

LINE TRANSPORT DEVICE

The invention relates to a line transport device for transporting electrical or optical lines such as wires, cables, optical fibres etc. along a conveying path, comprising a line conveying means which has at least two drivable pressure rollers between which the
5 conveying path runs.

Transport devices for lines are used in particular in cable processing in order to draw the cable to be processed into the cable processing machine. Accordingly such devices are frequently also designated as draw-in devices.

WO 2009/141794 A2, for example, discloses such a draw-in device. It comprises two
10 circulating bands or belts which press against the cable to be conveyed, which are driven by pressure rollers. In each case, only a single cable can be conveyed. For complex and highly automated application however a plurality of different cables must be alternately conveyed to the cable processing machine.

EP 0 598 276 A1 discloses a cable feeding and changing device for a cable processing
15 machine. Two identical parallel-operating belt drives are provided for simultaneously conveying two cables. The two cables coming from different directions are then combined by a coupler onto a common conveying path. The disadvantage of this solution is that two structurally the same belt drives are required, with the result that complexity and costs are doubled.

20 EP 0 708 050 A1 discloses a cable transport and pivoting device. This has a conveying mechanism consisting of two transport rollers.

EP 1 447 888 A1 also marginally discloses a belt conveying device having a similar principle which however also does not solve the aforementioned problems.

JP 2004-071237 A discloses a crimping machine. Cables of different thickness are
25 introduced into a (funnel-like) receiving device. However, this document contains no teaching as to how the two cables are conveyed.

US 5,820,008 A discloses a cable processing machine with a cable conveying means which has a special guide.

US 2005/0050713 A1 discloses a cable processing machine having a tool which is
30 disposed between two conveyor belt devices. A particular feature of this cable

processing machine is that the conveyor belt devices can be moved laterally (forwards and backwards) towards one another. This design comprises a manipulating device (cutting, processing) and not a cable conveying device.

WO 2011/055336 A1 discloses a cable transport device in the form of a belt drive with
5 a view to the present invention.

The disadvantages of the transport devices known in the prior art are that either only one line can be transported from the outset or two complete parallel-operating transport devices are used in order to draw cables simultaneously or successively into a cable processing device. In the first case the possible applications are limited. In the second
10 case, the increased complexity results in double manufacturing, maintenance and repair costs.

So-called multiple sequences are also known. However the line change in the sequencers requires a complex belt drive which allows a dipping of the lines through the drive mechanics. The required structure is complex and associated with high
15 expenditure, with the result that manufacturing costs and maintenance costs are very high.

The purpose of the present invention is to eliminate these disadvantages and provide a line transport device which enables an alternating conveyance of different lines. Complexity and costs should be reduced considerably compared to the previously
20 known solution. At the same time, a reliable and easily controllable transport of lines should be made possible.

The invention achieves this object with a line transport device of the type mentioned initially whereby the line transport device for alternating conveying two lines has at least one guide means which is movable relative to the conveying path, through which
25 one line can be brought into the conveying path between the pressure rollers and through which the other line can be brought out from the conveying path between the pressure rollers.

The line transport device thus comprises a line changer which arbitrarily frequently automatically changes two (or more) lines which had previously, for example, been
30 inserted manually in the device. This can comprises lines having the same cross-section but different identification (colour) or lines having different cross-section. The

conveying path is the same for both lines and runs between the pressure rollers .

Therefore only one line conveying means is required, with the result that the design expenditure can be reduced appreciably. The advantage of the invention consists in particular in that - according to requirements - the specifically desired line is conveyed
 5 whilst the other line remains outside the conveying path in the rest position. The pressure rollers on both sides of the conveying path are displaceable towards one another in order to enable changing of the lines in the open position (greater distance) and to effect conveyance of the lines in the closed position (pressing against the line or abutting against the line).

10 A particular area of application is the use of a line transport device according to the invention in a line twisting apparatus (wire twister). Here the transport device according to the invention takes over the function of a line changer for the line feed to the twisting unit. Two lines can be successively drawn into the twisting unit. As soon as both lines have successively arrived in the twisting unit, the twisting process can be started.

