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(71) Applicant: **Zamattio, Sergio**
33170 Pordenone (IT)

(72) Inventor: **Zamattio, Sergio**
33170 Pordenone (IT)

(74) Representative: **Petraz, Gilberto Luigi et al**
GLP S.r.l.
Piazzale Cavedalis 6/2
33100 Udine (IT)

(54) Method for bulking a strip of textile material, related device and strip of textile material thus obtained

(57) A method for bulking a strip of textile material (11) of wool and discontinuous fibers of animal origin, cotton and fibers of vegetable origin, artificial fibers, synthetic fibers, 100% pure or in a mix, comprises, downhill of a carding, drawing and/or combing step, and upstream of a spinning step, a first heating and/or humidifying step in which the strip (11) is taken to a substantially softened state of plastic or thermoplastic deformability, and a second compression step in which a desired pressure is imparted to the strip (11) in order to determine along it the formation of a plurality of waves, crimps and/or undulations.

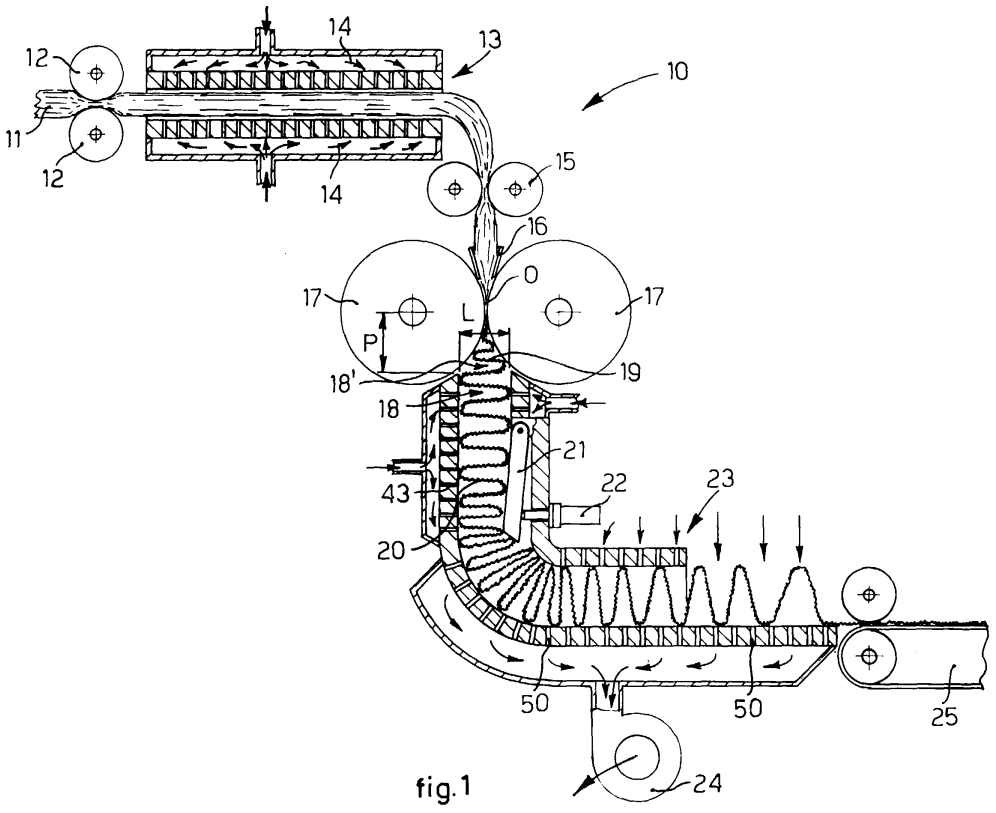

fig.1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a method, and the relative device, to treat the tops of wool fibers, or strips of cotton fibers, and more generally strips of discontinuous fibers of animal or vegetable origin, or strips of discontinuous synthetic or artificial fibers, said strips consisting of 100% pure fibers or in a mix.

[0002] The treatment according to the invention provides to impart waves or crimps longitudinally to the individual discontinuous fibers that make up the tops or strips, in order to increase the voluminosity of the strips and the cohesion of the individual fibers that make up the strips. This increased voluminosity, for example during the drawing and spinning step, gives greater resilience to the fibers, and also more extensive and efficient points of contact and of bonding between them.

[0003] The invention also concerns the tops or strips obtained using said method.

BACKGROUND OF THE INVENTION

[0004] It is known that the individual fiber of wool or cotton, in its natural state, has "waves", normally called "crimps".

[0005] The type of "crimping" is generally identified by the following two parameters:

- "crimping index", which represents the number of crimps per unit of length;
- "crimping rate", which represents the percentage difference between the length of the fiber with waves and the length of the fiber without waves.

[0006] The effect of this intrinsic characteristic of fibers in general, and those of natural origin in particular, such as wool and cotton, is extremely important in the field of textile working. This because the waves determine "bonding" points and therefore impart a certain cohesion between the fibers, which allows to render the textile processes of carding, drawing, combing, preparing and refining the count, and also the spinning operations, more efficient and qualitatively better.

[0007] In the case of fibers of vegetable origin, such as cotton, the spiral form of the fiber has the same effect as the crimp in the cases defined above, whereas other fibers such as hemp or linen by their nature have undulations, fragmentations and roughness of the surface which in a certain way supply a cohesive effect to the mass of fibers during working.

[0008] Generally, due to the effect of the intense stresses caused by the rubbing and sliding of the fibers caused by the drawing to which they are subjected during the textile working in the various steps of opening, washing, carding, combing and in the various passes of coupling and drawing, and preparing for spinning, the individual fibers progressively lose this natural characteristic. Because of this, the fibers arrive at the most important step of the process, that is, spinning, practically no longer with any crimps, and hence with an extremely low cohesion and with a very low resistance to the unwinding tension. Therefore, the reels of rove that are fed to the spinning machine have the problem that the strip breaks up during the unwinding step, which entails false drawing with negative repercussions on the quality (yarn with fine segments followed by thick segments), a great number of breakages during spinning, stoppage of the spindles, loss of production, great number of workforce required and smaller yield of material.

[0009] Another negative consequence of the loss of crimping is the need to have high torsions during spinning in order to obtain yarns with acceptable mechanical characteristics. This entails obtaining yarns which are not very "rounded" or voluminous, and also a reduced productivity of the spinning machine.

[0010] In any case, the loss of or reduction in crimps in the fibers entails a general difficulty in all the working steps and a loss of fibers during the passes, in the form of waste.

[0011] It is already known, for some types of artificial and synthetic fibers, to impart a sort of wave when they are in a state of continuous strip or tow in the form of continuous filaments, for example at the end of the extrusion step, or at the end of the tow-to-top process, after the "tugging" step, when, due to the effect of the breakage drawing to which they are subjected, they completely lose the crimping originally imparted to them after the extrusion step. In other cases, for example after the step of cutting the synthetic fibers in the converting process, or after the combing step, the emerging strip is tamped in a sort of compacting chamber; the purpose of this treatment is to compact, precisely, the emerging strip, and certainly not to impart waves on the individual fibers.

[0012] Purpose of the present invention is therefore to subject the strip or top of fibers to a treatment, at least upstream of the spinning step, and in any case at least after a step of carding and/or drawing and/or combing, which allows to obtain yarns with a better and more regular internal structure, and with a greater volume and bulk.

