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(54) **CARDING MACHINE**

(57) Described is a carding machine for one layer (F) of fibres comprising a carding unit (3) designed to interlace the fibres of the layer (F, F') of fibres and to adjust the thickness of the layer (F) of fibres, and a comb

cylinder (4) located downstream of the carding unit (3) and designed to comb the fibres of the layer (F, F'') of fibres.

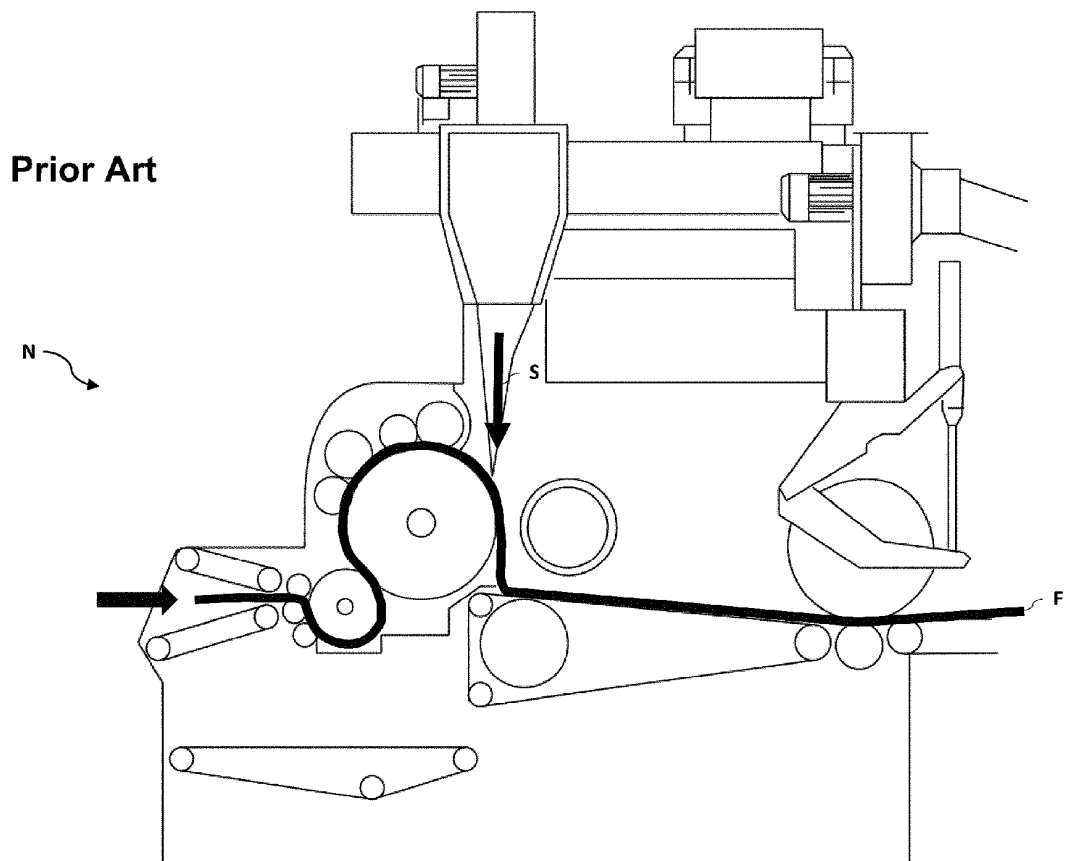


Fig. 1

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Description

[0001] This invention relates to a carding machine designed to operate in a system for producing padding, wadding, felts, insulating panels, filters, fabrics, loose products and the like.

[0002] More specifically, the carding machine according to the invention is such as to be able to process the fibres for making products with a wide range of thicknesses.

[0003] More specifically, the thicknesses of the products made by the carding machine according to the invention are advantageously in the range of between approximately 10 g/m² and approximately 1500 g/m².

[0004] The term "fibre" generically means materials both of a natural type, such as air-lay, wool, jute, kenaf, cotton and the like, and of a synthetic type, such as, for example, non-woven fabric (NWF), or regenerated fibres. There are currently prior art carding machines the aim of which is to comb, separate and parallelise the fibres. Through this processing, the semi-finished product produced by the carded fibres has improved properties, for example mechanical or filtering.

[0005] The prior art carding machines allow the thickness of the layer of fibres of the semi-finished product to be varied.

[0006] The processing interval of the prior art carding machines is, however, quite limited.

[0007] In general, the prior art carding machines allow a product to be made with a variation of thicknesses in the order of a few tens of g/m², between approximately 10 g/m² and approximately 30 g/m².

[0008] This constraint results in the production of special and dedicated machines depending on the type of product to be produced.

[0009] Moreover, especially if small products are to be made, the passage of the fibres through various machines adversely affects the quality of the material, increasing the number of defects in the layer of fibres produced.

[0010] In this regard, it is currently difficult to make a finished product with a small thickness and good quality with the prior art air-lay type carding machines.

[0011] Moreover, also if products with specific filtering features are to be produced it is necessary to subject the fibres to subsequent processing.

[0012] For example, in the case of production of an *Acquisition Distribution Layer* (ADL) for absorbent nappies, that is to say, the layer used to collect the urine before it is distributed to the lower layer, it is necessary to carry out two or more subsequent processing operations.

[0013] A solution is known from patent document JPS48102319U in which, however, a linear type comb is used and which performs the exclusive function of helping the detachment of the fibres from the card web without performing any additional processes for "interlacing" the fibres.

[0014] The aim of the invention is therefore to provide a carding machine which is able to perform processes for a large range of thicknesses of products.

[0015] A further aim of this invention is to provide a carding machine with greater processing flexibility.

[0016] Yet another aim is to provide a carding machine such that the production is increased and the processing times and costs are reduced.

[0017] A further aim of the invention is to provide a carding machine which is able to make finished products with a reduced number of defects.

[0018] Yet another aim is to provide a carding machine which is reduced in size and practical to use.

[0019] According to the invention, these aims and others are achieved by carding machine comprising the technical features described in the appended claims.

[0020] The technical features of the invention, with reference to the above-mentioned aims, are clearly described in the appended claims and its advantages are apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate a purely non-limiting example embodiment of the invention, in which:

- Figure 1 is a schematic side view of a carding machine according to the prior art;
- Figure 2 is a schematic side view of the carding machine according to the invention showing the possible movements which the parts of the machine can perform;
- Figure 3 is an enlarged cross section of the side view of Figure 2 of the carding machine according to the invention in a first configuration of use showing the path followed by the layer of fibres being processed;
- Figure 3A is a schematic side view of the carding machine according to the invention in the configuration of use of Figure 3 showing the layer of fibres being processed;
- Figure 4 is an enlarged cross section of the side view of Figure 2 of the carding machine according to the invention in a second configuration of use showing the path followed by the layer of fibres being processed;
- Figure 4A is a schematic side view of the carding machine according to the invention in the configuration of use of Figure 4 showing the layer of fibres being processed;
- Figure 5 is an enlarged cross section of the side view of Figure 2 of the carding machine according to the invention in a third configuration of use showing the path followed by the layer of fibres being processed;
- Figure 5A is a schematic side view of the carding machine according to the invention in the configuration of use of Figure 5 showing the layer of fibres being processed.

