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(54) APPARATUS FOR THE SORTING OR SELECTION OF A FIBRE SLIVER COMPRISING TEXTILE FIBRES, ESPECIALLY FOR COMBING

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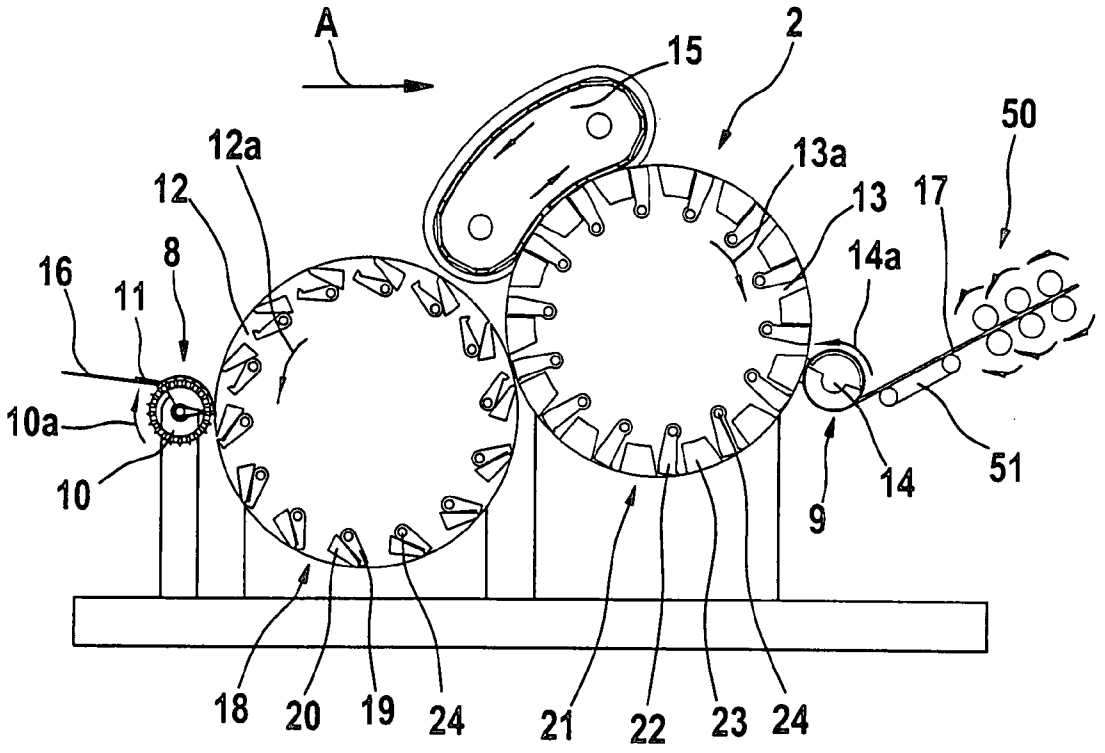
(57) **ABSTRACT**

An apparatus for the sorting or selection of fibre, especially for combing, is supplied by supply device to a sorting device. Clamping devices are provided which clamp the fibre sliver at a distance from its free end, for combing in order to loosen and remove non-clamped constituents, such as, for example, short fibres, neps, dust and the like from the free end. To enable productivity to be increased and an improved combed sliver to be obtained, downstream of the supply there is arranged at least one rotatably mounted roller which is provided with clamping devices for the fibre sliver, which clamping devices are distributed spaced apart around the periphery of the roller, and combing elements are associated with the periphery of the roller.