[0013] Another purpose is to obtain a more regular working performance and with a higher production both in the step of regularization and preparation for spinning and also in the specific spinning step, thanks to the reduced number of torsions necessary to obtain a yarn with analogous characteristics and with a lower number of breakages per 1000 spindles/hour. Another purpose is to obtain yarns with a greater volume from which to obtain fabrics, whether of the knitwear type or shuttle made, which have a greater covering and insulating power with weaves having a smaller number of yarns per cm.

[0014] Another purpose is to obtain, for the concepts expressed above, considerable savings during both the spinning and weaving processes.

[0015] The Applicant has devised, tested and embodied the present invention to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0016] The present invention is set forth and characterized in the respective main claims, while the dependent claims describe other characteristics of the main inventive idea.

[0017] According to the invention, the method provides to impart to the tops or strips of fibers, natural or mixed, a bulking treatment, understood as an increase in volume due to the waves or crimps imparted longitudinally to the discontinuous fibers, and of limited length, for example 30-70 mm in the field of cotton and 50-220 mm in the field of wool, and greater lengths for other kind of fibers, such as linen, ramie and hemp, that make up the strip or top.

[0018] According to the invention, the treatment is performed upstream of the spinning step, and downstream at least of a step of carding and/or combing and/or drawing to which said discontinuous fibers are subjected, that is, at a point in the production process where the fibers have already suffered all the stresses due to previous working and therefore are particularly weak, and have lost, due to the repeated drawing and rubbing suffered, a large part of the crimping that they originally had.

[0019] According to a preferential embodiment of the invention, the crimping treatment consists, in a first step, of making deformable the individual fibers that make up the strip or top, through an action of heating and/or humidifying and, in a second step, causing the subsequent folding thereof by means of an action of compression, without generating structural weakening or breakages. Thanks to this two-step treatment, an undulating structure of the fibers is obtained, properly called "crimping".

[0020] The undulations can be made with the desired pitch and height.

[0021] The first step of "thermoplastic" deformation of the fibers can be obtained, according to one embodiment of the invention, by delivering steam directly onto the fibers, or by means of hot air and/or pulverized or nebulized water. More generally, the deformation effect can be obtained using any fluid or liquid which is a vehicle of heat energy and/or in any case has a plasticizing action on said discontinuous fibers that constitute the top or strip being treated, even at low temperatures.

[0022] In a preferential embodiment, the second step of crimping proper provides to send the top or strip of fibers inside a substantially closed chamber where it is subjected to a combined action of pressure and counter-pressure; thanks to the fact that the top or strip is in a substantially softened condition of plastic or thermoplastic deformability, the action of pressure and counter-pressure imparts the desired waves or undulations to the individual fibers that make up the strip in transit.

[0023] Advantageously, according to a variant, the crimping chamber is substantially closed and pressurized steam is introduced inside it, which has the double purpose of making the fibers thermoplastic and of fixing at high temperature the new "undulating" structure of the fibers. At exit from the crimping chamber, in a preferential embodiment, a rapid cooling and stabilization zone is provided, suitable to fix in a stable and lasting manner the waves and undulations distributed longitudinally on the discontinuous fibers that make up the strip or top.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] These and other characteristics of the present invention will become apparent from the following description of some preferential forms of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 shows a first form of embodiment of a crimping device according to the present invention;
- fig. 2 shows a first variant of the device in fig. 1;
- fig. 3 represents a possible application of the crimping device in fig. 1;
- fig. 4 represents the application of the device according to the invention in a drawing frame with combs or disks of the type for wool, also equipped with a pressing device for the formation of bumps;
- fig. 5 represents the application of the device according to the invention in a drawing frame with cylinders, of the type for cotton;
- figs. 6 and 7 show two diagrams relating to working processes respectively for wool and cotton in which the present invention is used.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0025] Fig. 1 is a schematic representation of a form of embodiment of a crimping device 10 for tops or strips of wool, cotton, natural, artificial, synthetic discontinuous fibers and possible mixes thereof according to the invention. In the case shown here, a strip 11 is fed by means of the aid of a pair of feed calenders 12 into a heating and/or humidifying chamber 13 into which steam 14 is injected, in blade form from 2÷3 bar or more to atmospheric pressure. The steam 14 hits and penetrates the fibers of the strip 11, heating and humidifying the mass of fibers which make up the strip 11 being treated.

[0026] At exit from the heating and humidifying chamber 13 the strip 11 has a temperature and humidity such as to cause the fibers of which it consists to soften. In this condition of thermoplastic deformability, by means of a group of deviation calenders 15 and a conveyor funnel 16, the strip 11 is inserted between a pair of drawing and pressure rollers 17, or crimping rollers, which compress it and send it to a substantially closed crimping chamber 18.

[0027] In an intermediate position in the crimping

chamber 18 there is a counter-pressure element, consisting in this case of a mobile bar 21, described in more detail hereafter. Due to the contrasting pressure exerted by the mobile bar 21, which contrasts the advance of the strip 11, due to the temperature of the fiber and the humidity absorbed, the discontinuous fibers that make up the strip 11 transiting inside the crimping chamber 18 are deformed, assuming the characteristic form of crimp or wave desired.

[0028] The crimping chamber 18 has substantially the same width as the crimping rollers 17; the size is defined according to the type of material, the size and/or count of the strip 11 of fibers to be treated. Indicatively, the ratio between the width of the crimping rollers and the count of the strip to be treated is about 0.8÷1 mm per 1 g/m of weight of the strip; the inlet gap L is equal to about 0.6÷0.8 per 1 g/m of weight of the strip, and may be divergent in the direction of movement of the material, whereas the length "P" is a function of L and of the diameter of the crimping rollers. All these parameters, which determine the sizes of the "first crimping zone" 18' (upstream of the crimping chamber 18) in which the crimping proper develops on the fibers, must be selected on each occasion according to the type of material and the entity of crimping to be obtained.

[0029] The length P is defined as the distance between the point O of contact between the crimping rollers 17 and the start of the crimping chamber 18 proper, and represents the segment in which the so-called "primary crimp" 19 is formed on the individual fibers. On the contrary, the inlet gap L of the crimping chamber 18 determines the entity of the "secondary crimp" 20.

[0030] The "primary crimp" 19 proper represents the crimp that is imparted to the individual fibers proper, while the "secondary crimp" 20 consists of the folds imparted to the strip 11 in its entirety inside the crimping chamber 18 and defines the level of compactation of the strip 11.

[0031] Generally the value of the inlet gap L determines by how much the crimping chamber 18 can be inserted nearer the point O where the strip enters inside the crimping zone. This allows to define the entity of the segment "P" and hence to define the way the "primary crimps" 19 are formed, their "pitch", their "height" and their regularity and uniformity according to the counter-pressure exerted by the mobile bar 21.

[0032] The segment "P" represents, as we said, the zone where the "primary crimp" 19 is formed on the individual fibers. Once the crimp has been developed by means of drawing in a range where the length is greater than the length of the fibers, the value of the primary crimp 19 determines the points of bonding between fiber and fiber, the cohesion, the degree of sliding between them, and hence the voluminosity of the strip, its resilience, etc.

[0033] The value of the inlet gap L, on the contrary, determines the formation of the "secondary crimp" 20, that is, how the strip 11 is disposed inside the crimping chamber 18 and how the strip 11, understood as "overall mass of fibers", is compacted.