15 However the area of application is not restricted to the aforesaid example. A line transport device can be used wherever two or more different lines must be conveyed. Another example of application is a line changer for producing branched lines (double crimps) having different cross-sections or identifications (colours).

The attainable advantages are independent of the area of application and primarily to
 20 be seen in a low expenditure on apparatus coupled with low manufacturing costs and space-saving design. With only small extensions to existing pivoting belt draw-in devices, it is possible to update to a transport device according to the invention. There is only one line drive.

Advantageous further developments are set out in the figures and in the dependent
 25 patent claims.

In one embodiment the guide means comprise a base body having at least two guides configured therein and spaced apart from one another for the lines to be transported, wherein preferably the guides are configured in the form of passages. Guides provided specifically for each line increase the reliability of the line changing and guarantee well-
 30 defined conveying or rest positions. The design expenditure is also reduced by this measure.

In one embodiment the line transport device has two guide means which are spaced apart from one another along the conveying path. In this case, the lines can be raised from or into the conveying path over their entire length. The distance covered by the conveying means relative to the conveying path can thereby be minimised, which
 5 results in a space-saving solution. Such a line transport device preferably consists of guides which are displaceable relative to the line conveying means in the initial region and end region of the conveying distance defined by the line conveying means.

In one embodiment one guide means is disposed upstream of the line conveying means and the other guide means is disposed downstream of the line conveying
 10 means. As a result, the line conveying means and the guide means do not get in the way of each other during their relative movement, which enables a simplified design.

In one embodiment the two guide means can be driven by a common guide. As a result, a particularly easy to achieve synchronisation of the guide means is achieved.

In one embodiment the two guide means are connected to one another by a
 15 connecting element, preferably in the form of a rail, wherein preferably the guide means are each configured in one piece or two pieces with the connecting element. Such a connecting element enables a rapid equipping and changing of line pairs because both guide means can be dismounted jointly. During dismounting the lines remain in the rail and are optionally held by means of line brakes. For the purpose of
 20 changing, only the rail needs to be removed from the transport device, new lines are threaded into the guides and the rail is placed on the transport device again. Or a new already-threaded rail is inserted in the line changer.

Preferably the guide means are fastened exchangeably to the connecting element, e.g. rail and lines having different line diameters can be guided when using
 25 corresponding guide means.

In a preferred embodiment the connecting element extends above the conveying path. This prevents the line conveying means and the line changer (which comprises the movable guide means) from colliding during the movement sequences.

In one embodiment the rail between the guide means has a flat section, wherein the
 30 flat section is aligned substantially parallel to the conveying path and substantially parallel to the axes of rotation of the pressure rollers. In addition to small space

requirement and optimal mechanical stability, this solution is characterised by optimal handling properties. In particular space for additional elements such as line brakes can be provided by this design.

5 In one embodiment the rail has a recess in the region of the conveying path between the pressure rollers. There the line conveying means presses on both sides of the line and drives this. As a result of the recess which leaves the conveying path free, the line conveying means and line changer are prevented from getting in the way of each other in an elegant manner.

10 In one embodiment the guide means are movable in a direction substantially parallel to the axes of rotation of the pressure rollers. This enables a particularly simple construction which separates line conveying means and guide means from one another.

15 In one embodiment the line conveying means comprises at least two drive belts between which the conveying path runs and which are carried and driven by pressure rollers. As a result of the drive belts a larger contact area to the lines is obtained so that slipping through is eliminated from the outset.

20 In one embodiment the line transport device for each line has at least one brake for fixing that line which is located just outside the conveying path and preferably the brakes can be pneumatically actuated. The brake ensures that the line located in the rest position is fixed and cannot thread out.

Preferably the respective brake is configured as a clip (or line clip). In this embodiment the fixing of the line is accomplished by clamping (or clamping) the line.

25 Preferably the brake or the line clip is actuated by a pneumatically adjustable compressed air cylinder. That is, the line is pneumatically clamped and switched by means of a pneumatic cylinder drive. This has the advantage that the clamping force can be switched on and off as required and the compressed air supply in the compressed air cylinder can be adjusted so that the clamping force can be adapted to the particular line, e.g. having different line/insulation strength.