[0021] Figure 1 shows a carding unit N of known type, also called air-lay type.

[0022] The carding unit N is described in patent document IT2015FI00070, filed by the same Applicant.

[0023] With reference to Figures 2 to 5A, the numeral 1 denotes in its entirety a machine for carding a layer F of fibres made in accordance with the invention.

[0024] Advantageously, the layer F of fibres entering the carding machine 1 comprises a plurality of fibres positioned in a random manner.

[0025] According to alternative embodiments, the layer F of fibres at the infeed to the carding machine 1 comprises a plurality of fibres already partly oriented.

[0026] In this description, the term "layer F of fibres" is used to mean both the layer of fibres at the infeed and the one at the outfeed from the carding machine 1, unless expressly indicated otherwise, as in the case of the production of a double layer: in this situation, the two layers of fibres at the outfeed from the machine are labelled F' and F", whilst the layer of fibres at the infeed is labelled F.

[0027] Moreover, unless indicated otherwise, the processing of the fibres or of the layer of fibres means either the process of curling, twisting, combing, separating and/or parallelising the fibres of the layer of fibres.

[0028] With reference to Figure 2, the carding machine 1 comprises a carding unit 3 designed to interlace the fibres of the layer of fibres F and to adjust the thickness of the layer of fibres F.

[0029] The carding unit 3 is also designed to curl the layer F of fibres.

[0030] The carding machine 1 also comprises a comb cylinder 4 located downstream of the carding unit 3.

[0031] The comb cylinder 4 is configured both to facilitate the detachment of the layer F of fibres from the carding unit 3 and to perform a further interlacing of the layer F of fibres.

[0032] Advantageously, the carding unit 3 and the comb cylinder 4 are installed on a main frame 2.

[0033] According to alternative embodiments not illustrated, the carding unit 3 and the comb cylinder 4 each have a dedicated frame.

[0034] The carding unit 3 comprises a plurality of introductory rollers 31 to allow the entry of the layer F of fibres in the carding unit 3.

[0035] The carding unit 3 also comprises a first cylinder, the so-called feed roller 32, and a second cylinder, the so-called drum 33, wherein the fibres are processed.

[0036] For this purpose, both the feed roller 32 and the drum 33 have a lined surface, for example notched.

[0037] The carding unit 3 also comprises a rotary element 34 tangential both to the feed roller 32 and to the drum 33.

[0038] The rotary element 34 collects any fibres dispersed or escaping from the feed roller 32 and/or from the drum 33, to return them to the feed roller 32 or on the drum 33, in such a way that they re-enter the processing flow. In this configuration the rotary element 34 is also called the cleaning cylinder.

[0039] According to other embodiments, the rotary element 34 contributes to the processing of the layer F of

fibres thanks to the speed difference between the feed roller 32 and the rotary element 34.

[0040] According to this configuration the rotary element 34 is also called rotary processing unit.

5 **[0041]** According to embodiments not illustrated the rotary element 34 is not present.

[0042] The carding unit 3 also comprises rotary doffing elements 35 and rotary working elements 36, located close to the drum 33 and downstream of the feed roller 32.

10 **[0043]** The rotary doffing elements 35 and the rotary working elements 36 process the fibres in conjunction with the drum 33, to which they are tangential.

[0044] More specifically, the rotary doffing elements 35 and rotary working elements 36 work in pairs, that is to say, for each rotary working element 36 there is a rotary doffing element 35 associated with the rotary working element 36 which is tangential to it.

15 **[0045]** Both the rotary doffing elements 35 and the rotary working elements 36 have a lined surface, for example notched.

[0046] Advantageously, the rotary working means 36 have on the surface pairs of teeth and counter-teeth to perform the processing of the fibres.

[0047] The rotary doffing elements 35 have, on the other hand, teeth on the surface which do not process the fibres, but collect those which have remained on the corresponding rotary working element 36 to return them to the drum and replace them in the processing flow.

25 **[0048]** The carding unit 3 also comprises a rod 37 represented by a roller with a smooth surface.

[0049] The purpose of the rod is to favour the passage of the layer F of fibres between the rod 37 and the drum 33, so that the layer F of fibres remains adherent to the drum 33 before separating from it.

35 **[0050]** With reference to Figure 2, the carding unit 3 comprises an air emission unit S configured to facilitate the detachment of the layer F of fibres coming out from the carding unit 3.

[0051] Advantageously, the air emission unit S emits a jet tangential to the drum 33.

[0052] The air emission unit S is advantageously activated when required.

[0053] Advantageously, the air emission unit S is positioned above the drum 33.

45 **[0054]** According to other embodiments not illustrated the air emission unit S is not present.

[0055] According to these embodiments, the detachment from the layer F of fibres from the drum 33 occurs only by gravity. In fact, when the layer F of fibres is fed

50 out of the drum 33 in a direction almost parallel to the acceleration of gravity the detachment of the layer F of fibres from the drum 33 is favoured.

[0056] In these configurations, not illustrated, in order to prevent the layer F of fibres from returning to the drum 33, the drum 33 advantageously has a radius less than the configurations comprising the air emission unit S.

[0057] A seal on the drum 33 equipped with large gaps advantageously facilitates detachment of the layer F of

fibres from the drum 33.

[0058] The comber cylinder 4 is movable, that is to say, it is configured in such a way as to move towards or away from the carding unit 3.

[0059] The movement of the comber cylinder 4 is mainly translation.

[0060] The direction of movement is labelled A in the drawings. The comber cylinder 4 is designed to comb the fibres of the layer of fibres F.

[0061] The comber cylinder 4 also comprises randomizing means 7 designed to misalign the fibres on the surface of the layer F of fibres in contact with the randomizing means 7 in a random manner.

[0062] This is achieved thanks to the difference in speed between the randomizing means 7 or the speed difference between the randomizing means 7 and the comber cylinder 4.

[0063] This difference in speed is advantageously in the order of a few tens of m/min (10 m/min - 30 m/min).

[0064] Advantageously, the difference in speed between two adjacent randomizing means 7, or between one of the randomizing means 7 adjacent to the comber cylinder 4 and the comber cylinder 4, is approximately 25 - 55% between one means and the other, or between the means and the comber cylinder 4.

[0065] For example, when the speed of rotation of the comber cylinder 4 is 100 m/min, the speed of one of the randomizing means 7 adjacent to the comber cylinder 4 is advantageously 60 m/min and the speed of one of the successive randomizing means 7 adjacent to the previous one is 40 m/min.

[0066] In that way, the layer F of fibres is processed in a better and more effective manner, in terms of processing quality and processing times, for the production of a layer F of fibres which is thin.

[0067] The randomizing means 7 are advantageously in the form of rollers with a toothed surface which rotate about their longitudinal axis.

[0068] The geometry of the tooth of the toothed surface of the randomizing means 7 contributes to determining the thickness of the layer F of fibres coming out of the comber cylinder 4.

[0069] Advantageously, the randomizing means 7 have seals which form a toothed surface with a medium type tooth.

[0070] The expression "medium type tooth" means a tooth in which the number of tips per square inch is approximately between 80 and 200.

[0071] According to embodiments not illustrated the randomizing means 7 are not present.

[0072] The comber cylinder 4 also contributes to discharging the drum 33 of the layer F of fibres.