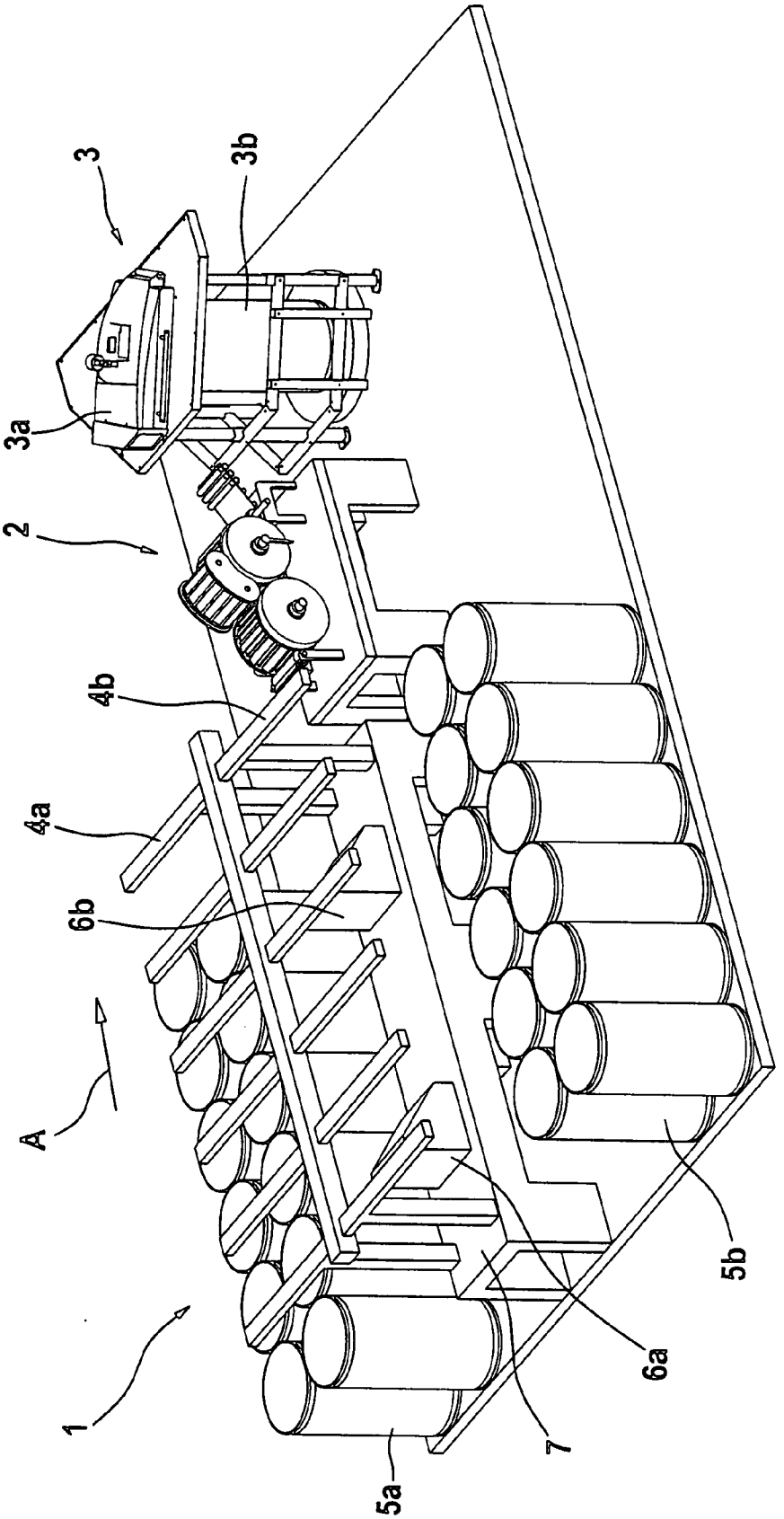


Fig. 1

Fig. 2

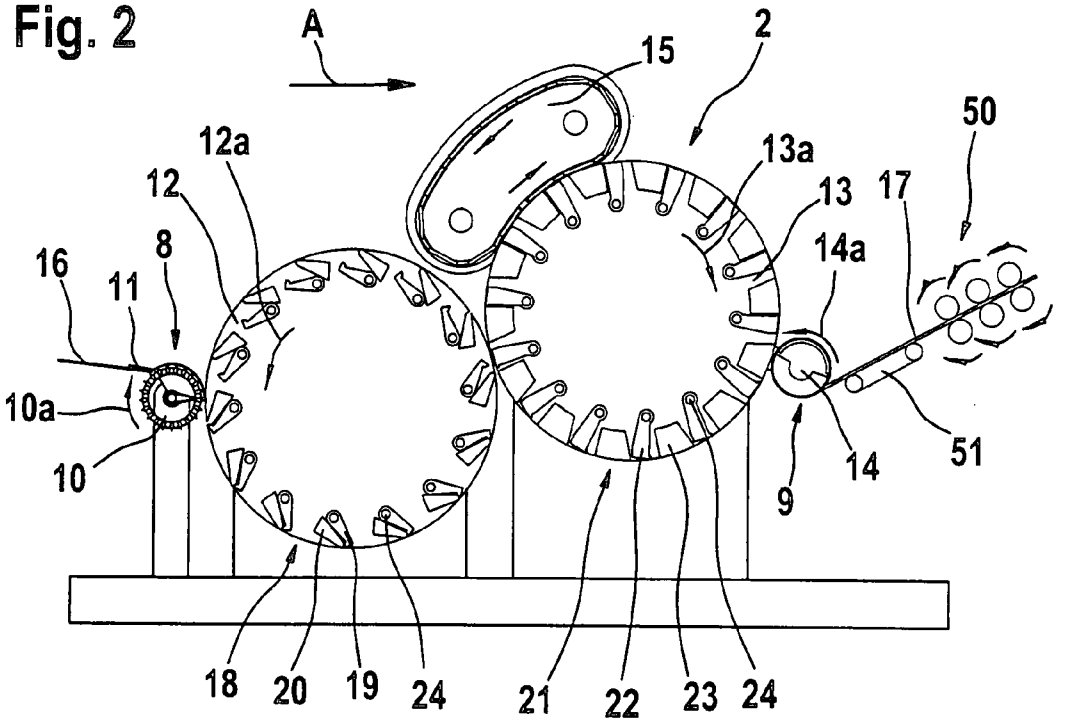

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Fig. 3

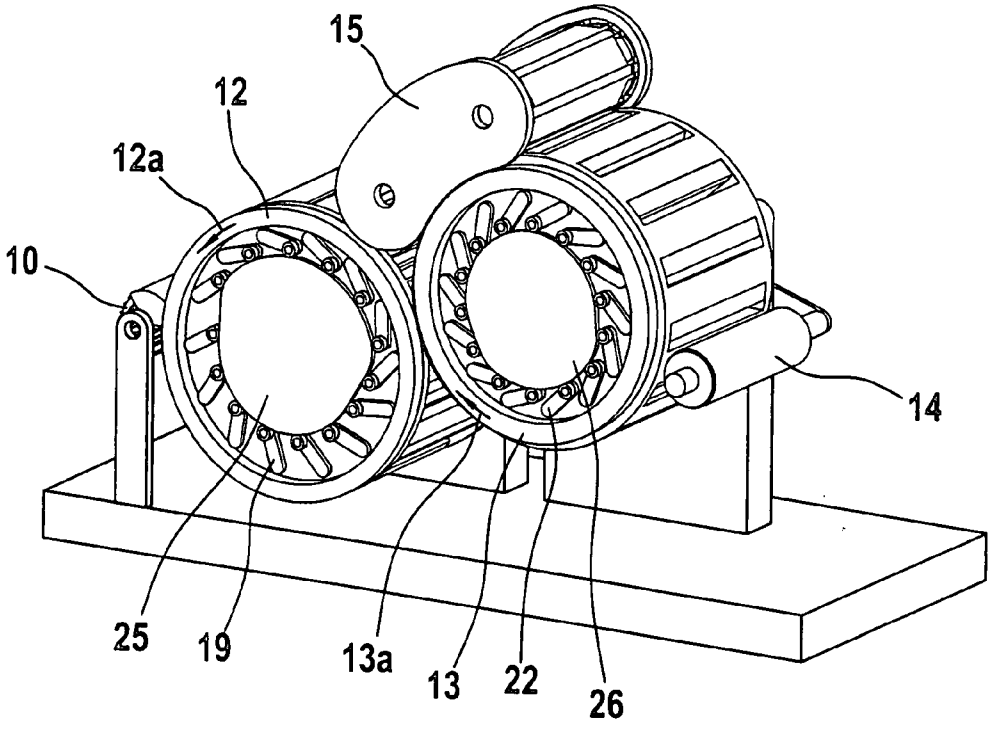
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Fig. 4

