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(54) **TREATMENT SECTION OF A PRODUCTION LINE FOR PRODUCING A BARRIER COATED FIBER WEB AND TREATMENT METHOD FOR PRODUCING A BARRIER COATED FIBER WEB**

(57) The invention relates to a treatment section of a production line for producing a barrier coated fiber web, in particular a barrier coated carton board web, which treatment section comprises a coating section (70), which comprises means to apply coating substance layers onto the fiber web to form one or more barrier coating layers, a heat sealable coating layer, which can also form one of the barrier coating layers, on the barrier coating

and a protective coating on the heat sealable coating layer with or without barrier properties, glass transition temperature (T_g) of which protective coating is same or higher than glass transition temperature of the heat sealable coating layer with or without barrier properties. The invention also relates to a treatment method for producing a barrier coated fiber web, in particular a barrier coated carton board web.

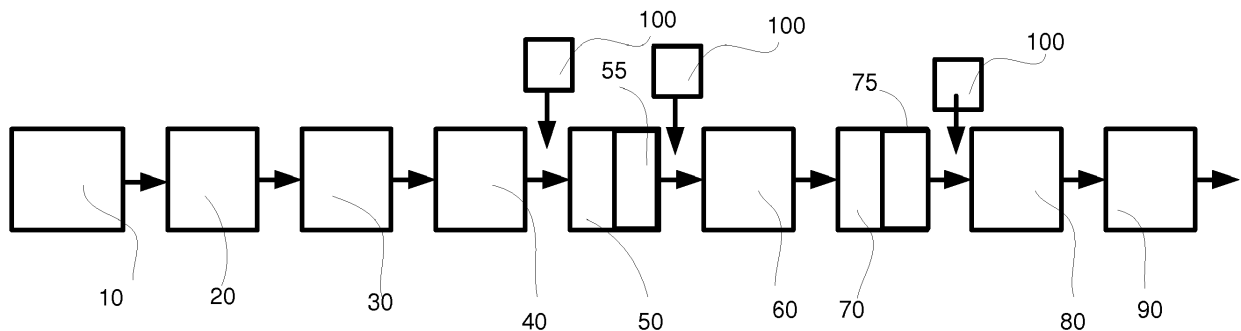


Fig. 1

Description

[0001] The invention relates to a treatment section of a production line for producing a barrier coated fiber web and a treatment method for producing a barrier coated fiber web. Especially the invention relates to a treatment section according to the features of the preamble part of claim 1 and to an arrangement according to the features of the preamble part of claim 8.

[0002] As known from the prior art in fiber web producing processes typically comprise an assembly formed by a number of apparatuses arranged consecutively in the process line. A typical production line comprises a head box, a wire section and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and/or sections for finishing the fiber web, for example, a pre-calender, a sizer, a final-calender, a coating section. The production line also typically comprises at least one slitter-winder for forming customer rolls as well as a roll packaging apparatus or a sheet cutter. In this description and the following claims by fiber webs are meant for example a paper and board webs.

[0003] In production of fiber webs, for example of paper or board webs, sizing is used to alter the properties of a fiber web by adding sizing substances, for example glue chemicals. Sizing can be divided to internal sizing and surface sizing. In internal sizing the sizing agent is added to pulp in the wet end of the fiber web machine before forming. In surface sizing the sizing substance is added onto the surface of the fiber web directly or via a roll typically at the dry end of the fiber web machine but the sizing substance can be added onto the fiber web at other parts of the fiber web production line, also. The sizing of paper and board web typically utilize a separate sizer. In connection with the sizer different kinds of sizing technology are employed in prior art arrangements, for example pond sizing technology or film-transfer technology or spray sizing technology.

[0004] Coated fiber web grades and coating are becoming more and more popular and thus the coating process and equipment have increasing demands imposed thereon. In coating, especially in pigment coating, at least one of the surfaces of a fiber web is formed with one or more layers of coating color (coating substance) at a coating station followed by drying. The process of coating can be divided in supplying the coating color onto the web surface, which is called the application of the coating color, as well as in the adjustment of final amount of coating color. The coating of paper and board web typically utilize a coating device - a coater. In connection with the coater different kinds of coating technology are employed in prior art arrangements, for example curtain coating, blade coating, spray coating or film transfer coating technology.

[0005] In DE publication 202007005188 U1 is disclosed a device for providing a multilayer curtain coating on a fiber web, which is formed as a multiple-layer tool

with several feeder devices, connected to associated storage containers for producing a free-falling, multi-layered curtain to apply a multilayer coating on the fiber web.

