangsprodukt sich voneinander in dem Typ des Elastomermaterials, in der Dichte der Drähte oder dem Typ des Drahts unterscheiden.

**Revendications**

1. Procédé de construction de différents types de pneus crus pour des roues de véhicule pour chaque dimension de pneu, par l’utilisation de produits semi-finis élémentaires, dans une usine de construction (1 ; 1') comprenant une pluralité de stations de travail, ledit procédé comprenant le fait :

- d’alimenter chaque k\textsuperscript{ème} station de travail parmi m stations de travail de ladite pluralité de stations de travail en n\textsubscript{k} différents produits semi-finis élémentaires, avec k se trouvant dans la plage allant de 1 à m, lesdites m stations de travail étant alimentées en lesdits n\textsubscript{k} produits semi-finis élémentaires ;
- de construire, dans chaque k\textsuperscript{ème} station de travail parmi lesdites m stations de travail, au moins une partie d’un composant structurel du pneu en cours de traitement en partant d’au moins un produit semi-finé élémentaire choisi parmi lesdits n\textsubscript{k} produits semi-finis élémentaires introduits dans la station de travail elle-même ;

où m et chaque n\textsubscript{k} sont des nombres entiers supérieurs ou égaux à 2, n\textsubscript{k} représentant le nombre de différents produits semi-finis élémentaires introduits dans la k\textsuperscript{ème} station de travail parmi lesdites m stations de travail.

2. Procédé selon la revendication 1, dans lequel la construction d’au moins une partie d’un composant structurel du pneu en cours de traitement en partant d’au moins un produit semi-finé élémentaire choisi parmi lesdits n\textsubscript{k} produits semi-finis élémentaires introduits dans la k\textsuperscript{ème} station de travail comprend le fait :

- d’enrouler au moins un élément allongé continu en matériau élastomère sur une surface radialement externe à un tambour de formation selon des bobines adjacentes et/ou radialement juxtaposées.

3. Procédé selon la revendication 2, dans lequel lesdits éléments allongés continus sont deux éléments et sont réalisés à partir de différents matériaux élastomères.

4. Procédé selon l’une quelconque des revendications 1 à 3, dans lequel chaque produit semi-finé élémentaire introduit dans une k\textsuperscript{ème} station de travail parmi lesdites m stations de travail est différent de chaque produit semi-finé élémentaire introduit dans une k\textsuperscript{ème} station de travail différente parmi lesdites m stations de travail.

5. Procédé selon l’une quelconque des revendications 1 à 4, dans lequel chaque produit semi-finé élémentaire introduit dans une k\textsuperscript{ème} station de travail parmi lesdites m stations de travail est différent de tous les produits semi-finis élémentaires restants introduits dans les stations de travail restantes parmi lesdites m stations de travail.

6. Procédé selon l’une quelconque des revendications 1 à 5, dans lequel m est supérieur ou égal à 3.

7. Procédé selon l’une quelconque des revendications 1 à 6, dans lequel m est égal à 4.

8. Procédé selon l’une quelconque des revendications 1 à 7, dans lequel n\textsubscript{k} est égal à 2 dans chaque station de travail parmi lesdites m stations de travail.

9. Procédé selon l’une quelconque des revendications 1 à 8, dans lequel au moins un n\textsubscript{k} d’une station de travail parmi lesdites m stations de travail est supérieur ou égal à 3.

10. Procédé selon l’une quelconque des revendications 1 à 9, comprenant en outre le fait :

- de stocker des produits semi-finis élémentaires, préalablement agencés, dans des unités de stockage temporaire respectives (29) de produits semi-finis élémentaires.

11. Procédé selon la revendication 10, comprenant en outre le fait :

- de transférer lesdits produits semi-finis élémentaires, agencés dans une ligne d’agencement de produits semi-finis élémentaires (28), dans les unités de stockage temporaire respectives (29).
12. Procédé selon la revendication 10 ou 11, comprenant en outre le fait :
- de transférer lesdits \( n_k \) produits semi-finis élémentaires à partir des unités de stockage temporaire (29) dans des unités correspondantes d’alimentation en produits semi-finis (12) de ladite \( m \) station de travail.

13. Procédé selon l’une quelconque des revendications 1 à 12, dans lequel ladite étape de construction dans chaque \( k \)ème station de travail parmi lesdites \( m \) stations de travail d’au moins une partie d’un composant structurel du pneu en cours de traitement est effectuée en choisissant au moins un desdits produits semi-finis élémentaires sur la base du type de pneus crus en cours de traitement.

