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(54) **Combined device for opening and feeding flock fibres to a carding machine**

(57) Combined device for opening and feeding flock fibres to a single carding machine, comprising a vertical silo that feeds the flock fibres to one or more clothed cylinders to open and clean the flocks, said cylinders being equipped with groups of treatment elements consisting of separating knives, sucking mouths and fixed carding sectors that purify and open the fibrous material, then taking it to a second silo that feeds it in the form of a mattress to the carding machine.

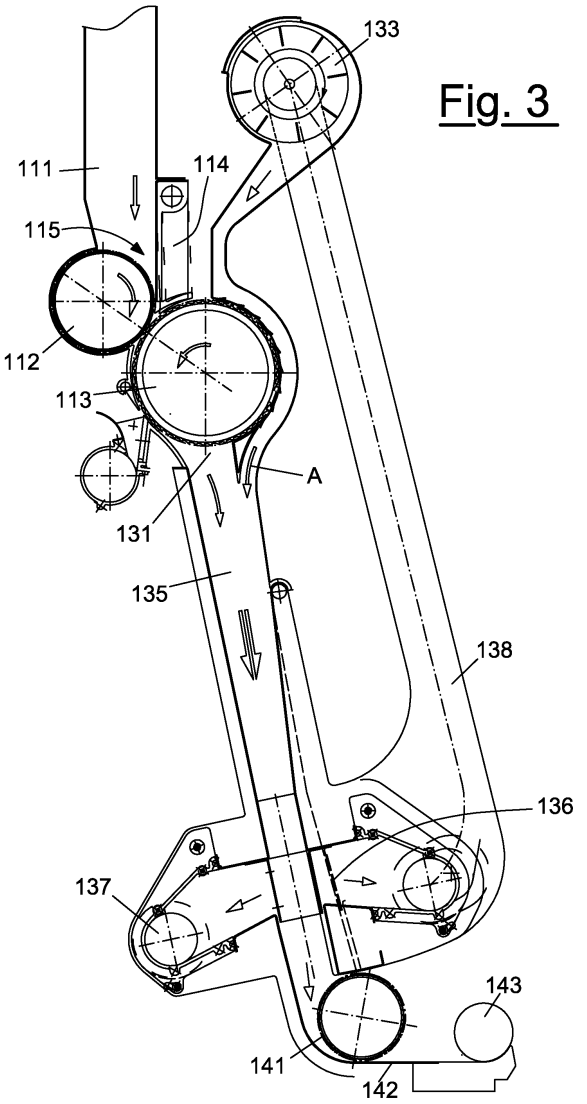

Fig. 3

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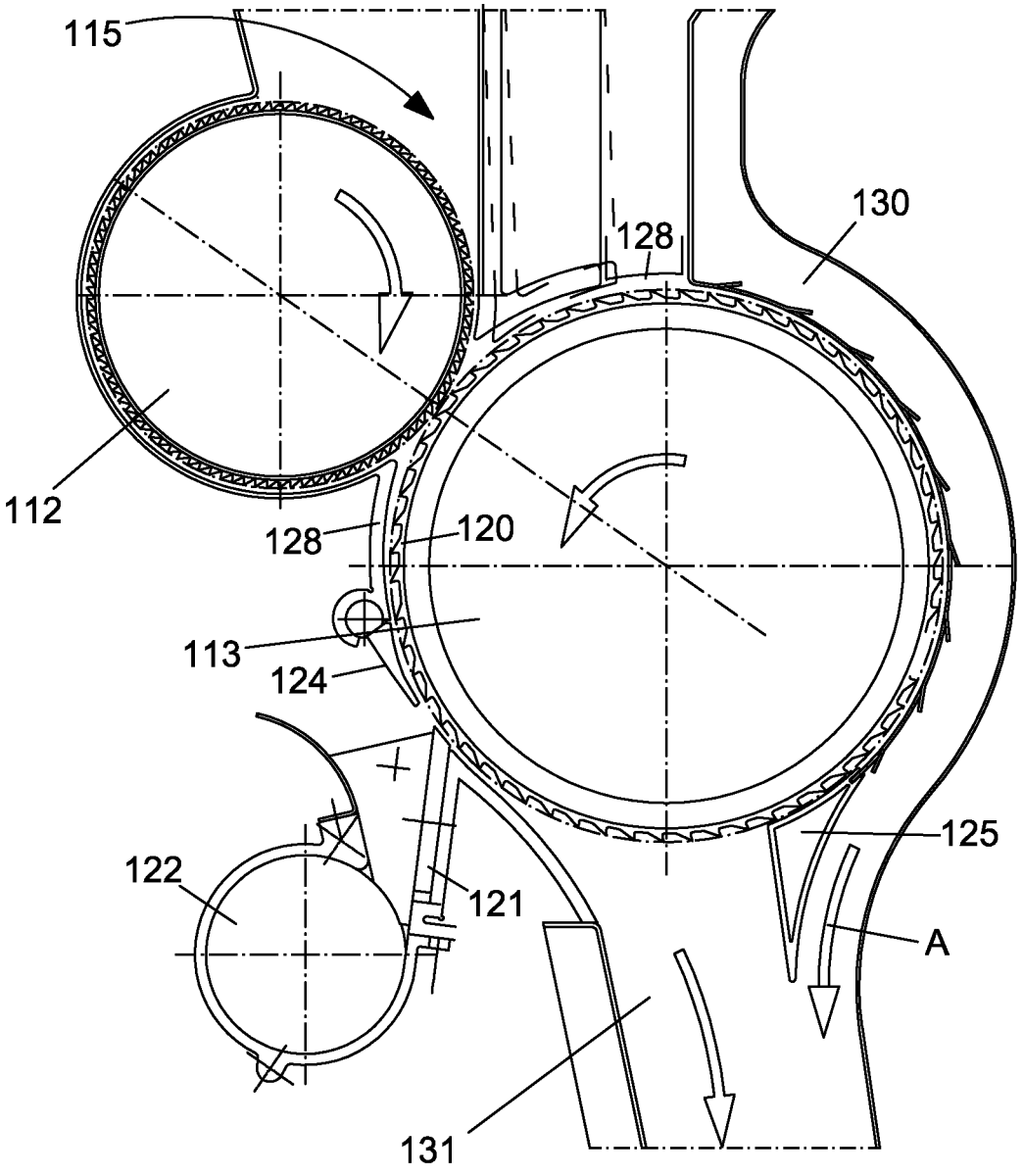
Fig. 3 bis



Description

[0001] The present invention refers to the feeding line of carding machines by which the fibrous material coming from bales of raw fibres - for example cotton - is processed in a series of devices, currently known as battery line, until the flock fibres are produced that are fed in the form of a wadding mattress for carding in the carding machines.