[0073] The carding machine 1 also comprises a plurality of conveyor belts 5 designed to move the layer F of fibres from an infeed position I to the carding machine 1 positioned at the carding unit 3 to an outfeed position U of the carding machine 1 located downstream of the comber cylinder 4.

[0074] More specifically, the conveyor belts 5 are movable relative to the carding unit 3 for varying the processing path of the layer F of fibres from the infeed position I of the machine to the outfeed position U of the machine.

[0075] The carding unit 3 is in fact arranged in a fixed position inside the carding machine 1.

[0076] As mentioned above, on the other hand, the comber cylinder 4, and the randomizing means 7 translate along the direction A.

[0077] The conveyor belts 5 are configured in such a way as to rotate, for example in the directions B and C for the conveyor belt 52 and for the conveyor belt 53.

[0078] More in general, the conveyor belts 5 each rotate according to a plane vertical to the relative conveying surface for varying the processing path of the layer F of fibres inside the carding machine 1.

[0079] The term "conveying surface" means the zone on which the layer F of fibres rests for being moved along the carding machine 1. That solution is described in patent document IT2015F100070, filed by the same Applicant.

[0080] Figure 2 highlights, with the letters B, C, E, E' and G, some possible directions of movement of the conveyor belts 5.

[0081] By mutually rotating the plurality of conveyor belts 5 it is possible to adapt the carding machine 1 to the processing requirements and to the products to be made. With reference to Figures 2 to 5A, the carding machine 1 comprises a pair of conveyor belts 51, one lower and one upper, located at the infeed position I.

[0082] The conveyor belts 51 converge, in such a way as to compress the layer F of fibres entering the carding unit 3.

[0083] This compression facilitates the entry of the layer F of fibres into the carding unit 3.

[0084] The carding machine 1 also comprises a conveyor belt 52 designed to receive the layer F of fibres at the outfeed from the carding unit 3.

[0085] The conveyor belt 52 is of the mobile type, in such a way as to advantageously interact with the layer F of fibres.

[0086] The direction of movement is labelled B in the drawings. The conveyor belt 52 is advantageously equipped with suction means 61 for volumizing the layer F of fibres during the passage on the conveyor belt 52.

[0087] The carding machine 1 comprises a conveyor belt 53 designed to receive the layer F of fibres coming out of the comber cylinder 4, as illustrated in Figures 5 and 5A.

[0088] The conveyor belt 53 also accompanies the layer F of fibres feeding out of the comber cylinder 4 towards the outfeed position U from the carding machine 1.

[0089] The conveyor belt 53 is of the mobile type, in such a way that it advantageously interacts with the layer of fibres F.

[0090] The direction of movement is labelled C in the drawings. This movement is advantageously actuated, for example, by hydraulic means 53' as illustrated in Fig-

ure 3.

[0091] According to embodiments not illustrated, the hydraulic means 53' are replaced with pneumatic means.

[0092] More specifically, with reference to Figure 3, the conveyor belt 53 is in the raised configuration.

[0093] With reference to Figures 3A, 4, 4A, 5 and 5A, the conveyor belt 53 is in the lowered configuration.

[0094] Moreover, the carding machine 1 comprises a conveyor belt 54, illustrated in Figures 2 and 5A, designed to receive the layer F of fibres when the lower conveyor belt 51 is lowered.

[0095] The carding machine 1 also comprises suction means 6 positioned downstream of the carding unit 3 designed to suck the fibres of the layer F of fibres at the outfeed from the carding unit 3.

[0096] With reference to Figures 3, 3A, 5 and 5A, the suction means 6 are such as to act advantageously on the layer F of fibres for volumizing the fibres.

[0097] The suction means 6 are also such as to hold the fibres around the conveyor belt 5 in question, for example the conveyor belt 52.

[0098] In order to increase or improve the volumizing, the suction means 6 act on both the upper and lower surfaces of the layer F of fibres.

[0099] In this regard, the suction means 6 comprise a first suction means 61 arranged below the conveyor belt 52.

[0100] The suction means 6 also comprise a rotating suction unit 62 arranged in such a way as to act on the opposite side of the layer F of fibres.

[0101] In this way, both the first suction means 61 and the rotating suction unit 62 operate by stressing approximately transversely the layer F of fibres.

[0102] The suction means 6 are movable.

[0103] More specifically, the rotary suction unit 62 is designed to rotate and translate from a first configuration AC1 when the comber cylinder 4 adopts the first configuration C1, to a second configuration AC2 when the comber cylinder 4 adopts said third configuration C3.

[0104] In this way, the rotary suction unit 62 does not interfere with the comber cylinder 4 in the two different configurations of use.

[0105] According to embodiments not illustrated, the conveyor belt 53 is of the suction type, that is to say, there are suction means 6 for holding and facilitating the passage of the layer F of fibres feeding out of the comber cylinder 4.

[0106] According to these embodiments, the suction means 6 are positioned in such a way as to act on the surface on the layer F of fibres when it is at the conveyor belt 53.

[0107] That is to say, the suction means 6 are positioned not so much on the conveyor belt 53 but around it.

[0108] The carding machine 1 also comprises a safety photocell, not shown in the drawings, positioned below the carding unit 3 and designed to prevent the return of the layer F of fibres into the carding unit 3.

[0109] In use, the carding machine 1 according to the

invention adopts a first configuration C1, shown in Figures 3 and 3A, wherein the machine operates solely as a carding unit.

[0110] According to this configuration the comber cylinder 4 is far from the carding unit 3 to allow the layer F of fibres to bypass the comber cylinder 4.

[0111] The processing path is shown in Figures 3, 4 and 5 by the grey arrows.

[0112] The layer F of fibres from the infeed I is conveyed by the belts 51 towards the plurality of introductory rollers 31 and then towards the feed roller 32 and then to the drum 33 for the fibres to be processed.

[0113] The rotary element 34 collects any fibres dispersed or contributes to the processing of the layer F of fibres. The rotary doffing elements 35 and the rotary working elements 36 process the fibres in conjunction with the drum 33.

[0114] After that, the layer F of fibres, passing from the rod 37, comes out of the drum 33.

[0115] With reference to Figures 3 and 3A, the layer F of fibres at the outfeed from the carding unit 3 is subjected to the flow of air emitted by the air emission unit S in such a way as to facilitate detachment of the layer F of fibres from the drum 33.

[0116] The layer F of fibres then falls onto the conveyor belt 52.

[0117] The suction means 6 provide volume and contribute to holding the layer F of fibres close to the conveyor belt 52.

[0118] The rotating suction unit 62 is positioned in the first configuration AC1.

[0119] In this configuration the direction of suction exerted by the rotary suction unit 62 and the direction of suction of the first suction means 61 defines an angle greater than 90° in the direction of the processing flow. The term "processing flow" means the passage of the layer F of fibres from the infeed position I to the outfeed position U.

[0120] Subsequently, again by means of the conveyor belt 52, the layer F of fibres is accompanied towards the outfeed U of the machine.

[0121] With this type of processing it is possible to make a single layer F of fibres even with a large thickness.

[0122] By adjusting the speed of rotation of the feed roller 32, of the drum 33, of the rotary doffing elements 35 and of the rotary working elements 36 and of the suction means 6 it is possible to vary the thickness of the layer F of fibres at the outfeed from the carding machine 1 according to the invention.