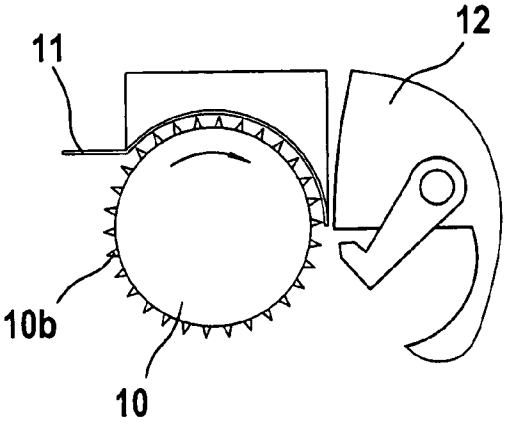


Fig. 5

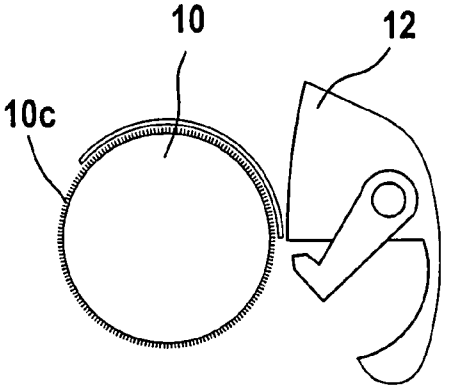


Fig. 6a

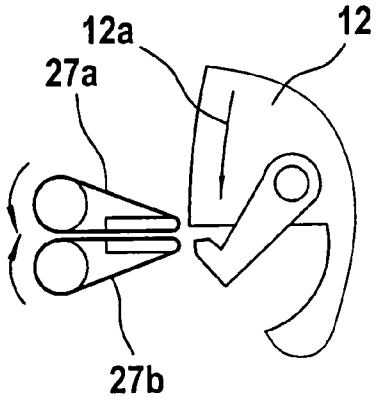


Fig. 6b

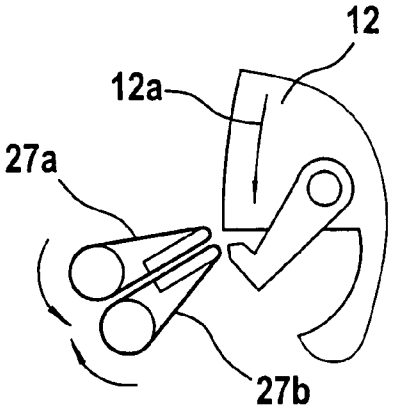


Fig. 7a

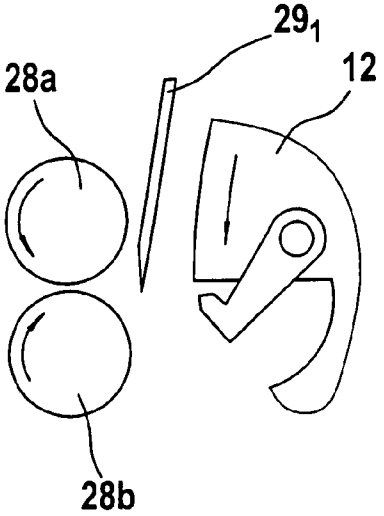


Fig. 7b

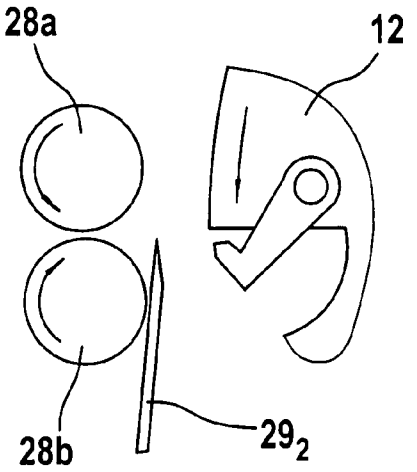


Fig. 8

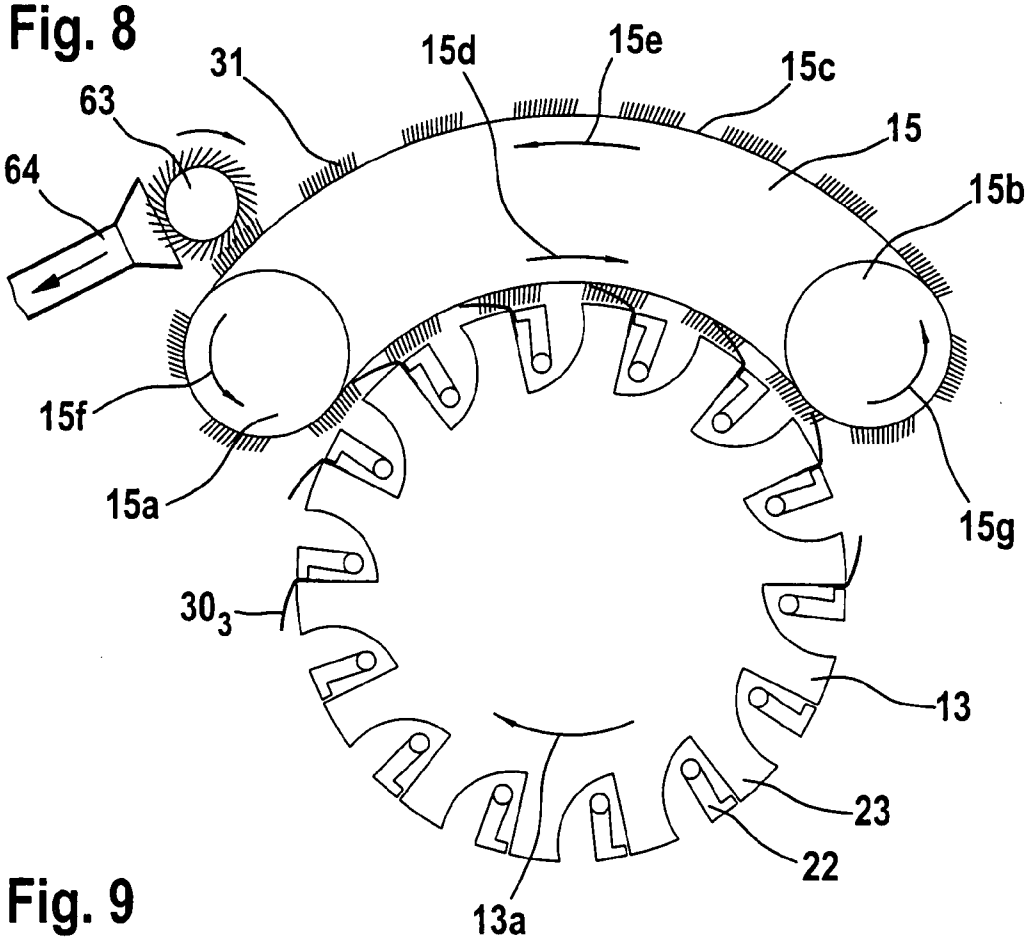


Fig. 9

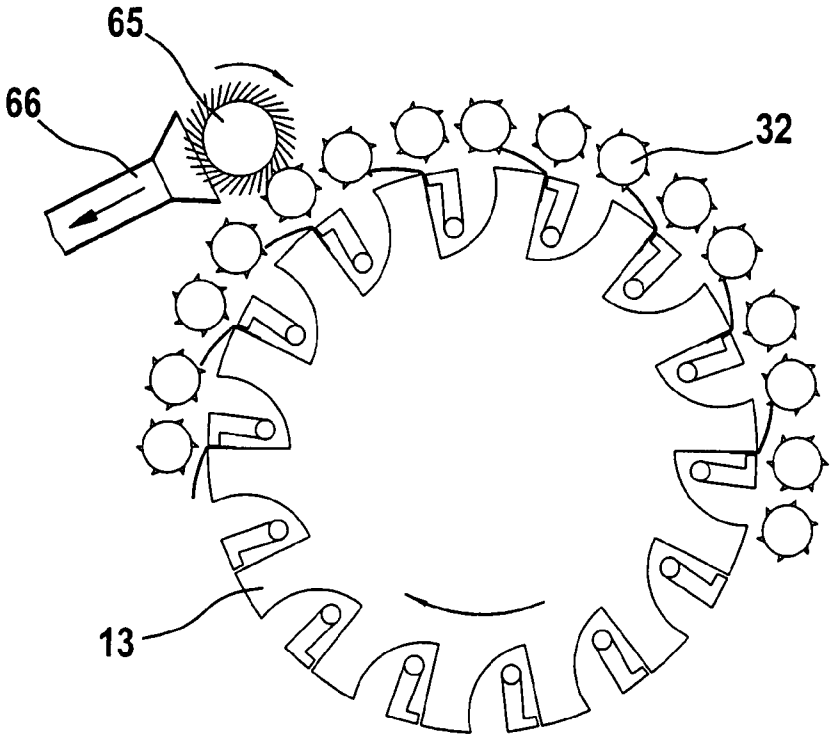


Fig. 10a

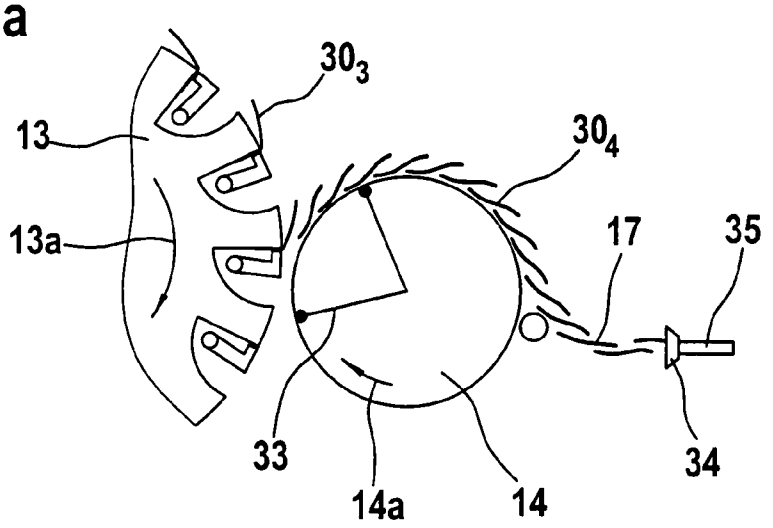


Fig. 10b

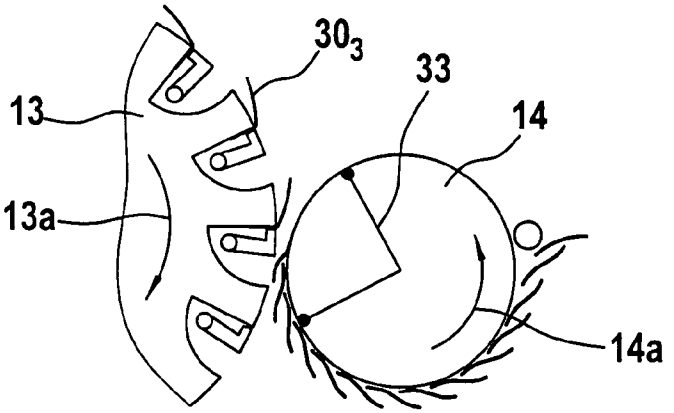


Fig. 11

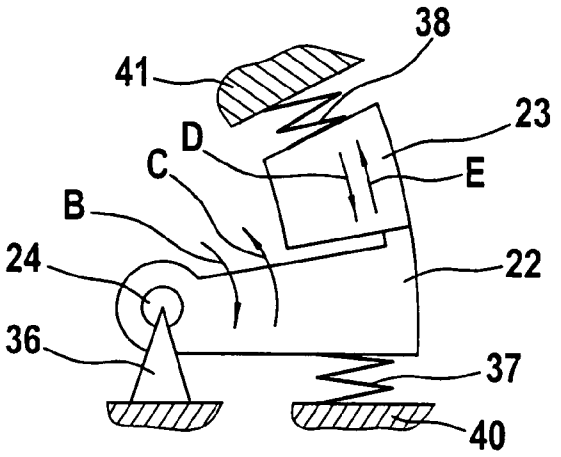


Fig. 12a

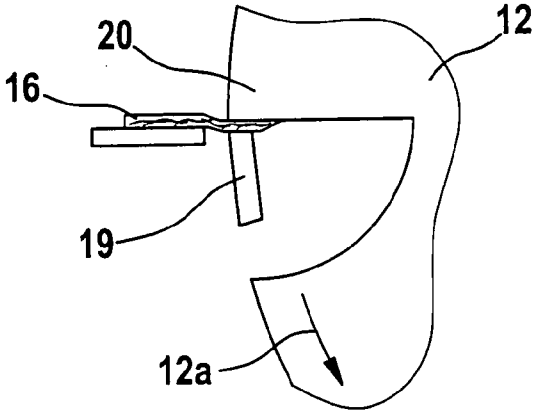


Fig. 12b

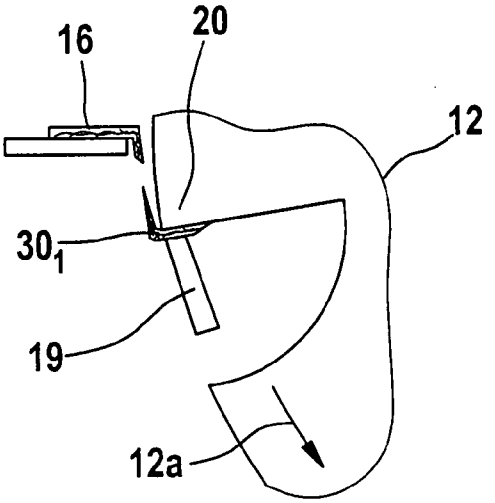


Fig. 12c

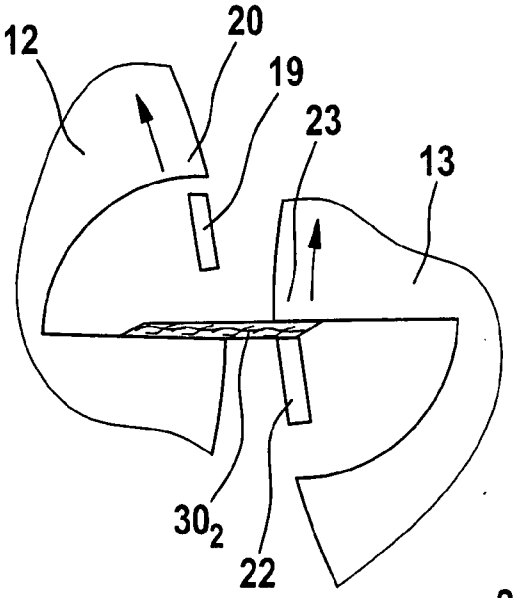


Fig. 12d

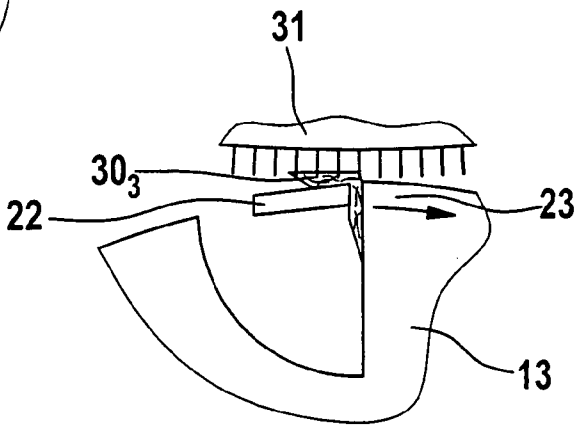


Fig. 13

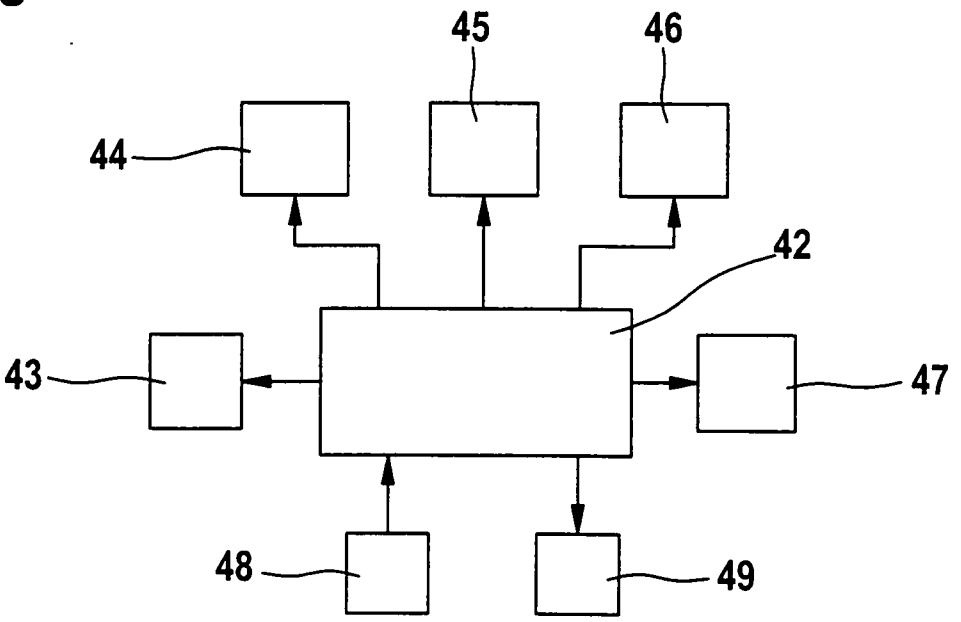
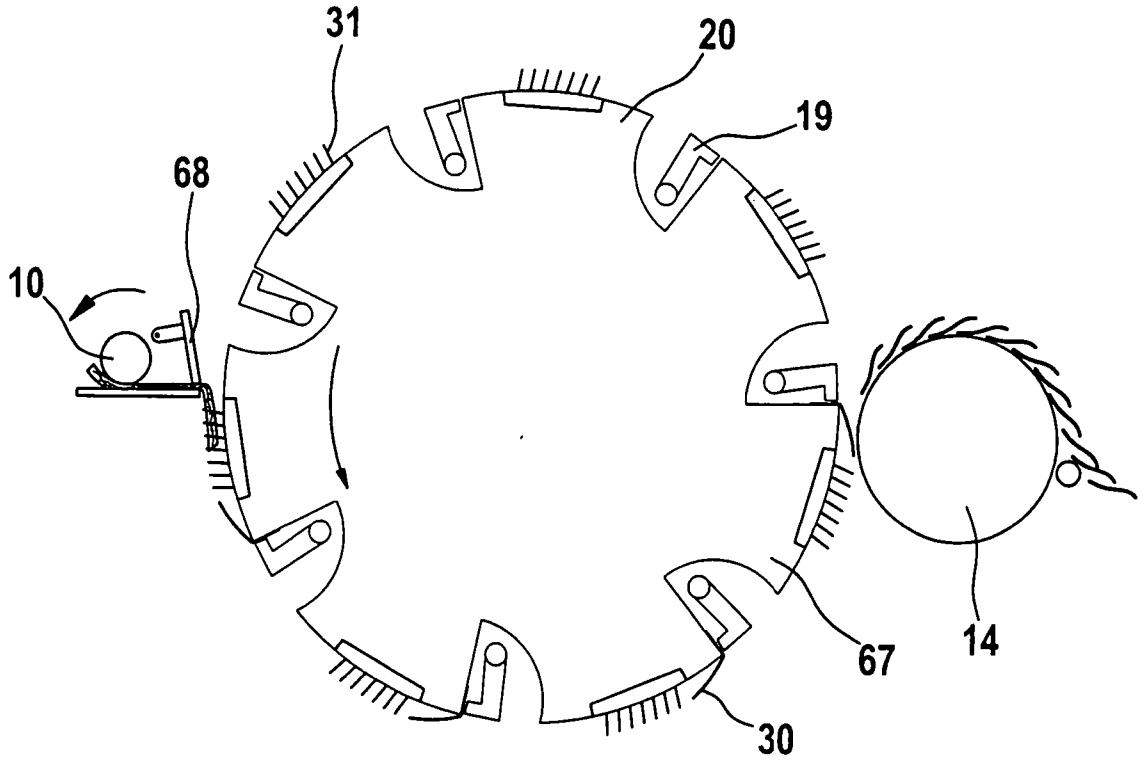


Fig. 14



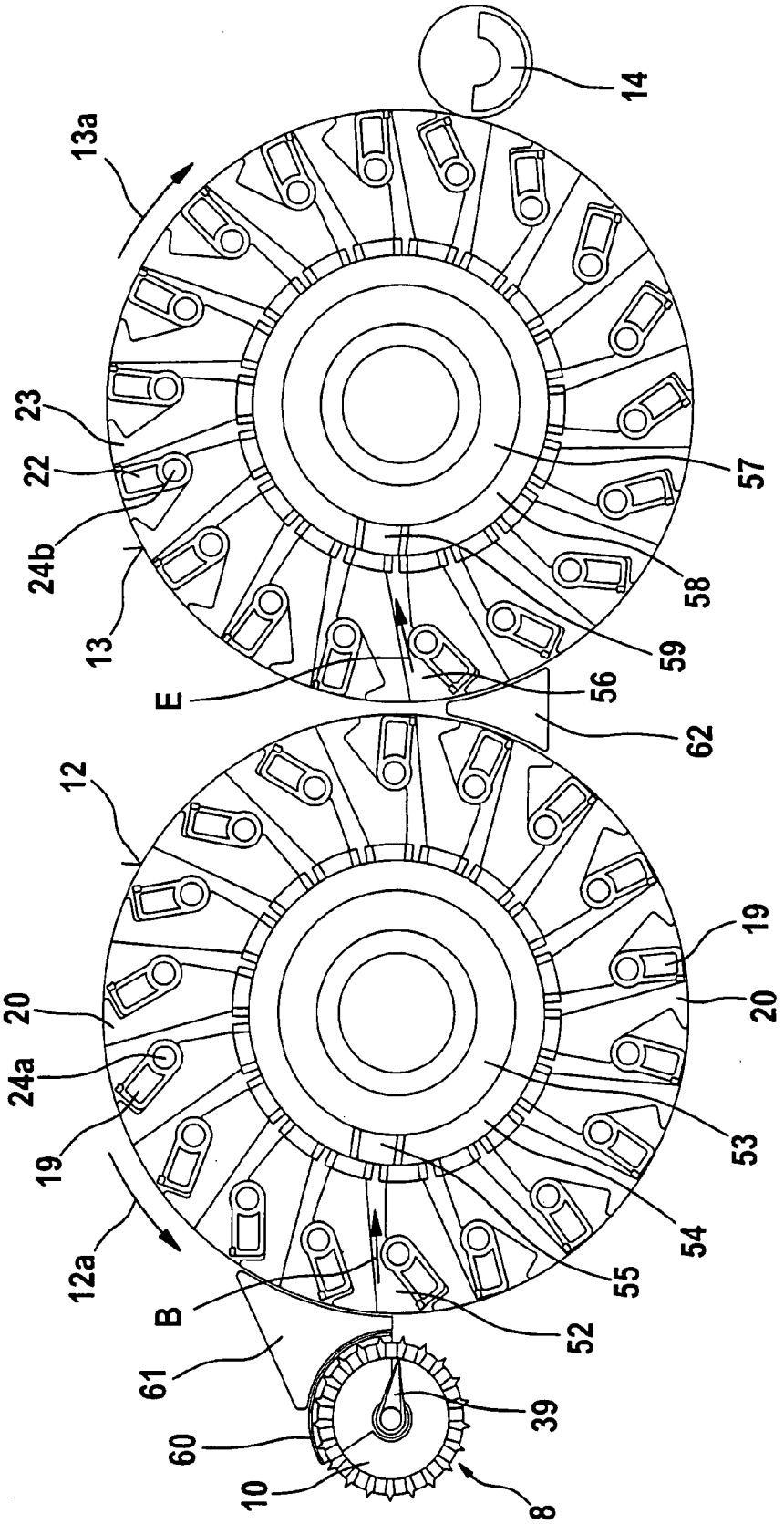

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Fig. 15

APPARATUS FOR THE SORTING OR SELECTION OF A FIBRE SLIVER COMPRISING TEXTILE FIBRES, ESPECIALLY FOR COMBING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from German Patent Application No. 10 2006 050 384.8 dated Oct. 20, 2006, German Utility Model Application No. 20 2007 010 686.6 dated Jun. 29, 2007 and German Patent Application No. 10 2007 037 426.9 dated Aug. 8, 2007, the entire disclosures of all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The invention relates to an apparatus for the sorting or selection of a fibre sliver comprising textile fibres, especially for combing. It is known for fibre slivers to be supplied by means of supply means to a fibre-sorting device, especially a combing device, in which clamping devices are provided which clamp the fibre sliver at a distance from its free end, mechanical means being present which generate a combing action from the clamping site to the free end of the fibre sliver in order to loosen and remove non-clamped constituents, such as, for example, short fibres, neps, dust and the like from the free end.