[0034] A high degree of compactation of the strip 11 is suitable to increase the quantity of material contained in the containers for subsequent workings, or to increase the quantity of strip in the packs, such as reels and bumps, destined for packing for dispatch or for storage.

[0035] The mobile bar 21, by means of the action of a piston 22, exerts a force of counter-pressure, advantageously adjustable, contrary to the direction of feed of the strip 11 in the crimping chamber 18. The pressure exerted by the mobile bar 21 is overcome by the thrust action of the crimping rollers 17, thus generating a compression on the individual fibers which make up the strip 11, which causes the crimping.

[0036] In the first segment of the crimping chamber 18, by means of a suitable series of holes 43 made on the walls, steam is introduced, in blade form from a pressure of 2÷3 bar or more according to necessity, to atmospheric pressure. The steam introduced, apart from facilitating the thermoplastic deformability of the fibers, improves the formation of the crimps and stabilizes the new structure of the fibers.

[0037] Immediately downstream of the zone where the secondary crimp 20 is formed, there is a rapid cooling zone 23, created by means of an action of forced aspiration which acts in the last segment of the crimping chamber 18.

[0038] The forced aspiration is obtained by the action of an aspirator 24 through holes 50 made on the walls of the last segment of the crimping chamber 18. The forced aspiration causes a thermal shock which fixes the new structure of the fibers comprising the waves and undulations. The thermal shock can be increased by cooling the air, which passes through the strip 11 due to the aspiration created by the aspirator 24, by means of a suitable cooler.

[0039] The strip 11, crimped and stabilized, is discharged by a conveyor belt 25 to the point where it is collected. The conveyor belt 25 has a speed such as to unwind regularly the crimped strip 11 from the cooling zone 23 without causing any drawing.

[0040] According to a variant, in the case of fibers sensitive to the effect of temperature, for example with strips consisting of a mix of retractile and non-retractile acrylic fiber (this last part can be wool or fixed acrylic and/or other fibers but stabilized) to obtain High Bulk yarns, the process is advantageously effected at a lower temperature, about 40°C-60°C (even lower, if necessary), exploiting the plasticizing effect of the steam, the humidity or pulverized water.

[0041] According to the variant shown schematically in fig. 2, where parts equal or equivalent to parts shown in fig. 1 have the same reference number, the crimping is imparted by the action of two heated crimping rollers 117 with the circumferential surfaces having grooves 42 between which the strip 11 passes, comes into contact with them and is lightly pressed between them.

[0042] The grooved rollers 117 act with a slight pres-

sure, advantageously adjustable, on the strip of fibers 11 previously treated in the heating and/or humidifying chamber 13; the strip 11 is super-fed by a first pair of calenders 15 to the crimping rollers 117 so as to impress and/or "print" the grooves on the fibers of the strip 11 without tension and allow the individual fibers to follow a greater segment of circumference, being compressed between the grooves 42, without suffering any drawing whatsoever.

[0043] In this way we obtain a crimping with a crimp index that depends on the pitch "p" of the grooves 42 engraved on the crimping rollers 117, whereas the "crimp rate" depends on the depth "h" of the grooves. With this device it is thus possible to obtain fibers, for example with 5÷8 crimps to the cm and with a crimping rate of 8÷10%, as we said, according to the number and size of the grooves 42.

[0044] The step of cooling and stabilizing the new form of fibers is obtained in a zone immediately downstream of the crimping rollers 117, on which a negative drawing acts between the crimping rollers 117 and a second pair of deviation calenders 32 between which the strip 11 is conveyed by means of a guide 31.

[0045] The super-feed imparted to the strip 11 by the first pair of calenders 15 with respect to the crimping rollers 117, and the negative drawing, understood as greater speed of the crimping rollers 117 with respect to the second deviation calenders 32, are both a function of the "crimping rate" which is to be imparted to the fibers of the strip 11 being treated.

[0046] This means that the fibers fed to the crimping rollers 117 must be in such a quantity as to travel over the profile of the grooves 42 without suffering false drawing, since the fiber is in a thermoplastic state; in the same way, the detachment of the crimped fibers from the crimping rollers must occur without false drawings which, in the opposite case, would cause a lengthening of the pitch "p", and the consequent reduction in the height "h" of the crimp with a decrease in the value of the crimping index and rate.

[0047] According to a variant, in correspondence with the grooves 42 the rollers 117 have apertures from which steam can be sent onto the strip of fibers in order to improve the formation of the waves and promote a more rapid stabilization thereof.

[0048] The strip 11, in its new, crimped and stabilized state, is sent to a collection unit 29. In the collection unit 29, by means of a deposit system 37, the crimped strip 11 is deposited inside a container with a mobile bottom 38, thrust in this case by a pre-loaded spring 28, which allows to collect the crimped strip 11 in a regular and uniform manner.

[0049] When filling is complete, the container 38 is discharged and is ready for transfer to subsequent workings.

[0050] Fig. 3 shows schematically another form of embodiment of the crimping device 10 according to the invention.

[0051] In this embodiment, one or more strips 11 of wool, cotton or fiber in general is taken from one or more containers 49 and fed, by means of the feed calenders 15 and the deviation calenders 33, to the heating and/or humidifying chamber 13, where it is taken to the ideal conditions of temperature and humidity for the fibers that make up the strip 11 for the crimping step.

[0052] By means of another pair of deviation calenders 15 the strip 11 is removed without drawing and without tension from the heating and/or humidifying chamber 13 and fed to the crimping rollers 17, which compress the strip in the crimping chamber 18. The crimping chamber 18, as seen above, comprises a first upper heating and fixing zone 34, into which a heating and/or humidifying fluid is injected, a zone 35 of counter-pressure exerted by the mobile bar 21 by means of the pressure piston 22, and a cooling and stabilization zone 23 obtained by means of the depression exerted by the aspirator 13 and a possible cooling.

[0053] As previously described, the strip 11, by means of the conveyor belt 25, is removed from the crimping chamber 18 and sent to the collection unit 29. In the collection unit 29, by means of another pair of introduction calenders 36 and the deposit system 37, the crimped strip 11 is deposited inside the container with the mobile bottom 38, thrust by the pre-loaded spring 28.

[0054] The device described schematically in fig. 3 can represent a unit of a multiple machine consisting of a series of identical units, in such a number as to satisfy the productive necessities required.

[0055] In fig. 4, according to a variant, the crimping device 10 is inserted downstream, at exit from a drawing frame with combs or disks 113 of the type for wool, and upstream of the collection unit 29 of the drawing frame, in order to form an integrated machine. In this machine, a certain number of strips of wool or tops of fibers in general of the wool type, is coupled, drawn and regularized by means of said head with combs or disks 113 and, at outlet from the drawing unit, through a pair of deviation calenders and a conveyor funnel 16, in which the heating and/or humidifying fluid is inserted, the fibers that make up the strip or top are taken to a plastic state. In the plastic state, they are subjected to the crimping process by means of the crimping rollers 17, in the crimping chamber 18 equipped with a mobile bar 21 on which the pressure piston 22 acts, and subsequently they are stabilized in the cooling zone where the aspirator 24 acts. Subsequently the strip of fibers is collected, by means of the collection unit 29, in a cylindrical container 38 with a mobile bottom and sent to subsequent workings.