[0123] Adjusting the rotation speed of the introductory rollers 31 and the position of the belts 51 varies the density of the layer F of fibres entering the carding machine 1. Moreover, by adjusting the speed of rotation of the feed roller 32, of the drum 33, of the rotary doffing elements 35 and of the rotary working elements 36 it is possible to vary the quality of the layer F of fibres, meaning the number of defects of the layer F of fibres.

[0124] The carding machine 1, starting from the first

configuration C1, shown in Figures 3 and 3A, moves to a second configuration C2, shown in Figures 4 and 4A.

[0125] According to this configuration the carding machine 1 operates solely as a comber cylinder.

[0126] According to this configuration the comber cylinder 4 is positioned alongside the carding unit 3 to allow the layer F of fibres to engage in sequence the carding unit 3 and the comber cylinder 4.

[0127] The layer F of fibres from the infeed position I is conveyed by the belts 51 towards the plurality of introductory rollers 31, then towards the feed roller 32, and then to the drum 33, for the fibres to be processed.

[0128] Similarly to what is described above, the layer F of fibres passes through the rotary element 34 which collects any fibres dispersed or which contributes to the processing of the layer F of fibres.

[0129] The rotary doffing elements 35 and the rotary working elements 36 process the fibres of the layer F of fibres in conjunction with the drum 33.

[0130] Next, the layer F of fibres, invited by the rod 37, comes out of the drum 33.

[0131] With reference to Figures 4 and 4A, the layer F of fibres at the outfeed from the carding unit 3 engages on the comber cylinder 4.

[0132] When the carding machine 1 is to operate as a comber cylinder, the air emission unit S is not active, in such a way as not to adversely affect the engagement of the layer F of fibres on the comber cylinder 4.

[0133] Once the layer F of fibres has engaged the comber cylinder 4 it is forced to slide tangentially to the randomizing means 7 which curl the surface of the layer F of fibres.

[0134] In this configuration the suction means 6 are not active.

[0135] The rotary suction unit 62 is translated in such a way as not to obstruct, and if necessary facilitate, the passage of the layer of fibres F.

[0136] At the outfeed of the randomizing means 7, the layer F of fibres falls onto the conveyor belt 53.

[0137] By means of the conveyor belt 53, the layer F of fibres is accompanied towards the machine outfeed U.

[0138] With this type of processing it is possible to make a single layer F of fibres even with reduced thickness.

[0139] In fact, by adjusting the speed of rotation of the feed roller 32, of the drum 33, of the rotary doffing elements 35 and of the rotary working elements 36, of the comber cylinder 4 and of the randomizing means 7 it is possible to vary the thickness of the layer F of fibres.

[0140] Moreover, by adjusting the speed of rotation of the rotary elements, such as the feed roller 32, the drum 33, the rotary doffing elements 35 and the rotary working means 36, the comber cylinder 4 and the randomizing means 7 it is possible to vary the quality of the layer F of fibres.

[0141] Adjusting the position of the conveyor belts 52 and 53 and of the comber cylinder 4 and of the randomizing means 7 varies the density of the layer F of fibres fed

out of the carding machine 1.

[0142] The carding machine 1, starting from the second configuration C2, shown in Figures 4 and 4A, moves to a third configuration C3, shown in Figures 5 and 5A.

[0143] According to this configuration the carding machine 1 operates simultaneously like a carding unit and like a comber cylinder.

[0144] That is to say, in this configuration the carding machine 1 according to the invention interlaces, or curls, and combs the layer F of fibres.

[0145] According to this configuration the comber cylinder 4 is positioned alongside the carding unit 3 to allow the layer F of fibres to engage completely on the carding unit 3 and partly on the comber cylinder 4.

[0146] The layer F of fibres from the infeed I is conveyed by the belts 51 towards the plurality of introductory rollers 31 and then towards the feed roller 32 and then to the drum 33 for the fibres to be processed.

[0147] The rotary element 34 collects any fibres dispersed or contributes to the processing of the layer F of fibres. The rotary doffing elements 35 and the rotary working elements 36 process the fibres in conjunction with the drum 33.

[0148] Next, the layer F of fibres, invited by the rod 37, comes out of the drum 33.

[0149] The layer F of fibres is subjected to the flow of air emitted by the air emission unit S in such a way as to facilitate detachment of the layer F of fibres from the drum 33.

[0150] The layer F of fibres at the outfeed from the carding unit 3 is partly diverted towards the conveyor belt 52 and is partly diverted towards the comber cylinder 4.

[0151] With reference to Figures 5 and 5A, the part of the fibres diverted towards the comber cylinder 4 is thinner than the part of the fibres diverted towards the conveyor belt 52 and to the suction means 6.

[0152] The third configuration C3 is in fact designed for the production of a layer F of fibres at the outfeed from the carding machine 1 comprising a first layer F' of fibres produced by the carding unit 3 and a second layer F'' of fibres produced by the comber cylinder 4, as shown in Figure 5A.

[0153] At the outfeed from the carding unit 3 the layer F' of fibres falls onto the conveyor belt 52.

[0154] By means of the suction means 6, the layer F' of fibres is stressed transversely and hence volumized.

[0155] The rotating suction unit 62 is positioned in the second configuration AC2.

[0156] That is to say, the rotary suction unit 62 is rotated and translated relative to the previous configurations of use of Figures 3, 3A and 4, 4° in such a way as to interact advantageously with the layers F' and F'' of fibres.

[0157] The directions of rotation and translation are shown in Figure 5 and labelled D and D'.

[0158] According to the configuration shown in Figures 5 and 5A, the direction of suction exerted by the rotary suction unit 62 is substantially parallel to the direction of

suction of the first suction means 61.

[0159] The direction of translation of the rotary suction unit 62 is towards the layer F' of fibres, as illustrated in Figure 5.

[0160] Consequently, the layer F' of fibres is volumized by the suction means and the fibres are advantageously retained at the conveyor belt 52.

[0161] Subsequently, again by means of the conveyor belt 52, the layer F' of fibres is accompanied towards the outfeed U of the machine.

[0162] At the outfeed from the carding unit 3 the layer F'' engages the comber cylinder 4 and is forced to slide tangentially to the randomizing means 7 which curl the surface of the layer F'' of fibres.

[0163] At the outfeed of the randomizing means 7, the layer F'' of fibres falls onto the conveyor belt 53.

[0164] By means of the conveyor belt 53, the layer F'' of fibres is accompanied towards the machine outfeed U.

[0165] By using this type of processing it is possible to make a two-layer layer of fibres consisting of the layer F'' of fibres superposed on the layer F' of fibres.

[0166] The mobility of the plurality of conveyor belts 5 contributes to adapting the carding machine 1 to the processing requirements and to the products to be made. According to embodiments not illustrated the layer F of fibres at the infeed is made to pass on the conveyor belt 54, for example for bypassing the carding unit 3.

[0167] This is possible by lowering the bottom conveyor belt 51, thereby inviting the layer of fibres F to fall onto the conveyor belt 54.

[0168] By also lowering the conveyor belt 52, the layer F of fibres feeding out of the conveyor belt 54 is conveyed on the conveyor belt 52 and then pushed towards the outfeed U of the carding machine 1.