[0006] The barrier coated fiber web products i.e. barrier products are typically coated paper or board based fiber web products which have one or more layers with barrier function such as water barrier, water vapor barrier, grease/oil/solvent barrier, gas and aroma barrier. Thus these barrier layers are against the penetration of gases (odor, aroma, oxygen, nitrogen, carbon dioxide, water vapor etc.), against the penetration of fluids and solvents either polar (f. ex. water) or non-polar (f. ex. grease, oil), against the penetration of solids and contamination of particles (nanoparticles, dust, fumes, dirt etc.) and of germs, bacteria, fungi etc., and against the penetration of radiation (electromagnetic, f. ex. visible light, IR, US, X-ray, "electro smog" et.) and of radioactivity. A barrier product may have one or more barrier layers with one or more different barrier functions.

[0007] Barrier coated fiber webs have been produced for example by applying polyethylene by extrusion onto the surface of the fiber web and/or by laminating onto the surface of the fiber web an aluminum foil. A disadvantage in extrusion coated barrier products is their poor pulping properties and thus poor recyclability. Application by dispersion coating has also been used, in which binder for example latex with several different types of fillers and/or mineral pigments and/or additives is applied. The use of dispersion coating has been limited due to more expensive coating substances than typically used in extrusion coating. The coating has been dried after application in order to provide a fixed, continuous, non-porous coating with desired barrier properties onto the surface of the fiber web. A main object in the barrier coating application is to achieve a uniform coating layer. Drying of the coating needs accurate and precise measures as a continuous and uniform coating layer is required but simultaneously the drying has to be effective enough in order to prevent adherence of the coating layers in reeling and/or winding i.e. avoid the blocking phenomena but not too intensive to preserve the heat sealability (hot melt) properties of the barrier coating layer. Often the surface of the dispersion coated barrier product needs to be seamed when for example packages are produced, in which good heat sealability properties are needed. In the blocking phenomena the surface of the barrier product i.e. barrier coated fiber web adheres in a too early stage, for example in reeling or winding, if the drying is not effective enough or the coated product is exposed to unsuitable temperature, humidity or pressure. Especially in on-line production of barrier coated fiber webs the risk of blocking is apparent if the fiber web has not enough time to cool after the dispersion coating before reeling or winding. Especially in on-line production of barrier coated fiber web there is also a risk, that the fiber web has too high temperature when coated, which may cause excessive penetration of the coating substance into the fiber web.

[0008] In WO publication 2010052571 is disclosed

coated recyclable paper or paperboard products and methods for their production for providing coated paper or paperboard products with enhanced barrier properties, in which method paper or paperboard is coated with a polymer emulsion in one or more coating stations which are off-line from the paper or paperboard machine. The method of producing a coated recyclable paper or paperboard disclosed comprises: supplying an aqueous coating to at least one coating machine, the aqueous coating including about 70 to about 90 weight %, based on the dry weight of the coating, of a polymer emulsion, and about 10 to about 30 weight %, based on the dry weight of the coating, of pigment; applying the aqueous coating to paper or paperboard to provide a coating layer on the paper or paperboard; drying the aqueous coating layer to provide a coated paper or paperboard; and cooling the coated paper or paperboard, wherein coating, drying and cooling are conducted at temperatures effective for providing a coated paperboard product with a water resistance of less than about 10 g/m² and a moisture vapor transfer rate of less than 120 g/m², wherein the coated paper or paperboard product is heat sealable. In this method the aqueous coating is supplied to an off-line coating machine and the off-line coating machine is in a same location as a machine supplying paper or paperboard. The polymer emulsion is selected from the group consisting of acrylic polymers, acrylic copolymers, copolymers of styrene and butadiene, vinyl acetate polymers, polyvinyl alcohol, polyethylene vinyl acetate, polyethylene vinyl chloride, polyvinyl diene chloride and mixtures thereof and the pigment is selected from the group consisting of aqueous dispersions of coating grade clays, titanium dioxide, calcium carbonate, barium sulfate, talc, zinc sulfate, aluminum sulfate, calcium oxide reaction products, lithopone, zinc sulfide, and mixtures thereof. It is disclosed that about 5 g/m² to about 10 g/m² of aqueous coating is applied with a rod or a bar and more than one coating layer is applied to a surface of the paper or paperboard and each coating layer is formed from a different polymer emulsion and at least one coating layer is applied to each side of the paper or paperboard.

