

Apparatus for transporting fibre material between a drafting device and a loop-forming machine and a circular knitting machine equipped with said apparatus

The invention relates to a device of the type indicated in the preamble of claim 1 and to a circular knitting machine equipped therewith.

Devices of this type are known in particular in conjunction with so-called spin-knitting machines, i.e. for example circular knitting machines (PCT WO 2004/079 068 A2, DE 10 2006 006 502 A1) which operate with extensively untwisted fibre materials instead of with normal yarns. The fibre material used for knitting is converted directly after emergence thereof from a drawing frame with the help of a spinning or transport device which has a so-called twisting member into a temporary yarn, the temporary twisting of the fibre material being maintained during the entire transport process. Transport of the temporary yarn is effected preferably in a transport pipe connected to the twisting member. For longer transport paths which are generally desirable, a plurality of transport units which are formed respectively from one twisting member and one transport pipe are connected in succession in order to be able to dispose the drawing frames at a comparatively large distance from the loop-forming machine. For the purpose of achieving a uniform transport of the fibre, it is normal in addition to leave a gap between two successive transport units of this type which serves to dissipate the compressed airflows which are required for producing the twists. Consequently, it is possible, on the one hand, to transport the fibre material, despite its low strength relative to normal yarns, over fairly long stretches from the drawing frame to an assigned system of a loop-forming machine, in particular a circular knitting machine, since it is achieved by this contrivance that the fibre material which is shaped into a temporary yarn meets all strength requirements on the transport path and no danger exists that it detaches or tears. On the other hand, the twists provided for the fibre

material in the temporary yarn are again reduced to zero (false twist principle) on the short stretch from the end of the outlet of the transport device to the relevant system of the loop-forming machine so that the fibre material processed into loops does not comprise a twisted yarn but essentially untwisted staple fibres which are disposed parallel to each other. Consequently, a knitted fabric with extreme softness is obtained as end product.

One disadvantage of the described transport resides in the fact that dirt particles, burls, short and foreign fibres and also other foreign bodies which adhere loosely to the fibre material and are entrained with the latter can lead to faults in the knitted fabric and to contamination of the loop-forming members. Differently from normal spinning, no spoolers or the like are present, by means of which impurities and other faults in the fibre material can be recognised and possibly eliminated by cutting up the temporary yarn and subsequent splicing.

Devices of the initially described type have therefore also already been proposed (DE 10 2007 018 369) which have, in the gaps between successive transport units, respectively an air supply member which, with the outlet and inlet openings of the transport units which abut against each other in the gaps, form an essentially closed system and serve, in addition to air removal, above all for cleaning and deflying the fibre material. It is consequently achieved that foreign particles in the region of the gap are trapped and removed from the fibre flow. However it has come to light in practical testing of such a system that essentially only the light particles are removed from the fibre flow, whereas heavier particles, in particular so-called shell parts, remain in the fibre flow and therefore ultimately are included with the fibre material in the knitted fabric. In addition, the downside of this type of cleaning is that the entire transport stretch from the drawing frame to the loop-forming machine forms not only a closed system but also one which is rigid and not particularly flexible, said system being connected to an additional

collecting line and being able to impede operations at the loop-forming machine.

Confronting this, the technical problem of the present invention resides in configuring the initially described device such that it can be handled more easily, can be adapted more easily to the requirements of the individual case and enables even more effective cleaning of the fibre flow.

This problem is resolved according to the invention in that a suction device is disposed in the region of the open gap which forms the air removal opening.

