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(54) **DRAWING DEVICE FOR A WEB WITH CARDING ROLLER FOR AIR SPINNING SYSTEMS, AIR SPINNING APPARATUS AND DRAWING METHOD FOR A WEB**

(57) A drawing device (4) for webs (8) of textile fibres comprising
- a feeder device (12) of a web (8) to be drawn,
- a carding machine (28) rotating according to a direction of rotation (S) comprising, on an outer side wall thereof (32), a plurality of teeth (36) arranged with a constant tangential pitch (P), adapted to draw said web (8),
- an extraction cylinder (56) placed downstream of the carding machine (28) and of the web (8),
wherein
- the feeder device (12) comprises a feeder roller (16), facing the carding machine (28), which rotates so as to feed the web to the carding machine (28) at an input speed and according to a direction of advancement (F) concordant with respect to said direction of rotation (S) of the carding machine (28),
- wherein the carding machine is driven in rotation so as to have a peripheral speed on the teeth equal to the product of the input speed times the total drawing of the web ± 20%, so that the drawing of the web takes place practically entirely on the carding machine,
- the total drawing being the ratio between the thread count of the yarn to be produced and the input web thread count. [Fig. 1]

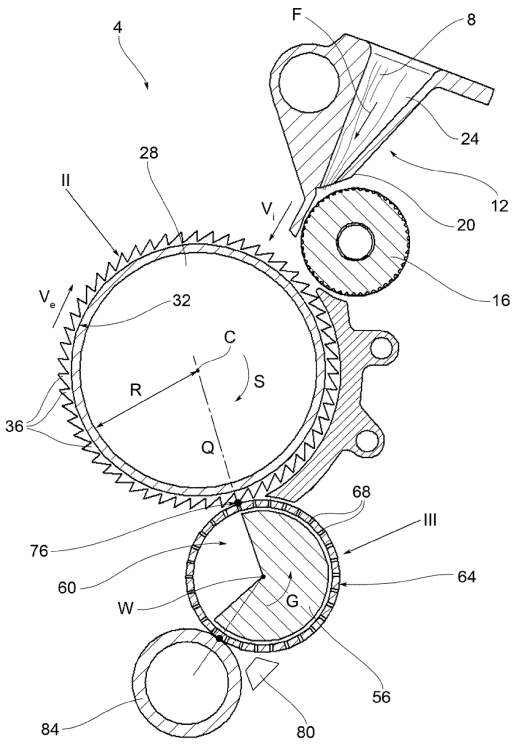

FIG.1

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Description

FIELD OF APPLICATION

[0001] The present invention relates to a drawing device for a web with carding machine for air spinning systems, an air spinning apparatus comprising said drawing device of a web with carding machine and a drawing method for a web with carding machine for air spinning systems thereof.

BACKGROUND ART

[0002] As known, webs with fibre length typically of 38 mm or longer and above all with fibre distribution as homogeneous as possible are required in air spinning systems. These characteristics of the upstream web allow obtaining good technical characteristics of the yarn, while the presence of short fibres significantly worsens such characteristics.

[0003] The drawing systems used are normally formed by three or more pairs of drawing and pressure cylinders, each of which performs a partial and progressive drawing of the web. The last pair uses belt systems which ensures greater delicacy in fibre parallelization and drawing.

[0004] The output fibre flow continuity is a fundamental requirement.

[0005] The drawing systems used in air spinning devices are derived *in toto* from those traditionally used in ring spinning and suffer from the same shortcomings, i.e. poor parallelization efficiency at high working speed and limited maximum obtainable drawing.

[0006] Carding machine drawing systems, instead, are used in open-end spinning systems to convey the fibres from the inlet to the rotor using the mechanical action of the teeth to tear the fibres from the web and the centrifugal action due to the high rotation speed to remove impurities and short fibres from the flow of fibres which enters into the rotor. In these systems, the continuous flow of fibres is not a fundamental requirement and nor is the presence of short or broken fibres. However, the systems with carding machine are more compact than those with rollers and above all the parallelization function of the fibres, ensured by the action of the teeth of the carding machine, is extremely effective and is not affected in any manner by the working speed or the imparted drawing amount.