[0009] The object of the present invention is to create a treatment section of a production line for producing a barrier coated fiber web and a treatment method for producing a barrier coated fiber web in which the above explained problems are solved or at least minimized.

[0010] In order to achieve the above mentioned and those later presented the treatment section according to the invention is mainly characterized by the features of the characterizing part of claim 1. The treatment method according to the invention, in turn, is mainly characterized by the features of the characterizing part of claim 8. Further advantageous embodiments and features of the invention are disclosed in the dependent claims.

[0011] According to the invention the treatment section of a production line for producing a barrier coated fiber web, in particular a barrier coated carton board web, comprises a coating section, which coating section comprises

means to apply coating substance layers onto the fiber web to form one or more barrier coating layers, a heat sealable coating layer, which can also form one of the barrier coating layers, on the barrier coating and a protective coating on the heat sealable coating layer with or without barrier properties, glass transition temperature of which protective coating is same or higher than glass transition temperature of the heat sealable coating layer with or without barrier properties.

[0012] According to the invention in the treatment method for producing a barrier coated fiber web, in particular a barrier coated carton board coating substance layers are applied in a coating section one-sidedly or two-sidedly onto the fiber web to form one or more barrier coating layers, a heat sealable coating layer, which can also form one of the barrier coating layers, on the barrier coating, and a protective coating on the heat sealable coating layer with or without barrier properties, glass transition temperature of which protective coating is same or higher than glass transition temperature of the heat sealable coating layer with or without barrier properties.

[0013] According to an advantageous feature of the invention the glass transition temperature of the protective coating is -20 - 50 °C, advantageously -10 - 20 °C, and the glass transition temperature of the heat sealable coating layer with or without barrier properties is -20 - 50 °C, advantageously -10 - 20 °C.

[0014] According to an advantageous feature of the invention the coating section comprises a multilayer curtain coater for applying one or more coating substance layers onto the fiber web to provide the barrier coating and the heat sealable coating layer with or without barrier properties and the protective coating. According to an advantageous feature of the invention the coating section comprises one or more coaters for applying one or more coating substance layers onto the fiber web to provide the barrier coating, the heat sealable coating layer and the protective coating.

[0015] According to an advantageous feature of the invention treatment section comprises a sizer for sizing the fiber web before the coating section.

[0016] According to an advantageous feature of the invention treatment section comprises a pre-calender.

[0017] According to an advantageous feature of the invention the treatment section comprises a cooling device located before the sizer and/or the precalender and/or the treatment section comprises a reel-up and optionally a cooling device located before the reel-up.

[0018] According to an advantageous feature of the invention the fiber web is sized before the coating section in a sizer one-sidedly or two-sidedly.

[0019] According to an advantageous feature of the invention the fiber web is calendered in a pre-calender.

[0020] According to an advantageous feature of the invention the fiber web is cooled before the sizer and/or the pre-calender and/or a reel-up.

[0021] Preferably according to an advantageous embodiment of the invention outermost layer of coating of

barrier coated fiber web is a protective coating layer preventing adherence of fiber web layers in a parent roll (a machine roll) and/or in customer rolls and/or decreasing friction in further processing of the fiber web for example in sheet production. The protective coating layer does not prevent the hot melting of as the protective coating is thin even though it has same or higher glass transition temperature (T_g) than the heat sealable barrier coating layer/layers.

[0022] In addition to ambient factors to blocking phenomena also the composition of the dispersion coating has an effect. For example the type of used polymer substance, cross-linking, use of waxes, fillers and pigments has an effect to the blocking phenomena. The main reason for the adherence in the blocking effect is the polymers used in the dispersion coating. The glass transition temperature of the amorphous polymers can be regarded as measure for its softness. Low glass transition temperature increases risk of the blocking phenomena and too high glass transition temperature has a negative effect to film forming and can cause difficulties in heat sealing process. Polymers in the dispersion coating that have a too low glass transition temperature can also cause processing problems due to higher friction coefficient of the coated surface.

[0023] Advantageously the sizing agent is starch based sizing agent, carboxy methyl cellulose based sizing agent, polyvinyl alcohol based sizing agent, synthetic or bio-based polymer latex. Synthetic or bio-based polymer latex is e.g. styrene butadiene latex, polyvinyl acetate latex, acrylate latex, polyvinyl alcohol dispersion, polyolefin dispersion or any of their mixtures, copolymers or derivatives thereof.