[0003] In practice, combing machines are used to free cotton fibres or woollen fibres of natural impurities contained therein and to parallelise the fibres of the fibre sliver. For that purpose, a previously prepared fibre sliver is clamped between the jaws of the nipper arrangement so that a certain sub-length of the fibres, known as the "fibre tuft", projects at the front of the jaws. By means of the combing segments of the rotating combing roller, which segments are edged with needle clothing or toothed clothing, the fibre tuft is combed and thus cleaned. The take-off device usually consists of two counter-rotating rollers which grip the combed fibre tuft and carry it onwards.

[0004] In order to separate short fibres, neps, dirt and other constituents from a fibre mixture it is known to supply the fibre material in the form of lap rolls to combing machines for mechanical combing-out, the end of the lap web being clamped by a nipper and the end projecting beyond the clamping line being mechanically combed-out by means of the comb clothing of a circular comb. The combed-out fibre tuft is then transferred to a detaching roller pair where it is in turn formed into a coherent web, or "pieced". When the fibre tuft is removed from the nipper by the detaching rollers, the end severed from the lap is likewise pulled through a mechanical top comb, so that as far as possible no short fibres, neps, dirt and other undesirable constituents remain in the combed web. A disadvantage of that known combing method is, in particular, the discontinuous mode of operation, in which large masses have to be accelerated and decelerated during the operating cycle.