PRESENTATION OF THE INVENTION

[0007] The need is therefore felt to solve the drawbacks and limitations mentioned above with reference to the prior art.

[0008] Such need is met by a drawing device with carding machine according to claim 1, by an air spinning apparatus according to claim 20 and by a drawing method with carding machine for air spinning according to claim 21.

DESCRIPTION OF THE DRAWINGS

[0009] Further features and advantages of the present invention will be more comprehensible from the following description of preferred embodiments given by way of nonlimiting examples, in which:

- figure 1 shows a diagrammatic view of a drawing device with carding machine according to an embodiment of the present invention;
- figures 2a-2b show enlarged views of detail II in figure 1;
- figure 3 is an enlarged view of detail III in figure 1.

[0010] Elements or parts in common to the embodiments described below will be indicated using the same reference numerals.

DETAILED DESCRIPTION

[0011] With reference to the aforementioned figures, reference numeral 4 indicates a drawing device for webs 8 of textile fibres as a whole.

[0012] In particular, the drawing device 4 comprises a feeder device 12 of a web 8 to be drawn, comprising a feeder roller 16.

[0013] The feeder roller 16 is driven so as to rotate about a rotation pivot thereof.

[0014] According to a possible embodiment, the feeder device 12 further comprises a nozzle or a mouth 20 which conveys the web 8 to be drawn towards the successive drawing processes.

[0015] The nozzle or mouth 20 defines a passage channel 24 for the web 8 together with the feeder roller 16.

[0016] The nozzle or mouth 20 is preferably pressed towards the feeder roller 16 so as to apply a pressure which is as a function of the input web thread count.

[0017] The feeder roller 16, by virtue of its motorized rotation, sets in motion the web 8, which is fed at an input speed Vi.

[0018] The drawing device 4 further comprises a carding machine 28 comprising, on its outer side wall 32, a plurality of teeth 36 arranged at a constant tangential pitch P. The teeth 36 are shaped so as to draw the web 8.

[0019] The feeder roller 16 rotates and directly faces the carding machine 28 so as to feed the web to the carding machine 28 at said input speed Vi.

[0020] Preferably, the tangential pitch P between the teeth 36 of the carding machine 28 is comprised between 5 and 15 mm.

[0021] As explained below, this pitch P is particularly wide compared with the pitches of the solutions of the prior art: this reduces the complexity and cost of the carding machine 28.

[0022] Preferably, said teeth 36 have a substantially triangular shape which protrudes from the outer side wall 32 of the carding machine 28, according to a first front portion 40, which directly faces the web 8, and a second

rear portion 44 which forms a vertex 48 with the first front portion 40.

[0023] Preferably, said vertex 48 has a radial height 52, measured with respect to the outer side wall 32 along a radial direction R passing through a rotation axis C of the carding machine 28, comprised between 0.5 and 2 mm.

[0024] According to an embodiment, the first front portion 40 identifies a first angle β comprised between 5 and 10 degrees with radial direction R, passing through a rotation axis C of the carding machine 28.

[0025] According to an embodiment, the second rear portion 44 identifies a second angle α comprised between 40 and 70 degrees with tangential direction T perpendicular to a radial direction R passing through the rotation axis C of the carding machine 28.

[0026] The web 8 is fed by the feeder device 12, at the input speed Vi according to a direction of advancement F agreeing with a direction of rotation S of the carding machine 28.

[0027] In this manner, the teeth of the carding machine 28, during rotation, cling to the web 8 and draw it according to its direction of advancement F.

[0028] This operating condition is opposite to the known solutions in which the teeth oppose the direction of advancement of the web.