[0056] This application is advantageously applied in the step of preparing for spinning, since the crimping of the fibers is regenerated and increased in desired terms, in a step immediately upstream of the final spinning step, taking the greatest advantage therefrom in terms of workability of the fibers, working performance, productivity of the spinning machine, quality and volume of the yarn obtained.

[0057] In the embodiment shown in fig. 4, inside the

cylindrical container 38 a pneumatic pre-pressing piston can act, which allows to collect the crimped and stabilized strip 11 in a regular manner and with a slight pressure.

[0058] At the end of filling, in a known manner, the container 38 can be transferred to a pressing and bonding unit 51 where, for example using a piston 52 and a counter-piston 53, it is possible to remove the strip 11, crimped and regularly packed in pressed spirals, from the container 38, in order to take it to the bonding step, performed by a bonding machine 54.

[0059] The pack thus obtained is thus ready to be packed for dispatch and/or storage.

[0060] The pack, consisting of the strip compacted in the crimping step, contains a quantity of strip 11 greater than an analogous pack consisting of a strip not subjected to the treatment.

[0061] This application is advantageously applied in the intermediate working step of the wool cycle, where the strips of wool are mixed and recombed so as then to be packed in reels and/or bumps and then baled for storage, transport and sale. With the crimping process as described above, individual packs of strip are obtained with a greater specific density, with advantages in terms of logistics and reduced transport costs.

[0062] The strip thus treated with a crimping process transfers to the final user all the advantages of regeneration and increase in crimping of the individual fibers with better working performances and with a better quality and volume of the yarn obtained.

[0063] The advantage of packs with increased density can also be found in the dyeing step for tops, where the dyeing apparatus can be loaded with a greater quantity of material for each batch.

[0064] Fig. 5 shows another variant in which the crimping device 10 is inserted downstream of a drawing unit with cylinders 30 of a drawing frame for cotton and upstream of a collection unit 29.

[0065] In particular, the strips of cotton 11 or of fibers in general of cotton type, as we said above, are coupled and regularized by means of the drawing imparted to them by the drawing unit with cylinders 30. Then, by means of the pair of feed calenders 12 and the conveyor funnel 16, in which a heating and/or humidifying fluid can be introduced, the strip 11 is introduced into the crimping chamber 18 comprising the crimping rollers 17. As shown with reference to the previous embodiments, the strip 11 is cooled, stabilized and made up in cylindrical containers 38 by means of a collection unit 29 of a known type.

[0066] The strip thus treated is then fed to the subsequent working passes.

[0067] Fig. 6 shows some working steps typical of the wool field, and specifically:

Fig. 6a: Combing
In this case, the drawing frame 40 integrated with the crimping device 10 is inserted as a finisher and in combination with the pressing, bonding and bump-packing unit 60, downstream of pre-combing drawing frames 61, combing machines 62 and the post-combing gathering drawing frame 63. Alternatively, the finishing drawing frame 40 integrated with the crimping device 10 can include the reeler unit 160.

Fig. 6b: Recombing
In this line too, the finishing drawing frame 40, integrated with the crimping device 10 and located downstream of pre-combing drawing frames 61, the combing machines 62 and the gathering drawing frame 63, is inserted in combination with the pressure, bonding and packing unit 60.
Alternatively, the finishing drawing frame 40, integrated with the crimping device 10, is provided with a unit for making up reels 160.

Fig. 6c: Preparation for spinning
In this line the drawing frame 40, integrated with the crimping device 10, is inserted as a first preparation pass; in the second preparation pass we have the advantage of developing the crimping imparted in the first pass.
The advantages of the strip treated according to the invention will also and especially be had in the subsequent passes, in the rubber finisher 65 and then in the spinning machine 67.

[0068] Fig. 7 shows schematically the work cycles for cotton, specifically:

Fig. 7a: Combed spinning
In this embodiment, the drawing frame 140 integrated with the crimping device 10 is inserted in the technological cycle downstream of the combing device 62 and upstream of the last pass of preparing for spinning, immediately before the spindle holder 66, so as to exploit the advantages of the crimped strip 11 immediately in proximity with the spinning machine 67.

Fig. 7b: Carded spinning
In this case too, the drawing frame 140 integrated with the crimping device 10 is provided upstream of the drawing frame 67 that feeds to the spindle holder 66, so as to take maximum advantage during spinning of the special features of the crimped strip.
It is clear, however, that modifications and/or additions of parts may be made to the bulking method and device 10 as described heretofore, without departing from the field and scope of the present invention.

Claims

1. Method for bulking a strip of textile material (11) of wool and discontinuous fibers of animal origin, cotton and fibers of vegetable origin, artificial fibers, synthetic fibers, 100% pure or in a mix, **characterized in that** it comprises, at least downstream of a carding, drawing and/or combing step, and at least up-

stream of a spinning step, a first heating and/or humidifying step in which said strip (11) is taken to a substantially softened state of plastic or thermoplastic deformability, and a second compression step in which a desired pressure is imparted to said strip (11) in order to determine along it the formation of a plurality of waves, crimps and/or undulations.

2. Method as in claim 1, **characterized in that** downstream of said second step of forming said waves, crimps and/or undulations, a third step of forced cooling is provided, in order to fix said waves, crimps and/or undulations along said strip (11).

3. Method as in claim 1 or 2, **characterized in that** said second step of forming said waves, crimps and/or undulations is performed by making said strip (11) transit in a substantially closed chamber (18) inside which a heating and/or humidifying fluid is injected.

4. Method as in any claim hereinbefore, **characterized in that** said second step of forming said waves, crimps and/or undulations provides to use drawing and pressure roller means (17) which exert a pressure on said strip (11) in its direction of feed, and a mobile counter-pressure bar (21) which exerts a pressure on said strip (11) in a direction contrary to its direction of feed.

5. Method as in any claim from 1 to 3, **characterized in that** said second step of forming said waves, crimps and/or undulations provides to use heated roller means (117) which exert a pressure on said strip (11) in its direction of feed and have a plurality of grooves (42) on their circumference.

6. Method as in claim 5, **characterized in that** the form, size and distribution of the grooves (42) on the circumference of the rollers (117) is chosen as a function of the form, size and distribution of said waves, crimps and/or undulations to be imparted to said strip (11).

7. Method as in any claim hereinbefore, **characterized in that** steam in blade form from 2-3 bar and more to atmospheric pressure is introduced into said heating and humidifying chamber (13).

8. Device for bulking a strip of textile material (11) of wool and fibers of animal origin, cotton and fibers of vegetable origin, artificial fibers, synthetic fibers, 100% pure or in a mix, **characterized in that** it comprises, in an intermediate position between a carding and/or drawing and/or combing device, and a spinning device (67), a heating and/or humidifying chamber (13) able to take said strip (11) to a substantially softened state of thermoplastic deformation, and a compression unit (17, 117) able to impart to said strip (11) a desired pressure in order to determine along it the formation of a plurality of waves, crimps and/or undulations.

9. Device as in claim 8, **characterized in that**, downstream of said compression unit (17, 117), it comprises forced cooling means (24) able to fix said waves, crimps and/or undulations along said strip (11).

10. Device as in claim 8 or 9, **characterized in that** said compression unit (17) is disposed in association with a substantially closed chamber through which said strip (11) transits, inside which a heating and/or humidifying fluid is injected.