[0002] Generally, carding consists of passing the flock material onto a series of equipped surfaces, in other words equipped with a multitude of spikes, rotating at increasing peripheral speed. On these surfaces the fibrous material is opened in the form of single stretched out fibre, the dirt, like dust, short fibres and stubble are to a large extent eliminated, the fibres undergo mixing together and a band of non-twisted fibres is formed, to be sent to the subsequent processing stages.

[0003] In order to illustrate the technical problems connected to feeding the carding machines from raw fibres, a scheme of the battery line up to the carding machines is described hereafter with reference to figure 1.

[0004] In its most general lines, the feeding operation to the cotton-type carding from bales of raw fibre involves the following apparatuses and processes.

[0005] It all starts from bales of cotton that are stretched out side-by-side on the floor to form a fibrous layer and are subjected to the action of a plucker 1 with one or more reels that crosses with back-and-forth motion the layer of bales that is progressively used up. Such a plucker 1 essentially has the task of opening, i.e. of picking up the flock fibres, the bales of cotton and it is not equipped with dirt elimination elements: all of the material of the bales is therefore taken up and entered into the line.

[0006] The duct 2 carries the flock material by pneumatic transportation to the subsequent treatment. Along its path elements for separating the flow are inserted, for example slits with grids, which allow the heaviest parts of the material carried by the transportation air that travel in the bottom parts of the duct to be eliminated. The first opening point of the opened material consists of an opener 3 with one or two reels, where the first elimination takes place through separation grids that allow the coarsest impurities to be discarded. The reels of this opener are equipped with a small number of pins and not with just real clothings. There are no knives or sucking mouths. In the opener 3 the degree of opening of the flock is low and carries out a sort of pre-opening of the material that is then stored in the mixer 4, in which the different quality of the product loaded in the line by the plucker 1 is homogenised. Indeed, it must be taken into account that the bales are not all the same and that the compactness of the fibres inside the individual bales is subject to substantial variation. The flock fibres are therefore fed in pneumatic transportation to the opener 5 itself.

[0007] The opener 5 is equipped with many reels - generally three or four - equipped with a clothing, having sawteeth, points or needles according to the material to be treated. In general the population of the clothing increases from the first to the last reel, cooperating with impurity elimination groups consisting of knives and sucking mouths. The opener 5 is the point of the battery line where most of the opening process of the flock material and the elimination of its impurities is carried out. However, this is also the point where there is the most deterioration of the treated fibres, also due to the need to work on large amounts of material - from 600 even up to 1200 kg/h - sufficient to feed around ten carding machines, according to the type of production intended to be carried out.

[0008] After the opener 5 the treated material arrives at the launch cage 6 from which it is fed towards the feeding silo 7 of the carding machines 8. Said feeding silo, like for example the silo according to patent EP 1.004.693 to the same Applicant, essentially have the task of preparing and feeding, in input to the feeding table of the carding machine, a wadding mattress that is homogeneous in terms of compactness and thickness. From such a table the feeding cylinder loads the cotton onto the introduction and preparation cylinders of the carding machine, known as licker-in, which shall be discussed later on. The operation carried out in the feeding silo 7 consists of flaking and subsequently compacting the flock material. Flaking is carried out with two or more rotary elements, whereas compacting is carried out with flows of air in the loading area to the carding machine. The thickness of the mattress thus formed is adjusted with levelling cylinders.

[0009] The feeding system of the prior art described up to now has some problems. According to a tendency to rationalise and simplify the battery lines, as already outlined above, the size and unitary capacity of the openers have been increased so as to serve a greater number of carding machines downstream. In fact, openers have a much higher unitary productivity than carding machines.

[0010] On such openers the opening points and modes have been intensified, working on greater layer thicknesses. Consequently, in the fibres thus treated the number of neps, in other words the tangles of fibres that are formed during work, increases, the length of the fibres is reduced due to the greater stress undergone, the elimination of dirt occurs to a lower percentage, in other words there is more residual dirt in the flock cotton material fed to the carding machines. The quality of the flock fibres that arrive at the carding machines is substantially worse than conventional battery lines.

[0011] It should be considered that the limiting factor of the productivity of carding machines is the degree of stretching out and of cleaning of the band of fibres that is produced: the greater is the amount of dirt in the starting product, the lower is the production of the carding machine. In order to avoid this situation, according to the most recent technique, an initial preparation stage is foreseen on the carding machines, carried out - instead of on a single cylinder - on a plurality of cleaning and prep-

aration cylinders, commonly known as licker-in, arranged in series in front of the main carding drum. The licker-in rolls in series are equipped with toothed clothings, fixed carding elements, separating knives and sucking mouths to stretch out the fibres and separate the dirt from them. The licker-in rolls in series work at increasing peripheral speed, in any case necessarily less than that of the main carding drum that must "strip" the last licker-in of the fibres carried by its clothing.

[0012] As already stated, the intended purpose of such licker-in rolls is to preventively improve the opening, stretching out and homogeneity of the material arriving on the main carding drum beforehand, and also to separate a further amount of impurities. The expectations for such insertion of the licker-in rolls in series are aimed, overall, at increasing the unitary production capacity of the carding machine, at increasing the quality of the band, at improving the carding effect, i.e. the stretching out of the fibres, increasing the lifetime of the clothings - in particular of the main drum and of its flats - and finally at having a band that is more suited to being used in open-end spinning machines, in which the residual "neps" and stubble can cause frequent breaking of the thread coming out from the spinning rotor.

[0013] Such expectations are only partially respected in carding machines equipped with many licker-in rolls because the amount of dirt that is removed from the fibres is not greatly increased compared to carding machines with a single licker-in. This circumstance, at least to a large extent, can be put down to the fact that the two-three licker-in rolls, which work in series and at increasing speed, have limits to their peripheral speed that must in any case be less than that of the main carding drum, and that is insufficient to obtain the desired purifying effect and is in any case less that what can be achieved in the preceding openers.

[0014] The present invention refers more specifically to a device for preparing and feeding flock fibres to a carding machine that allows higher production and better quality to the carding machine downstream, since it supplies staples that are more open and cleaner, and with the degree of preparation that is most advantageous for the single carding machine that is downstream from it.

[0015] The device according to the invention is defined, in its essential characteristics, in the first claim, and in its preferred embodiments in the claims dependent upon it.