[0169] Both the carding unit 3 and the comber cylinder 4 are bypassed in this processing flow.

[0170] In this mode, the carding machine 1 acts solely as a station for transporting the layer F of fibres.

[0171] Alternatively, in this configuration, the suction means 6 may be actuated in such a way as to process the layer F of fibres before it escapes from the outfeed U of the carding machine 1.

[0172] The carding machine 1 according to the invention, due to the mobility of its component elements, except for the carding unit 3, is able to adopt different configurations, thus being able to perform a different number of different processing operations and produce different products.

[0173] Advantageously, the carding machine 1 is able to make a layer F of fibres, or a double layer consisting of the layer F' of fibres and F'', at the outfeed from the carding machine 1 with a thickness of between approximately 10 g/m² and approximately 1500 g/m².

[0174] Moreover, the carding machine 1 it is able to produce double layers with a control on the orientation of the fibres in the layer F' and F'' of fibres.

[0175] Thanks to this, the layer F of fibres of the double layer type can be made with an orientation approximately

equal to or different of the fibres of the layer F' and F'' of fibres.

[0176] According to embodiments not illustrated, the carding machine 1 according to the invention is inserted inside systems for processing the fibres with several processing stations.

[0177] For example, a first plant comprises the installation of a forming machine located upstream of the carding machine 1.

[0178] The forming machine is designed to feed the carding machine 1 with a layer F of fibres wherein the layer F of fibres is in the form of a uniform web of fibres.

[0179] According to other embodiments not illustrated, a pre-carding machine is inserted upstream of the carding machine 1 according to the invention to perform a first carding.

[0180] According to a further embodiment of the system, downstream of said carding machine 1 there is a lapping machine.

[0181] The versatility of the processing operations and of the products which can be made with the carding machine 1 is further varied using these systems.

[0182] The carding machine 1 according to the invention achieves the preset aims and brings important advantages.

[0183] A first advantage of the carding machine according to the invention is the possibility of performing various types of processes by providing a single machine.

[0184] A further advantage is the possibility of making products and semifinished items with a wide range of thicknesses. Another advantage is the possibility of making products and semifinished items with a large range of densities. A further advantage is due to the fact that the processing times are reduced, reducing the number of processing operations necessary for making the semifinished product or finished product.

[0185] Yet another advantage is the possibility of obtaining finished products, even with a small thickness, of good quality, that is to say, with a reduced number of defects.

[0186] Where the technical features indicated in any claim are reference by reference characters, these reference characters are included solely for the purpose of increasing the clarity of the claims and do not in any way limit the scope of the inventive concept.

Claims

- Carding machine for one layer (F) of fibres comprising:
 - a carding unit (3) designed to interlace the fibres of said fibre layer (F, F') and to adjust the thickness of said fibre layer (F, F');
 - a comber cylinder (4) placed downstream of said carding unit (3) and able to comb the fibres

of said fibre layer (F, F');

characterized in that said comber cylinder (4) is movable from a first configuration (C1) away from said carding unit (3) to allow said layer (F) of fibres to bypass said comber cylinder (4), to a second configuration (C2) adjacent to said carding unit (3) to allow said layer (F) of fibres to engage in sequence said carding unit (3) and said comber cylinder (4).

2. Machine according to claim 1, **characterized in that** said carding unit (3) comprises an air emission unit (S) configured to facilitate the detachment of the layer (F, F') of fibres coming out of said carding unit (3).
3. Machine according to claim 1, **characterised in that** said comber cylinder (4) is also movable in a third configuration (C3) adjacent to said carding unit (3) in order to allow said layer (F) of fibres to engage completely on said carding unit (3) and partly on said comber cylinder (4), said third configuration being suitable for the production of a layer (F) of fibres coming out of the machine comprising a first layer (F') of fibres produced by said carding unit (3) and a second layer (F'') of fibres produced by said comber cylinder (4).
4. Machine according to claim 1, **characterised in that** it comprises a plurality of conveyors (5) capable of moving said layer (F, F', F'') of fibres from an entry position (I) of the machine placed in correspondence of said carding unit (3) to an exit position (U) of the machine placed downstream of said comber cylinder (4).
5. Machine according to claim 1, **characterized in that** it comprises suction means (6) disposed downstream of said carding unit (3) designed to suck said fibres of said layer (F, F') of fibres coming out of said carding unit (3) in order to bulk said fibres.
6. Machine according to claim 5, **characterized in that** said suction means (6) are mobile.
7. Machine according to claim 5, **characterized in that** said suction means (6) comprise a rotating suction unit (62) capable of rotating and shifting from a first configuration (AC1) when said comber cylinder (4) takes on said first configuration (C1) to a second configuration (AC2) when said comber cylinder (4) takes on said third configuration (C3) .
8. Machine according to claim 4, **characterized in that** said conveyors (5) of said plurality are mobile with respect to said carding machine (3) in order to vary the processing path of said layer (F, F', F'') of fibres from said entry position (I) of the machine to said exit position (U) of the machine.

9. Machine according to claim 1, **characterized in that** said comber cylinder (4) comprises randomizing means (7) designed to randomly misalign the fibres on the surface of said layer (F, F'') of fibres in contact with said randomizing means (7).

10. Machine according to claim 1, **characterized in that** it comprises a safety photocell placed under said carding unit (3) and capable of preventing the return of said layer (F) of fibres to said carding unit (3).