11. Device as in claim 10, **characterized in that** said compression unit comprises drawing and pressure roller means (17) able to exert a pressure on said strip (11) in its direction of feed, and a mobile counter-pressure bar (21) able to exert a pressure on said strip (11) in a direction contrary to its direction of feed.

12. Device as in any claim from 8 to 10, **characterized in that** said compression unit comprises heated roller means (117) able to exert a pressure on said strip (11) in its direction of feed and having a plurality of grooves (42) on the circumference.

13. Device as in claim 12, **characterized in that** said heated grooved rollers (117) are associated upstream with a super-feed device (15) and downstream with means (32) able to impart a negative drawing on the strip (11).

14. Device as in claim 12, **characterized in that** said heated rollers (117), in correspondence with said grooves (42), have apertures to emit steam towards said strip (11).

15. Device as in any claim from 8 to 14, **characterized in that** it is inserted downstream of a regularization and drawing unit with combs or disks (113), and upstream of a collection unit (29) in containers (38) or reels.

16. Device as in claim 15, **characterized in that** said collection unit (29) cooperates with removal and pressure means (52, 53) to obtain bump-type packs of strip.

17. Device as in any claim from 8 to 14, **characterized in that** it is inserted downstream of a combing unit (61, 62) and is associated with a finishing drawing unit (40).

18. Device as in any claim from 8 to 14, **characterized**

in that it is inserted upstream of a rubber finisher or a bench of spinning spindles (66).

19. Strip of textile material (11) of wool and fibers of animal origin, cotton and fibers of vegetable origin, artificial fibers, synthetic fibers, 100% pure or in a mix, comprising longitudinally a plurality of waves, crimps and/or undulations obtained with the method and with the device as in any claim hereinbefore.