It was established surprisingly that the suction device leads to substantially more effective cleaning of the fibre flow or temporary yarn if it is operated in the manner of an open system, for example is disposed below the gap which is formed between two transport units and consequently uses in addition the natural gravity of any dirt particles and the like which are present. In particular, it is possible in an advantageous manner to undertake the suction with such a small low pressure that the transport of the fibre material in the transport units is consequently not impaired, as could be the case when using air supply devices which operate with blown air. In addition, the result advantageously is that the lighter particles are removed as before by suctioning out of the fibre flow, whilst the heavier particles, such as e.g. shell particles, are ejected at the same time through the open gap and then dropped for example as a result of gravity. The fibre flow which passes through the suction device is freed of disruptive components consequently surprisingly much more effectively than when using a closed system. Finally, it is also advantageous that the suction device can abut against an open gap, i.e. a closed system for guiding air is unnecessary, which facilitates access to the various components.

Further advantageous features of the invention are revealed in the sub-claims.

The invention is explained subsequently in more detail in embodiments in conjunction with the accompanying drawings. There are shown:

- Fig. 1 schematically a device for transporting fibre material between a drawing frame and a loop-forming machine;
- Fig. 2 a schematic longitudinal section through a transport unit of the device according to Fig. 1 which is formed from one twisting member and one transport pipe;
- Fig. 3 a perspective view of the device according to Fig. 1 according to a first embodiment of the invention;
- Fig. 4 details of the device according to Fig. 3;
- Fig. 5 to 8 various transport units which are configured according to the invention for the device according to Fig. 3 and 4; and
- Fig. 9 a longitudinal section through a device according to Fig. 1 according to a second embodiment of the invention.

Fig. 1 shows roughly schematically in a vertical partial section a loop-forming machine in the form of a circular knitting machine 1 with a needle cylinder 2 in which normal knitting needles 3 are mounted displaceably and can be moved at a knitting position, subsequently termed knitting system, with the help of cam parts, not shown, into a receiving position which is suitable for receiving fibre material 4. The circular knitting machine 1, which can be configured for example as a right/left circular knitting machine, stands on a floor of a workplace or a knitting room indicated by the reference number 5. An operator can

operate the knitting machine 1 from the workplace floor 5. In addition, a plurality of cans 6 are placed on the workplace floor 5 in which slivers 7 comprising fibres are placed.

The slivers 7 are supplied to a drawing frame 9 via conveyor belts 8 or the like, which drawing frame is accessible for the operator from a working platform 10 disposed above the workplace floor 5. Such a drawing frame 9 is assigned to each of a large number of knitting systems, only one of which is shown in Fig. 1, said drawing frame having for example three pairs of drawing rollers 11 in the manner known per se. In addition, an auxiliary thread 12 which is withdrawn from a supply spool 14 can be supplied to each knitting system if required. The auxiliary thread 12 can be supplied optionally either with the help of a thread guide directly or, as shown in Fig. 1, via a pair of output rollers 11a of the drawing frame 9 to the knitting system.

A fibre web, not shown, which comes from the drawing frame 9 essentially comprises untwisted staple fibres which are disposed parallel to each other, is supplied, as is evident more precisely in Fig. 2, to an assigned knitting system with the help of a transport device which is designated in general with the reference number 15. The transport device 15 contains at least one twisting member 16 and a spinning or transport pipe 17 connected thereto (Fig. 2), three transport units, which have respectively one twisting member 16a, 16b, 16c and a transport pipe 17a, 17b, 17c being connected in succession in the embodiment according to Fig. 1 because of the comparatively large distance of the circular knitting machine 1 from the drawing frame 9. The first twisting member 16a in the transport direction of the fibre material 4 is disposed directly behind the pair of output rollers 11a or the delivery godet 18 of the drawing frame 9, whilst the last transport pipe 17c in the transport direction ends close to hook 19 (Fig. 2) of the knitting needles 3 which are extended into the fibre receiving position at the relevant knitting system. Behind the knitting needles 3, a suction

element 20 which is connected for example to a central suction device 21 can be disposed.