[0016] In order to illustrate the characteristics and advantages of the present invention more clearly, it is described with reference to a typical embodiment thereof shown in figures 1 to 4, as a non-limiting example, which schematically illustrate:

- in figure 1 the state of the art and the technical problem of feeding the carding machine in general;
- in figures 2, 2bis, 3 and 3bis two schematic embodiments of the present invention with one opening cylinder;
- in figure 4 a schematic embodiment of the present invention with two opening cylinders;
- in figure 5 a schematic embodiment of the present invention with three opening cylinders.

[0017] The embodiment illustrated in figure 2 shows a preparing and feeding device consisting of a vertical silo 11 in which the fibrous material comes by pneumatic transportation in air current from the launch cage 6 and accumulates in its end part, for example with a fill level control technique already described in the quoted patent EP 1.004.693.

[0018] At the bottom of the silo 11 the feeding cylinder or roller 12 is arranged that feeds the flock fibres to the equipped cylinder 13 that unravels the material and opens and cleans the flocks picked up. The two cylinders 12 and 13 operate with rotation in unison to take away the material and send it forwards.

[0019] The feeding roller 12 is actuated at variable rotation speed and is made lobed or equipped with a clothing with saw-teeth, in a *per* se known way. The feeding roller 12 works facing the wall 14 of the end part of the silo 11, to create a gap 15 for the passage of the fibres between them.

[0020] The cylinder 13 is equipped with groups of flock fibre treatment elements, according to a known scheme for cotton-type openers, for example from patent EP 952.244 to the same Applicant, shown more clearly in the enlarged detail of figure 2bis. Such a group consists of a clothing 20 with needles or saw-teeth, which receives the fibres from the roller 12, arranges them on the clothing and presents them to the treatment elements that consist of:

- separating knives 21, arranged in the free space around the rotary clothing 20, to free the fibrous material from impurities,
- sucking mouths 22 that evacuate the dirt separated by the knives 21,
- fixed carding sectors 23 equipped with tips that, in counterposition to the rotary clothing 20, stretch out and open the flock fibres,
- mobile deflectors 24 to modify the opening of the free space between the clothing 20 and the treatment group.

[0021] The groups are mounted on rod supports 26. Elements 28 for containing the cylinder 13 are also foreseen.

[0022] At the end of the path through the treatment groups the flock material, opened and cleaner, is detached by a stripping knife 30 that operates in the ascending contracted vein space that comes into the duct 31 through the effect of the blower 33.

[0023] The air-flow goes upstream the duct 34 and goes downstream the second silo 35, along with the flock material. Said silos are preferably formed of quadrangular sections of plates. At the bottom of the silo 35 are

arranged, on one or more of its walls, grids 36 for evacuation from the silo towards the outside and of recycle of the transportation air, which leave the fibrous flock material inside the bottom of the silo. The transportation air is gathered into collectors 37 and sent back through the duct 38 to the inlet 39 of suction of the blower 33.

[0024] In the bottom of the second silo 35 the density of the flock material can be controlled and regulated by pneumatic effect. A group of discharge cylinders or lobed rollers 41, rotating at commanded speed to regulate the flow rate of fibres, discharges the fibres onto a chute 42 that feeds the fibres in the form of a mattress to the carding machine with a conveying roller 43.

[0025] The scheme according to figure 2 allows fibres even with a large amount of impurities to be processed, whilst still working with a single pair of cylinders 12, 13.

[0026] In the case in which the fibres to be treated do not contain large amounts of impurities, the scheme of figure 2 can be further simplified, as shown in figures 3 and 3bis.

[0027] In the embodiment illustrated in figure 3, the fibres go down from a vertical silo 111 in which the fibrous material comes by pneumatic transportation in air current from the launch cage 6. The descending fibres encounter a first feeding roller 112 that feeds and cooperates with the equipped cylinder 113 to unravel the fibres and clean the flocks picked up. Also in the embodiment of figure 3 the two cylinders 112 and 113 operate with rotation in unison to guide the descending fibrous material, as shown by the arrows in the figure. The feeding roller 112 works facing the wall 114 of the end part of the silo 111, to create a hinged gap 115 between them that can be regulated for the downward passage of the fibres. On its periphery, similarly to the scheme of figure 2, the cylinder 113 is equipped with one or more groups of elements for treating the flock fibres, shown in the enlarged detail of figure 3bis, in which a single group of elements is shown as an example. Such a group consists of a clothing 120 with saw-teeth, which receives the fibres from the roller 112, arranges them on its periphery and takes them into contact with:

- separating knives 121, arranged in the free space around the rotary clothing 120, to free the fibrous material from impurities,
- sucking mouths 122 that evacuate the dirt separated by the knives 121,
- mobile deflectors 124 to modify the opening of the free space between the clothing 120 and the treatment group.

[0028] At the end of the path through the treatment group the flock material, opened and cleaned, carried by the clothing 120 arrives at the mouth 131 into the descending discharge channel 135, which also acts as a silo for the unravelled material. In the mouth 131 the stripping effect of the fibres from the clothing 120 is obtained both by pneumatic effect with the jet of air, shown with the arrow A, which comes from the blower 133, which crosses the duct 130 and that expands in the mouth 131 with Venturi effect, which acts as stripping means drawing air and fibres from the clothing 120, and by centrifugal effect. Such a centrifugal stripping effect can be increased by increasing the rotation speed of the cylinder 113.

[0029] The flow of flock material detached from the clothing 120 is deviated and made to fall with the left face of the wedge 125, which joins the mouth 131 with the duct 130.

[0030] The current of air A with the flock material descends and is contained in the silo duct 135. At the end of the descent in the duct 135 grids 136 are arranged that separate the transportation air and leave the flock material inside. The transportation air A is taken back with the manifolds 137 and sent on with the duct 138 to the blower 133.

[0031] At the bottom of the silo duct 135 one or more discharge cylinders 141, actuated to regulate the flow rate of fibres, discharges the fibres onto a chute 142 that feeds the fibres in the form of a mattress to the following carding machine with a conveying roller 143.

[0032] Figure 4 illustrates an embodiment of the device according to the present invention with two opening cylinders 53 and 53'. Compared to the embodiment of figures 2 and 2bis with a single opening cylinder 13, the same elements keep the same reference numerals. The cylinders 53, 53' also counter-rotate and rotate a progressively greater speeds, so that the following cylinder strips the preceding cylinder of its film of fibres, sending it forwards. Unlike the previous case according to figures 2 and 2bis, the fibrous flock material, detached by the stripping knife 30, is always conveyed into the duct 31 and into the silo 35 with the help of a contracted vein of transportation air coming from the blower 33, but with descending flow.