30 In one embodiment the brake acts on the lines in the region of the guide means. This enables a particularly simple design, since in this case the brake can act against a wall of the guide and can clamp the line between brake and wall. The guide therefore

already provides a countersurface or pressure surface against which the brake can press the line.

In one embodiment the brakes are fastened to the guide means and are movable with this/these whilst the actuating device for the brakes is stationary in relation to the guide means. In this embodiment the brakes can be pre-tensioned in the closing direction so that the brakes fix the lines without external action. Due to the movement of a line in the conveying path, the relevant brake comes into the active region of the actuating device which then opens this brake. In other words: the brake which is assigned to a line located in the conveying path is located in the active region of the actuating device, whereas the brake which is assigned to a line located in the rest position is located outside the active region of the actuating device. The actuating device is an opener which holds the brake open for the time of the conveying process. In this exemplary embodiment an actuating device is simultaneously assigned to two brakes, i.e. the brake for the first line and the brake for the second line.

In one embodiment the brakes comprise bolts which can be actuated, which are movable in the direction of the guide means, preferably perpendicular to the conveying path. An optimal braking effect is thereby achieved.

In one embodiment the line conveying means and the conveying means are carried by a common frame. This enables a compact design.

In one embodiment the line conveying means and the guide means as a whole are pivotable about a pivot axis, wherein preferably the pivot axis is aligned substantially vertically. This enables the line transport device to be used as a pivoting draw-in device for various applications such as, for example, a line twister.

In order that two lines can be conveyed successively, the guide means (e.g. guide tubes) for each line have a groove. Additional devices are disposed on the base plate of the line draw-in device which enable the guide means to be displaced between the opened pressure rollers or belts in such a manner that in one case the first and in one case the second line stands precisely between the drive belts and can be conveyed by these. In order that the lines cannot slip into the guide means, suitable brakes are installed. If the brakes are actively actuated, appropriate actuators are provided for this.

Further advantages, features and details of the invention are obtained from the following description in which exemplary embodiments of the invention are described with reference to the drawings. In this case, the features mentioned in the claims and in the description can in each case be essential to the invention individually by
 5 themselves or in any combination.

The reference list is part of the disclosure. The figures are described cohesively and in an overlapping manner. The same reference numbers denote the same components, reference numbers with different indices specify functionally the same or similar components.

10 In the figures:

Fig. 1 shows a side view of a line transport device according to the invention,

Fig. 2 shows the line transport device from Fig. 1 in detail,

Fig. 3 shows a cross-section through the conveying path normal to the conveying direction,

15 Fig. 4 shows an embodiment of the invention in perspective view,

Fig. 5 shows a line transport device for better view without line changer,

Fig. 6 shows a rail with two integrated guide means in perspective view.

Figure 1 shows a line transport device 22 according to the invention for alternately conveying two lines 1, 2 in a conveying direction F. To this end, the line transport
 20 device 22 comprises a line conveying means 23 which has mutually opposite pressure rollers 20, 21 between which the conveying path 24 runs. In the present embodiment circulating drive belts 5, 6 are additionally provided in each case which are held by the pressure rollers 20, 21 and driven (also called belt draw-in device, see Fig. 4). Preferably pressure rollers 20, 21 and drive belts 5, 6 cooperate via a toothed
 25 structure. Consequently the line conveying means 23 comprises two mutually opposite parts which press against the line to be conveyed and thereby drive this. Structure and functioning principle of the line conveying means 23 are deduced clearly from the embodiments of Fig. 4 and Fig. 5. Upstream of the line transport device 22 so-called aligning tools 3 are provided which prepare the lines 1, 2 and provide them aligned for
 30 further conveying. One aligning tool is provided for each line.