The transport device 15 which is configured as spinning device or each transport unit which comprises twisting member 16 and transport pipe 17 serves according to Fig. 2 for converting the fibre web issued from the drawing frame 9 firstly into a temporary yarn 22 with real twists. The twisting member 16 is formed for this purpose for example from an essentially hollow cylindrical body 23, the inner cavity of which receives in itself for example the initial portion of the transport pipe 17 and terminates flush with the latter at a front end side 24. At least one air channel 25, preferably a plurality of air channels 25, extends from the end side 24, said air channels all being disposed diagonally relative to a central axis of the transport pipe 17. The air channels 25 penetrate the wall of the bodies 23 and of the transport pipe 17 and end at an inner wall of the transport pipe 17. During operation, compressed or blown air is supplied by means, not shown, to the ends of the air channels 25 which abut against the outside of the body 23 so that the twisting member 16 draws the fibre material which appears in the delivery godet 18 of the pair of output rollers 11a into the transport pipe 17 and, at the same time, also conducts it further through the transport pipe 17 in the direction of the relevant knitting system. Because of the diagonal arrangement of the air channels 25, air turbulence 26 is produced in addition in the transport pipe 17 in such a manner that the fibre material coming from the output rollers 11a not only is suctioned in but is also spun into the temporary yarn 22 in that a large number of rotations are imparted to it and simultaneously compact the fibre material. The temporary yarn 22 keeps the twists essentially up to the end of the transport pipe 17, whereupon these twists are then undone again up to the entry of the fibre material 4 into the knitting needles 3, i.e. are reduced to zero (false twist effect). Therefore a compacted but almost untwisted fibre material 4 enters into the knitting needles 3. The same effect is obtained if, according to Fig. 1, three transport units

comprising twisting members and transport pipes 16a/17a to 16c/17c are connected in succession. These transport units can be disposed, according to Fig. 1, also at preselected angles relative to each other, as a result of which it is possible to transport the refined fibre material coming from the drawing frame 9 over comparatively long stretches without it being damaged.

Between two successive transport units, the compressed airflow required for producing turbulence is discharged externally via air removal openings which are formed by gaps 27 (Fig. 1) between an outlet end 28 of a preceding transport unit (e.g. 16a, 17a) and an inlet end 29 of a subsequent transport unit (e.g. 16b, 17b).

Circular knitting machines of the described type are known for example from documents PCT WO 2004/079 068 A2 and DE 10 2006 006 502 A1 which are herewith made the subject of the present disclosure in order to avoid repetitions by reference to them.

Analogously to Fig. 1, Fig. 3 shows a drawing frame 9 which has, in contrast to Fig. 1, two adjacent transport lines for fibre material and therefore respectively two adjacent transport units 16a, 17a or 16b, 17b or 16c, 17c. In addition, only the lower rollers 11, 11a of the drawing frame 9 are represented in order to simplify the illustration. Finally, Fig. 3 shows respectively one thread guide 30 which is disposed at the end of the respectively last transport pipe 17c, by means of which the supplied fibre material 4 is supplied to the knitting needles 3 (Fig. 2).

According to the invention and according to Fig. 3, at least one suction device 31a, 31b is disposed respectively in the region of at least one air removal opening or of the gap forming the latter, preferably in the region of all the gaps 27a, 27b etc. Said suction device preferably contains a suction pipe which extends closely, with one end, and particularly advantageously from the bottom up to the relevant gap 27a, 27b and,

with another end, is connected to a suction or low pressure source, not shown. The suction power of the suction source is preferably chosen such that a low pressure of e.g. 20 mbar to 50 mbar below ambient air pressure is set directly at the relevant gap 27a, 27b. As a result, effective freeing of the fibre flow or of the temporary yarn 22 of impurities entrained in the latter is achieved. Moreover, it is clear that the low pressure in the regions abutting on the gaps 27a, 27b, taking into account the blown air emerging from these and produced by the relevant twisting member (e.g. 16a) and the suction power of the twisting member (e.g. 16b) which abuts against the relevant gap 27a, 27b, should be adjusted such that a favourable cleaning effect is achieved on the one hand and, on the other hand, the transport of the temporary yarn 22 is not impaired when passing through the gaps 27a, 27b and the remaining portions of the transport stretch.