[0024] Advantageously the substance for barrier coating layer(s) comprises synthetic or bio-based polymer latex and mineral filler / pigments. Synthetic or bio-based polymer latex is e.g. styrene butadiene latex, polyvinyl acetate latex, acrylate latex, polyvinyl alcohol dispersion, polyolefin dispersion or any of their mixtures, copolymers or derivatives thereof.

[0025] Advantageously the heat sealable coating layer with or without barrier properties comprises synthetic or bio-based polymer latex with or without mineral filler / pigments. Synthetic or bio-based polymer latex is e.g. styrene butadiene latex, polyvinyl acetate latex, acrylate latex, polyvinyl alcohol dispersion, polyolefin dispersion or any of their mixtures, copolymers or derivatives thereof.

[0026] Advantageously the protective coating layer is synthetic or bio-based polymer latex with or without mineral filler / pigments and/or wax substances. Synthetic or bio-based polymer latex is e.g. styrene butadiene latex, polyvinyl acetate latex, acrylate latex, polyvinyl alcohol dispersion, polyolefin dispersion or any of their mixtures, copolymers or derivatives thereof.

[0027] All coating compositions may include additives; thickening agents, de-foaming / antifoaming agents, dispersing aids, additional pigments, crosslinking agents /

insolubilizers, slip additives / lubricants, release agents and anti-blocking agents.

[0028] Barrier coating weight (for one layer) (dry solids) is 3 - 20 g/m², advantageously 4 - 9 g/m². Heat sealable coating (with or without barrier properties) weight (dry solids) is 3 - 20 g/m², advantageously 6 - 9 g/m². Protective coating weight (dry solids) is 1 - 10 g/m², advantageously 3 - 6 g/m².

[0029] Preferably according to an advantageous embodiment of the invention the fiber web is sized in the treatment section by surface sizing by a sizer before applying coating layers. By this the surface strength and stiffness of the barrier coated fiber web is improved. The sizing also seals and smooths the surface of the fiber web so that the barrier coating substances do not penetrate into the fiber web, which would cause loss of barrier properties. The sizing is advantageously provided by a pond size press, a film size press, a spray sizer or very advantageously by a nip sizer with curtain applicator(s) or foam applicator(s), which improves the smoothness and strength and provides a uniform coating layer, by which for example short or long fibers, fiber based fines, nano-cellulose based substances, lignin based substances, mineral pigments / fillers, nanofibers can be provided in connection with the sizing substance onto the fiber web.

[0030] In the treatment section according to the invention dispersion coating device is used for the barrier substance as it is applicable in on-line process coater and also typically, as such known, coating equipment can be used. Advantageously multilayer curtain coater is used.

[0031] Advantageously cooling device is located in the treatment section following the coater to help preventing the blocking phenomena.

[0032] Advantageously in the treatment section a precalender is used. Before the sizer and/or the precalender advantageously a cooling device is located to preserve bulkiness of the fiber web and to prevent excessive penetration of the coating substance into the fiber web, thus enhancing the formation of the barrier coating layers.

[0033] The coatings layers can be applied on one side of the fiber web or on both sides of the fiber web.

[0034] In the following the invention is described in detail by reference to the accompanying drawing, in which

Figure 1 shows schematically one advantageous example of a production line for barrier coated fiber webs.

Figure 2 shows schematically one example of a barrier coated fiber web.

[0035] In the figures and the description thereof same reference signs have been used for corresponding parts, part components and sections unless otherwise mentioned.

[0036] In the example of figure 1 the production line of a barrier coated fiber web product is shown very sche-

matically and it is well understood by one skilled in the art that the actual production line for the barrier coated fiber web product comprises several components, parts and devices which can be constructed in various ways known as such to one skilled in the art. It should also be noted that the invention can be utilized both in connection with production of one-sided fiber web products and in connection with two-sided fiber web products and for many types of barrier coated fiber web products (barrier products).