[0005] The back and forth swinging movement of the nipper assembly gives rise to very substantial vibration, especially in the case of high nip rates, which on the one hand requires the drive elements and bearing elements to be of suitably stable construction and on the other hand places high demands on the framework of the machine as well as on the base on which the machine is mounted.

[0006] In order to be able to remove the partially cleaned fibres from the jaws of the nipper unit using the rollers of the take-off device, either the relatively heavy take-off device needs to move linearly or over part of an arc of a circle to the fibre tuft held between the jaws of the nipper arrangement or, the other way round, the nipper arrangement has to be moved towards the stationary take-off rollers. In the case of the 450 nips per minute usually required, the large masses being moved result in a high level of dynamic agitation of the entire combing machine which limits its operating speed and productivity.

[0007] Furthermore, a problem of conventional combing machines is that when the combed fibres are removed by the counter-rotating take-off rollers, up to 50% of the fibre length has not been cleaned by the circular comb, because during the combing process, that is to say when the combing segment passes, the fibres were clamped between the jaws of the nipper arrangement or were located behind the jaws, seen in the transport direction. In order also to clean that portion of the fibres as well as possible, those fibres are conventionally pulled through a top comb arranged in front of the take-off rollers. The top comb is an additional structural element for every combing head.

[0008] The detaching roller pair, consisting of a lower detaching roller and an upper detaching roller, is directly adjacent to the nipper apparatus and the circular comb. The lower detaching roller is located between the path of movement of the comb tips of the circular comb and the upper detaching roller and, together with the upper detaching roller, forms the clamping nip for the combed sliver. The nipper arrangement is mounted so as to swing in two directions. Firstly, it is moved, at a distance from the detaching roller pair, towards the path of movement of the comb tips of the circular comb. In that position, the combing of the fibre tuft is carried out by the circular comb. When that operation is complete, the nipper apparatus is raised as a unit so that the fibre tuft that has just been combed arrives in front of the clamping nip of the detaching roller pair. During that movement, the nipper apparatus also approaches the detaching roller nip horizontally. The portion of combed sliver conveyed back at that time point is overlapped with the tips of the new, combed fibre tuft, compressed in the clamping nip of the detaching rollers and drawn in the take-off direction by the detaching rollers, the top comb being inserted into the end of the fibre tuft that has just been combed and combing out that free piece of fibre. As a result of the receding movement of the nipper apparatus and the take-off movement of the detaching roller pair, the combed fibre tuft is detached and a fresh fibre tuft is supplied to the nipper apparatus by the feed roller, clamped and brought into the combing position relative to the circular comb. Such an arrangement is disadvantageous because, in particular, the nipper apparatus has to perform a variety of very large movements with greater or lesser degrees of acceleration. The operating speed is thus considerably limited, a large amount of noise is generated and the inertial forces that arise result in above-average wear. Adjustment of the detaching distance and the feed quantity can be effected only while the machine is stationary. A further crucial disadvantage is that the free end of the fibre tuft that has just been combed also has to be moved at relatively high speed, with its free fibre tips to the front, over large distances and placed in an exactly defined position onto the returned end of the combed sliver. In dependence upon the air vortices that occur and the

respective air resistance, the fibre tuft is frequently incorrectly positioned on the returned combed sliver so that it is necessary to operate at relatively low speeds. In any case, however, losses of quality are observed in the combed sliver. A further disadvantage of the known apparatus is that uncontrolled fold-formation occurs between the detaching roller pair and the take-off rollers as a result of the pilgrim-step motion of the detaching rollers, which additionally results in disruption of the combing process.

[0009] When the nipper is located in its forward position, it is opened and transfers the combed-out fibre tuft to the detaching roller pair, that tuft being pieced with the previously detached fibre tuft.

[0010] The known cotton-combing process is a discontinuous process. During a nipping operation, all assemblies and their drive means and gears are accelerated, decelerated and in some cases reversed again. High nip rates result in high acceleration. Particularly as a result of the kinematics of the nippers, the gear for the nipper movement and the gear for the pilgrim-step movement of the detaching rollers, high acceleration forces come into effect. The forces and stresses that arise increase as the nip rates increase. The known flat combing machine has reached a performance limit with its nip rates, which prevents productivity from being increased. Furthermore, the discontinuous mode of operation causes vibration in the entire machine which generates dynamic alternating stresses.

[0011] EP 1 586 682 A discloses a combing machine in which, for example, eight combing heads operate simultaneously one next to the other. The drive of those combing heads is effected by means of a lateral drive means arranged next to the combing heads having a gear unit which is in driving connection by way of longitudinal shafts with the individual elements of the combing heads. The fibre slivers formed at the individual combing heads are transferred, one next to the other on a conveyor table, to a subsequent drafting system in which they are drafted and then combined to form a common combing machine sliver. The fibre sliver produced in the drafting system is then deposited in a can by means of a funnel wheel (coiler plate). The plurality of combing heads of the combing machine each have a feed device, a pivotally mounted, fixed-position nipper assembly, a rotatably mounted circular comb having a comb segment for combing out the fibre tuft supplied by the nipper assembly, a top comb and a fixed-position detaching device for detaching the combed-out fibre tuft from the nipper assembly. Disadvantages of that combing machine are especially the large amount of equipment required and the low hourly production rate. There are eight individual combing heads which have in total eight feed devices, eight fixed-position nipper assemblies, eight circular combs with comb segments, eight top combs and eight detaching devices. A particular problem is the discontinuous mode of operation of the combing heads. Additional disadvantages result from large mass accelerations and reversing movements, with the result that high operating speeds are not possible. Finally, the considerable amount of machine vibration results in irregularities in the deposition of the combed sliver. Moreover, the ecartement, that is to say the distance between the nipper lip of the lower nipper plate and the clamping point of the detaching cylinder, is structurally and spatially limited.

SUMMARY OF THE INVENTION

[0012] It is an aim of the invention to provide an apparatus of the kind described at the beginning which avoids or mitigates the mentioned disadvantages and which in a simple way, in particular, enables the amount produced per hour (productivity) to be substantially increased and an improved combed sliver to be obtained.

[0013] The invention provides an apparatus for the sorting or selection of a fibre structure comprising textile fibres which is supplied by means of a supply device to a sorting device, wherein the sorting device comprises:

[0014] at least one rotatably mounted roller, arranged downstream of the supply device, that rotates rapidly without interruption;

[0015] clamping devices which can clamp a portion of the fibre at a distance from its free end;

[0016] a mechanical combing device comprising at least one combing element which generates a combing action from the clamping site to the free end of the fibre in order to loosen and remove non-clamped constituents from the free end;

wherein the clamping devices are provided on said at least one rotatably mounted roller distributed spaced apart in the region of the roller periphery, and the at least one combing element is associated with the periphery of the roller.

[0017] By implementing the functions of clamping and moving the fibre bundles to be combed-out on a rotating roller, high operating speeds (nip rates) are achieved—unlike the known apparatus—without large mass accelerations and reversing movements. In particular, the mode of operation is continuous. When a high-speed roller is used, a very substantial increase in hourly production rate (productivity) is achieved which had previously not been considered possible in technical circles. A further advantage is that the rotary rotational movements result in a calming of vibration as well as more uniform movement sequences of the machine and accordingly in an improved combed sliver. The ecartement is advantageously not limited structurally. Moreover, the feed quantity of the incoming fibre lap is increased as a result and the separation of long-fibres is reduced.

[0018] The clamping devices advantageously cooperate with the means for generating a combing action (combing elements). Advantageously, the means for generating a combing action (combing elements) are located opposite the periphery of the roller. Advantageously, there is a space between the means for generating a combing action (combing elements) and the clamping devices. Advantageously, there is a space between the means for generating a combing action (combing elements) and the periphery of the roller. Advantageously, during combing-out the fibre sliver being combed out is in engagement with a clamping device and with a means for generating a combing action (combing element). The supply arrangement for the rotating roller may in some embodiments comprise a top comb roller. The supply arrangement may instead or as well comprise one or more of: a roller having clothing, needles or the like; a comb circulation element; two endlessly circulating belts; at least two feed rollers; or a slow-speed feed roller and a feed table. In certain embodiments, the supply arrangement may be formed from a drafting system. Advantageously, a top comb is arranged between the supply arrangement and the rotat-

able roller. Advantageously, the supply arrangement is fixed. Advantageously, the supply arrangement conveys the fibre lap continuously. Advantageously, means are provided to separate the fibre sliver delivered by the supply arrangement step-wise into individual fibre tufts. Advantageously, the means for creating individual fibre tufts comprise the rotatably mounted first roller. Advantageously, the rotatably mounted roller is provided with first clamping devices distributed spaced apart around its periphery, which preferably each have a nipper device. Preferably, there are means for transferring the fibre tufts to the subsequent sorting device (combing device). Preferably, the first roller serves for transferring the fibre tufts to the subsequent fibre-sorting device (combing device). Advantageously, when transferring the fibre tufts the first clamping elements and second clamping devices of a second roller cooperate. Advantageously, a rotatably mounted second roller is associated axially parallel to the first roller. In certain embodiments, the first roller and the second roller rotate in opposite directions to one another. Advantageously, the second roller is provided with second clamping devices distributed spaced apart around its periphery, the second clamping devices each advantageously having a nipper device. With respect to the first and/or second roller, the nipper devices may have a rotatably or displaceably mounted gripping element (upper nipper) and/or a fixedly mounted counter-element (lower nipper). The nipper devices may have a fixedly mounted counter-element (lower nipper). Advantageously, the counter-element (lower nipper) is movably mounted. Advantageously, the gripping element (upper nipper) is loaded by a force element, for example by a spring. Advantageously, the movably mounted counter-element (lower nipper) is force-loaded, for example by a spring. Advantageously, there is a relative movement between the nipper devices of the first roller and the supply arrangement. Advantageously, the second clamping devices cooperate with the means for generating a combing action. Advantageously, the means for generating a combing action are arranged at a distance from the outer periphery of the second roller. Advantageously, the second clamping devices cooperate with the means for generating a combing action. Advantageously, the means for generating a combing action are arranged at a distance from the outer periphery of the second roller. The means for generating a combing action may be of any suitable kind. For example, the means for generating a combing action may have endlessly circulating comb elements (revolving top). In that case, the comb elements run in the same direction as the clamped fibre bundles. It is preferred that the speed ratio between the second roller (combing rotor) and the comb top circulation is greater than 1.