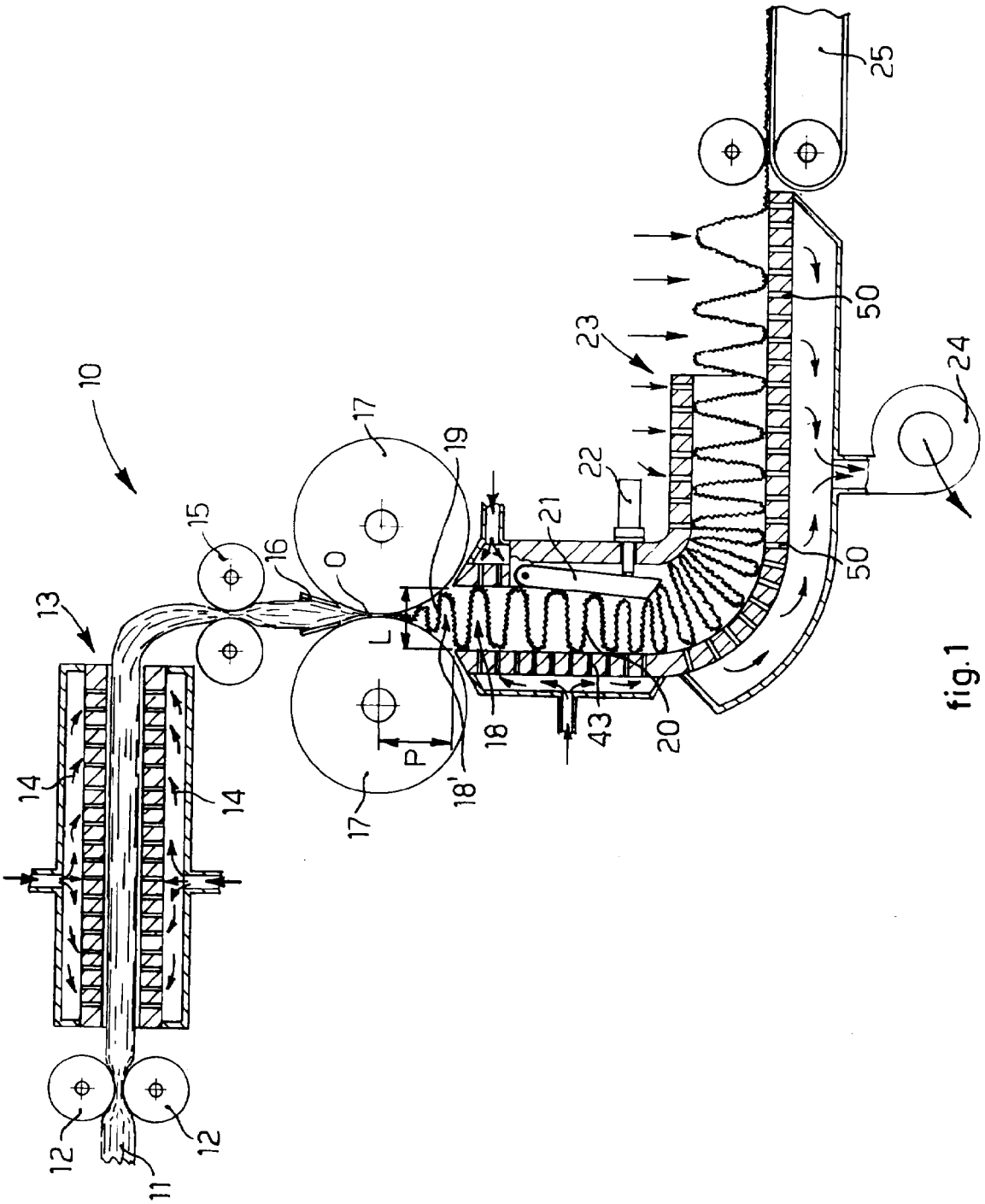

fig.1

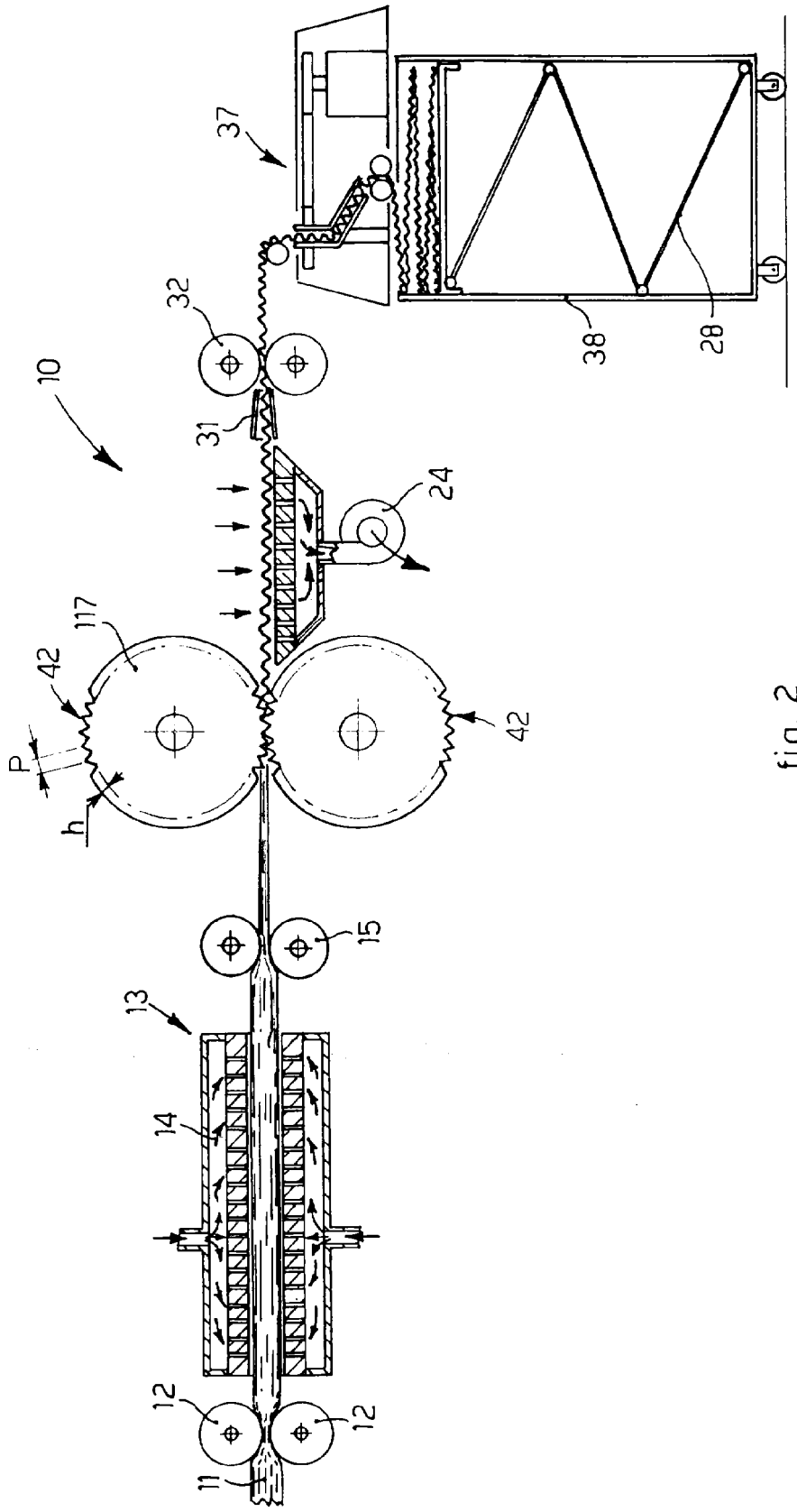

fig. 2

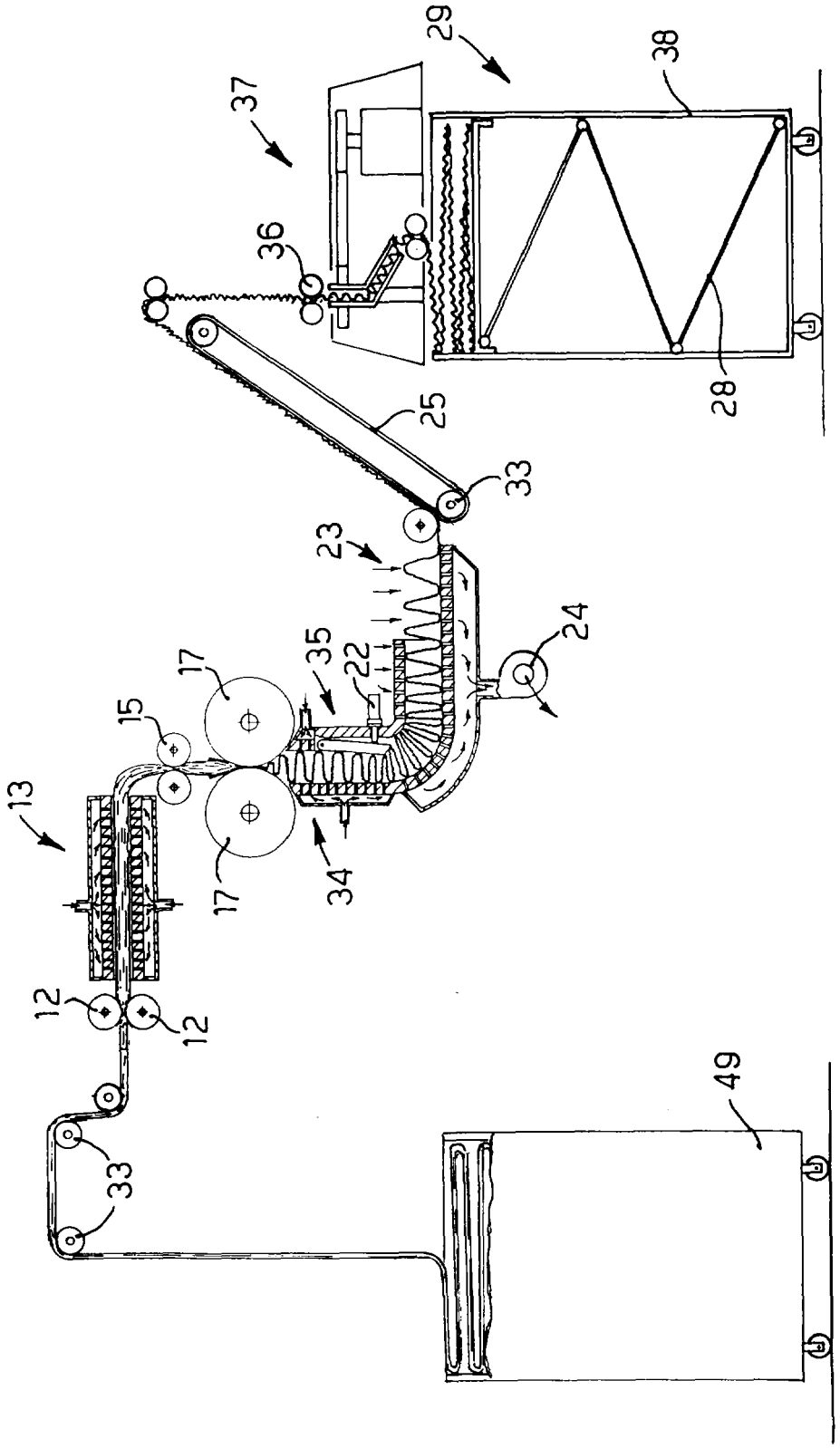

fig. 3