[0029] Advantageously, the carding machine 28 is driven in rotation so as to have a peripheral speed or extraction speed Ve on the teeth 36 equal to the product of the input speed Vi times the total drawing St of the web 8, so that the drawing of the web 8 takes place entirely on the carding machine 28.

[0030] In other words: $Ve = Vi \times St \pm 20\%$.

[0031] Therefore, the Ve value must remain about 20% of the product of the input speed Vi times the total drawing St.

[0032] Preferably, the Ve value must remain about 10% of the product of the input speed Vi times the total drawing St.

[0033] Even more preferably, the Ve value must remain about 5% of the product of the input speed Vi times the total drawing St.

[0034] Total drawing St means the ratio between the thread count of the yarn to be produced and the input web thread count.

[0035] The drawing device 4 further comprises an extraction cylinder 56 placed downstream of the carding machine 28 and of the web 8.

[0036] In other words, the carding machine 28 receives the web 8 from the feeder device 12 and, by rotating in the same direction as the direction of advancement F of the web 8, pulls and draws the web 8 towards the extraction cylinder 56, arranged downstream of the carding machine 28 and of the web 8 with respect to said direction of advancement F of the web 8.

[0037] It is worth noting that the carding machine 28 and the extraction cylinder 56 rotate in mutually opposite directions of rotation S,G. In particular, the extraction cylinder 56 rotates in a counter-rotating direction G with respect to the direction of rotation S of the carding machine 28.

[0038] The successive removal of the fibres of the web 8 is facilitated and improved by virtue of the counterpoised rotations of the carding machine 28 and of the extraction cylinder 56.

[0039] For this purpose, the extraction cylinder 56 has a specific shape.

[0040] In particular, the extraction cylinder 56 defines an inner cavity 60 and has a perforated side wall 64, provided with a plurality of holes 68 communicating with the inner cavity 60, adapted to create a suction flow in order to facilitate the detachment of the fibres from the carding machine 28. In particular, the inner cavity 60 is connected to a vacuum source so as to create a suction flow through said holes 68 which facilitates the removal of the fibres from the carding machine 28.

[0041] It is apparent that the opposite rotation between carding machine 28 and extraction roller 56 further facilitates such detachment of the fibres of the web 8 from the carding machine 28.

[0042] For this purpose, said holes 68 are circular holes having a diameter comprised between 1 and 3 mm.

[0043] According to an embodiment, said holes 68 are arranged according to a matrix diagram along a pair of directions perpendicular to each other, and are spaced apart according to a first and a second pitch L1, L2.

[0044] Preferably, said first and second pitches L1, L2 are comprised between 2 and 4 mm.

[0045] Preferably, said first and second pitches L1, L2 are equal to each other.

[0046] According to a possible embodiment, one of said directions of the matrix diagram is parallel to a rotation axis W of the extraction cylinder 56.

[0047] Obviously, the rotation axes W, C of the extraction cylinder 56 and the carding machine 28 are respectively parallel to each other.

[0048] Generally, the perforated side wall 64 of the extraction cylinder 56 has holes 68 arranged along an extraction band 72 having an axial thickness H, parallel to the rotation axis W of the extraction cylinder 56, comprised between 4 and 11 mm.

[0049] In relation to the relative arrangement of carding machine 28 and extraction cylinder 56, preferably with respect to a direction Q joining the rotation axes C, W of the carding machine 28 and of the extraction cylinder 56, the vertices 48 of the teeth 36 and the side wall 64 of the extraction cylinder 56 are distant by a pitch 76 comprised between 0.1 and 2 mm.

[0050] A conveying device 80 is arranged downstream of the extraction cylinder 56 equipped with an output roller 84 which turns in idle manner and facilitates the extraction of the yarn from the extraction cylinder 56.

[0051] A spinning apparatus for the successive operations to be performed on the yarn may be advantageously arranged downstream of the drawing device 4.

