CLAIMS:

1. A winch apparatus comprising first and second drum assemblies each defining a circumferentially discontinuous drum contact surface for engaging a common spoolable medium, each drum assembly having a plurality of support elements which interleave each other and collectively define the respective drum surfaces, wherein the first and second drum assemblies are arranged to rotate about respective first and second axes of rotation which are inclined relative to each other.

2. The winch apparatus according to claim 1, wherein said winch apparatus is configured as a capstan winch apparatus.

3. The winch apparatus according to claim 1 or 2, wherein the first and second axes of rotation are inclined relative to each other in two reference planes.

4. The winch apparatus according to claim 3, wherein the two reference planes are mutually perpendicular.

5. The winch apparatus according to any preceding claim, wherein the first and second axes of rotation are inclined at least one of axially and radially relative to each other.

6. The winch apparatus according to any preceding claim, wherein each drum contact surface is aligned generally parallel to an associated drum axis of rotation such that the drum contact surfaces of the respective first and second drum assemblies are also inclined relative to each other to the same extent as the first and second axes of rotation.

7. The winch apparatus according to any preceding claim, wherein the first and second drum assemblies are configured to engage a wrapped intermediate portion of the common spoolable medium, such that end portions of the common spoolable medium on either side of the intermediate wrapped portion extend outwardly from the winch apparatus to define an outboard end portion and an inboard end portion.

8. The winch apparatus according to claim 7, comprising a tensioner arrangement for applying a degree of tension to at least one end portion of the common spoolable medium.

9. The winch apparatus according to any preceding claim, wherein the relative inclined alignment of the first and second axes of rotation of the drum assemblies is arranged to permit the respective drum contact surfaces to cooperate to manipulate an associated spoolable medium to follow a predefined path.

10. The winch apparatus according to claim 9, wherein the predefined path is helical.

11. The winch apparatus according to any preceding claim, wherein the angle of relative inclination of the first and second axes of rotation is fixed.

12. The winch apparatus according to any of claims 1 to 10, wherein the angle of relative inclination is adjustable.

13. The winch apparatus according to any preceding claim, wherein the angle of relative inclination of the first and second axes of rotation is selected to be in the region of 1 to 3 degrees.

14. The winch apparatus according to any preceding claim, wherein for each single wrap of the common spoolable medium, one portion of the common spoolable medium wrap engages the drum contact surface of the first drum assembly, and the remaining portion engages the drum contact surface of the second drum assembly.

15. The winch apparatus according to any preceding claim, wherein the drum assemblies overlap in an axial direction.

16. The winch apparatus according to any preceding claim, wherein the drum assemblies overlap in a radial direction.

17. The winch apparatus according to any preceding claim, wherein the drum assemblies intermesh each other.

18. The winch apparatus according to any preceding claim, wherein the support elements are elongate.

19. The winch apparatus according to any preceding claim, wherein the support elements are circumferentially arranged about a respective axis of rotation of the drum assemblies.

20. The winch apparatus according to any preceding claim, wherein each support element comprises an individual support surface arranged to define a discrete portion of a respective drum contact surface.

21. The winch apparatus according to claim 20, wherein the individual support surface of one or more support elements defines an arc shape.

22. The winch apparatus according to any preceding claim, wherein each support element defines an arc shape support surface, wherein the combined arc angle of the support elements of a single drum assembly extends approximately 360 degrees.

23. The winch apparatus according to any preceding claim, wherein a pair of adjacent support elements define respective arc shaped surfaces, wherein facing edges of the adjacent arc shaped surfaces are arranged tangentially to each other.

24. The winch apparatus according to any preceding claim, wherein the support elements are rigidly mounted within the respective drum assemblies.

25. The winch apparatus according to any of claims 1 to 23, wherein the support elements are adjustably mounted within a respective drum assembly.

26. The winch apparatus according to any preceding claim, wherein the support elements are arranged relative to each other to create the discontinuous drum contact surface, with adjacent support elements spaced from each other to define a gap therebetween.

27. The winch apparatus according to claim 26, wherein the support elements of one drum assembly are positioned in the gaps between the support elements on the other drum assembly.

28. The winch apparatus according to any preceding claim, wherein the drum assemblies are arranged on separate support shafts.

29. The winch apparatus according to any of claims 1 to 27, wherein the drum assemblies are arranged on a common support shaft.