The suction devices 31a, 31b or suction pipes can, as Fig. 3 and 4 show, stand at least in the region of their suction openings perpendicular to a transport direction $\underline{y}$ which is prescribed by the transport pipes 17a to 17c, as is indicated in Fig. 4 by a central axis 32b of the suction device 31b. However it can also be expedient to dispose the suction devices diagonally relative to the transport direction $\underline{y}$. This is indicated in Fig. 4 in that the suction device 31a can also assume positions 31a1 and 31a2 with axes 32a1, 32a2, shown in broken lines. A diagonal position corresponding to the axis 32a1 is for example sensible if an outlet end 28a of the transport unit 16a, 17a which abuts against the relevant gap 27a is bevelled and provided with a diagonal front or end face 33a and has an outlet opening which is orientated towards the suction device 31a and the axis of which extends for example coaxially relative to the axis 32a1. This bevel of the outlet end 28a is however not achieved in that the transport pipe 17a is bent over at the relevant end. Rather, a straight pipe is preferably cut diagonally at the end thereof in order to configure the end face 33a (Fig.

4) in order that the axes of successive pipes can be continuously in alignment.

Due to the bevel, an enlargement of the free opening and consequently of the space available for the suction at the outlet end of the respective transport pipe 17 is achieved, as a result of which the length of the gaps 27 measured in the transport direction $\underline{y}$ can be reduced in this case.

The angle at which the end face 33a is inclined relative to the axis of the transport pipe 17a can be different, as a comparison with a diagonal front or end face 33b at the outlet end of the transport pipe 17b shows in Fig. 4.

Hence Fig. 4 shows in total an embodiment with a diagonally downwardly pointing end face (e.g. 33a in Fig. 4) in combination with a suction device 31 which is attached thereon from the bottom, e.g. in position 31a2. Loose entrained particles are separated in this case, assisted by gravity, particularly easily from the fibre flow or temporary yarn 22.

Further possible embodiments of the configuration of the transport pipes 17 at the outlet ends thereof are evident in Fig. 5 to 8. More detailed explanations in this respect appear unnecessary.

A further advantageous embodiment can be obtained in that the diagonal end faces 33a are disposed directed towards the side and the axes of the suction devices 31 horizontally instead of vertically as in Fig. 4. As a result, undesired sagging of the fibre material in the region of the gap 27a, 27b can be extensively avoided. Finally, diagonally extending outlet ends confer the advantage that they prescribe a preferred direction for the excess air which is to be removed and direct the latter consequently automatically away from the subsequent inlet opening.

Furthermore, it has proved to be expedient with respect to the desired cleaning effect to choose the lengths x_1 , x_2 (Fig. 4) of the gaps 27a, 27b, measured in the transport direction y to be neither too large nor too small. A dimension $0 < x \leq 2d_i$ is regarded as particularly advantageous, in which d_i means the internal diameter of the transport pipe 17a, 17b which precedes the respective gap 27a, 27b. The dimension x is measured respectively from the outermost edge of the preceding transport pipe (e.g. 17a) up to the beginning of the inlet opening 29 (Fig. 1) of the subsequent transport pipe (e.g. 17b), as Fig. 4 clearly shows. The inlet end of the subsequent transport pipe can thereby be defined by this itself, as indicated in Fig. 1, or also by the inlet opening of a twisting member (e.g. 16b) which is connected to the relevant transport pipe. This depends upon the respective construction and for example upon whether the twisting member is disposed in front of the inlet end of the transport pipe or is penetrated by the transport pipe over its entire length. In total, the length x indicates therefore the smallest distance between two transport units formed respectively from one twisting member 16 and one transport pipe 17.

Moreover, the use of the dimensions $0 < x \leq 2d_i$ has the advantage that, after breakage of the temporary yarn 22 or running empty of a transport unit 16, 17 for other reasons, no problems arise with starting to spin again and the forming yarn 22 is automatically threaded into the inlet opening of the respectively subsequent transport unit.

