CLAIMS

1. Double drum traction winch comprising a frame supporting a first and second rotatable drum such that a wire can be wound about the two drums, further comprising one or more drives for rotating both drums about their respective rotational axis, wherein the outer surface of each drum is provided with parallel circumferential grooves perpendicular to the rotational axis of the drum for carrying the wire that is wound about both drums, and wherein in use the tension in the wire carried by the grooves increases with each groove it passes through from a low tension end of a drum, where tension in the carried wire is low, towards a high tension end of a drum, were the tension in the carried wire is high, **characterized in that**, the rotatable drums are both drums with adjustable grooves, each drum comprising:

a core body, mounted in the frame for rotation about the rotational axis of the drum by said one or more drives;

multiple, for example three or more, curved segments, each segment defining a section of a circumferential groove, such that multiple circumferential grooves are each composed of several curved segments, which curved segments are each movably supported on the core body for movement in a substantial radial direction relative to the rotational axis of the drum,

an actuator mechanism for the curved segments, comprising actuators that cause essentially radial displacement of the curved segments, and that:

a) allow to move curved segments into an outward position to increase the circumference of the grooves, and

b) allow to move curved segments into an inward position to reduce the circumference of the grooves, and wherein

the actuator mechanism allows the curved segments to be positioned such that the circumference of a groove at the low tension end of the drum is smaller than the circumference of a groove at the high tension end of the drum.

2. Double drum traction winch according to claim 1, wherein a circumferential groove is composed out of at least four, for example eight, or more curved segments.

3. Double drum traction winch according to claim 1 or 2, wherein the curved segments are each at one end shaped for supporting an overlying end of an adjacent curved segment, and at the opposite end are each shaped for engaging an curved segment for support, such that the curved segments forming a groove support each other like overlapping members.

4. Double drum traction winch according to one or more of the preceding claims, wherein the actuator mechanism is provided with a control system adapted to operate the actuators while the drums carry a wire and in particular while the drums carrying a wire are rotated, such that a curved segment is moved in the substantial radial direction only when the groove section of that curved segment only partially carries a wire, in particular is moved only when the groove section of that curved segments does not carry a wire.

5. Double drum traction winch according to one or more of the preceding claims, wherein the curved segments are arranged parallel in rows along the longitudinal axis of the drum and wherein the actuator mechanism comprises actuators common to such a row of curved segments for moving the curved segments simultaneously.

6. Double drum traction winch according to claim 5, wherein each common actuator comprises a cam shaft supported by the core body and extending in a direction parallel to the rotational axis of the drum, each cam shaft interacting with a row of curved segments for simultaneous movement in the radial direction of the multiple curved segments by rotating the cam shaft.

7. Double drum traction winch according to one or more of the preceding claims, wherein the actuator mechanism is adapted for moving the curved segments of a drum at a predetermined and fixed ratio from one groove to the next groove to adjust the circumferential distance of each groove in relation to a predetermined non-linear elastic behaviour of the wire.

8. Double drum traction winch according to one or more of the preceding claims, wherein the actuator mechanism is provided with a control system comprising one or more sensors for detecting the wire speed and/or tension in the wire carried by the drum, which control system is adapted to operate the actuators such that the segments are positioned in dependence of the actual tension and thus the stretch of the wire for forming grooves having a circumferential distance such that the surface of the curved segment carrying the wire has substantially the same speed as the wire.

9. Double drum traction winch according to one or more of the preceding claims, wherein the diameter of the adjustable drum is at least 2 meter, for example 2,5 meter or 3 meter, and the position of the curved segments can be adjusted in the radial direction at least

over a range of up to 10 mm, for example over a range up to 15 mm, such as a range up to 20 mm.

10. Double drum traction winch according to one or more of the preceding claims, wherein the core body supports at fixed angularly spaced locations cam shafts that extend parallel to and at equal radial distance from the rotation axis of the drum,

wherein a first row of curved segments each have a first end of the a curved segment cooperating with a first cam shaft to displace said end substantially in radial direction and wherein each second end of a segment of the first row is supported by a first end of a segment of an adjacent second row, and a second cam shaft cooperates with said first ends of the segments of the second row to displace said ends in said radial direction.

