

Line guiding system

5 The invention concerns a line guide system for receiving and guiding supply lines between two connection points which are movable relative to each other in a circular movement with respect to a rotary axis over a rotary angle range, wherein the line guide system has an elongate strand which is coupled to the connection points and at or in which the supply
10 lines can be arranged in guided relationship, and the strand is reciprocatingly displaceable guidedly over a circular arc within the rotary angle range, forming a first run, a second run and a deflection arc connecting the first and second runs together.

A problem with such line guide systems is a rotary angle range which
15 is frequently too small. That can admittedly be enlarged in the case of more recent line guide systems by means of a strand with a rearward bending radius, that is to say with a possible bending of the strand in two directions, up to 600°. That however can still be too small in the use of certain machines like wind power installations and floating cranes. To enlarge the
20 rotary angle range it would be possible for electric lines to be transferred by way of contact rings and sliding contacts, but in that case known transmission problems, for example as a consequence of lack of electric contact or the effect of moisture, can occur, which under some circumstances can even require complicated and expensive encapsulation
25 of the contact rings and sliding contacts.

The object of the invention is to provide a line guide system of the general kind set forth, which permits guidance of the supply lines over an increased rotary angle range and which is of a simple structure.

According to the invention that object is attained by the features of
30 claim 1. Advantageous developments are described in the appendant claims. The specified object is already attained in that there are provided at least two strands, a first strand and a second strand, which are arranged coupled one behind the other.

By virtue of the strands being coupled one behind the other or in serial relationship the individual rotary angle ranges of the strands are added to afford an overall rotary angle range so that it can be increased for example when using a rearward bending radius in relation to the respective strands to up to 1200° in comparison with the known line guide systems. A plurality of strands can also be coupled together 'in series', that is to say one behind the other, in cascade-like relationship one behind the other or in serial relationship so that the individual rotary angle ranges thereof are added together in respect of the rotary angle ranges to give a total rotary angle range. In a direction of succession from the first strand towards the second strand the first strand can be connected at the front to the one movable connection point and the second strand in the direction of succession can be connected at the rear to the other movable connection point. The supply lines can be arranged guided in the strands in the direction of succession. The supply lines to be guided in the strands can thus be introduced into the first strand at one of the relatively mutually movable connection points, guided in the first strand to the end thereof, there transferred to the second strand and guided to the end thereof. At that other end the other of the relatively mutually movable connection points can be disposed. For that purpose the strand ends at which the transition from the first strand to the second strand takes place can be arranged in stationary relationship with each other.

The deflection arc of the individual strands can have a bending axis parallel to the rotary axis. The strands can be arranged displaceably in the same direction by way of their respective deflection arcs, relative to the rotary axis. The deflection arcs of the strands can thus be arranged opened in the same peripheral direction or in the same direction of rotation, with respect to the rotary axis. The radii of curvature of the deflection arcs can involve the same peripheral direction with respect to the rotary axis.

The strands can be arranged spaced relative to each other axially or radially with respect to the rotary axis. As described in greater detail hereinafter it is also possible to provide a plurality of serially coupled strands which are arranged spaced relative to each other axially and/or

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circular movement with respect to a rotary axis over a rotary angle range, wherein
the line guide system has an elongate strand which is coupled to the connection
points and at or in which the supply lines can be arranged in guided relationship,
and the strand is reciprocatingly displaceable guidedly over a circular arc within the
10 rotary angle range, forming a first run, a second run and a deflection arc
connecting the first and second runs together, wherein at least two strands, a first
strand (3.1) and a second strand (3.2), which are arranged coupled one behind the
other, the connection points (2.1, 2.2, 2.3) of the strands (3.1, 3.2, 3.3) are in the
form of a front connection point (2.1) and a rear connection point (2.2) with
15 respect to a direction of succession (a) from the first strand (3.1) towards the
second strand (3.2), wherein the rear connection point (2.2) of the first strand
(3.1) is arranged stationarily relative to the front connection point (2.1) of the
second strand (3.2), for guiding the strands (3.1, 3.2, 3.3) there is provided a
guide system (6) having three guide units which are rotationally movable relative
20 to each other with respect to the rotary axis (d), with respect to the direction of
succession (a) a front guide unit (8.1), a central guide unit (8.2) and a rear guide
unit (8.3), wherein the front connection point (2.1) of the first strand (3.1) is fixed
to the front guide unit (8.1).