[0033] In the passage between the cylinders 53, 53' the film of fibres is reversed, since the fibres in a film that are farthest outside on the cylinder 53, and are most exposed to the action of the opening and purifying elements, in the passage to the next cylinder 53' are farthest inside, and this time leave the fibres that had been less opened and less cleaned on the previous cylinder 53 to the action of said opening and purifying elements.

[0034] Figure 5 illustrates an embodiment of the device according to the present invention with three opening cylinders 63, 63' and 63" . Compared to the embodiment of figures 2 and 2bis with a single opening cylinder 13, the same elements keep the same reference numerals. The cylinders 63, 63', 63" also counter-rotate and rotate a progressively greater speeds, so that the following cylinder strips the preceding cylinder of its film of fibres, sending it forwards. The discharging scheme of the fibres into the duct 31 with contracted vein remains the same as the one of figure 2.

[0035] In the case of the embodiment of the device according to figures 2 and 3, with a single opening cyl-

inder, the cylinder 13, 113 is actuated at a peripheral speed within the range from 5 to 18 m/sec.

[0036] On the other hand, in the case of the embodiments with two or three opening cylinders, the speed range referring to the last cylinders of the series, 53' and 63" respectively, goes from 25 to 50 m/sec, whereas the actuation speed values of the preceding cylinders are less by about 25-40%, for every passage, in order to allow the correct transfer of the film of treated fibres.

[0037] In the schemes with many opening cylinders in series the clothings of the cylinders have a progressively denser and less in relief population of tips, needles or saw-teeth, taking into account that the film deposited on it is progressively cleaner, more stretched out and thinner.

[0038] Compared to the conventional opener 5 of figure 1, the devices according to the invention work on the film of fibres with a work scheme that seems similar, but with the difference of serving a single carding machine, i.e. with much lower thicknesses of the layer of flock fibres. In the device according to the invention, the ease of detachment and elimination of impurities, be they dirt, neps or short fibres, is enormously greater and less aggressive clothings can be adopted, which therefore reduce the deterioration of the fibres.

[0039] Due to the fact that it serves a single carding machine, the device according to the invention boasts clothings and carding members of size and aggressiveness that differ from those used in conventional openers and carries out an opening and preparation process of the flocks that is more delicate and effective.

[0040] Generally, the following parameters are adopted for the solution with many opening cylinders. The peripheral speeds on the first cylinder are in the order of 5-15 m/sec. The sizes of the cylinders are within the range of 200-300 mm. The clothings of the cylinders consist of a population within the range of 4-50 tips per square inch, i.e. 62-765 tips per dm^2, with needles and/or saw-teeth.

[0041] The device for preparing and feeding flock fibres for a carding machine according to the present invention allows substantial advantages with respect to the prior art. Amongst them, the following characteristics deserve at least an explicit mention. For the purposes of the quality of the product and the efficiency of the treatment it is quite important that the opening cylinders that equip the device practically do not have the peripheral speed limitations that the licker-in rolls on board the carding machines do on the other hand have, being able to work at the peripheral speeds of the openers but on much thinner layers of fibre. The carding machine downstream requires a single licker-in, works on a much cleaner feed and can have a higher unitary production. The technological advantages deriving from this are substantial, because the opening cylinders on board the device work at the same unitary production of the carding machine and can be set at the ideal speed for discarding dirt, with low production of neps and safeguarding the length of the fibres. In such conditions a good separation of the so-called "pepper trash", the finest fraction of dust, is also obtained, which conventional openers arranged upstream are unable to carry out, working on thicker layers of fibres. The wadding mattress presented to the carding machine is of excellent quality, in terms of its smaller and more homogeneous flocks and its greater consistency due to the compression of the air produced in the ventilator integrated in the device, the blower 33. The quality of the band produced by the carding machine, the carding effect and the lifetime of the clothings are substantially advanced due to this.

[0042] In addition to this, the device for preparing and feeding flock fibre to the carding machine according to the present invention allows the conventional scheme shown in figure 1 to be overcome, being able to eliminate from this scheme the conventional opener 5 with large capacity arranged upstream of the carding machines 8 with the described drawbacks, and delegate its function to the opening cylinders of the device according to the invention.

[0043] With the device according to the present invention the functions of the opening devices 5 and feeding silo 7, according to the conventional scheme of figure 1, are fulfilled, overcoming the aforementioned drawbacks thereof and taking the opening and cleaning function of the fibres at the feeding of each carding machine. The overall processing scheme allows greater flexibility over the entire battery line and advantages in carrying out the opening of the fibres, since it is carried out on many machines and on a smaller unitary amount, with much thinner layers of fibre, thus giving a more efficient and softer opening on the fibres and giving the carding machine a cleaner and more stretched out material. The positive effect also propagates downstream, being able to work on the carding machine with greater unitary capacity, and the carding machine not requiring the series of many licker-in rolls. Such advantages also affect the subsequent ironing, combing, sliver - yarn formation processes.

Claims

1. Combined device for opening and feeding flock fibres to a single carding machine, comprising a vertical silo (11, 111) in which the flock material accumulates in its bottom end part, carrying a feeding cylinder (12, 112) at the base that feeds the flock fibres to one or more cylinders in sequence (13; 53, 53'; 63, 63', 63"; 113) to open and clean the flocks, said cylinders (12, 112) and (13; 53; 63; 113) operating with rotation in unison, **characterised in that** said cylinders (13; 53, 53'; 63, 63', 63"; 113) are equipped with a clothing (20, 120) that opens and purifies the flock fibres in cooperation with groups of treatment elements consisting of separating knives (21, 121), sucking mouths (22, 122) and fixed carding sectors (23) in counterposition to the rotary cloth-

ing (20, 120); and **in that**, at the end of the path through the treatment groups the flock material, opened and cleaner, is detached by stripping means (30, A) that carry the fibrous material to the base of a second silo (35, 135), from which the fibres are discharged to directly feed the fibres in the form of a mattress to the carding machine.

2. Device according to claim 1, comprising a vertical silo (111) in which the flock material accumulates in its bottom end part, carrying a feeding cylinder (112) at the base that feeds the flock fibres to a cylinder (113) to open and clean the flocks, said cylinders (112, 113) and operating with rotation in unison, **characterised in that** the cylinder (113) is equipped with a clothing (120) that opens and purifies the flock fibres in cooperation with groups of treatment elements consisting of separating knives (121), sucking mouths (122) in counterposition to the rotary clothing (120); and **in that**, at the end of the path through the treatment groups the flock material is stripped from the clothing through the cooperation of centrifugal effect and Venturi effect generated by a jet of air (A) that expands drawing air and fibres from the clothing (120), and is sent to directly feed the fibres to the carding machine.