11. Double drum traction winch according to claim 10, wherein for each cam shaft a cam shaft actuator is provided on the core body, e.g. a hydraulic or electric motor, and wherein, in an embodiment, said cam shaft actuators are operable independent from one another.

12. Use of a double drum traction winch according to one or more of the preceding claims in off-shore operations, for example for abandonment and recovery applications, oceanography, dredging at great depths, or for towing by a tow boat.

13. Vessel provided with a double drum traction winch according to one or more of the preceding claims.

14. Method for reducing wire slip on a double drum traction winch, the method comprising the steps of:

Providing a double drum traction winch according to one or more of the claims 1-11;

Providing a storage drum with a wire to be carried by the double drum traction winch

Adjusting the radial position of the curved segments and thus adjusting the circumferential length of grooves defined by those curved segments;

Guiding the wire from the storage drum to the traction winch, winding the wire about the two traction drums such that the wire is carried by the grooves;

Guiding the wire from the traction winch to a load, and connecting the wire to the load;

Lifting or lowering the first load using the traction winch and the wire.

15. Method according to claim 14, comprising the step of adjusting the circumference of multiple grooves, in an embodiment simultaneously, by adjusting the radial position of multiple curved segments, while the drums are carrying the wire.

16. Method according to claim 15, comprising the step of dynamically adjusting the circumference of the grooves, in an embodiment simultaneously, by adjusting the radial position of multiple curved segments while the drums are rotated, and wherein a curved segment is moved in the substantial radial direction only when the groove of that curved segment only partially carries a wire, in an embodiment is moved only when the groove of that curved segments does not carry a wire,

and wherein the position of the curved segments defining a groove is adjusted in a consecutive fashion along the circumferential distance of the groove.

Claims

1. Double drum traction winch (1) comprising a frame (2) supporting a first (3) and second (4) rotatable drum such that a wire (5) can be wound about the two drums, further comprising one or more drives for rotating both drums about their respective rotational axis (9), wherein the outer surface of each drum is provided with parallel circumferential grooves (7, 8)

   perpendicular to the rotational axis of the drum for carrying the wire that is wound about both drums, and wherein in use the tension in the wire carried by the grooves increases with each groove it passes through from a low tension end of a drum, where tension in the carried wire is low, towards a high tension end of a drum, were the tension in the carried wire is high, **characterized in that**, the rotatable drums are both drums with adjustable grooves, each drum comprising:

   a core body (10), mounted in the frame for rotation about the rotational axis of the drum by sald one or more drives;
   multiple, for example three or more, curved segments (11), each segment defining a section of a circumferential groove, such that multiple circumferential grooves are each composed of several curved segments, which curved segments are each movably supported on the core body for movement in a substantial radial direction relative to the rotational axis of the drum,
   an actuator mechanism (12, 13) for the curved segments, comprising actuators that cause essentially radial displacement of the curved segments, and that:

a) allow to move curved segments into an outward position to increase the circumference of the grooves, and
b) allow to move curved segments into an inward position to reduce the circumference of the grooves, and wherein

the actuator mechanism allows the curved segments to be positioned such that the circumference of a groove at the low tension end of the drum is smaller than the circumference of a groove at the high tension end of the drum.

2. Double drum traction winch according to claim 1, wherein a circumferential groove is composed out of at least four, for example eight, or more curved segments.

3. Double drum traction winch according to claim 1 or 2, wherein the curved segments are each at one end shaped for supporting an overlying end of an adjacent curved segment, and at the opposite end are each shaped for engaging an curved segment for support, such that the curved segments forming a groove support each other like overlapping members.

4. Double drum traction winch according to one or more of the preceding claims, wherein the actuator mechanism is provided with a control system adapted to operate the actuators while the drums carry a wire

and in particular while the drums carrying a wire are rotated, such that a curved segment is moved in the substantial radial direction only when the groove section of that curved segment only partially carries a wire, in particular is moved only when the groove section of that curved segments does not carry a wire.