A problem with such line guide systems is a rotary angle range which is
25 frequently too small. That can admittedly be enlarged in the case of more recent
line guide systems by means of a strand with a rearward bending radius, that is to
say with a possible bending of the strand in two directions, up to 600°. That
however can still be too small in the use of certain machines like wind power
installations and floating cranes. To enlarge the rotary angle range it would be
30 possible for electric lines to be transferred by way of contact rings and sliding
contacts, but in that case known transmission problems, for example as a
consequence of lack of electric contact or the effect of moisture, can occur, which
under some circumstances can even require complicated and expensive
encapsulation of the contact rings and sliding contacts.

35 JP 2009 044 809 A discloses a line guide system as described above
comprising an inner guide unit, a middle guide unit and an outer guide unit in each
of which two strands are provided which are arranged coupled one behind the
other and are reciprocatingly displaceable guided over a deflection arc.

EP 0 460 667 A2 discloses a line guide system comprising at least two strands which are arranged in a spiral-shaped manner and are rotatable around the axis of the spiral while changing the radius of the spiral.

The object of the invention is to provide a line guide system of the general kind set forth, which is of a compact structure.

According to the invention that object is attained by the features of claim 1. Advantageous developments are described in the appendant claims. The specified object is already attained in that the guide units are arranged into axially spaced planes, a first plan and a second plan perpendicularly to the axis of roation.

By virtue of the strands being coupled one behind the other or in serial relationship the individual rotary angle ranges of the strands are added to afford an overall rotary angle range so that it can be increased for example when using a rearward bending radius in relation to the respective strands to up to 1200° in comparison with the known line guide systems. A plurality of strands can also be coupled together 'in series', that is to say one behind the other, in cascade-like relationship one behind the other or in serial relationship so that the individual rotary angle ranges thereof are added together in respect of the rotary angle ranges to give a total rotary angle range. In a direction of succession from the first strand towards the second strand the first strand can be connected at the front to the one movable connection point and the second strand in the direction of succession can be connected at the rear to the other movable connection point. The supply lines can be arranged guided in the strands in the direction of succession. The supply lines to be guided in the strands can thus be introduced into the first strand at one of the relatively mutually movable connection points, guided in the first strand to the end thereof, there transferred to the second strand and guided to the end thereof. At that other end the other of the relatively mutually movable connection points can be disposed. For that purpose the strand ends at which the transition from the first strand to the second strand takes place can be arranged in stationary relationship with each other.

The deflection arc of the individual strands can have a bending axis parallel to the rotary axis. The strands can be arranged displaceably in the same direction by way of their respective deflection arcs, relative to the rotary axis. The deflection arcs of the strands can thus be arranged opened in the same peripheral direction or in the same direction of rotation, with respect to the rotary axis. The radii of curvature of the deflection arcs can involve the same peripheral direction with respect to the rotary axis.

The strands can be arranged spaced relative to each other axially or radially with respect to the rotary axis. As described in greater detail hereinafter it is also possible to provide a plurality of serially coupled strands which are arranged spaced relative to each other axially and/or

CLAIMS

1. A line guide system (1) for receiving and guiding supply lines between two connection points (2.1, 2.2) which are movable relative to each other in a circular movement with respect to a rotary axis (d) over a rotary angle range, wherein the line guide system (1) has an elongate strand (3.1, 3.2, 3.3) which is coupled to the connection points (2.1, 2.2) and at or in which the supply lines can be arranged in guided relationship, and the strand (3.1, 3.2, 3.3) is reciprocatingly displaceable guidedly over a circular arc within the rotary angle range, forming a first run (4.1), a second run (4.2) and a deflection arc (5) connecting the first and second runs together, characterised in that there are provided at least two strands, a first strand (3.1) and a second strand (3.2), which are arranged coupled one behind the other.

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2. A line guide system according to claim 1 characterised in that the strands (3.1, 3.2, 3.3) are arranged spaced relative to each other axially or radially with respect to the rotary axis (d).