30. The winch apparatus according to claim 29, wherein one or both of the drum assemblies are offset relative to the support shaft to provide the relative inclination between the first and second axes of rotation.

31. The winch apparatus according to any of claims 1 to 16, 18 to 26 or 28, wherein the drum assemblies are arranged to be offset from each other in a radial direction to be positioned side by side.

32. The winch apparatus according to any preceding claim, comprising a drive arrangement configured to drivingly rotate both drum assemblies.

33. The winch apparatus according to claim 32, wherein the drive arrangement is configured to synchronously drive both drum assemblies.

34. The winch apparatus according to claim 32 or 33, wherein the drive arrangement comprises a single drive assembly configured to drive both drum assemblies.

35. The winch apparatus according to claim 32 or 33, wherein the drive arrangement comprises a first drive apparatus associated with the first drum assembly, and a second drive apparatus associated with the second drum assembly.

36. The winch apparatus according to any of claims 32 to 35, wherein the drive arrangement functions to provide braking to one or both drum assemblies.

37. The winch apparatus according to any preceding claim, wherein the surface of one or both of the drum contact surfaces is configured such that the coefficient of friction between the respective surfaces and the common spoolable medium is less than the coefficient of friction between individual components of the common spoolable medium.

38. A method for establishing a tension gradient within a common spoolable medium, comprising:

providing first and second drum assemblies each having a plurality of support elements which interleave each other and define a circumferentially discontinuous drum contact surface;

wrapping a portion of the common spoolable medium around the contact surface of both the first and second drum assemblies;

rotating both the first and second drum assemblies about respective first and second axes of rotation which are inclined relative to each other;

wherein said common spoolable medium is in intermittent contact with each discontinuous drum contact surface.

39. A winch system comprising a winch apparatus including first and second drum assemblies each having a plurality of support elements which interleave each other and define a circumferentially discontinuous drum contact surface for engaging a common spoolable medium, wherein the first and second drum assemblies are arranged to rotate about respective first and second axes of rotation which are inclined relative to each other.

40. A winch apparatus comprising first and second drum assemblies each including a plurality of support elements forming a circumferentially discontinuous drum contact surface for engaging a common spoolable medium, wherein the support elements of each drum assembly interleave each other.

41. The winch apparatus according to claim 40, wherein the drum assemblies are arranged to rotate about respective first and second axes of rotation which are inclined relative to each other.

CLAIMS:

1. A winch apparatus comprising first and second drum assemblies each defining a discontinuous drum contact surface for engaging a common spoolable medium, wherein the first and second drum assemblies are arranged to rotate about respective first and second axes of rotation which are inclined relative to each other.

2. A winch apparatus according to claim 1, configured as a capstan winch apparatus.

3. The winch apparatus according to claim 1 or 2, wherein the first and second axes of rotation are inclined relative to each other in two reference planes.

4. The winch apparatus according to claim 3, wherein the two reference planes are mutually perpendicular.

5. The winch apparatus according to any preceding claim, wherein the first and second axes of rotation are inclined at least one of axially and radially relative to each other.

6. The winch apparatus according to any preceding claim, wherein each drum contact surface is aligned generally parallel to an associated drum axis of rotation such that the drum contact surfaces of the respective first and second drum assemblies are also inclined relative to each other to the same extent as the first and second axes of rotation.

7. The winch apparatus according to any preceding claim, wherein the first and second drum assemblies are configured to engage a wrapped intermediate portion of

a spoolable medium, such that end portions of the spoolable medium on either side of the intermediate wrapped portion extend outwardly from the winch apparatus to define an outboard end portion and an inboard end portion.

8. The winch apparatus according to claim 7, comprising a tensioner arrangement for applying a degree of tension to at least one end portion of a spoolable medium.

9. The winch apparatus according to any preceding claim, wherein the relative inclined alignment of the first and second axes of rotation of the drum assemblies is arranged to permit the respective drum contact surfaces to cooperate to manipulate an associated spoolable medium to follow a predefined path.

10. The winch apparatus according to claim 9, wherein the predefined path is helical.

11. The winch apparatus according to any preceding claim, wherein the angle of relative inclination of the first and second axes of rotation is fixed.