5. Double drum traction winch according to one or more of the preceding claims, wherein the curved segments are arranged parallel in rows along the longitudinal axis of the drum and wherein the actuator mechanism comprises actuators common to such a row of curved segments for moving the curved segments simultaneously.

6. Double drum traction winch according to claim 5, wherein each common actuator comprises a cam shaft (12) supported by the core body and extending in a direction parallel to the rotational axis of the drum, each cam shaft interacting with a row of curved segments for simultaneous movement in the radial direction of the multiple curved segments by rotating the cam shaft.

7. Double drum traction winch according to one or more of the preceding claims, wherein the actuator mechanism is adapted for moving the curved segments of a drum at a predetermined and fixed ratio from one groove to the next groove to adjust the circumferential distance of each groove in relation to a predetermined non-linear elastic behaviour of the wire.

8. Double drum traction winch according to one or more of the preceding claims, wherein the actuator mechanism is provided with a control system comprising one or more sensors for detecting the wire speed and/or tension in the wire carried by the drum, which control system is adapted to operate the actuators such that the segments are positioned in dependence of the actual tension and thus the stretch of the wire for forming grooves having a circumferential distance such that the surface of the curved segment carrying the wire has substantially the same speed as the wire.

9. Double drum traction winch according to one or more of the preceding claims, wherein the diameter of the adjustable drum is at least 2 meter, for example 2,5 meter or 3 meter, and the position of the curved segments can be adjusted in the radial direction at least over a range of up to 10 mm, for example over a range up to 15 mm, such as a range up to 20 mm.

10. Double drum traction winch according to one or more of the preceding claims, wherein the core body supports at fixed angularly spaced locations cam shafts that extend parallel to and at equal radial distance

from the rotation axis of the drum,
wherein a first row of curved segments (11a) each have a first end (14) of the a curved segment cooperating with a first cam shaft (12a) to displace said end substantially in radial direction and wherein each second end (15) of a segment of the first row is supported by a first end (16) of a segment (11b) of an adjacent second row, and a second cam shaft (12b) cooperates with said first ends (15) of the segments of the second row to displace said ends in said radial direction.

11. Double drum traction winch according to claim 10, wherein for each cam shaft a cam shaft actuator is provided on the core body, e.g. a hydraulic or electric motor, and wherein, in an embodiment, said cam shaft actuators are operable independent from one another.

12. Use of a double drum traction winch according to one or more of the preceding claims in off-shore operations, for example for abandonment and recovery applications, oceanography, dredging at great depths, or for towing by a tow boat.

13. Vessel provided with a double drum traction winch according to one or more of the preceding claims.

14. Method for reducing wire slip on a double drum traction winch, the method comprising the steps of:

    Providing a double drum traction winch according to one or more of the claims 1-11;
    Providing a storage drum with a wire to be carried by the double drum traction winch
    Adjusting the radial position of the curved segments and thus adjusting the circumferential length of grooves defined by those curved segments;
    Guiding the wire from the storage drum to the traction winch, winding the wire about the two traction drums such that the wire is carried by the grooves;
    Guiding the wire from the traction winch to a load, and connecting the wire to the load;
    Lifting or lowering the first load using the traction winch and the wire.

15. Method according to claim 14, comprising the step of adjusting the circumference of multiple grooves, in an embodiment simultaneously, by adjusting the radial position of multiple curved segments, while the drums are carrying the wire, the method preferably further comprising the steps of:

    dynamically adjusting the circumference of the grooves, in an embodiment simultaneously, by adjusting the radial position of multiple curved

segments while the drums are rotated, and wherein a curved segment is moved in the substantial radial direction only when the groove of that curved segment only partially carries a wire, in an embodiment is moved only when the groove of that curved segments does not carry a wire,
and wherein the position of the curved segments defining a groove is adjusted in a consecutive fashion along the circumferential distance of the groove.