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3. A line guide system according to claim 1 or claim 2 characterised in that there are provided a plurality of strands (3.1, 3.2, 3.3) which are coupled one behind the other and are arranged spaced relative to each other axially or radially with respect to the rotary axis (d).

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4. A line guide system according to one of claims 1 to 3 characterised in that the connection points (2.1, 2.2, 2.3) of the strands (3.1, 3.2, 3.3) are in the form of a front connection point (2.1) and a rear connection point (2.2) with respect to a direction of succession (a) from the first strand (3.1) towards the second strand (3.2), wherein the rear connection point (2.2) of the first strand (3.1) is arranged stationarily relative to the front connection point (2.1) of the second strand (3.2).

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5. A line guide system according to claim 4 characterised in that for guiding the strands (3.1, 3.2, 3.3) there is provided a guide system (6)

having three guide units which are rotationally movable relative to each other with respect to the rotary axis (d), with respect to the direction of succession (a) a front guide unit (8.1), a central guide unit (8.2) and a rear guide unit (8.3), wherein the front connection point (2.1) of the first strand (3.1) is fixed to the front guide unit (8.1), the rear connection point (2.2) of the first strand (3.1) and the front connection point (2.1) of the second strand (3.2) is fixed to the central guide unit (8.1) and the rear connection point (2.2) of the second strand (3.2) is fixed to the rear guide unit (8.3).

10 6. A line guide system according to claim 4 characterised in that the front guide unit (8.1) is arranged stationarily on a base (B).

15 7. A line guide system according to claim 5 or claim 6 characterised in that the guide units (8.1, 8.2, 8.3) for each run (4.1, 4.2) associated with them, for guidance thereof on circular arcs, have respective circular ring-like contact surfaces, a peripheral contact surface (9.2) and a radial contact surface (9.1).

20 8. A line guide system according to claim 7 characterised in that the contact surfaces (9.1, 9.2) provided for the two runs (4.1, 4.2) of a strand (3.1, 3.2, 3.3) are arranged spaced relative to each other coaxially and radially relative to the rotary axis (d), wherein the deflection arc (5) bridges over the radial spacing of the contact surfaces from the one guide unit (8.1, 8.2, 8.3) for the first run (4.1) of said strand (3.1, 3.2, 3.3) to the guide unit (8.2, 8.3, 8.1) for the second run (4.2) of said strand.

30 9. A line guide system according to claim 8 characterised in that the contact surfaces (9.1, 9.2) provided for the two runs (4.1, 4.2) of a strand (3.1, 3.2, 3.3) delimit a guide channel (7.1, 7.2, 7.3) for said strand (3.1, 3.2, 3.3).

10. A line guide system according to claim 9 characterised in that the connection point (2.1, 2.2) of a run (4.1, 4.2) is respectively fixed to the radial contact surface (9.1) associated with said run (4.1, 4.2).

5 11. A line guide system according to one of claims 4 to 10 characterised in that the guide units (8.1, 8.2, 8.3) are arranged in a first plane (E.1) perpendicularly to the rotary axis (d).

10 12. A line guide system according to claim 11 characterised in that the front guide unit (8.1) is fixed in position on the base (B) and the central guide unit (8.2) and the rear guide unit (8.3) are mounted rotationally movably on the base (B).

15 13. A line guide system according to one of claims 4 to 12 characterised in that the guide units (8.1, 8.2, 8.3) are arranged in two axially spaced planes, a first plane (E.1) and a second plane (E.2), perpendicularly to the axis of rotation (d).

20 14. A line guide system according to claim 13 characterised in that the front guide unit (8.1) is arranged in the first plane (E.1) and the rear guide unit (8.3) is arranged in the second plane (E.2) and the central guide unit (8.2) is arranged in bridging relationship of the axial spacing of the planes (E.1, E.2) in both planes (E.1, E.2) in such a way that the rear connection point (2.2) of the first strand (3.1) in the first plane (E.1) and
25 the front connection point (2.2) of the second strand (3.2) in the second plane (E.2) is fixed to the central guide unit (8.2).