As in particular Fig. 1, 3 and 4 show, the transport pipes 17a, 17b and 17c preferably all have central axes which extend in a straight line. In addition Fig. 1 shows a variant in which at least one transport pipe 17c is disposed at an angle relative to other transport pipes 17a, 17b, however all the pipe axes being in alignment. In the embodiment according to Fig. 3, all three transport pipes 17a, 17b and 17c are in addition disposed coaxially relative to each other. In contrast, Fig. 4

shows a particularly preferred embodiment for the purposes of the invention which has one substantial special feature.

This special feature resides in the fact that the transport pipes 17a to 17c, regarded per se, have in fact continuously constant internal diameters, these internal diameters however become gradually smaller from the drawing frame 9 in the direction of the knitting machine 1. In particular, the transport pipe 17a has the largest internal diameter, the transport pipe 17b a medium one and the transport pipe 17c the smallest one. Consequently, the advantage is achieved that the transport line formed from the transport pipes 17a, 17b and 17c has at the beginning a comparatively large internal diameter and at the end a comparatively small internal diameter. The large initial diameter assists undisturbed transfer of the fibre flow coming from the drawing frame 9, whilst the small end diameter assists undisturbed insertion of the fibre flow 4 into the knitting needles 3. In this case, the gap 27a, 27b between successive transport units 16, 17 is expediently dimensioned to be so large that, of the quantity of air which emerges from the preceding transport units which have larger internal diameters, only as much is transferred to the subsequent transport units as they are able to receive because of their smaller internal diameter.

It is particularly advantageous if the transition from a preceding first transport unit (e.g. 16a, 17a) in the transport direction $\underline{y}$ to a directly subsequent second transport unit (e.g. 16b, 17b) is chosen to be larger than the transition from this second transport unit (e.g. 16b, 17b) to a further subsequent third transport unit (e.g. 16c, 17c). In this case, the temporary yarn 22 forms a comparatively large balloon in the first transport pipe 17a, which assists good separation of the entrained foreign particles in the subsequent first gap 27a. As a result, the largest part of the impurities is removed already in the region of this gap 27a. Therefore subsequent transport pipes, in particular the last transport pipes 17c respectively in the transport direction $\underline{y}$, obtain a

correspondingly reduced internal diameter, as a result of which the balloon formation is smaller and a narrower guidance is achieved, which is advantageous for clean insertion of the fibre material into the knitting needles.

A further advantageous embodiment (Fig. 4) provides configuring in fact all the transport pipes 17a, 17b and 17c to be straight and to dispose them with axes which extend parallel to each other, but providing an offset which extends transversely relative to the transport direction y between the axes of successive transport pipes. As Fig. 4 shows, an offset or spacing A1 exists for example between the axes of the transport pipes 17a and 17b and an offset A2 between the axes of the transport pipes 17b and 17c. In the embodiment, there is thereby expediently $A1 > A2$ since the internal diameter of the transport pipes 17a, 17b, 17c becomes constantly smaller in the direction of the knitting machine 1. One advantage of the offset A resides in the fact that, by means of it, geometric positional differences between the drawing frame outlet and the inlet hole of the thread guide 30 can be compensated for in a simple manner without requiring to bend one of the transport pipes 17 for this purpose. The size of the offset should be chosen in accordance with the individual case and, with normal internal diameters of the transport pipes of e.g. 1.5 mm to 4 mm, should be smaller than or at most just as large as half the internal diameter of the respectively subsequent transport pipe. The direction of the offset A can be such that a subsequent transport pipe is situated offset by the offset A at the side or towards the top or bottom relative to a preceding pipe, the respective position requiring to be chosen in particular with reference also to the air conditions prevailing in the gaps 27a, 27b.