12. The winch apparatus according to any one of claims 1 to 10, wherein the angle of relative inclination is adjustable.

13. The winch apparatus according to any preceding claim, wherein the angle of relative inclination of the first and second axes of rotation may be selected to be in the region of 1 to 3 degrees.

14. The winch apparatus according to any preceding claim, wherein for each single wrap of a spoolable medium, one portion of the spoolable medium wrap

engages the drum contact surface of the first drum assembly, and the remaining portion engages the drum contact surface of the second drum assembly.

15. The winch apparatus according to any preceding claim, wherein the drum assemblies overlap in an axial direction.

16. The winch apparatus according to any preceding claim, wherein the drum assemblies overlap in a radial direction.

17. The winch apparatus according to any preceding claim, wherein the drum assemblies intermesh each other.

18. The winch apparatus according to any preceding claim, wherein each drum assembly comprises a plurality of support elements which collectively define the respective drum contact surfaces.

19. The winch apparatus according to claim 18, wherein the support elements are elongate.

20. The winch apparatus according to claim 18 or 19, wherein the support elements are circumferentially arranged about a respective axis of rotation of the drum assemblies.

21. The winch apparatus according to claim 18, 19 or 20, wherein each support element comprises an individual support surface arranged to define a discrete portion of a respective drum contact surface.

22. The winch apparatus according to claim 21, wherein the individual support surface of one or more support elements defines an arc shape.

23. The winch apparatus according to any one of claims 18 to 22, wherein each support element defines an arc shape support surface, wherein the combined arc angle of the support elements of a single drum assembly extends approximately 360 degrees.

24. The winch apparatus according to any one of claims 18 to 23, wherein a pair of adjacent support elements define respective arc shaped surfaces, wherein facing edges of the adjacent arc shaped surfaces are arranged tangentially to each other.

25. The winch apparatus according to any one of claims 18 to 24, wherein the support elements are rigidly mounted within the respective drum assemblies.

26. The winch apparatus according to any one of claims 18 to 24, wherein the support elements are adjustably mounted within a respective drum assembly.

27. The winch apparatus according to any one of claims 18 to 26, wherein the support elements are arranged relative to each other to create a discontinuous drum contact surface, with adjacent support elements spaced from each other to define a gap therebetween.

28. The winch apparatus according to any one of claims 18 to 27, wherein the support elements of each drum assembly interleave each other.

29. The winch apparatus according to claim 27, or claim 28 when dependent on claim 27, wherein the support elements of one drum assembly are positioned in the gaps between the support elements on the other drum assembly.

30. The winch apparatus according to any preceding claim, wherein the drum assemblies are arranged on separate support shafts.

31. The winch apparatus according to any one of claims 1 to 29, wherein the drum assemblies are arranged on a common support shaft.

32. The winch apparatus according to claim 31, wherein one or both of the drum assemblies are offset relative to the support shaft to provide the relative inclination between the first and second axes of rotation.

33. The winch apparatus according to any one of claims 1 to 16, 18 to 27 or 30, wherein the drum assemblies are arranged to be offset from each other in a radial direction to be positioned side by side.

34. The winch apparatus according to any preceding claim, comprising a drive arrangement configured to drivingly rotate both drum assemblies.

35. The winch apparatus according to claim 34, wherein the drive arrangement is configured to synchronously drive both drum assemblies.

36. The winch apparatus according to claim 34 or 35, wherein the drive arrangement comprises a single drive assembly configured to drive both drum assemblies

37. The winch apparatus according to claim 34 or 35, wherein the drive arrangement comprises a first drive apparatus associated with the first drum assembly, and a second drive apparatus associated with the second drum assembly.

38. The winch apparatus according to any one of claims 34 to 37, wherein the drive arrangement functions to provide braking to one or both drums.

39. The winch apparatus according to any preceding claim, wherein the surface of one or both of the drum contact surfaces may be configured such that the coefficient of friction between the respective surfaces and a spoolable medium is less than the coefficient of friction between individual components of the spoolable medium, such as braids, strands or the like.

40. A method of establishing a tension gradient within a spoolable medium, comprising:

providing first and second drum assemblies each defining a discontinuous drum contact surface;

wrapping a portion of the spoolable medium around the contact surface of both the first and second drum assemblies; and

rotating both the first and second drum assemblies about respective first and second axes of rotation which are inclined relative to each other.

41. A winch system comprising a winch apparatus according to any one of claims 1 to 39.