[0019] In another advantageous embodiment, the means for generating a combing action have at least one rotating circular comb (circular comb rollers). The circular comb may have combing elements around its periphery. The circular comb may have circular comb rollers equipped with needles or the like around their periphery.

[0020] Advantageously, the second roller is associated with a take-off device. Preferably, there is a rotatably mounted take-off roller axially parallel to the second roller (combing rotor). The take-off roller may be provided with a clothing or the like on its outer periphery. Advantageously, the outer cylindrical surface of the take-off roller has air-passage openings. Advantageously, the interior of the take-off roller is connected to a source of negative pressure. In practice, it may be advantageous for a portion of the inner cylindrical surface of the take-off roller to be sealed by a screen element. Advantageously, the take-off roller is used for piecing the combed fibre tufts. Preferably, at least two fibre tufts are arranged to be supplied to the sorting device. Preferably, the fibre tufts are arranged to be supplied one after another to the fibre-sorting device. Preferably, a drafting device is arranged downstream of the take-off roller. As well, or instead, a sliver-deposition device may be arranged downstream of the take-off roller. In certain preferred arrangements, a drive device, for example a motor, is provided for moving the clamping devices, for example the upper nipper. It is preferred for a cam gear, for example a cam disc gear, to be arranged between the drive device, for example a motor, and the clamping devices. Preferably, at least one roller (supply roller, combing roller) is associated with a drive device, for example an electric motor. Preferably, the first roller and the second roller are drivable by a common gear. Advantageously, the drive device, for example an electric motor, drives the common gear.

[0021] In practice, two or more rotor combing machines are typically present. In that case, a drafting system is advantageously arranged downstream of each rotor combing machine. It is preferred for there to be provided, in association with a combing element or elements, a cleaning device, for example, a rotating cleaning roller. The cleaning roller is advantageously associated with an extraction device.

[0022] The invention also provides an apparatus for the sorting or selection of a fibre sliver comprising textile fibres, especially for combing, which is supplied by means of supply means to a sorting device, especially a combing device, in which clamping devices are provided which clamp the fibre sliver at a distance from its free end, and mechanical means are present which generate a combing action from the clamping site to the free end of the fibre sliver in order to loosen and remove non-clamped constituents, such as, for example, short fibres, neps, dust and the like from the free end, characterised in that downstream of the supply means there is arranged at least one rotatably mounted roller that rotates rapidly without interruption and that is provided with clamping devices for the fibre sliver, which clamping devices are distributed spaced apart in the region of the roller periphery, and the mechanical means for generating a combing action (combing elements) are associated with the periphery of the roller.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. **1** is a diagrammatic perspective view of a device for combing fibre material, comprising a combing preparation device, a rotor combing machine and a sliver-deposition device,

[0024] FIG. **2** is a diagrammatic side view of a rotor combing machine according to the invention having two rollers,

[0025] FIG. **3** is a perspective view of the rotor combing machine according to FIG. **2** having two cam discs,

[0026] FIG. **4** shows a top comb roller as supply means,

[0027] FIG. **5** shows a clothed roller as supply means,

[0028] FIGS. **6***a*, **6***b* show two arrangements of a double belt device as supply means,

[0029] FIGS. **7***a*, **7***b* show two feed rollers as supply means, having a top comb from above (FIG. **7***a*) and from below (FIG. **7***b*),

[0030] FIG. **8** is a side view of the second roller (combing roller) having clamping devices and a revolving card top device for combing elements,

[0031] FIG. **9** is a side view of the second roller (combing roller) having clamping devices and circular combs (comb rollers) as combing elements,

[0032] FIGS. **10***a*, **10***b* show the second roller (combing rotor) and the take-off roller for counter-direction piecing (FIG. **10***a*) and same-direction piecing (FIG. **10***b*),

[0033] FIG. **11** is a diagrammatic view of a clamping device comprising a spring-loaded upper nipper (gripping element) and a spring-loaded lower nipper (counter-element),

[0034] FIG. **12***a* to **12***d* show in diagrammatic form the operating sequence of fibre selection in the case of the two-rotor combing machine,

[0035] FIG. **13** is a block circuit diagram showing an electronic control and regulation device for the spinning preparation machine, the rotor spinning machine and the sliver-deposition device and

[0036] FIG. **14** is a diagrammatic side view of a further embodiment of the rotor combing machine having a roller.

[0037] FIG. **15** is a schematic side view of first and second rollers of a rotor combing machine including a plurality of suction openings.

DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

[0038] With reference to FIG. **1**, a combing preparation machine **1** has a sliver-fed and lap-delivering spinning room machine and two feed tables **4***a*, **4***b* (creels) arranged parallel to one another, there being arranged below each of the feed tables **4***a*, **4***b* two rows of cans **5***a*, **5***b* containing fibre slivers (not shown). The fibre slivers withdrawn from the cans **5***a*, **5***b* pass, after a change of direction, into two drafting systems **6***a*, **6***b* of the combing preparation machine **1** which are arranged one after the other. From the drafting system **6***a*, the fibre sliver web that has been formed is guided over the web table **7** and, at the outlet of the drafting system **6***b*, laid one over the other with, and brought together with, the fibre sliver web produced therein. By means of the drafting systems **6***a* and **6***b*, in each case a plurality of fibre slivers are combined to form a lap and drafted together. A plurality of drafted laps (two laps in the example shown) are doubled by being placed one on top of the other. The lap so formed is introduced directly into the supply device (feed element) of the downstream rotor combing machine **2**. The flow of fibre material is not interrupted. The combed fibre web is delivered at the outlet of the rotor combing machine **2**, passes through a funnel (see FIG. **10***a*), forming a comber sliver, and is deposited in a downstream sliver-deposition device **3**. Reference numeral A denotes the operating direction.

[0039] An autoleveller drafting system **50** (see FIG. **2**) can be arranged between the rotor combing machine **2** and the sliver-deposition device **3**. The comber sliver is thereby drafted.

[0040] In accordance with a further construction, more than one rotor combing machine **2** is provided. If, for example, two rotor combing machines **2***a* and **2***b* are present, then the two delivered comber slivers **17** can pass together through the downstream autoleveller drafting system **50** and be deposited as a drafted comber sliver in the sliver-deposition device **3**.

[0041] The sliver-deposition device **3** comprises a rotating coiler head **3***a*, by which the comber sliver can be deposited in a can **3***b* or (not shown) in the form of a can-less fibre sliver package.

[0042] FIG. **2** shows an illustrative embodiment in which a rotor combing machine **2** having a supply device **8** comprises a feed roller **10** and a feed tray **11**, having a first roller **12** (turning rotor), second roller **13** (combing rotor), a take-off device **9** comprising a take-off roller **14** and a revolving card top combing assembly **15**. The directions of rotation of the rollers **10**, **12**, **13** and **14** are shown by curved arrows **10***a*, **12***a*, **13***a* and **14***a*, respectively. The incoming fibre lap is indicated by reference numeral **16** and the delivered fibre web is indicated by reference numeral **17**. The rollers **10**, **12**, **13** and **14** are arranged one after the other. Arrow A denotes the operating direction.

[0043] The first roller **12** is provided in the region of its outer periphery with a plurality of first clamping devices **18** which extend across the width of the roller **12** (see FIG. **3**) and each consist of an upper nipper **19** (gripping element) and a lower nipper **20** (counter-element). In its one end region facing the centre point or the pivot axis of the roller **12**, each upper nipper **19** is rotatably mounted on a pivot bearing **24***a* (see FIG. **11**) which is attached to the roller **12**. The lower nipper **20** is mounted on the roller **12** so as to be either fixed or movable (see FIG. **11**). The free end of the upper nipper **19** faces the periphery of the roller **12**. The upper nipper **19** and the lower nipper **20** co-operate so that they are able to grip a fibre sliver **16**, $\mathbf{30}_1$, $\mathbf{30}_2$ (clamping) and release it (FIG. **12***a* to **12***c*).

[0044] The second roller **13** is provided in the region of its outer periphery with a plurality of two-part clamping devices **21** which extend across the width of the roller **13** (see FIG. **3**) and each consist of an upper nipper **22** (gripping element) and a lower nipper **23** (counter-element). It will be appreciated that the terms "upper" and "lower" in relation to the nippers refer to their relative positions, which may change during operation, and are used merely for convenience. Thus, in the rotational position of the roller shown in FIG. **11**, the upper nipper **22** is in fact shown as being below the lower nipper **23**. In its one end region facing the centre point or the pivot axis of the roller **13**, each upper nipper **22** is rotatably mounted on a pivot bearing **24***b* (see FIG. **11**) which is attached to the roller **13**. The lower nipper **23** is mounted on the roller **13** so as to be either fixed (see FIG. **8**) or movable (see FIG. **11**). The free end of the upper nipper **22** faces the periphery of the roller **13**. The upper nipper **22** and the lower nipper **23** co-operate so that they are able to grip a fibre sliver $\mathbf{30}_2$, $\mathbf{30}_3$ (clamping) and release it (FIGS. **8**; **10***a*, **10***b*; **12***c*, **12***d*). In the case of roller **12**, around the roller periphery between the feed roller **10** and the second roller **13** the clamping devices **18** are closed (they clamp fibre bundles (not shown) at one end) and between the second roller **13** and the feed roller **10** the clamping devices **18** are open. In roller **13**, around the roller periphery between the first roller **12** and the doffer **14** the clamping devices **21** are closed (they clamp fibre bundles (not shown) at one end) and between the doffer **14** and the first roller **12** the clamping devices **21** are open. Reference numeral **50** denotes a drafting system, for example an autoleveller drafting system. The drafting system **50** is advantageously arranged above

the coiler head **3***a*. Reference numeral **51** denotes a driven ascending conveyor, for example a conveyor belt. It is also possible to use an upwardly inclined metal sheet or the like for conveying purposes.