Fig. 9 shows a further preferred embodiment of the invention which is considered to be best at present, only two transport units, in contrast to Fig. 4, with respectively one twisting member 35a, 35b and a transport

pipe 36a, 36b which is connected thereto being represented, although here also three or more transport units could be present. The parts 35a, 36a here form a preceding transport unit and the parts 35b, 36b a subsequent one. Between an outlet end 37 of the preceding transport unit 35a, 36a and an inlet end 38 of the subsequent transport unit 35b, 36b, again an open gap 39 which is intended to form an air removal opening is provided. In the region of this gap 39, a suction device 40 is disposed. In contrast to Fig. 4, the latter has a suction chamber 42 which is connected to a suction pipe 41, said suction chamber being sealed by a first end wall 42a and a second end wall 42b which is expediently parallel and opposite to said first end wall, said end walls being disposed essentially perpendicular to the transport direction of the fibre material and at a spacing from each other. The transport pipe 36a of the preceding transport unit protrudes through a passage of the first end wall 42a and extends with its free end portion which forms the outlet end 37 up to the gap 39 and the second end wall 42b disposed there. This end wall 42b is provided with an outlet opening 43 which is situated opposite the inlet end 38a of the subsequent transport unit and the inner cross-section of which outlet opening is larger than the outer cross-section of the transport pipe 36a of the preceding transport unit at this position.

As Fig. 9 shows, the free end portion of the transport pipe 36a can protrude through the outlet opening 43 in particular in such a manner that its outermost edge, which establishes the length x of the gap 39 with the beginning of the inlet opening 38 analogously to Fig. 4, projects slightly outwards beyond the inlet opening 37 and protrudes into the gap 39, as Fig. 9 shows clearly. As a result of these measures, it is achieved surprisingly that the air, which swirls with loose fibres, emerges from the transport pipe 36a and strikes the subsequent twisting member 35b or transport pipe 36b, is thrown back into the annular circumferential gap which is formed between the edge of the outlet opening 43 and the transport pipe 36a and is then discharged

together with possible, in particular lighter fluff, impurities or the like, through the suction pipe 41. At the same time, heavier particles are ejected through the open gap 39 and removed from the fibre flow which enters into the subsequent twisting member 35b. Consequently, effective cleaning is achieved as in the other described embodiments.

The cleaning effect is particularly good if the transport pipe 36a is disposed in the first end wall 42b sealed for example with the help of an O-ring 44 and therefore the suction effect of the suction pipe 41 becomes effective almost exclusively in the region between the edge of the outlet opening 43 and the transport pipe 36a.

In order that the suction chamber 42 can be produced simply and opened and cleaned when required, the second end wall 42b is configured expediently as a cover which is connected in a sealed and detachable manner to the suction chamber 42. A further O-ring 45 can serve expediently for sealing. At the same time, it is achieved with the help of the O-rings 44, 45 that the suction chamber 42 can be configured, apart from the suction pipe 41 and the region between the end wall 42b and the transport pipe 36a which opens into the gap 39, as a completely closed housing which is situated opposite the inlet end 38 of the subsequent transport unit 35b, 36b at a spacing.

Corresponding suction chambers 42 can be provided at the transitions between further, not shown transport units.

Moreover, the transport units evident in Fig. 9 can be constructed analogously to those according to Fig. 1 to 8.

The invention is not restricted to the described embodiments which can be modified in many ways. For example, the described angles evident in the drawing, at which the end faces are bevelled at the outlet ends of the transport units, should only be understood as examples which can

be deviated from according to expediency. The same is true for the angles between successive transport units (e.g. 16b, 17b and 16c, 17c in Fig. 1). Furthermore, the transport pipes 17 and 36 can have different circular inner contours from those tacitly assumed here. If the contours deviate from the circular shape, the average internal diameter of a transport pipe is expediently used as dimension d_i . Furthermore, it can be expedient to use transport pipes, the internal diameters of which reduce gradually, e.g. conically, from the inlet openings in the direction of the outlet openings. Furthermore, twisting members other than those described, in particular also mechanical ones, can be applied. In addition, transport pipes, the inner jackets of which are provided with at least one helical groove, can be used in order consequently to improve the rotation of the temporary yarn in the transport pipes, the pitch of the grooves requiring to be chosen as a function of which twists are prescribed by the twisting members. Furthermore, the described transport devices can also be formed on loop-forming machines other than the described circular knitting machines. Finally, it is understood that the different features can be applied also in combinations other than those described and illustrated.