[0052] The operation of the drawing device according

to the invention will now be described.

[0053] In particular, as mentioned, the feeder device sends the web 8 at an advancement speed Vin through the nozzle or mouth 20. The advancement speed Vin of the web 8 also corresponds to the tangential rotation speed of the feeder roller 16 at its point of contact with the web itself.

[0054] So, the carding machine 28 is driven in rotation, according to a direction of rotation S, in a direction agreeing with the direction of advancement F of the web 8.

[0055] The difference in speed between the tangential or extraction speed Ve of the teeth 36 of the carding machine 28 and the advancement speed Vi of the web 8 determines the total drawing St of the web 8.

[0056] Moreover, the web 8 is then passed from the carding machine 28 to the extraction cylinder 56 which, as seen, rotates in direction of rotation G opposite to the direction of rotation S of the carding machine 28.

[0057] The perforated extraction cylinder 56, which delimits the inner cavity 60, has a perforated side wall 64, provided with a plurality of holes 68 communicating with said inner cavity 60 and with a vacuum source.

[0058] The removal of the fibres of the web 8 from the carding machine 28 is facilitated by virtue of the vacuum and also by the opposite rotation of the extraction cylinder 56 according to a direction of rotation W opposite to the direction of rotation S of the carding machine 28.

[0059] The rotation speed of the extraction cylinder 56 is such that the tangential speed on the side wall 64 is approximately equal to the tangential speed of the teeth 36 of the carding machine 28.

[0060] The fibres of the web 8 is then conveyed from the inner cavity 60 output from the extraction cylinder 56, towards the conveying device 80 and the output roller 84.

[0061] As can be appreciated from the description above, the present invention allows overcoming the drawbacks presented in the prior art.

[0062] The use of the carding machine in the conditions and manner described in the present patent ensures a "soft" manipulation of the fibres, minimizing the possibility of breakage thereof and ensuring the continuity of the fibres at the input of the subsequent spinning units.

[0063] This condition of continuity and the reduced presence of short fibres can be obtained by virtue of the operating condition of the present invention according to which the carding machine works at a linear speed equal to the product of the web input speed times the total drawing of the web $\pm$ 20%.

[0064] As long as the linear speed value is within 20% of such a value, yarn continuity is obtained, with fibres of longer length and with a minimum risk of breakage thereof.

[0065] Advantageously, the present invention allows obtaining a high-quality yarn, according to the desired thread count because fibre continuity is always ensured. In other words, although the drawing is obtained in a single step on the carding machine, the fibres are drawn rapidly but progressively and above all continuously. The result is a homogeneous and uniform yarn free of broken fibres and/or short length.

[0066] Advantageously, the solution of the present invention envisages that the carding machine rotates according to a direction of rotation agreeing with the direction of rotation of the web of fibres: in this manner, it is possible to significantly increase the working speed and drawing amount compared to the solutions of the prior art, without incurring the risk of damaging the fibres.

[0067] Advantageously, the fibres of the web are drawn practically entirely on the carding machine, which for this purpose is provided with teeth which are not very dense compared to prior art solutions.

[0068] This reduces the production costs of the carding machine itself. Furthermore, the fibres are less stressed and can be drawn in a more progressive manner than in the solutions of the prior art.

[0069] This therefore strongly limits the risk of obtaining broken and thus "short" fibres due to the excessively abrupt mechanical action of the teeth of the carding machine.

[0070] Moreover, by virtue of the fact that the entire drawing action is performed by the carding machine, it is possible to reduce the overall dimensions and the overall costs of the drawing device.

[0071] A person skilled in the art can make numerous changes and variants to the drawing devices and drawing methods of the present invention, all contained within the scope of protection defined by the following claims in order to satisfy contingent, specific needs.