30 15. A line guide system according to claim 13 or claim 14 characterised in that the front guide unit (8.1) is fixed in position on the base (B) and the central guide unit (8.2) is rotationally movably mounted on the base (B) and the rear guide unit (8.3) is rotationally movably mounted on the front guide unit (8.1).

16. A line guide system according to one of claims 1 to 15 characterised in that the rotary angle ranges of the strands (3.1, 3.2, 3.3) are abutment-limited and/or drive-limited.

5 17. A line guide system according to one of claims 1 to 16 characterised in that provided at least for one strand (3.1, 3.2, 3.3) is a spacer body (23) for spacing its runs (4.1, 4.2), which spacer body is arranged between the runs (4.1, 4.2) and on the inside of the deflection arc (5) and is coupled to the displacement of said strand (3.1, 3.2, 3.3).

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18. A line guide system according to one of claims 1 to 17 characterised in that there are provided two first strands (3.1) and/or two second strands (3.2), wherein the first strands (3.1) and the second strands (3.2) are respectively arranged in a plane (E.1, E.2, E.3) and
15 displaceably in opposite relationship therein relative to each other.

19. A line guide system according to claim 18 characterised in that provided for the first strands (3.1) and/or the second strands (3.2) is a respective spacer body (23) which in part-peripheral relationship is
20 arranged between the runs (4.1, 4.2) of the first strands (3.1) and the second strands (3.2) respectively and at the end on the inside bearing with play against the deflection arcs (5) of the first strands (3.1) and the second strands (3.2) respectively.

25 20. A line guide system according to one of claims 17 to 19 characterised in that the spacer body (23) is in the form of a chain with chain link members which are arranged guided in the line guide system (1) pivotably relative to each other in parallel relationship with the rotary axis (6).

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21. A line guide system according to one of claims 1 to 20 characterised in that the strands (3.1, 3.2, 3.3) are respectively in the form of a line guide chain (26) with chain link members (27) which in the

position of installation in the line guide system (1) are arranged pivotably relative to each other in parallel relationship with the rotary axis (d).

22. A line guide system according to one of claims 1 to 21
5 characterised in that it has a connection device (S) for its installation in or connection to a machine structure (M).

CLAIMS

1. A line guide system (1) for receiving and guiding supply
5 lines between two connection points (2.1, 2.2) which are
movable relative to each other in a circular movement with
respect to a rotary axis (d) over a rotary angle range,
wherein the line guide system (1) has an elongate strand
(3.1, 3.2, 3.3) which is coupled to the connection points
10 (2.1, 2.2) and at or in which the supply lines can be
arranged in guided relationship, and the strand (3.1, 3.2,
3.3) is reciprocatingly displaceable guidedly over a
circular arc within the rotary angle range, forming a first
run (4.1), a second run (4.2) and a deflection arc (5)
15 connecting the first and second runs together, there are
provided wherein at least two strands are provided, a first
strand (3.1) and a second strand (3.2), which are arranged
coupled one behind the other, the connection points (2.1,
2.2, 2.3) of the strands (3.1, 3.2, 3.3) are in the form of
20 a front connection point (2.1) and a rear connection point
(2.2) with respect to a direction of succession (a) from the
first strand (3.1) towards the second strand (3.2), wherein
the rear connection point (2.2) of the first strand (3.1) is
arranged stationarily relative to the front connection point
25 (2.1) of the second strand (3.2), for guiding the strands
(3.1, 3.2, 3.3) there is provided a guide system (6) having
three guide units which are rotationally movable relative to
each other with respect to the rotary axis (d), with respect
to the direction of succession (a) a front guide unit (8.1),
30 a central guide unit (8.2) and a rear guide unit (8.3),
wherein the front connection point (2.1) of the first strand
(3.1) is fixed to the front guide unit (8.1), the rear
connection point (2.2) of the first strand (3.1) and the
front connection point (2.1) of the second strand (3.2) is
35 fixed to the central guide unit (8.1) and the rear
connection point (2.2) of the second strand (3.2) is fixed
to the rear guide unit (8.3),

characterised in that the guide units (8.1, 8.2, 8.3) are arranged in two axially spaced planes, a first plane (E.1) and a second plane (E.2), perpendicularly to the axis of rotation (d).