Claims

1. Device for transporting fibre material between a drawing frame (9) and a loop-forming machine (1) containing at least two transport units which are disposed in succession in a transport direction ($\underline{v}$) and have respectively one inlet end (29, 37) and one outlet end (28, 38), said transport units being formed from respectively one twisting member (16a, 16b, 16c, 35a, 35b) and one transport pipe (17a, 17b, 17c, 36a, 36b) connected thereto, there being provided between an outlet end (28, 37) of a preceding transport unit and the inlet end (29, 38) of a subsequent transport unit an open gap (27a, 27b, 39) which is intended for forming an air removal opening, characterised in that, in the region of the gap (27a, 27b, 39), a suction device (31a, 31b, 40) which is open towards the latter is disposed.
2. Device according to claim 1, characterised in that the gap (27, 27b, 39) has a smallest length x measured in the transport direction ($\underline{v}$) which fulfils the inequation $0 < x \leq 2d_i$, d_i being the internal diameter at the outlet end (28, 37) of the preceding transport unit.
3. Device according to claim 1 or 2, characterised in that the transport pipes (17a, 17b, 17c, 36a, 36b), observed in the transport direction ($\underline{v}$), have increasingly smaller internal diameters.
4. Device according to one of the claims 1 to 3, characterised in that the outlet end (28a) of at least one transport unit (16a, 17a) is provided with an outlet opening which extends diagonally relative to the axis thereof.

5. Device according to one of the claims 1 to 4, characterised in that the transport pipes (17a, 17b, 17c, 36a, 36b) have axes which extend parallel to each other.
6. Device according to claim 5, characterised in that the axes of two successive transport pipes (17a, 17b, 17c) are disposed with a preselected offset (A1, A2) which extends transversely relative to the transport direction (v).
7. Device according to claim 6, characterised in that the offset (A1, A2) is at most equal to half the internal diameter of the respectively subsequent transport pipe.
8. Device according to one of the claims 1 to 7, characterised in that the suction device contains a suction pipe (31a, 31b, 40).
9. Device according to claim 8, characterised in that the suction pipe (31a) has an axis (32a1, 32a2) which extends diagonally relative to the transport direction (v).
10. Device according to one of the claims 4 to 9, characterised in that the suction pipe (31a, 31b) contains a bevelled outlet opening which is orientated towards the gap (27a, 27b).
11. Device according to one of the claims 1 to 10, characterised in that the axes of successive transport pipes (17b, 17c) form an angle with each other.
12. Device according to one of the claims 1 to 11, characterised in that the suction device (40) has a suction chamber (42) which is connected to a suction pipe (41), having a first end wall (42a) and a second end wall (42b) which is situated opposite said first end wall, the transport pipe (36a) of the preceding transport unit

protruding through a passage of the first end wall (42a) and extending up to the second end wall (42b) which, in the region of the gap (39), has an outlet opening (43) which is situated opposite the inlet end (38) of the subsequent transport unit and has an inner cross-section which is larger than the outer cross-section of the transport pipe (36a) of the preceding transport unit at this position.

13. Device according to claim 12, characterised in that the transport pipe (36a) of the preceding transport unit is disposed sealed in the first end wall (42a).
14. Device according to one of the claims 12 or 13, characterised in that the second end wall (42b) is configured as a cover which is connected in a sealed and detachable manner to the suction chamber (42).
15. Circular knitting machine, characterised in that it is provided with at least one device according to one or more claims 1 to 14.