14. Usine (1 ; 1’) de construction de différents types de pneus crus pour des roues de véhicule pour chaque dimension de pneu, par l’utilisation de produits semi-finis élémentaires introduits dans une pluralité de stations de travail appartenant à ladite usine, ladite usine comprenant
- au moins des première et deuxième stations de travail de ladite pluralité de stations de travail, dont chacune est alimentée en au moins des premier et deuxième produits semi-finis élémentaires qui sont différents l’un de l’autre ;
- au moins une première unité d’alimentation (12) en ledit premier produit semi-finis élémentaire et une deuxième unité d’alimentation (12) en ledit deuxième produit semi-finis élémentaire pour chacune desdites au moins première et deuxième stations de travail alimentées en lesdits au moins premier et deuxième produits semi-finis élémentaires ; où :
  - chacune desdites première et deuxième stations de travail est adaptée pour construire au moins une partie d’un composant structurel du pneu en cours de traitement en partant d’au moins un produit semi-finis élémentaire choisi entre lesdits premier et deuxième produits semi-finis élémentaires introduits dans la station de travail elle-même.

15. Usine selon la revendication 14, comprenant au moins une unité de stockage temporaire (29) de produits semi-finis élémentaires.


17. Usine selon l’une quelconque des revendications 14 à 16, dans laquelle au moins l’une desdites au moins première et deuxième stations de travail alimentées en au moins des premier et deuxième produits semi-finis élémentaires comprend l’une parmi les stations de travail suivantes :
- une première station de travail d’application de ceinture (9) pourvue de dispositifs permettant d’appliquer au moins une première bande de ceinture ;
- une deuxième station de travail d’application de ceinture (9) pourvue de dispositifs permettant d’appliquer une deuxième bande de ceinture dans une position radialement externe par rapport à ladite première bande de ceinture ;
- une station de travail d’application de câblé (10) pourvue de dispositifs permettant d’appliquer au moins une première couche de câblés textiles ou métalliques, agencée de manière circonférentielle sur la bande de ceinture radialement externe, appliquée au moins au niveau de ses parties axialement externes ;
- une station de travail d’application de pli (8) pourvue de dispositifs permettant d’appliquer au moins un premier pli de carcasse.

18. Usine selon l’une quelconque des revendications 14 à 17, comprenant en outre :
- au moins une ligne de construction de structure de carcasse (2 ; 2’) sur un premier tambour de formation (6), ladite structure de carcasse comprenant au moins un pli de carcasse et une paire de structures d’ancrage annulaires ;
- au moins une ligne de construction de structure de couronne (3 ; 3’) sur un deuxième tambour de formation (7), ladite structure de couronne comprenant au moins une structure de ceinture et une bande de roulement.

19. Usine selon la revendication 18, comprenant en outre :
- au moins une station de travail d’assemblage et de façonnage (4 ; 4’) du pneu en cours de traitement adaptée pour façonner ladite structure de carcasse en l’assemblant sur ladite structure de couronne de manière à obtenir un pneu cru.

20. Usine selon l’une quelconque des revendications 14 à 19, comprenant en outre au moins une station de travail du type suivant :
- au moins une station de travail de construction de bande de roulement (11), pourvue d’au moins un dispositif d’application (30) de bande de roulement adaptée pour déposer un élément allongé continu en matériau élastomère par l’enroulement de ce dernier sur une surface radia-
lement externe à un tambour de formation, selon des bobines adjacentes et/ou radialement juxtaposées.

21. Usine selon la revendication 20, dans laquelle ladite station de travail de construction de bande de roulement (11) comprend au moins deux parmi lesdits dispositifs d’application (30), chacun distribuant un élément allongé continu en matériau élastomère différent de l’autre.

22. Usine selon l’une quelconque des revendications 14 à 21, comprenant en outre des dispositifs permettant de transférer le pneu en cours de traitement d’une station de travail à la station de travail suivante.

23. Usine selon la revendication 22, dans laquelle lesdits dispositifs de transfert comprennent au moins un bras robotisé (27).


25. Usine selon l’une quelconque des revendications 14 à 24, dans laquelle lesdits au moins premier et deuxième produits semi-finis élémentaires sont différents l’un de l’autre en termes de type de matériau élastomère, de densité de câblés et/ou de type de câblé.
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0448407 A [0013]
- EP 0776756 A1 [0015]
- WO 0132409 A [0016] [0019] [0021] [0023]
- WO 09040594 A [0017] [0021] [0023]
- US 2007017567 A [0018]
- EP 0776756 A [0020] [0021] [0023]