Claims

1. Drawing device (4) for webs (8) of textile fibres comprising

   - a feeder device (12) of a web (8) to be drawn,
   - a carding machine (28) rotating according to a direction of rotation (S) comprising, on an outer side wall thereof (32), a plurality of teeth (36) arranged with a constant tangential pitch (P), suitable to draw said web (8),
   - an extraction cylinder (56) placed downstream of the carding machine (28) and of the web (8),

   wherein

   - the feeder device (12) comprises a feeder roller (16), facing the carding machine (28), which rotates so as to feed the web to the carding machine (28) at an input speed and according to a direction of advancement (F) concordant with respect to said direction of rotation (S) of the carding machine (28),
   - wherein the carding machine (28) is driven in rotation so as to have a peripheral speed on the teeth equal to the product of the input speed for

the total drawing of the web ± 20%, so that all the drawing of the web takes place substantially between the carding machine (28) and the feed roller (16),
- the total drawing being the ratio between the thread count of the yarn to be produced and the thread count of the web in input.

2. Drawing device (4) according to claim 1, wherein the carding machine (28) is driven in rotation so as to have a peripheral speed on the teeth or extraction speed equal to the product of the input speed for the total drawing of the web ± 10%.

3. Drawing device (4) according to claim 1 or 2, wherein the carding machine (28) is driven in rotation so as to have a peripheral speed on the teeth or extraction speed equal to the product of the input speed for the total drawing of the web ± 5%.

4. Drawing device (4) according to any of the preceding claims, wherein said tangential pitch (P) between the teeth (36) of the carding machine (28) is between 5 and 15 mm.

5. Drawing device (4) according to any of the claims from 1 to 4, wherein said teeth (36) have a substantially triangular shape which protrudes from the outer side wall (32) of the carding machine (28), in a first front portion (40), which directly faces the web (8), and a second back portion (44) which forms a vertex (48) with the first front portion (40).

6. Drawing device (4) according to claim 5, wherein said vertex (48) has a radial height (52), measured with respect to the outer side wall (32) along a radial direction (R) passing through a rotation axis (C) of the carding machine (28), between 0.5 and 2 mm.

7. Drawing device (4) according to claim 5 or 6, wherein the first front portion (40) identifies with a radial direction (R), passing through a rotation axis (C) of the carding machine (28), a first angle (B) between 5 and 10 degrees.

8. Drawing device (4) according to any of the claims from 5 to 7, wherein the second rear portion (44) identifies with a tangential direction (T), perpendicular to a radial direction (R) passing through a rotation axis (C) of the carding machine (28), a second angle (A) between 40 and 70 degrees.

9. Drawing device (4) according to any of the claims from 5 to 8, wherein with respect to a direction (Q) joining the rotation axes (C, W) of the carding machine (28) and of the extraction cylinder (56), the vertices (48) of the teeth (36) and a side wall (64) of the extraction cylinder (56) are distant by a pitch (76) of between 0.1 and 2 mm.

10. Drawing device (4) according to any of the preceding claims, wherein the extraction cylinder (56) delimits an inner cavity (60) fluidically connected to a vacuum source and has a perforated side wall (64), provided with a plurality of holes (68) communicating with the inner cavity (60), suitable for detaching the fibres from the carding machine.

11. Drawing device (4) according to claim 10, wherein said holes (68) are circular holes having a diameter between 1 and 3 mm.

12. Drawing device (4) according to claim 10 or 11, wherein said holes (68) are arranged according to a matrix diagram along a pair of directions perpendicular to each other, and are spaced apart according to a first and a second pitch (L1, L2).

13. Drawing device (4) according to claim 12, wherein said first and second pitches (L1, L2) are comprised between 2 and 4 mm.

14. Drawing device (4) according to claim 12 or 13, wherein said first and second pitches (L1, L2) are the same as each other.

15. Drawing device (4) according to any one of the claims from 1 to 14, wherein the carding machine (28) and the extraction cylinder (56) rotate in directions of rotation (S, W) opposite to each other.