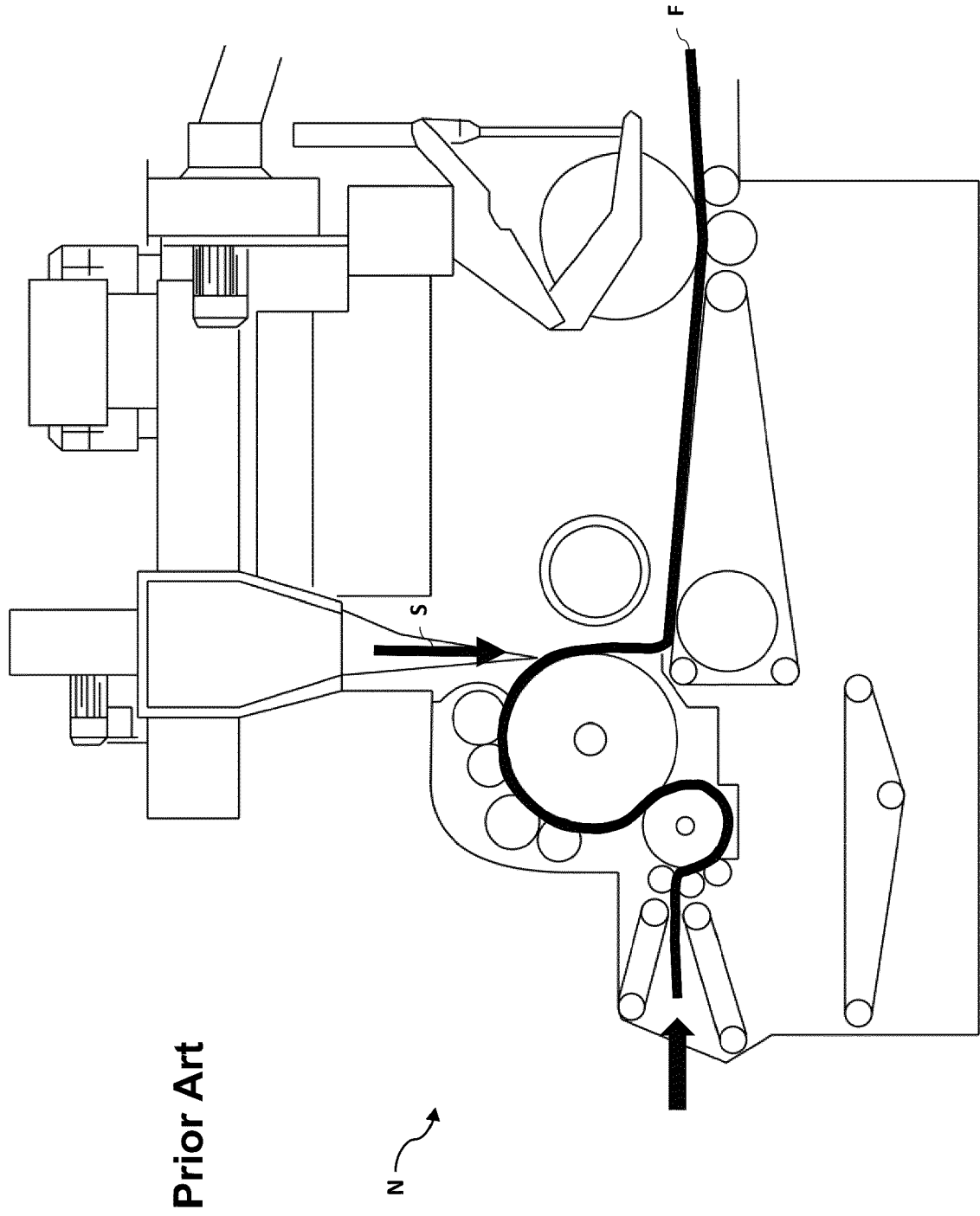


Fig. 1

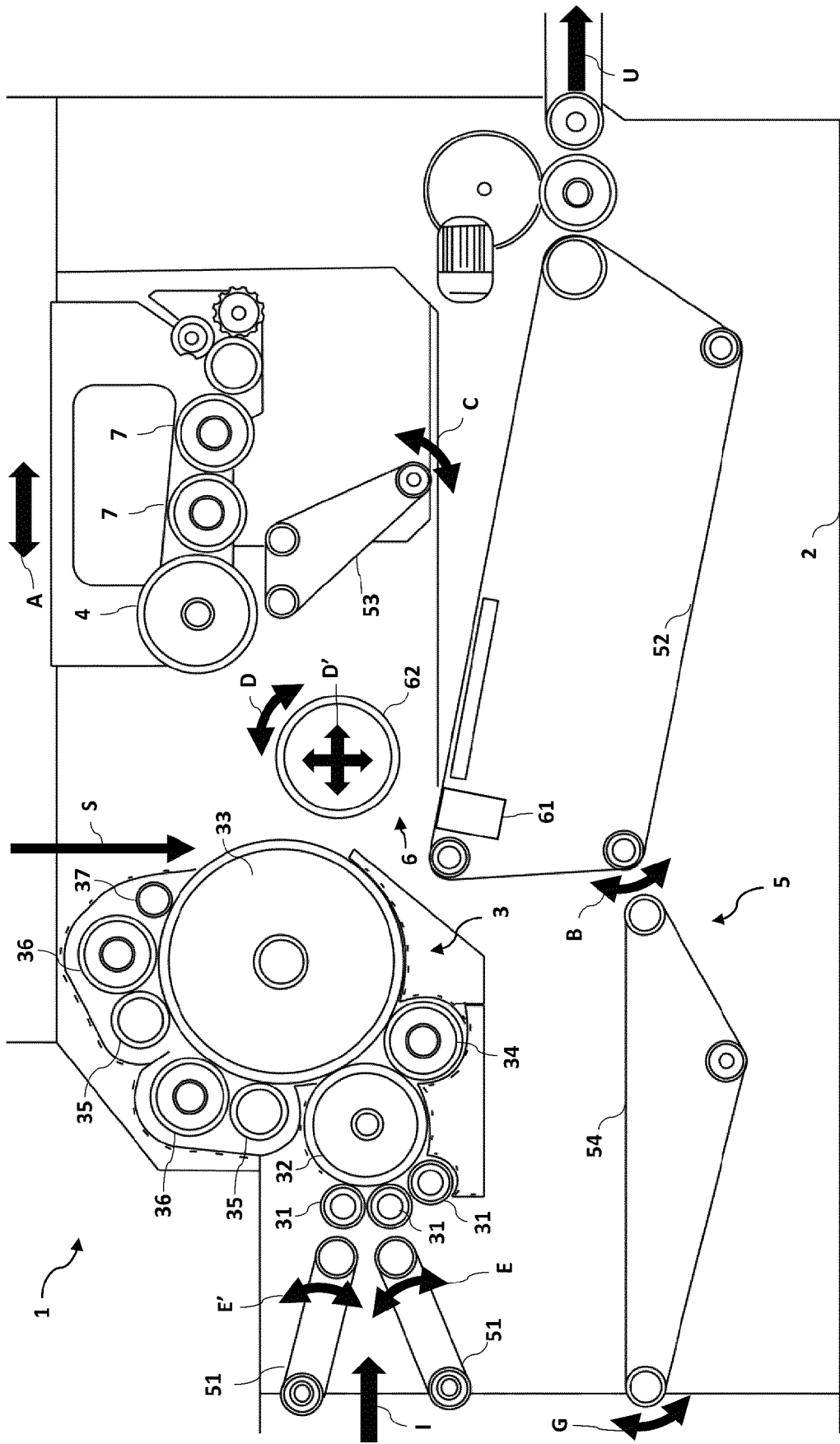


Fig. 2