3. Device according to claim 1, comprising a vertical silo (11) in which the fibrous flock material accumulates in its bottom end part, carrying a feeding cylinder (12) at the base that feeds the flock fibres to one or more cylinders in sequence (13; 53, 53'; 63, 63', 63") to open and clean the flocks, said cylinders (12) and (13; 53; 63) operating with rotation in unison, **characterised in that** said cylinders (13; 53, 53'; 63, 63', 63") are equipped with a clothing (20) that opens and purifies the flock fibres in cooperation with groups of treatment elements consisting of separating knives (21), sucking mouths (22) and fixed carding sectors (23) in counterposition to the rotary clothing (20); and **in that**, at the end of the path through the treatment groups the flock material is detached by a stripping knife (30) that operates in cooperation with a flow of air in contracted vein that carries the fibrous material to the base of a second silo (35), from which the fibres are discharged to directly feed the fibres to the carding machine.

4. Device according to claim 3, **characterised in that** it comprises a plurality of clothed cylinders (53, 53'; 63, 63', 63") in sequence to open and clean the flocks, which counter-rotate and that rotate at progressively higher speed, so that the following cylinder strips the preceding cylinder of its film of fibres.

5. Device according to claim 3, **characterised in that** the groups of treatment elements of the flock fibres comprise, at the outlet of the group, mobile deflectors (24, 124) to modify the opening of the free space between the clothing (20, 120) and the treatment group.

6. Device according to claim 4, **characterised in that** the clothings of the cylinders (53, 53'; 63, 63', 63") in sequence to open and clean the flocks have a progressively denser and less in relief population of tips, needles or saw-teeth.

7. Device according to claim 1 or 2, **characterised in that** it comprises a single opening cylinder (13, 113) actuated at a peripheral speed within the range from 5 to 18 m/sec.

8. Device according to claim 4, **characterised in that** it comprises two or three opening cylinders, in which the last cylinders of the series are actuated at a peripheral speed within the range from 25 to 50 m/sec, the actuation speed values of the preceding cylinders are lower by within the range of 25-40% for each passage.

9. Device according to claim 4, **characterised in that** it comprises many opening cylinders, in which the first cylinder is actuated at a peripheral speed in the order of 5-15 m/sec, the size of the cylinders being within the range of 200-300 mm.

10. Device according to claim 3, **characterised in that** the clothings of the cylinders consists of a population within the range of 62-765 tips per dm^2, said clothings being with needles and/or saw-teeth.