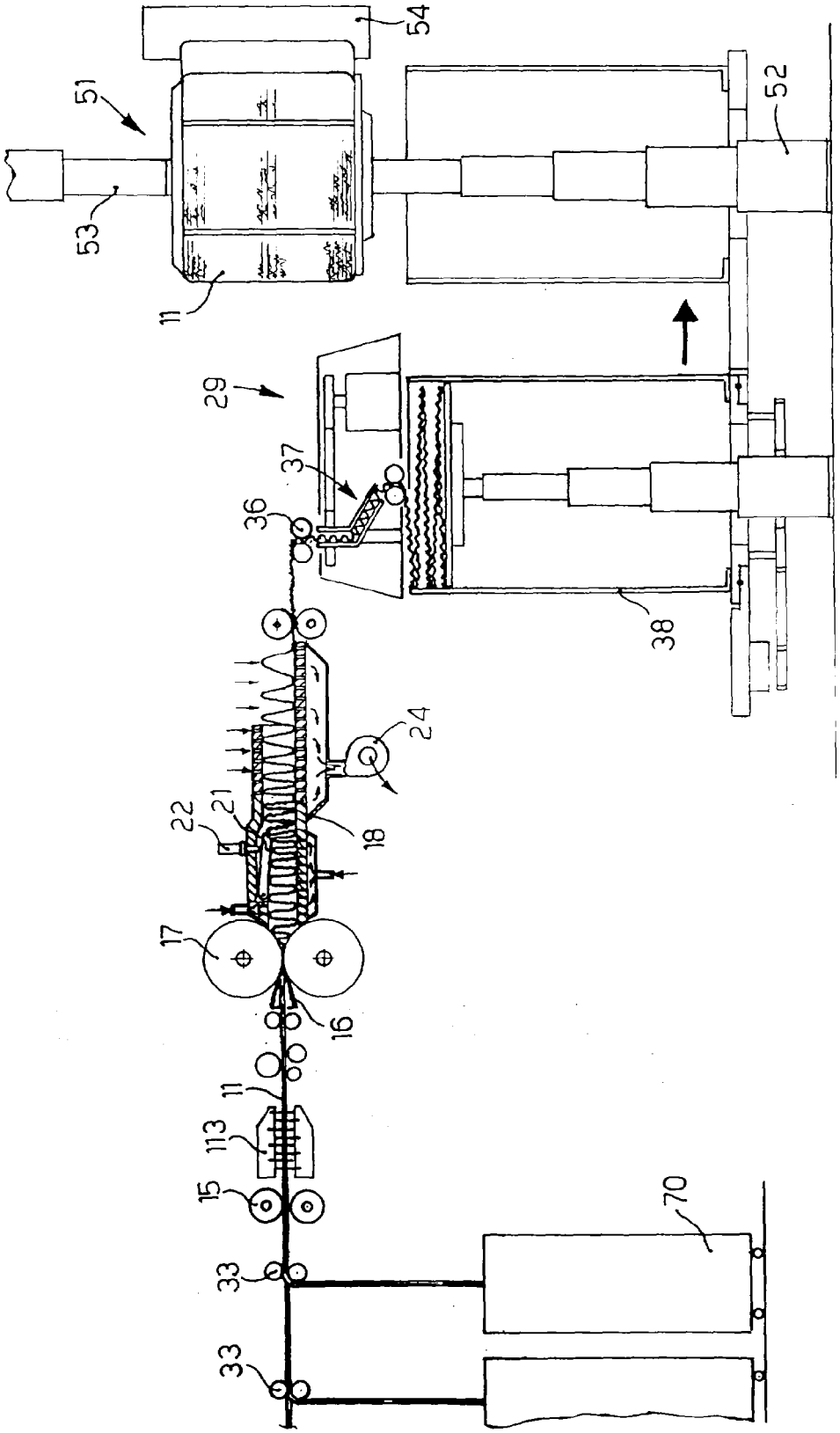

fig. 4

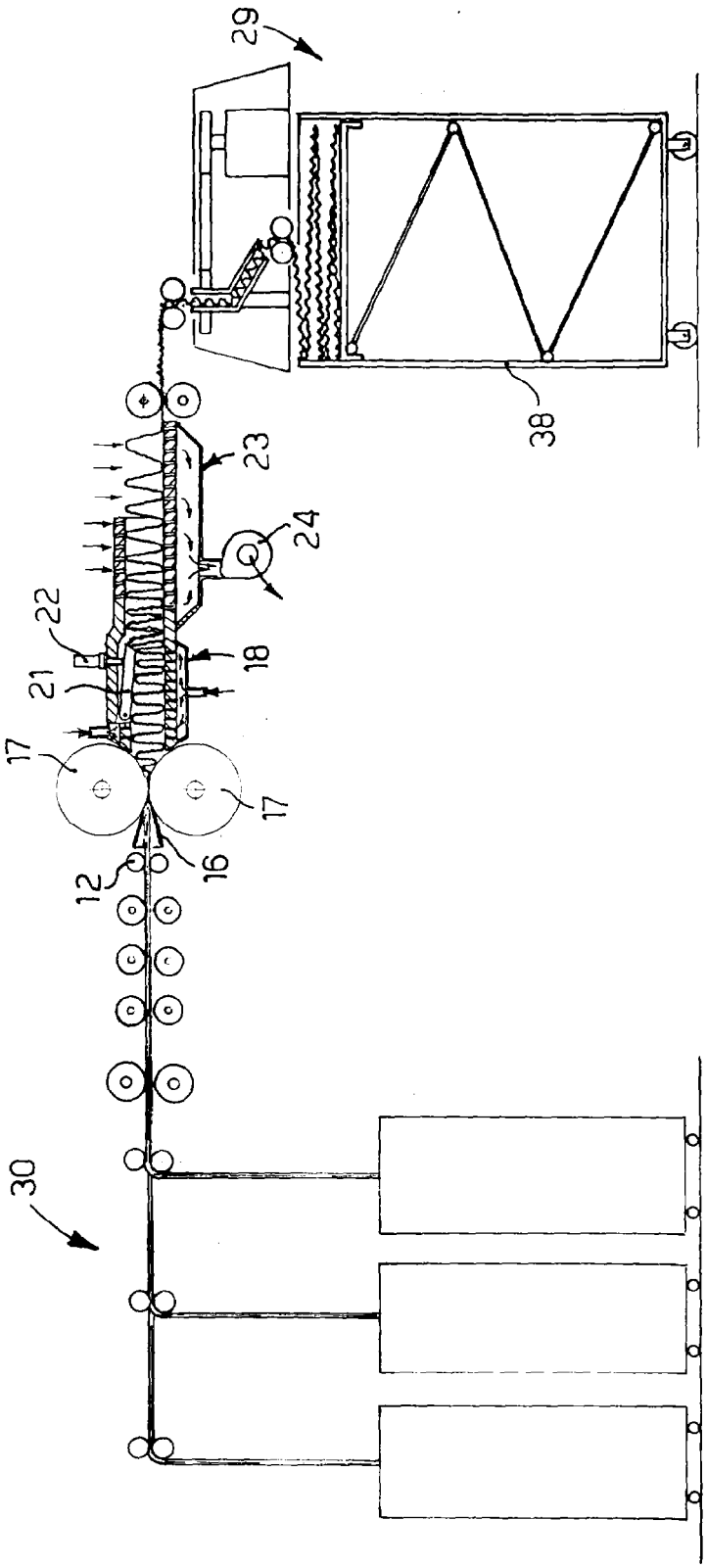

fig. 5

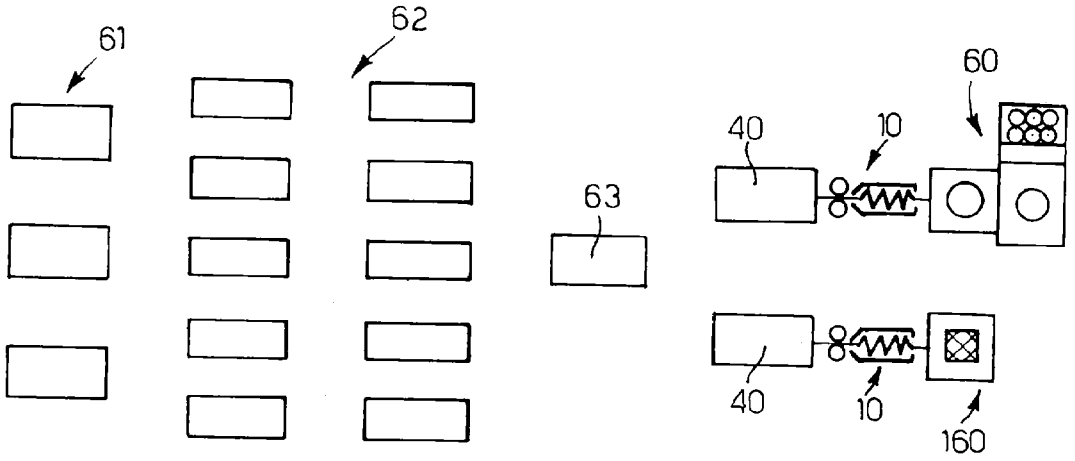

fig. 6(a)