16. Drawing device (4) according to any one of the preceding claims, wherein downstream of the extraction cylinder (56) a conveying device is arranged (80) equipped with an output roller (84) which idles and facilitates the extraction of the yarn from the extraction cylinder (56).

17. Drawing device (4) according to claim 16, wherein the extraction cylinder identifies, on its own outer side wall, an extraction arc extending from an extraction starting point, in which the web is pinched between the extraction cylinder and the carding machine, to an extraction end point, in which the web is pinched between the extraction cylinder and the output roller.

18. Drawing device (4) according to claim 17, wherein said extraction arc is in fluidic connection with an internal cavity (60) of the extraction cylinder fluidically connected to a vacuum source to facilitate detachment of the fibres from the carding machine.

19. Drawing device (4) according to claim 17 or 18, wherein said extraction arc has an extension comprised between 0.7 and 1.5 times the average length

of the fibres of the web extracted from the carding machine.

20. Air spinning apparatus comprising at least one drawing device (4) according to any one of the claims from 1 to 19 and at least one air spinning device.

21. Method of drawing a textile fibre web comprising the steps of:

- providing a feeder device (12) of a web (8) to be drawn,
- providing a carding machine (28) comprising, on an outer side wall thereof (32), a plurality of teeth (36) arranged at a constant tangential pitch (P), suitable for drawing said web (8),
- preparing an extraction cylinder (56) placed downstream of the carding machine (28) and of the web (8),
- providing the feeder device (12) with a feed roller (16), facing the carding machine (28), which rotates so as to feed the web to the carding machine (28) at an input speed and according to a direction of advancement (F) concordant with respect to said rotation direction (S) of the carding machine (28),
- driving the carding machine (28) in rotation so as to have a peripheral speed on the teeth or extraction speed equal to the product of the input speed for the total drawing of the web $\pm$ 20%, so that all the drawing of the web takes place on the carding machine,
- the total drawing being the ratio between the thread count of the yarn to be produced and the thread count of the web in input.

22. Drawing method according to claim 21, comprising the step of providing a drawing device (4) according to any of the claims from 1 to 19.