[0037] In the example of figure 1 the production line comprises a head box 10, a wire section (i.e. forming section) 20 and a press section 30 as well as a subsequent drying section 40, a sizer 50 and an optional pre-calender 60, a coating section 70, a reel-up 80 and a slitter-winder 90. The production line may also comprise a roll packaging apparatus or a sheet cutter. In the example of figure 1 after the sizer 50 drying equipment 55 is located to dry the fiber web and also after the coating section 70 drying equipment 75 is located to dry the fiber web before reeling the fiber web in the reel-up 80 to a parent roll. Optional cooling devices 100 are in this example located before the sizer 50 and the precalender 60 and the reel-up 80. The sizer 50 can be located in any other part or section of the production line before the coating section 70. The sizer 50 is advantageously a pond size press, a film size press, a spray sizer or very advantageously a nip sizer with curtain applicator(s) or a foam applicator(s). The coating section 70 advantageously comprises a multilayer curtain coater for applying one or more coating substance layers onto the fiber web to provide the barrier coating layer/-s and the heat sealable coating layer, which can also form one of the barrier coating layers, and the protective coating. The coating section 70 can also be provided successive coaters, each for one or more coating substance layers.

[0038] In the treatment method from the head box 10 pulp is fed onto the wire section (i.e. forming section) 20, in which water is removed from the pulp by water removal means. In the press section 30 water is further removed by pressing the fiber web in press nips and/ or in shoe - or belt nips. In the subsequent drying section 40 the fiber web is dried, typically by contact drying by leading the fiber web to run in contact over heated surfaces of drying cylinders. After the drying section 40 in the sizer 50 sizing substance is applied onto the fiber web and thereafter the fiber web is typically drying by following drying equipment 55. Thereafter the fiber web may be pre-calendered in the optional pre-calender 60 at least one coating layer is applied onto the fiber web in the coating section 70 in order to provide the barrier coating and the protective coating. After coating the fiber web is dried by drying equipment 75, typically at least in the beginning of this drying by contactless drying equipment. In the reel-up 80 the fiber web is reeled into the parent roll, which is unwound in an unwinder of the slitter-winder 90 ja then slit into partial webs in a slitter, which are wound to customer rolls in the winder. The customer roll may be packed in

a roll packaging machine. The fiber web may also be cut into sheets in a sheet cutter. By the optional cooling devices 100 before the sizer 50 and/or the pre-calender 60 and/or the reel-up 80 the fiber web may be cooled. The sizing can also be done in any other part or section of the production line before the coating section 70.

[0039] In the example of figure 2 is very schematically shown one example of a barrier product. In this example the barrier coating is provided on one side of the fiber web i.e. as a one-sided fiber web product but it should be noted that the product can also be two-sided, in which the coatings of the sides are similar or different. Next to the surface of the fiber web W is shown the sizing substance layer S. Outwards from the sizing substance is the barrier coating layer/-s B, which comprises one or more coating substance layers to form the barrier coating layer/-s onto the fiber web W. Typically at least two coating substance layers are used to provide the barrier coating layers. On top of the barrier coating layer/-s B is the heat sealable coating layer H, which can also form one of the barrier coating layers, and as outermost layer is the protective layer P. The outermost layer of coating of barrier coated fiber web is a protective coating layer P, which has the same or higher glass transition temperature (T_g) than the heat sealable layer/layers H with or without barrier properties.

[0040] Above the invention has been explained only with reference to some advantageous examples but many modifications and variations are possible within the inventive treatment section of a barrier coated fiber web and the inventive treatment method of producing a barrier coated fiber web.

35 Claims

1. Treatment section of a production line for producing a barrier coated fiber web, in particular a barrier coated carton board web, which treatment section comprises a coating section (70, **characterized in that** the coating section (70) comprises means to apply coating substance layers onto the fiber web (W) to form one or more barrier coating layers (B), a heat sealable coating layer (H), which can also form one of the barrier coating layers, on the barrier coating (B) and a protective coating (P) on the heat sealable coating layer (H) with or without barrier properties, glass transition temperature (T_g) of which protective coating (P) is same or higher than glass transition temperature of the heat sealable coating layer (H) with or without barrier properties.
2. Treatment section according to claim 1, **characterized in that** the glass transition temperature of the protective coating (P) is -20 - 50 °C, advantageously -10 - 20 °C, and that that the glass transition temperature of the heat sealable coating layer (H) with or without barrier properties is -20 - 50 °C, advanta-

geously -10 - 20 °C.