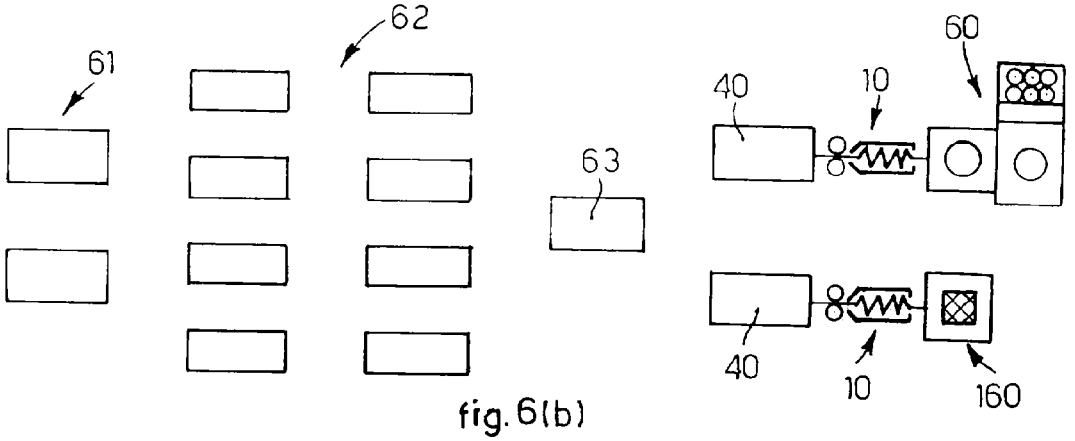

fig. 6(b)

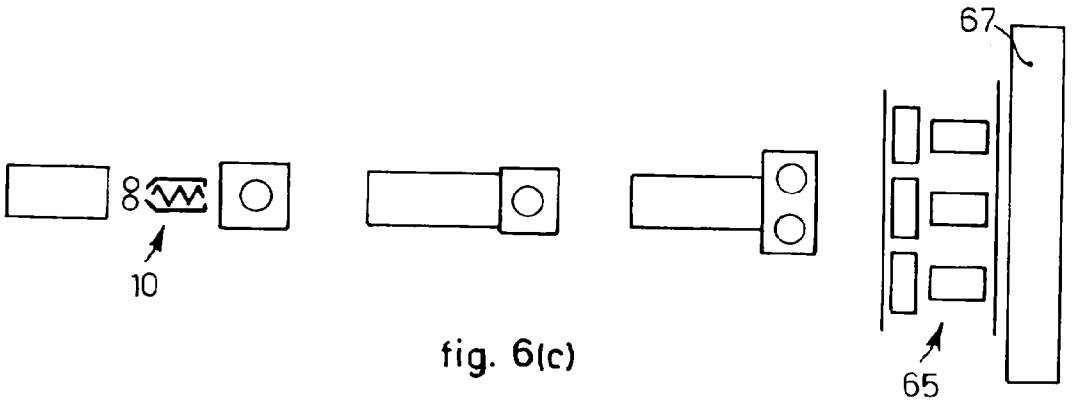

fig. 6(c)

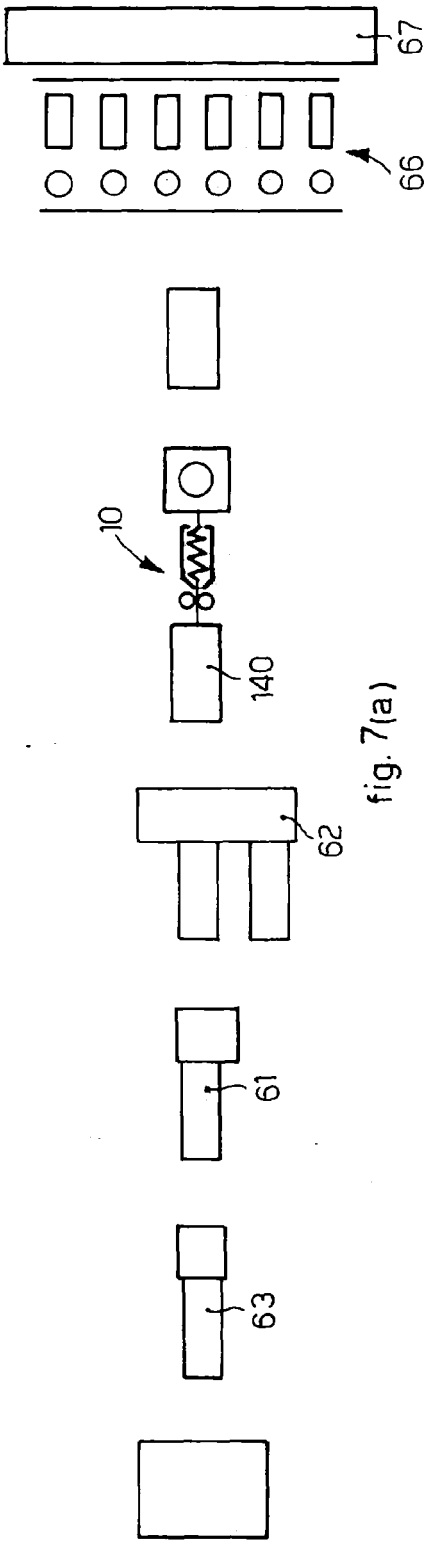

fig. 7(a)

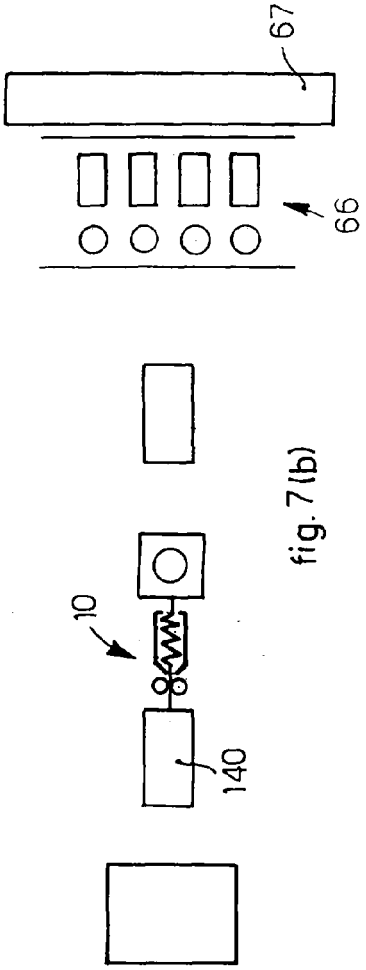

fig. 7(b)

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Application Number
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Place of search	Date of completion of the search	Examiner
The Hague	2 May 2007	D'Souza, Jennifer

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