Returning to Fig. 1, respectively one guide means 7, 8 for the lines 1, 2 is provided upstream and downstream of the line conveying means 23, which guide means can be moved relative to the conveying path 24 whereby one line 1 can be brought into the conveying path 24 between the pressure rollers 20, 21 (conveying position) and the other line 2 can be brought out from the conveying path 24 (rest position). The directions of movement of the guide means 7, 8 are perpendicular to the conveying direction F and are each shown by an arrow P. The guide means 7, 8 each comprise a base body with two guides 7a, 7b or 8a, 8b (see, e.g. Fig. 6) configured therein and spaced apart from one another (perpendicular to the conveying direction) for the lines 1, 2 to be transported. The guides are preferably configured in the form of passages such as, for example, holes or tubes into which the lines 1, 2 are threaded. The lines 1, 2 are held at a distance by the guides in the threaded-in state. A displacement actuator 9 is provided for the drive of the guide means 7 and a displacement actuator 10 is provided for the drive of the guide means 8. The displacement actuators are actuated synchronously whereby the lines 1, 2 are brought out from or into the conveying path 24 with their entire length extending in the line conveying means 23.

In Fig. 1 the second line 2 is in the conveying position whilst the first line 1 stays in its rest position 12. The rest position 13 of the second line 2 is indicated by the dashed line. The second line 2 comes into this position as a result of the guide means 7, 8 moving downwards. The guide means 7, 8 is (are) movable in the exemplary embodiment shown in a direction P substantially parallel to the axes of rotation 20', 21' of the pressure rollers 20, 21.

The two mutually opposite parts of the line conveying means 23, i.e. the pressure rollers 20 and 21 with the respective circumferential belts 5 and 6 are movable relative to one another and specifically in a direction normal to their axes of rotation 20' and 21', whereby the pressure rollers press against the line just located in the conveying path 24. The pressure rollers 20, 21 and therefore the drive belts 5, 6 are driven by a preferably common drive.

The line conveying means 23 and the guide means 7, 8 and their displacement actuators 9, 10 are carried by a common frame 4, e.g. a platform, a table or a mounting plate. In order to be used as a pivoting conveyor, the line conveying means 23 and the guide means 7, 8 as a whole are pivotable about a pivot axis 4', where the pivot axis 4' is preferably substantially vertically aligned, which is favourable for most applications.

Figure 2 shows the line transport device 22 from Fig. 1 in detail. In the exemplary embodiment shown the actuating device 15 for opening and closing the belt draw-in device (relative movement of the pressure rollers 20, 21 with the drive belt 5, 6 held by these) is disposed below the frame 4.

5 Figure 3 shows a cross-section normal to the conveying direction F. The drive belts 5, 6 located on both sides of the conveying path 24 between which specifically the first line 1 (in conveying position) is located can be seen here. The second line 2 is located below the conveying path 24 in rest position 13 and is not driven by the rotating drive rollers 20, 21. Indicated above the conveying path 24 is the rest position 12 of the first
10 line 1 which this adopts when the guide means move the lines 1, 2 held at a distance from one another upwards. The second line 2 then comes into the conveying path 24 and therefore into the conveying position and the first line 1 comes into the rest position 12. The frame 4 can also be seen, where space is provided between drive belts 5, 6 and frame 4 for the second line 2.

15 Figure 4 shows a preferred embodiment of the invention in which the guide means 7 upstream of the line conveying means 23 and the guide means 8 downstream of the line conveying means 23 are interconnected by a rail 16 as connecting element. The guide means which remain concealed in the view in Fig. 4 are each located in the (right and left) end region of the rail 16. The position of the guide means in the region on
20 which the brakes 17 act (which will be discussed subsequently in detail) can be envisaged.

In the preferred embodiment of Fig. 4 the guide means 7, 8 are each formed in one piece with the rail 16. By removing the rail 16 the lines 1, 2 held therein can be changed or threaded in or out in one working step.

25 As can be seen from Fig. 4, the rail 16 is configured to be flat and aligned substantially parallel to the conveying path 24 and substantially parallel to the axes of rotation 20', 21' of the pressure rollers 20, 21. A holder 19 for the rail 16 adjoins the upper side. In order not to collide with the parts of the line conveying means 23, the rail 16 has a recess in the region of the conveying path 24 between the pressure rollers 20, 21. The
30 lines 1, 2 run specifically in this recess and are driven there by the opposing drive belts 5, 6.