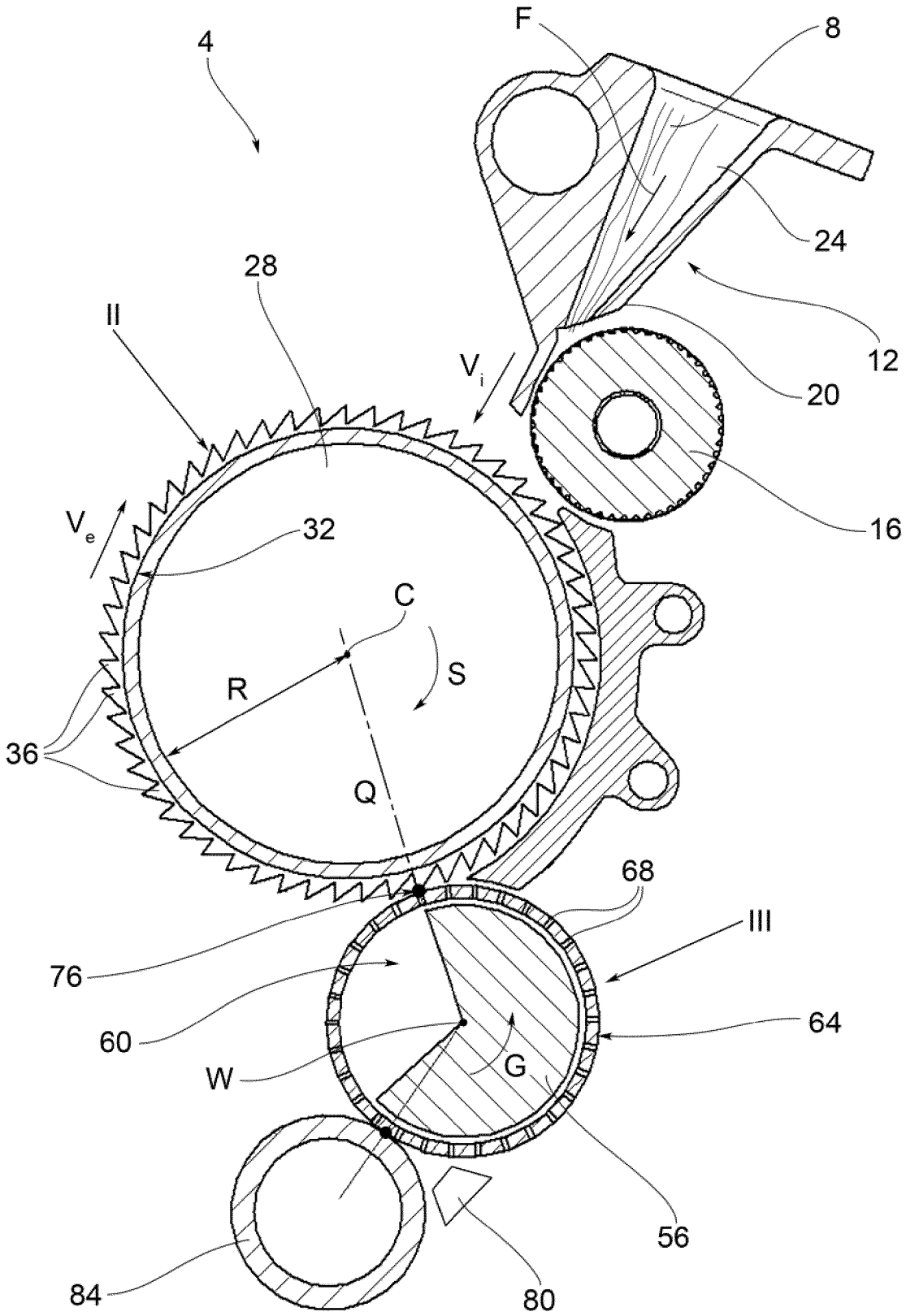

FIG.1

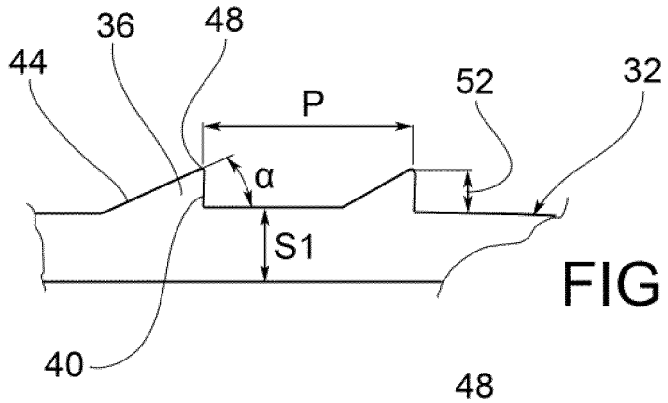

FIG.2a

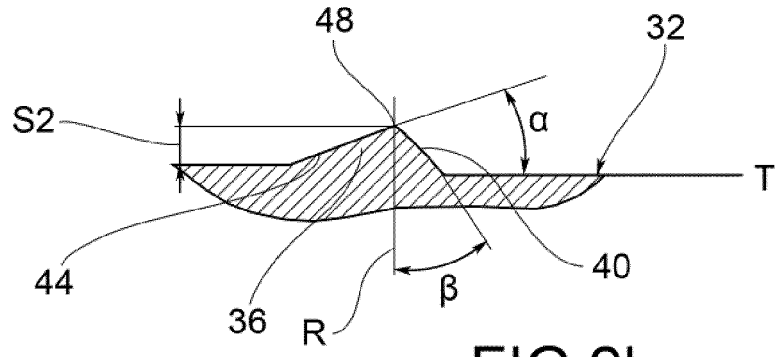

FIG.2b

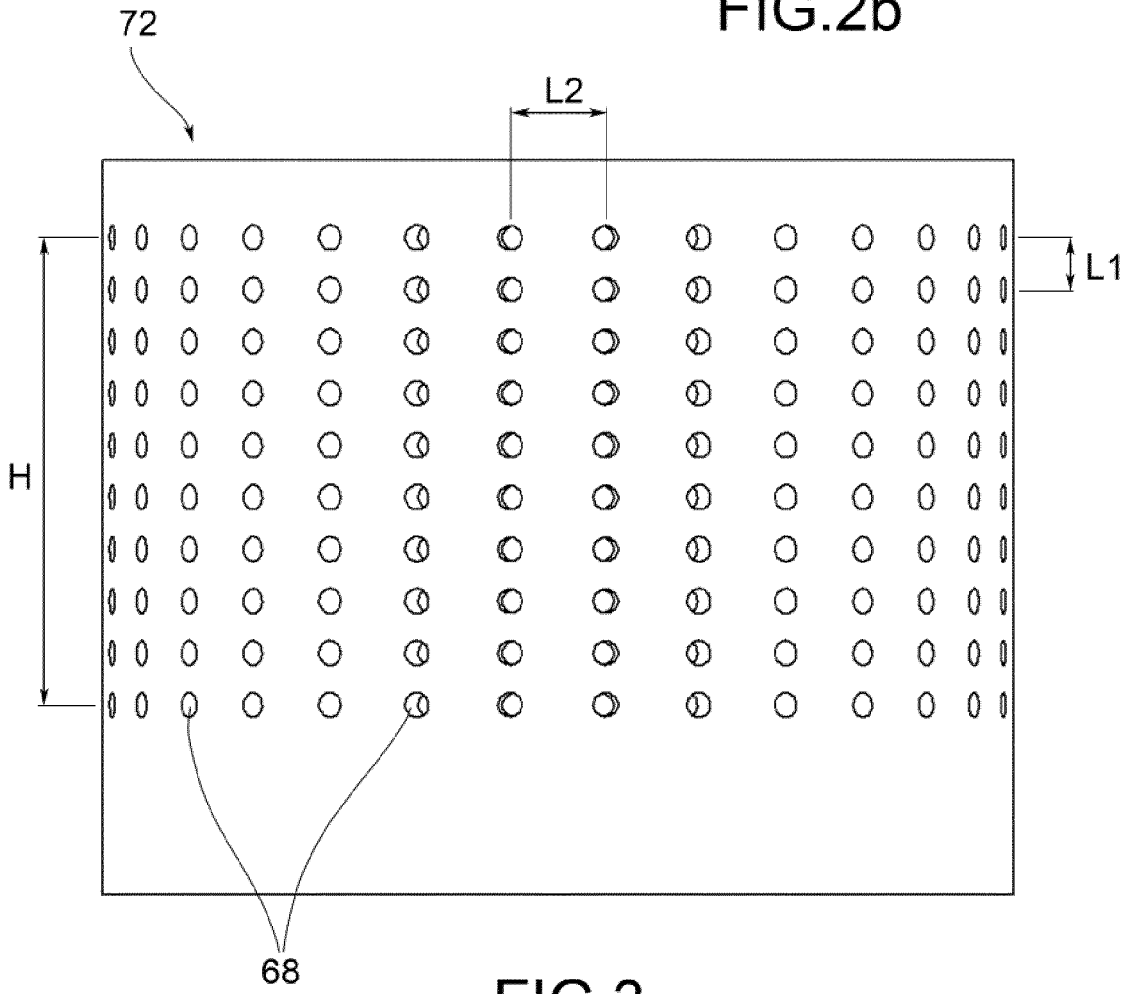

FIG.3

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 May 2019	Todarello, Giovanni

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 17 0327

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
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82