Fig.1

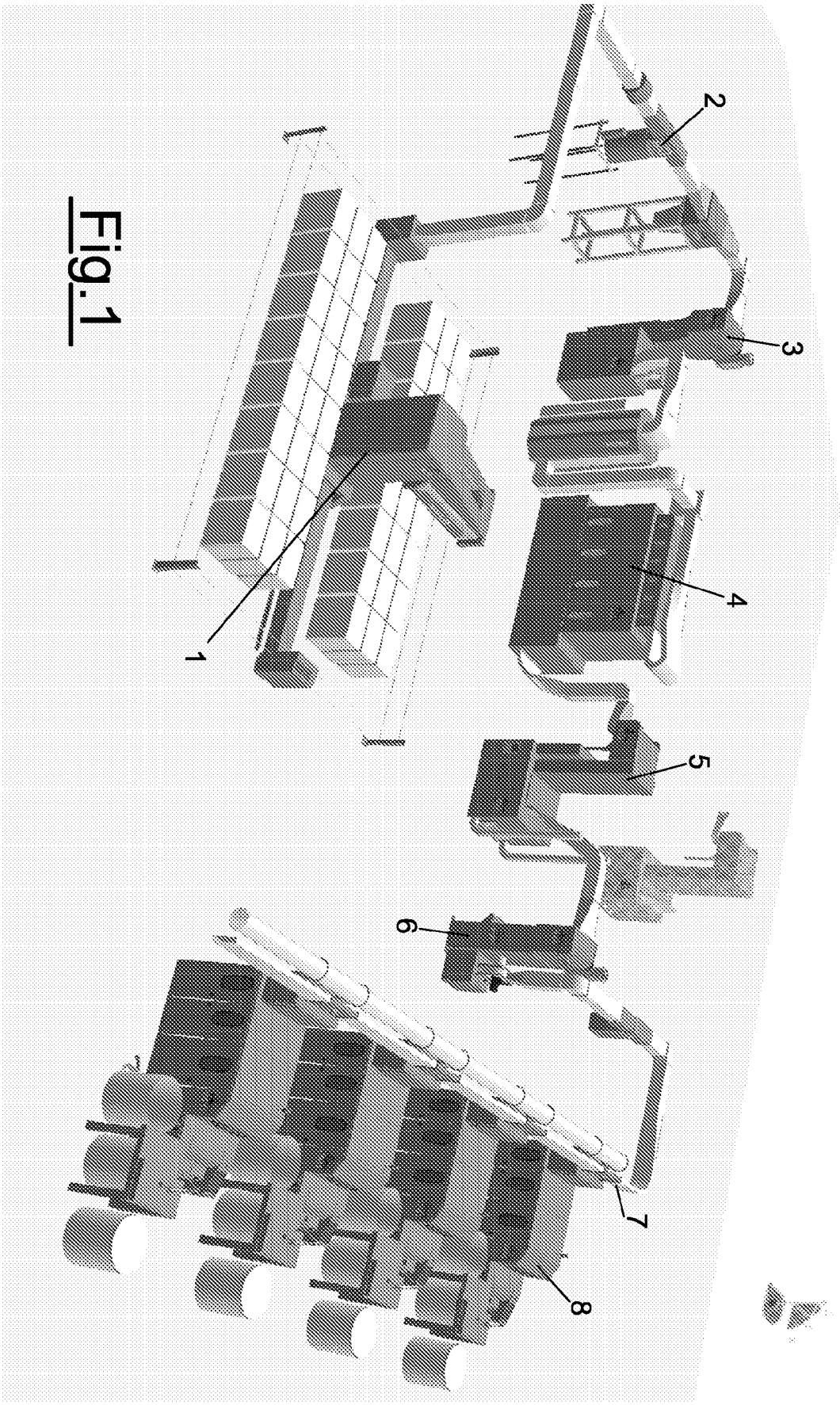


Fig.2bis

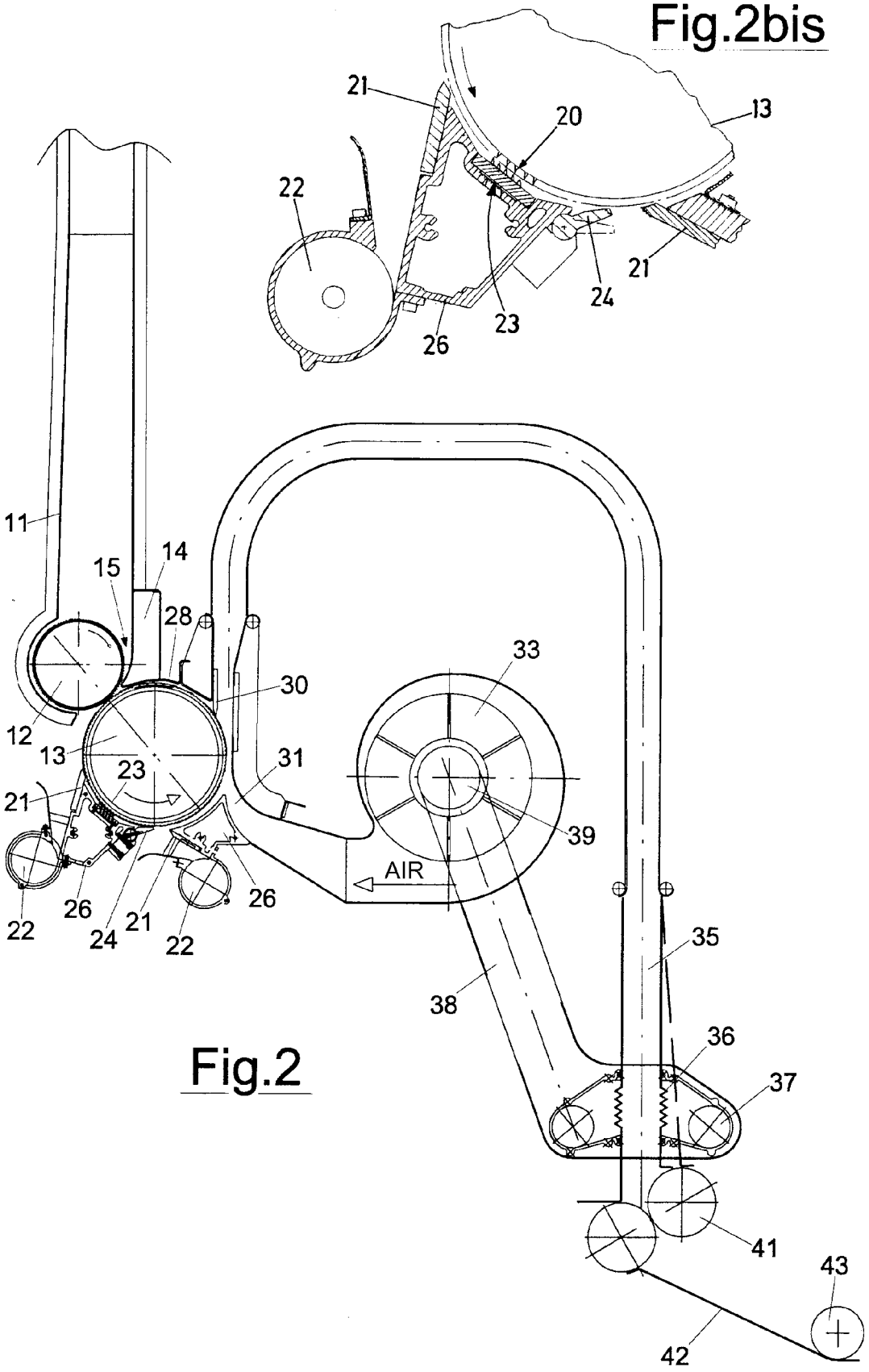