3. Treatment section according to claim 1 or 2, **characterized in that** the coating section (70) comprises a multilayer curtain coater for applying one or more coating substance layers onto the fiber web (W) to provide the barrier coating (B), the heat sealable coating layer (H) with or without barrier properties and the protective coating (P). 5
4. Treatment section according to claim 1 or 2, **characterized in that** the coating section (70) comprises one or more coaters for applying one or more coating substance layers onto the fiber web (W) to provide the barrier coating (B), the heat sealable coating layer (H) with or without barrier properties and the protective coating (P). 10
5. Treatment section according to any of the previous claims, **characterized in that** treatment section comprises a sizer (50) for sizing the fiber web before the coating section (70). 15
6. Treatment section according to any of the previous claims, **characterized in that** treatment section comprises a pre-calender (60). 20
7. Treatment section according to claim 5 or 6, **characterized in that** the treatment section comprises a cooling device (100) located before the sizer (50) and/or the precalender (60) and/or the treatment section comprises a reel-up (80) and optionally a cooling device (100) located before the reel-up (80). 25
8. Treatment method for producing a barrier coated fiber web, in particular a barrier coated carton board web, in which treatment method coating substance layers are applied in a coating section (70) one-sidedly or two-sidedly onto the fiber web (W) to form one or more barrier coating layers (B), a heat sealable coating layer (H), which can also form one of the barrier coating layers, on the barrier coating (B), and a protective coating (P) on the heat sealable coating layer (H) with or without barrier properties, glass transition temperature (T_g) of which protective coating (P) is same or higher than glass transition temperature of the heat sealable coating layer (H) with or without barrier properties. 30
9. Treatment method according to claim 8, **characterized in that** the fiber web is sized before the coating section (70) in a sizer (50) one-sidedly or two-sidedly. 35
10. Treatment method according to claim 8 or 9, **characterized in that** the fiber web is calendered in a pre-calender (60). 40
11. Treatment method according to any of claims 8 - 10, **characterized in that** the fiber web is cooled before the sizer (50) and/or the pre-calender (60) and/or a reel-up (80). 45
12. Method according to any of claims 8 - 11, **characterized in that** the sizing agent is starch based sizing agent, carboxy methyl cellulose based sizing agent, polyvinyl alcohol based sizing agent, synthetic or bio-based polymer latex. 50
13. Method according to any of claims 8 - 12, **characterized in that** substance for barrier coating layer(s) comprises synthetic or bio-based polymer latex and mineral filler / pigments. 55
14. Method according to any of claims 8 - 13, **characterized in that** protective coating layer is synthetic or bio-based polymer latex with or without mineral filler / pigments and/or wax substances.

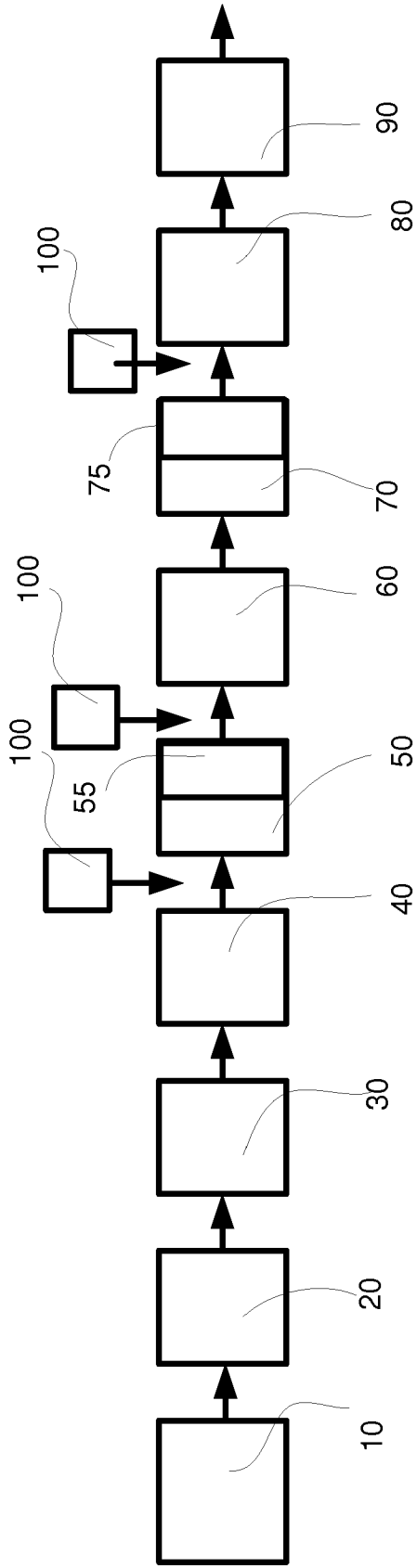


Fig. 1



Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 18 15 5723

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 April 2018	Examiner Billet, Aina
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.02 (P04C01)



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Place of search Munich		Date of completion of the search 16 April 2018	Examiner Billet, Aina
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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