Figure 6 shows schematically a rail 16 having a flat shape in which the two guide means 7, 8 are integrated. For changing the lines 1, 2 the rail 16 merely needs to be removed from the line change and the lines newly threaded in. One guide means 7, 8 in this case comprises two guides 7a, 7b or 8a, 8b which are spaced apart from one another perpendicular to the conveying path 2, which hold the two lines 1, 2 at a distance. Between the guide means 7, 8 the flat section of the rail 16 has a recess 26. Precisely there the drive rollers 20, 21 or the drive belts 5, 6 press on both sides against one of the lines 1, 2. A drive (not shown) moves the rail 16 along the double arrow P.

- 10 In order that that line which is located in the rest position cannot move and jump out of its guide, the line transport device 22 has at least one brake 17 for each line 1, 2 to be transported for fixing that line which is located outside the conveying path 24. The brakes 17 act preferably in the region of the guide means 7, 8 on the lines 1, 2. In the exemplary embodiment shown, the brakes 17 comprise pneumatically actuatable bolts
15 which are movable in the direction of the guide means 7, 8 and there press the lines against a pressure surface, e.g. against one wall of the guide.

- Preferably the force of the brakes 17 is directed perpendicular to the conveying path 24. An actuating device 18 for opening the brakes 17 is also shown in Fig. 4. The brakes 17 move up and down with the rail 16 whilst the actuating device(s) 18 is
20 fastened stationarily on the platform 4. The brakes 17 can be pre-tensioned, e.g. in the closing direction so that a brake 17 always fixes the line assigned to it without actuation. The actuating device 18 acts in this case as an opener and acts on the respective brake 17 during the entire conveying process. At the end of the conveying process of one of the lines, the brake 17 is released by the actuating device 18 with the
25 result that this again reaches the closing position. The design can be configured particularly simply: as a result of the upward and downwards movement of the guides 7a, 7b or 8a, 8b and therefore of the associated brakes 17, the "correct" brake 17 arrives in the active region of the actuating device 18 which then holds this open for the conveying time.

- 30 Figure 5 shows a line transport device 22 which is shown without the line changer for better clarity. The drive belts 5, 6 are also omitted here. The entire belt draw-in device is disposed on a platform 4 which is pivotable about a vertical pivot axis 4. The drive for pivoting the platform 4 can be seen partially by drive rollers and circulating belts. The

belt draw-in device (line conveying means 23) consists of pressure rollers 20, 21 which are rotatable about axes of rotation 20', 21' parallel to one another. The conveying path 24 runs between opposite pressure rollers 20, 21 and optionally provided intermediate rollers 25. A first line 1 is moved specifically in conveying direction F.

- 5 The embodiments of Figs. 1 to 6 differ from one another in respect of certain features. Further embodiments within the scope of the claimed invention are also possible. For example, the pressure rollers can press directly on the lines and drive these, i.e. without additional drive belts. Also the line changer can be configured for more than only two lines. Accordingly it need only have one guide per line. Appropriate space
10 must be taken into account for the rest positions of the lines which are specifically not conveyed.

The disclosure of the following applications: S124PWO, S125PWO, S126PWO, S141PWO (Internal file reference of the applicant), which were all deposited at the International Bureau (IB) on 9.11.2012, form an integral component of the present
15 application and should be seen in combination with the same since these separate applications each relate to different aspects of the same machine. Further synergistic effects result from this.