Fig.2

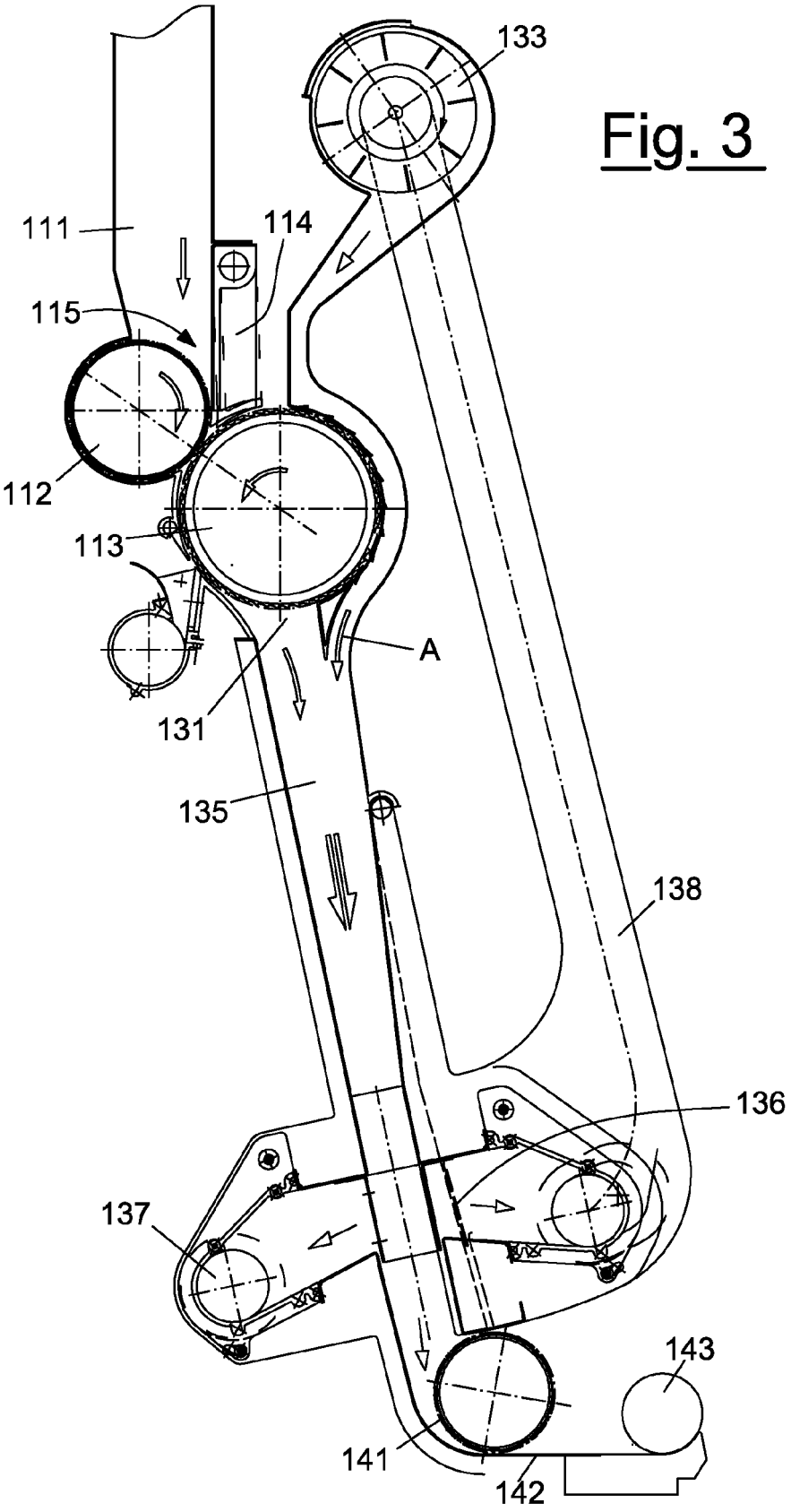
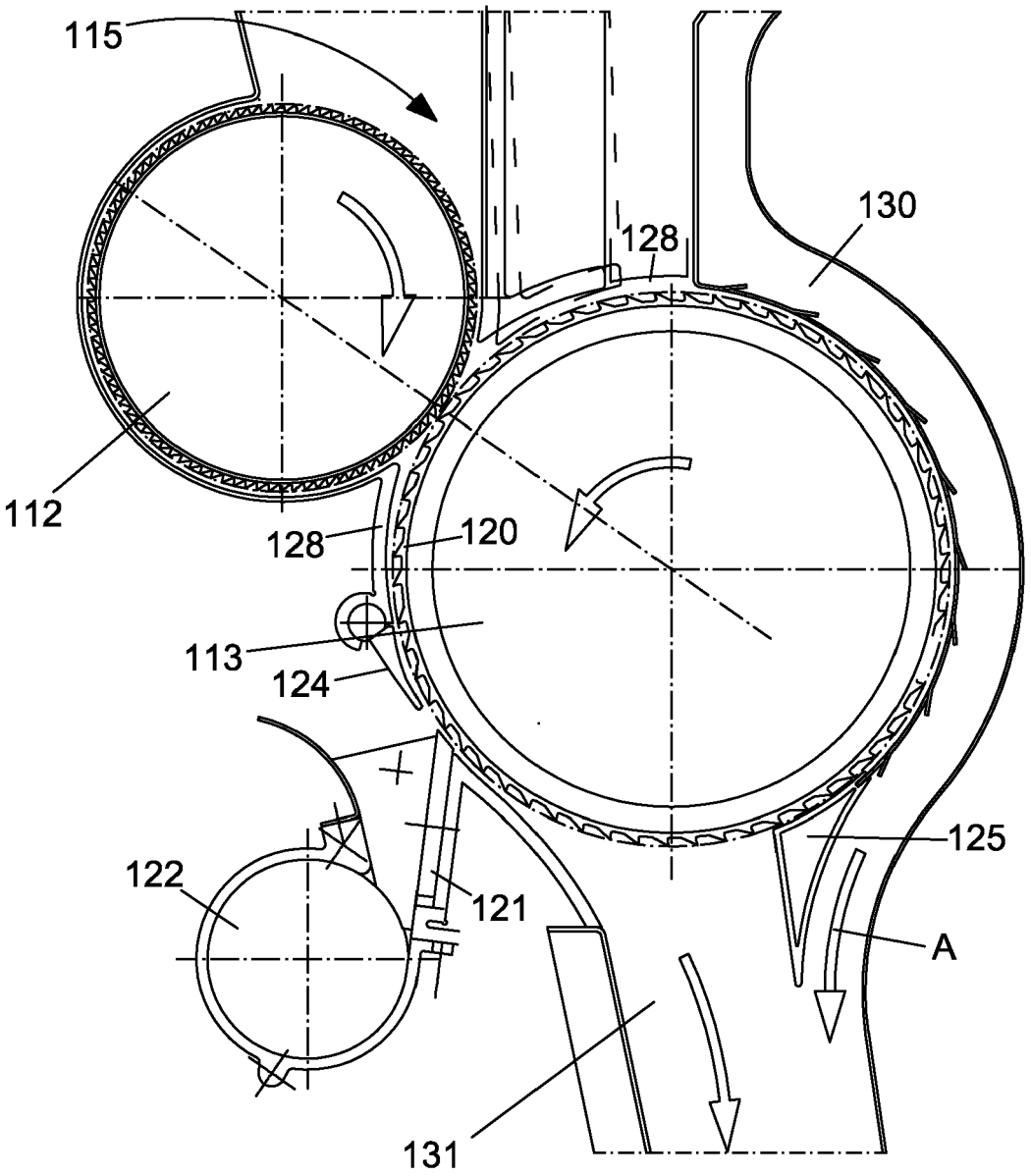