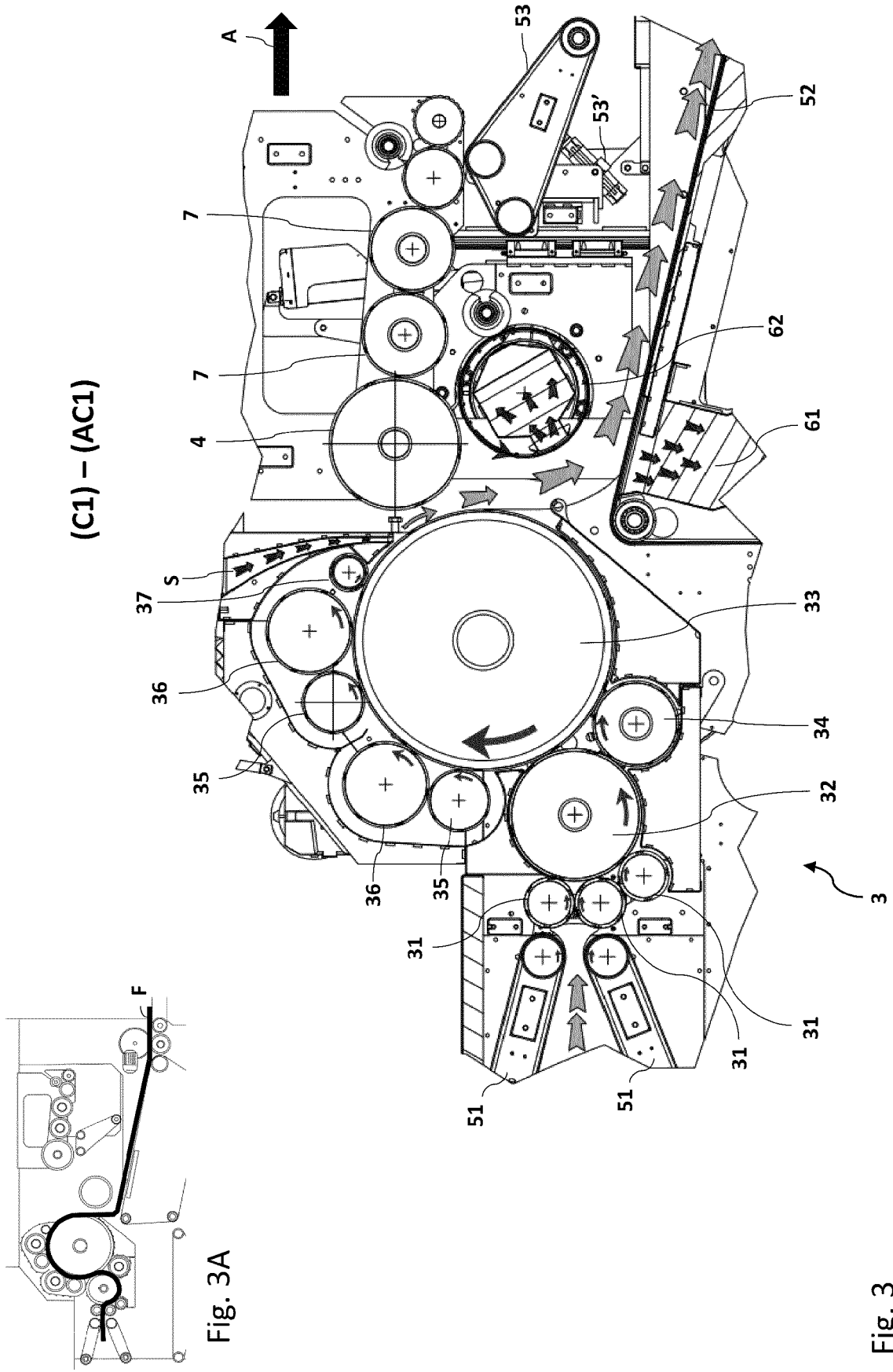


Fig. 3

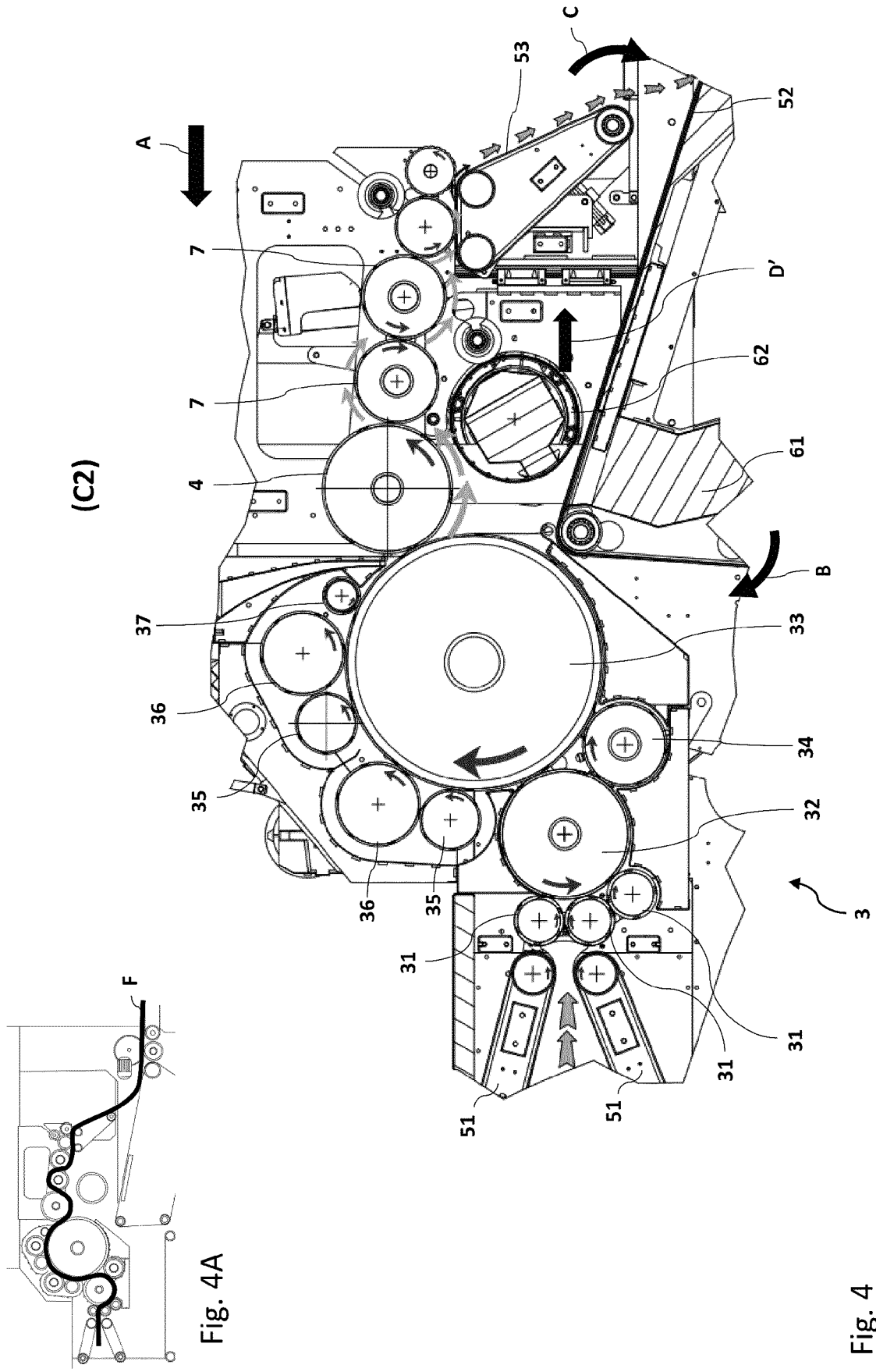


Fig. 4A

Fig. 4

(C3) - (AC2)