Reference list

- 1 First line
- 2 Second line
- 3 Aligning tool
- 5 4 Frame, pivoting draw-in
- 5 (Right) drive belt
- 6 (Left) drive belt
- 7 First guide means
- 7a, 7b Guides in first guide means 7
- 10 8 Second guide means
- 8a, 8b Guides in second guide means 8
- 9 Displacement actuator for first guide means 7
- 10 Displacement actuator for second guide means 8
- 11 Conveying position
- 15 12 Rest position of first line 1
- 13 Rest position of second line 2
- 15 Actuating device for opening and closing the belt draw-in device
- 16 Rail for connecting the first and second guide means (guide rail)
- 17 Brake for a line
- 20 18 Actuating device of the line brake
- 19 Holder for guide rail
- 20 Pressure roller
- 21 Pressure roller
- 22 Line transport device
- 25 23 Line conveying means
- 24 Conveying path
- 25 Intermediate rollers
- 26 Recess in the rail 16
- F Conveying direction of the line(s)
- 30 P Direction of movement of the guide means

1. Line transport device (22) for transporting electrical or optical lines (1,2) such as wires, cables, optical fibres etc. along a conveying path (24) comprising a line conveying means (23) which has at least two drivable pressure rollers (20,21) between which the conveying path (24) runs, wherein the line transport device (22) has at least one guide means (7,8) which is movable relative to the conveying path (24) for the alternate conveying of two lines (1,2), through which one line (1) can be brought into the conveying path (24) between the pressure rollers (20,21) and through which the other line (2) can be brought out from the conveying path (24) between the pressure rollers (20,21), **characterised in that** the line conveying means (23) and the guide means (7,8) as a whole are pivotable about a pivot axis (4'), wherein preferably the pivot axis (4') is aligned substantially vertically.
2. The line transport device according to claim 1, **characterised in that** the line transport device (22) for each line (1,2) has at least one brake (17) for fixing that line (1,2) which is located just outside the conveying path (24) and that preferably the brakes (17) can be pneumatically actuated.
3. The line transport device according to claim 2, **characterised in that** the brake (17) acts on the lines (1,2) in the region of the guide means (7,8) and/or that the brakes(17) are pre-tensioned in the closing direction.
4. The line transport device according to any one of claims 2 or 3, **characterised in that** the brakes are each fastened to the guide means (7,8) and are movable with this/these whilst an actuating device (18) for actuating the brakes (17) is stationary in relation to the guide means (7,8).
5. The line transport device according to at least one of the preceding claims, **characterised in that** the line conveying means (23) and the guide means (7,8) are carried by a common frame (4).
6. The line transport device according to at least one of the preceding claims, **characterised in that** the guide means (7,8) comprise a base body having at least two guides configured therein and spaced apart from one another for the

lines (1, 2) to be transported, wherein preferably the guides are configured in the form of passages.

7. The line transport device according to at least one of the preceding claims,
characterised in that the line transport device (22) has two guide means (7, 8)
5 which are spaced apart from one another along the conveying path (24).
8. The line transport device according to claim 7, **characterised in that** one guide means (7) is disposed upstream of the line conveying means (23) and the other guide means (8) is disposed downstream of the line conveying means (23).
9. The line transport device according to any one of claims 7 or 8, **characterised in**
10 **that** the two guide means (7, 8) can be driven by a common guide.
10. The line transport device according to any one of claims 7 to 9, **characterised in**
that the two guide means (7, 8) are connected to one another by a connecting element, preferably in the form of a rail (16), wherein preferably the guide means (7, 8) are fastened exchangeably to the connecting element.
11. The line transport device according to any one of claims 7 to 10, **characterised in**
15 **that** the two guide means (7, 8) are each formed in one piece or in two pieces with the connecting element (16).
12. The line transport device according to claim 10 or 11, **characterised in that** the connecting element (16) has a flat section between the guide means (7, 8),
20 wherein the flat section is aligned substantially parallel to the conveying path (24) and substantially parallel to the axes of rotation (20', 21') of the pressure rollers (20, 21).
13. The line transport device according to any one of claims 10 or 11, **characterised**
in that the connecting element (16) has a recess (26) in the region of the
25 conveying path (24) between the pressure rollers (20, 21).
14. The line transport device according to any one of the preceding claims,
characterised in that the guide means (7, 8) are movable in a direction substantially parallel to the axes of rotation (20', 21') of the pressure rollers (20, 21).

15. The line transport device according to any one of the preceding claims,
characterised in that the line conveying means (23) comprises at least two drive belts (5, 6) between which the conveying path (24) runs and which are carried and driven by pressure rollers (20, 21).