Fig. 3

Fig. 3 bis



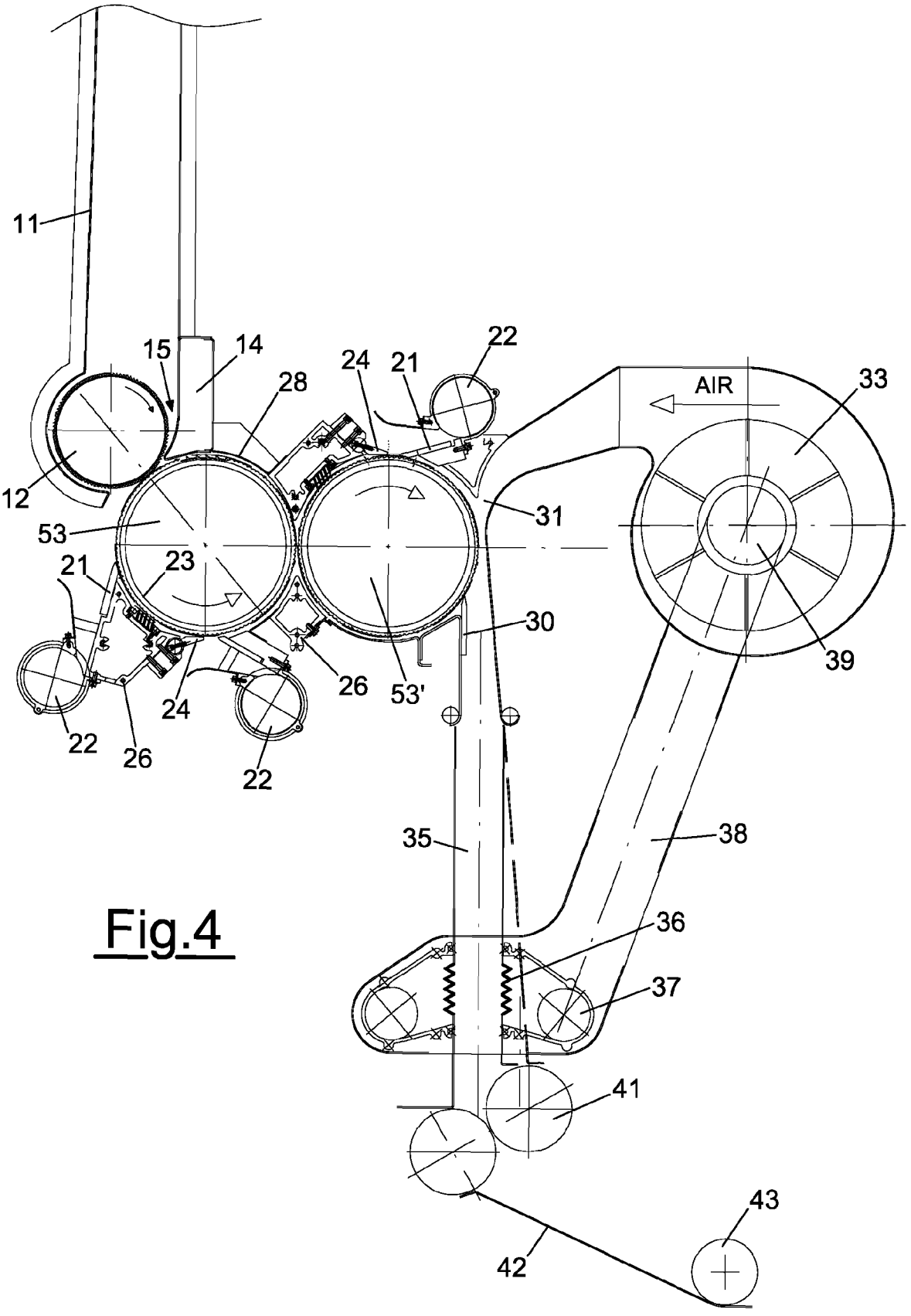

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Fig.4

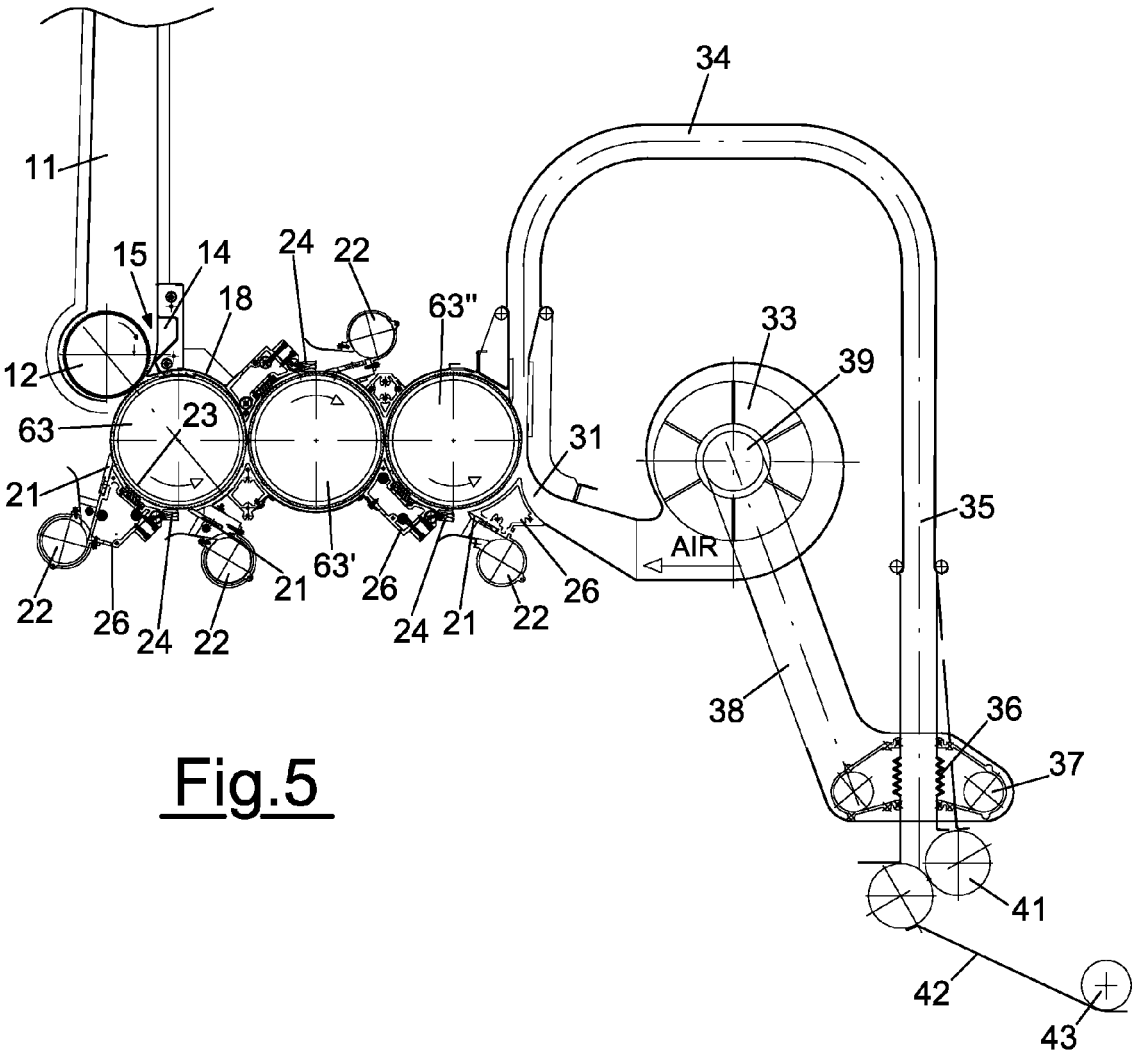
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Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 1856

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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
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