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2. A line guide system according to claim 1 characterised in that the strands (3.1, 3.2, 3.3) are arranged spaced relative to each other axially or radially with respect to the rotary axis (d).

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3. A line guide system according to claim 1 or claim 3 characterised in that the front guide unit (8.1) is arranged stationarily on a base (B).

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4. A line guide system according to one of claims 1 to claim 3 characterised in that the guide units (8.1, 8.2, 8.3) for each run (4.1, 4.2) associated with them, for guidance thereof on circular arcs, have respective circular ring-like contact surfaces, a peripheral contact surface (9.2) and a radial contact surface (9.1).

20

5. A line guide system according to claim 4 characterised in that the contact surfaces (9.1, 9.2) provided for the two runs (4.1, 4.2) of a strand (3.1, 3.2, 3.3) are arranged spaced relative to each other coaxially and radially relative to the rotary axis (d), wherein the deflection arc (5) bridges over the radial spacing of the contact surfaces from the one guide unit (8.1, 8.2, 8.3) for the first run (4.1) of said strand (3.1, 3.2, 3.3) to the guide unit (8.2, 8.3, 8.1) for the second run (4.2) of said strand.

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6. A line guide system according to claim 5 characterised in that the contact surfaces (9.1, 9.2) provided for the two runs (4.1, 4.2) of a strand (3.1, 3.2, 3.3) delimit a guide channel (7.1, 7.2, 7.3) for said strand (3.1, 3.2, 3.3).

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7. A line guide system according to claim 6 characterised in that the connection point (2.1, 2.2) of a run (4.1, 4.2) is respectively fixed to the radial contact surface (9.1) associated with said run (4.1, 4.2).

8. A line guide system according to one of the claims 3 to 7 characterised in that the central guide unit (8.2) and the rear guide unit (8.3) are mounted rotationally movably on the base (B).

9. A line guide system according to one of claims 1 to 8 characterised in that the front guide unit (F.1) is arranged in the first plane (E.1) and the rear guide unit (8.3) is arranged in the second plane (E.2) and the central guide unit (8.2) is arranged in bridging relationship of the axial spacing of the planes (E.1, E.2) in both planes (E.1, E.2) in such a way that the rear connection point (2.2) of the first strand (3.1) in the first plane (E.1) and the front connection point (2.2) of the second strand (3.2) in the second plane (E.2) is fixed to the central guide unit (8.2).

10. A line guide system according to one of claims 1 to 9 characterised in that the front guide unit (8.1) is fixed in position on the base (B) and the central guide unit (8.2) is rotationally movably mounted on the base (B) and the rear guide unit (8.3) is rotationally movably mounted on the front guide unit (8.1).

11. A line guide system according to one of claims 1 to 10 characterised in that the rotary angle ranges of the strands (3.1, 3.2, 3.3) are abutment-limited and/or drive-limited.

12. A line guide system according to one of claims 1 to 11 characterised in that provided at least for one strand (3.1, 3.2, 3.3) is a spacer body (23) for spacing its runs (4.1, 4.2), which spacer body is arranged between the runs (4.1,

4.2) and on the inside of the deflection arc (5) and is coupled to the displacement of said strand (3.1, 3.2, 3.3).

13. A line guide system according to one of claims 1 to 12 characterised in that there are provided two first strands (3.1) and/or two second strands (3.2), wherein the first strands (3.1) and the second strands (3.2) are respectively arranged in a plane (E.1, E.2, E.3) and displaceably in opposite relationship therein relative to each other.

14. A line guide system according to claim 13 characterised in that provided for the first strands (3.1) and/or the second strands (3.2) is a respective spacer body (23) which in part-peripheral relationship is arranged between the runs (4.1, 4.2) of the first strands (3.1) and the second strands (3.2) respectively and at the end on the inside bearing with play against the deflection arcs (5) of the first strands (3.1) and the second strands (3.2) respectively.

15. A line guide system according to one of claims 12 to 14 characterised in that the spacer body (23) is in the form of a chain with chain link members which are arranged guided in the line guide system (1) pivotably relative to each other in parallel relationship with the rotary axis (d).