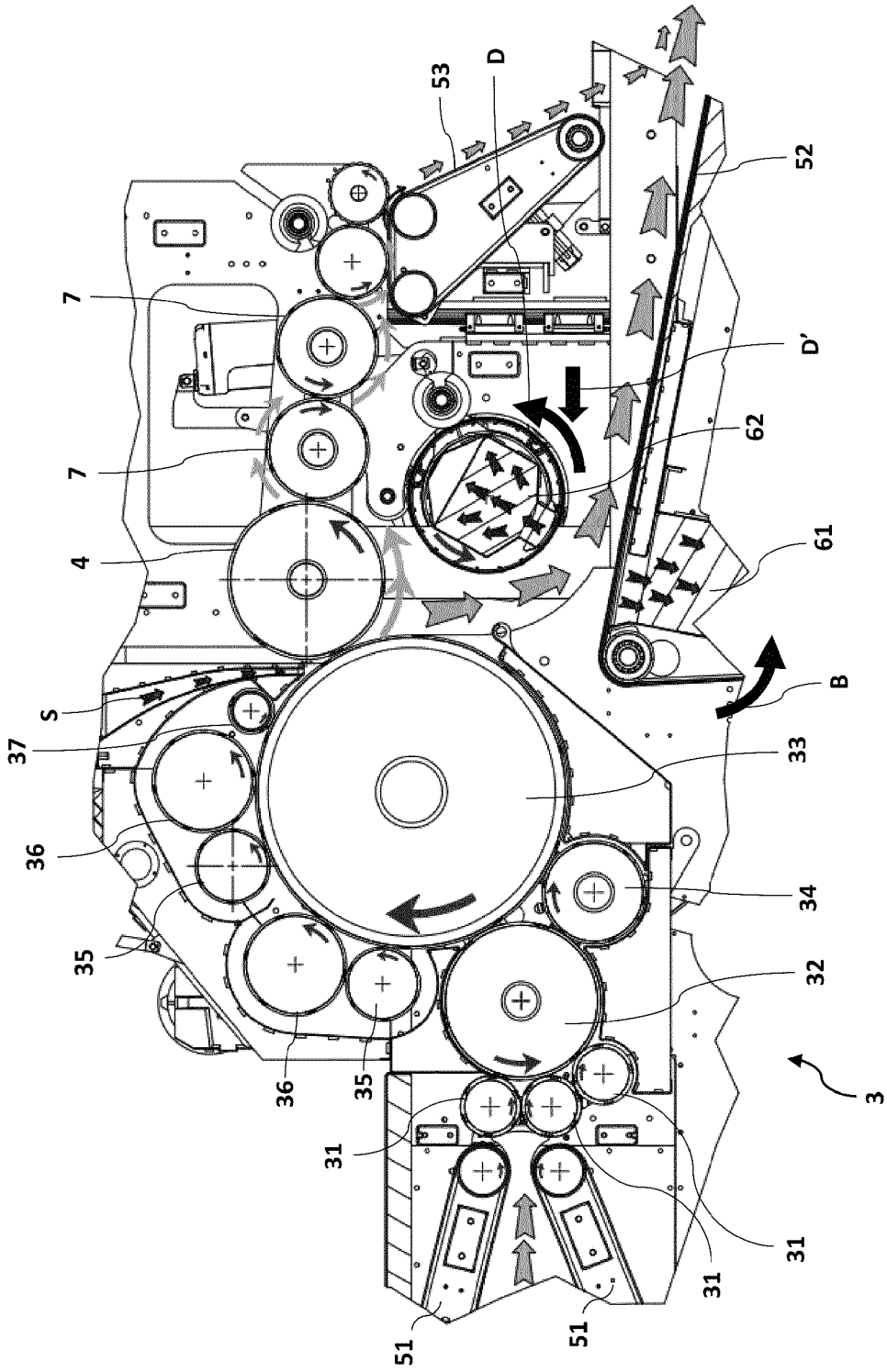


Fig. 5

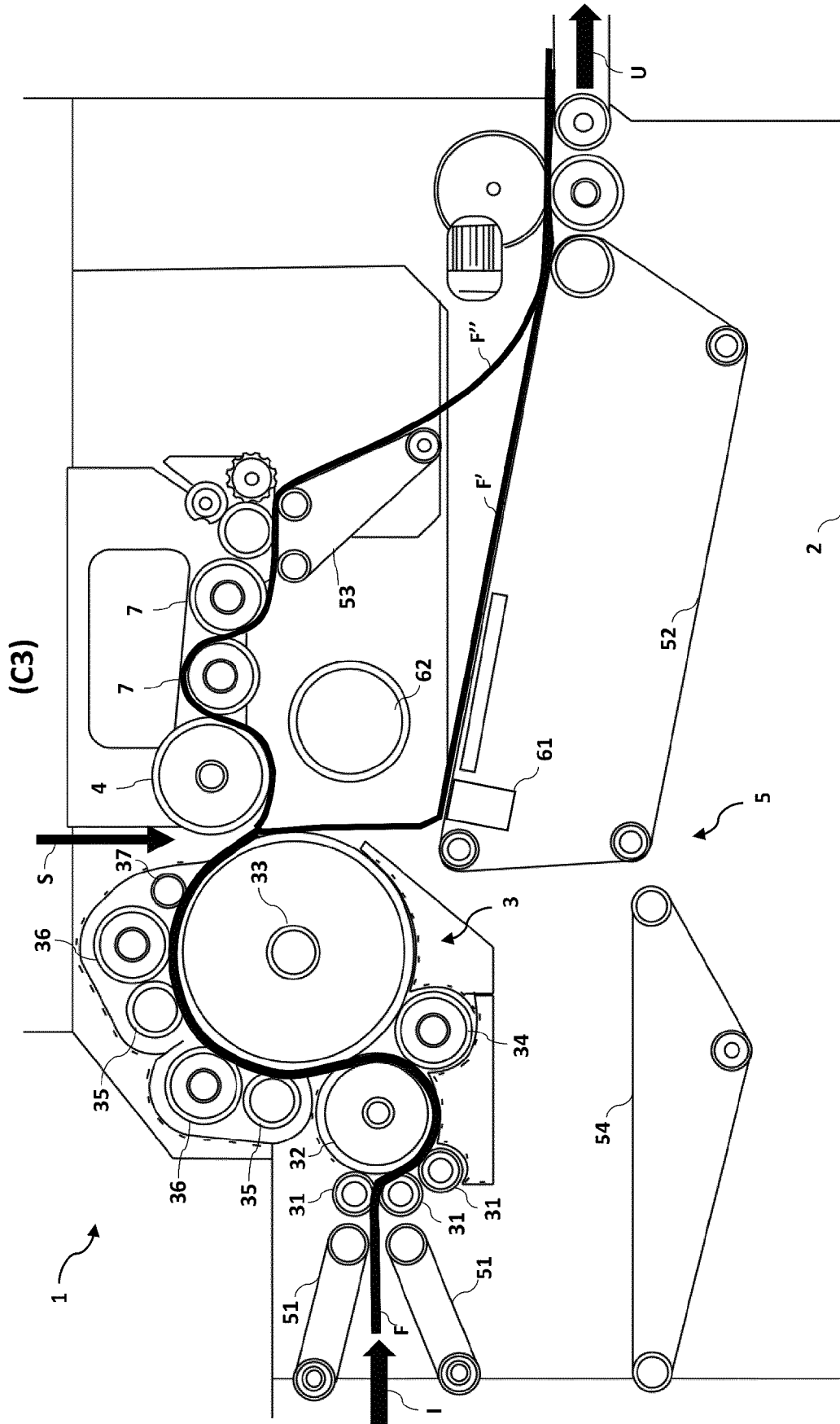


Fig. 5A



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Application Number
EP 21 18 7399

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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 13 September 2021	Examiner Todarello, Giovanni
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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