[0045] The roller **12**, and preferably also the roller **13**, is mounted rotatably and in use rotates rapidly without interruption.

[0046] In the embodiment of FIG. **3**, for the purpose of opening and closing the clamps, two fixed cam discs **25** and **26** are provided, about which the roller **12** having the first clamping devices **18** and the roller **13** having the second clamping device **21** are rotated in the direction of arrows **12***a* and **13***a*, respectively. The loaded upper nippers **19** and **22** are arranged in the intermediate space between the outer periphery of the cam discs **25**, **26** and the inner cylindrical surfaces of the rollers **12**, **13**. By rotation of the rollers **12** and **13** about the cam discs **25** and **26**, the upper nippers **19** and **22** are rotated about pivot axes **24***a* and **24***b*, respectively. In that way, the opening and closing of the first clamping devices **18** and the second clamping devices **21** is implemented.

[0047] In the arrangement of FIG. **4**, the feed roller **10** has around its periphery comb segments **10***b* which are arranged axially parallel across the width. The feed roller **10** in accordance with another embodiment shown in FIG. **5** has around its periphery a clothing **10***c*, preferably all-steel clothing. In the embodiments of FIGS. **6***a*, **6***b*, the supply device consists of two endlessly revolving belts **27***a*, **27***b*, between which there is a conveyor gap for the incoming fibre lap **16**. The conveyor gap in FIG. **6***a* is arranged substantially radially with respect to the roller **12**, while the conveyor gap in FIG. **6***b* is arranged opposite the direction of rotation **12***a*. In yet further embodiments according to FIGS. **7***a* and **7***b*, between a feed roller pair **28***a*, **28***b* (for directions of rotation see curved arrows) and the first roller **12** there is arranged a fixed comb $\mathbf{29}^1$ and $\mathbf{29}_2$, respectively, the comb teeth of the fixed comb $\mathbf{29}^1$ engaging the fibre lap **16** from above and the comb teeth of the fixed comb $\mathbf{29}_2$ engaging the fibre lap **16** from below.

[0048] Using the embodiment of FIG. **8**, the fibre bundles $\mathbf{30}_3$ are clamped at one end by some of the clamping devices **21** between the upper nipper **22** and the lower nipper **23**, that is to say at a distance from their free end. The fibre bundles $\mathbf{30}_3$ are then bent over in the direction of their free ends, the free end regions of the fibre bundles $\mathbf{30}_3$ each being directed against the direction of rotation **13***a*. The revolving top combing assembly **15** consists of a flexible belt element **15***c* endlessly revolving around two guide rollers **15***a* and **15***b* and having a plurality of combing elements **31** mounted on its outer side. The free ends of the combing teeth of the combing elements **31** point in the direction away from the belt element **15***c*. The combing elements **31** are arranged in the combing-out region at a distance from the periphery of the roller **13**. In the combing-out region, the direction of movement **15***d* of the belt element **15***c* and the direction of movement **13***a* of the roller **13** are the same, that is to say same-direction operation applies. The speeds of the belt element **15***c* having the combing elements **31** on the one hand and of the roller **13** having the clamping elements **21**, including the sliver bundles $\mathbf{30}_3$, are different, however, that is to say a relative speed applies. The circumferential speed of the roller **13** in the operating region (combing region) is greater than the speeds of movement of the combing elements **31**.

[0049] In the embodiment of FIG. **9**, the combing elements are implemented by a plurality of rotating combing rollers **32** which lie opposite, and at a distance from, the periphery of the roller **13** in the region between the doffer **14** and the roller **12** (see FIG. **2**).

[0050] In an arrangement shown in FIG. **10***a*, the directions of rotation **13***a* and **14***a* of the roller **13** and the doffer **14** are the same (both clockwise). As a result, counter-direction piecing is implemented. The combed fibre bundles $\mathbf{30}_4$ are placed one over the other in the manner of roof tiles on the cylindrical surface of the doffer. In the interior of the doffer **14** there is a fixed screen element **33**. The cylindrical surface of the doffer **14** has air-permeable openings. By applying a negative pressure −p in the space between the doffer **14** and the inner cylindrical surface, the fibre bundles $\mathbf{30}_3$ are sucked from the roller **13** onto the outer cylindrical surface of the doffer **14**. Outside the screen element **33**, that is to say in the region without a negative pressure, the fibre bundles $\mathbf{30}_4$ can be detached from the outer cylindrical surface of the doffer **14**.

[0051] In another arrangement shown in FIG. **10***b*, the directions of rotation **13***a* and **14***a* of the roller **13** and the doffer **14** are opposite to one another. As a result, same-direction piecing is implemented. The combed fibre bundles $\mathbf{30}_3$ are removed from the roller **13** by the doffer **14** in substantially the same way as that described with reference to the construction according to FIG. **10***a*. Downstream of the doffer **14** there is a sliver funnel **34** into which the overlapping fibre bundles $\mathbf{30}_4$ enter and emerge or are withdrawn as a combed sliver **35**.

[0052] FIG. **11** shows in detail one illustrative clamp arrangement. The upper nipper **22** is substantially in the form of a single-arm rotatable lever arm which is at its one end region rotatable in the direction of arrows B and C about a pivot axis **24**. The bearing **36** is mounted on the roller **13**. The upper nipper **22** is resiliently biased by a spring **37**, for example a compression spring. The resilient bias co-operates with the cam disc **26** (see FIG. **3**) so that the upper nipper **22** is deflected by the cam disc **26** against the pressing force of the spring **37**. The lower nipper **23** is resiliently biased in the region of its one end by a spring **38**, for example a compression spring, so that the lower nipper **23** is movable in the direction of arrows D and E. As a result, on closing the upper nipper **22** the pressure impacts on the lower nipper **23** are resiliently cushioned, with the result that vibration, wear and impairment of the fibre bundles $\mathbf{30}_3$ are substantially reduced. Reference numerals **40** and **41** denote fixed bearings on which one end of each of the springs **37** and **38** is supported.

[0053] The upper nippers **19** and the lower nippers **20** of the first clamping device **18** can be resiliently biased in a corresponding way to that shown in FIG. **11** for the second clamping devices **21**.

[0054] FIGS. **12***a* to **12***d* show in diagrammatic form the operating sequence of fibre selection in the case of the rotor combing machine **2** (two-rotor combing machine), the Figures showing one after the other in chronological order: clamping of the fed lap **16** by the first clamping device **18** (FIG. **12***a*), removal of a fibre tuft $\mathbf{30}_1$ in the direction of rotation **12***a* of the first roller **12** (FIG. **12***b*), transfer of the fibre tuft $\mathbf{30}_2$ from the roller **12** to the roller **13** by opening of the clamping device **18** and closing of the clamping device **21**, with the fibre tuft $\mathbf{30}_2$ being clamped (FIG. **12***c*),

and combing of the fibre tuft 30_3 by motive engagement into the combing element **31** (FIG. **12***d*).

[0055] According to an illustrative arrangement shown in FIG. **13**, an electronic control and regulation device **42** (machine and system control means), for example a microcomputer with a microprocessor, is provided, to which inter alia the drive devices **43**, **44**, **45**, **46**, **47**, for example electric motors for the rollers **10**, **12**, **13**, **14** and for the revolving card top assembly **15** (guide roller **15***a*) of the rotor combing machine **2**, are connected. Reference numeral **48** denotes an input device and reference numeral **49** denotes a display device. The drive devices for the combing preparation machine **1**, the drafting system **50**, the conveyor belt **51** and for the sliver-deposition device **3**, are advantageously also connected (not shown).

[0056] Insofar as the rollers **12** and **13** are driven by means of a common gear, the drive motor for the common gear is connected to the control and regulation device **42**.

[0057] The circumferential speeds are, for example, for the feed roller about from 0.2 to 1.0 m/sec; the first roller **12** about from 2.0 to 6.0 m/sec; the second roller **13** about from 2.0 to 6.0-m/sec; the doffer about from 0.4 to 1.5 m/sec; and the revolving top assembly about from 1.5 to 4.5 m/sec. The diameter of the first roller **12** and the second roller **13** is, for example, about from 0.3 m to 0.8 m.

[0058] In respect of the mode of operation and operating sequence of the apparatus according to the invention, typically:

[0059] Lap Preparation

[0060] A plurality of slivers are combined to form a lap **16** and drafted together. A plurality of laps **16** can be doubled by being placed one on top of the other. The resulting lap **16** is introduced directly into the feed element **10** of the rotor combing machine **2**. The flow of material is not interrupted by forming a wound lap.

[0061] Feed

[0062] Unlike a flat combing machine, the upstream lap **16** is fed continuously by means of a conveyor element. The feed quantity is determined by the length of lap **16** conveyed between two closure time points of the nippers **18** (reversing nippers) of the first rotor **12** (turning rotor).

[0063] Clamping **1**

[0064] The fibre tuft aligned and projecting out of the lap **16** is clamped by a clamping device **18** (reversing nipper) of the first rotor **12** (turning rotor). The clamping device **18** of the first rotor **12** assumes the function of detachment.

[0065] Removal

[0066] As a result of the rotation of the turning rotor **12** with the reversing nippers **18** located thereon, the clamped fibre tuft is removed from the feed lap, it being necessary for a retaining force to act on the lap **16** so that the fibres in the lap **16** not clamped by the reversing nipper **8** are retained. The retaining force is applied by the conveyor element of the feed means or by additional means such as a feed tray or a top comb. The elements that generate the retaining force assume the function of the top comb.

[0067] Clamping **2**

[0068] The fibre tuft is aligned and transferred to the clamping device **21** (combing nipper) of the second rotor **13** (combing rotor). The distance between the reversing nipper clamping line and the combing nipper clamping line at the time the combing device **21** closes determines the ecartement.

[0069] Combing

[0070] The fibre tuft projecting out of the combing nipper **21** contains non-clamped fibres that are eliminated by means of combing.

[0071] Piecing

[0072] The combed-out fibre tuft 30_3 is deposited on a take-off roller **14**. The surface of the take-off roller **14**, which surface is acted upon by suction and is air-permeable, causes the fibre tuft to be deposited, stretched-out, on the take-off roller **14**. The fibre tufts are placed one on top of the other, overlapping in the manner of roof tiles, and form a web of fibre portions 30_4.

[0073] Web Removal and Comber Sliver Formation

[0074] The web **17** is removed from the take-off roller **14** at a point on the take-off roller not acted upon by suction and is guided into a funnel **34**.

[0075] Comber Sliver Procedure

[0076] The resulting comber sliver can be doubled and drafted (drafting system **50**) and is then deposited, for example, in a can **3***b* by means of coiler **3***a*.

[0077] In an exemplary embodiment shown in FIG. **14**, a rotor combing machine has a feed device **10**, a roller **53** and doffer roller **14**. The clamping devices **19**, **20** and the combing elements **31** are arranged on the periphery of the one rotating roller.

[0078] In FIG. **8**, reference numeral **63** denotes a rotating cleaning roller which loosens combed-out constituents such as fibres, neps, dust and the like from the combing elements **31** and propels them into a collecting and extracting device **64**.

[0079] In FIG. **9**, the combing rollers are likewise provided with a cleaning roller **65** with extracting device **66**.

[0080] Using the rotor combing machine **2** according to the invention, more than 2000 nips/min, for example from 3000 to 5000 nips/min, are achieved.

[0081] In a further embodiment shown in FIG. **15**, the rotatably mounted rollers **12** and **13** with clamping devices **19**, **20** and **22**, **23** are equipped additionally with suction channels **52** and **56**, respectively (suction openings), which, in the region of the delivery between the supply device **8** and the roller **12** and in the region of the delivery between the rollers **12** and **13**, influence the alignment and movement of the fibres being transported. In that way, the time for the taking up of the fibre material from the supply device **8** onto the first roller **12** and the delivery to the second roller **13** is significantly reduced so that the nip rate can be increased. The suction openings **52**, **56** are arranged within the rollers **12** and **13**, respectively, and rotate with the rollers. At least one suction opening is associated with each clamping device **19**, **20** and **22**, **23** (nipper device). The suction openings **52**, **56** are each arranged between a gripping element (upper nipper) and counter-element (lower nipper). In the interior of the rotors **12**, **13** there is an underpressure region **53** to **55** and **57** to **59**, respectively, created by the suction flow at the suction openings **52**, **56**. The underpressure can be generated by connecting to a flow-generating machine. The suction flow at the individual suction openings **52**, **56** can be so switched between underpressure region and suction opening that it is applied only at particular selected angular positions on the roller circumference. For the purpose of the switching, valves or a valve pipe **54**, **58** with openings **57** and **59**, respectively, in the corresponding angular positions can be used. The release of the suction flow may also be brought about by the movement of the gripping element (upper

nipper). Furthermore, it is possible to arrange a region of underpressure only at the corresponding angular positions.

[0082] Additionally, a blowing flow can be provided in the region of the supply device **8** and/or in the region of transfer between the rollers. The source of the blowing flow (blowing nozzle **39**) is arranged inside the feed roller **10** and has effect, through the air-permeable surface of the supply device or air passage openings, towards the outside in the direction of the first roller. Also, in the region of the supply device **8**, the element for producing the blown air flow can be fixedly arranged, directly under or over the supply device **8**. In the region of the transfer between the rollers **12**, **13** the blown air current sources can be arrange at the perimeter of the first roller **12**, directly under or over each nipper device. For the blown air generation there may be used compressed air nozzles or air blades.

[0083] The suction flow B can favourably influence and shorten not only the guiding, but also the separation process between the lap and the tufts to be removed in the region of the supply device **8**.

[0084] As a result of the provision of additional air guide elements **60** and lateral screens **61**, **62** the direction of the flow can be influenced and the air carried round with the rotors separated off. In that way the time for set up can be further shortened. In particular, a screen element between the first rotor **12** and supply device **8** over the lap and a screen element on each side of the roller have proved useful.

[0085] The combed out fibre portion $\mathbf{30}_3$ passes from the second roller **13** onto the piecing roller **14**.

[0086] In use of the rotor combing machine according to the invention there is achieved a mechanical combing of the fibre material to be combed, that is, mechanical means are used for the combing. There is no pneumatic combing of the fibre material to be combed, that is, no air currents, e.g. suction and/or blown air currents, are used.

[0087] In the rotor combing machine according to the invention there are present rollers that rotate rapidly without interruption and that have clamping devices. Rollers that rotate with interruptions, stepwise or alternating between a stationary and rotating state are not used.

[0088] Although the foregoing invention has been described in detail by way of illustration and example for purposes of understanding, it will be obvious that changes and modifications may be practiced within the scope of the appended claims.

What is claimed is:

1. An apparatus for the sorting or selection of a fibre structure comprising textile fibres which is supplied by means of a supply device to a sorting device, wherein the sorting device comprises:

at least one rotatably mounted roller, arranged downstream of the supply device, that rotates rapidly without interruption;

clamping devices which can clamp a portion of the fibre at a distance from its free end;

a mechanical combing device comprising at least one combing element which generates a combing action from the clamping site to the free end of the fibre in order to loosen and remove non-clamped constituents from the free end;

wherein the clamping devices are provided on said at least one rotatably mounted roller distributed spaced apart in the region of the roller periphery, and the at least one combing element is associated with the periphery of the roller.

2. An apparatus according to claim **1**, in which the clamping devices co-operate with combing elements located opposite the periphery of the roller and spaced therefrom.

3. An apparatus according to claim **1**, in which, during combing-out, the fibre sliver being combed out is in engagement with a clamping device and with a combing element.

4. An apparatus according to claim **1**, in which the supply device comprises one or more of: a roller having clothing or needles; a circulating comb element; two endlessly circulating belts; at least two feed rollers; and a slow-speed feed roller and a feed table.

5. An apparatus according to claim **1**, in which a top comb is arranged between the supply arrangement and the rotatable roller.

6. An apparatus according to claim **1**, in which the supply device conveys the fibre lap continuously, and a separation device is provided to separate the fibre lap delivered by the supply device stepwise into individual fibre tufts.

7. An apparatus according to claim **1**, in which there is a first roller provided with first clamping devices distributed spaced apart around its periphery and a second roller provided with second clamping devices distributed spaced apart around its periphery.

8. An apparatus according to claim **7**, in which the first clamping devices and the second clamping devices each have a rotatably or displaceably mounted gripping element.

9. An apparatus according to claim **8**, in which the first and second clamping devices each have a fixedly mounted counter-element or a movably mounted counter-element.

10. An apparatus according to claim **1**, in which there is a relative movement between the clamping devices of the first roller and the supply device.

11. An apparatus according to claim **7**, in which, when transferring the fibre bundles from the first roller to the second roller, the first clamping elements and the second clamping devices co-operate.

12. An apparatus according to claim **7**, in which the first roller and the second roller rotate in opposite directions to one another.

13. An apparatus according to claim **7**, in which the second clamping devices co-operate with further combing elements, which are arranged at a distance from the outer periphery of the second roller.

14. An apparatus according to claim **7**, in which the combing device has endlessly circulating comb elements on a revolving top device, associated with the second roller.

15. An apparatus according to claim **14**, in which the comb elements run in the same direction as the clamped fibre tufts and the speed ratio between the second roller and the top device circulation is greater than 1.

16. An apparatus according to claim **15**, in which the combing device has at least one rotating circular comb roller with combing elements around its periphery.

17. An apparatus according to claim **7**, further comprising a take-off roller associated with the second roller upon which combed fibre tufts can be pieced.

18. An apparatus according to claim **17**, in which the outer cylindrical surface of the take-off roller has air-passage openings and in which the interior of the take-off roller is connected to a source of negative pressure.

19. An apparatus according to claim **18**, in which a portion of the inner cylindrical surface of the take-off roller is sealed by a screen element.

20. An apparatus according to claim **1**, in which a drive device is provided for moving the clamping devices, and a cam gear is arranged between the drive device and the clamping devices.

21. An apparatus according to claim **1**, further comprising a cleaning device comprising a cleaning roller and an extraction device associated with the cleaning roller.

22. An apparatus according to claim **7**, in which, for the suction of the supplied slivers, at least one suction device is associated with the clamping devices in the region of the take-up of the fibre sliver from the supply device to the first roller and/or in the region of the take-up of the fibre material from the first roller to the second roller.

23. An apparatus according to claim **7**, in which, at least one blowing opening is provided in the region of the delivery of the fibre sliver from the supply device to the first roller and/or in the region of the delivery of the fibre material from the first roller to the second roller.

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