CLAIMS

1. A conveyor belt comprising:

a series of rows of belt modules having a top side and a bottom side and hingedly linked together between consecutive rows along hinge joints defining hinge axes extending perpendicular to a conveying direction from a first side edge of the rows to an opposite second side edge of the rows, wherein the hinge joints have play in the conveying direction to allow the rows to collapse together at the first side edge when the first side edge is at the inside of a turn in a conveying path, the first side edge including a drive face;

a plurality of teeth, each tooth projecting outward from the first side edge of one of the rows to a distal end and having a guide surface oriented to guide an end of an external drive member between the teeth and into driving contact with the drive face of the row or a consecutive row to drive the conveyor belt in the conveying direction.

2. A conveyor belt as in claim 1 wherein each tooth extends upward from the top side of the row.

3. A conveyor belt as in claim 1 wherein each tooth extends downward from the bottom side of the row.

4. A conveyor belt as in claim 1 wherein each tooth extends radially outward from the first side edge of the row.

5. A conveyor belt as in claim 4 wherein each tooth is diamond-prism-shaped with four guide surfaces.

6. A conveyor belt as in claim 1 wherein each tooth has a pair of guide surfaces converging with distance from the distal end.

7. A conveyor belt as in claim 1 wherein each tooth is tent-shaped with two guide surfaces.

8. A conveyor belt as in claim 1 wherein the tooth has rounded drive surfaces.

9. A conveyor belt as in claim 1 comprising multiple teeth projecting outward from the first side edge.

10. A conveyor belt as in claim 1 wherein each tooth is removably attachable to the first side edge.

11. A conveyor belt as in claim 1 wherein each tooth is unitarily formed with the first side edge.

12. A spiral conveyor comprising:

a rotating cylindrical drive tower having an outer periphery extending from a bottom to a top with a belt entry level proximate the bottom for an upgoing spiral or proximate the top for a downgoing spiral;

a plurality of parallel drive members extending in length on the periphery of the drive tower, each having a ridge projecting radially outward from a bottom end to a top end, wherein the bottom ends of the ridges are indented a first distance upward from the belt entry level for an upgoing spiral or the top ends of the ridges are indented a first distance downward from the belt entry level for a downgoing spiral;

a conveyor belt advancing up or down in a conveying direction along a helical conveying path around the outer periphery of the rotating cylindrical drive tower, the conveyor belt including a plurality of rows of belt modules having a top side and a bottom side and hingedly linked together between consecutive rows along hinge joints defining hinge axes extending perpendicular to the conveying direction from a first side edge of the rows to an opposite second side edge of the rows, wherein the hinge joints have play in the conveying direction to allow the rows to collapse together at the first side edge when the first side edge is at the inside of the helical conveying path, the first side edge including a drive face on each row, wherein the first side edge of the conveyor belt includes a series of outwardly extending teeth with guide surfaces oriented to guide the bottom ends of the ridges in an upgoing spiral or the top ends of the ridges in a downgoing spiral between the teeth and position the ridges into driving contact with the drive faces to drive the conveyor belt in the conveying direction along the helical conveying path.

13. A spiral conveyor as in claim 12 wherein the first distance is great enough to allow enough contact between the conveyor belt and the periphery of the cylindrical drive tower for the first edge of the conveyor belt to collapse before the conveyor belt engages the bottom or top ends of the drive members.

14. A spiral conveyor as in claim 12 wherein the guide surfaces on the teeth guide the ridges into driving contact with the drive faces from the bottom side of the rows in a downgoing spiral.

15. A spiral conveyor as in claim 12 wherein each tooth extends downward from the bottom side of the row.

16. A spiral conveyor as in claim 12 wherein the guide surfaces on the teeth guide the ridges into driving contact with the drive faces from the top side of the rows in an upgoing spiral.
17. A spiral conveyor as in claim 12 wherein each tooth extends upward from the top side of the row.
18. A spiral conveyor as in claim 12 wherein the ridges at the top ends or the bottom ends of the drive members are tapered.
19. A spiral conveyor as in claim 12 wherein the teeth extend radially outward from the first side edges of the rows.
20. A spiral conveyor as in claim 12 wherein each tooth has a pair of guide surfaces converging with distance from the distal end.
21. A spiral conveyor as in claim 12 comprising multiple teeth extending outward from the first side edge of each row and multiple ridges formed on each of the drive members to engage the multiple teeth on each row.
22. A spiral conveyor as in claim 12 wherein the teeth are removably attachable to the first side edge.
23. A spiral conveyor as in claim 12 wherein the teeth are unitarily formed with the first side edge.
24. A spiral conveyor as in claim 12 wherein the ridges are slanted off vertical.
25. A spiral conveyor comprising:

a drive tower extending from a bottom to a top and rotating about a vertical axis;

a plurality of parallel drive members extending in length from the bottom to the top of the drive tower;

wherein each of the drive members includes an outwardly projecting ridge whose distance from the vertical axis varies from the bottom to the top of the drive tower.
26. A spiral conveyor as in claim 25 wherein the distance of the ridge from the vertical axis is constant along a majority of the length of the drive member.
27. A spiral conveyor as in claim 25 wherein each drive member includes an upper segment at the top of the drive tower wherein the ridge in the upper segment tapers down toward the top of the drive tower.
28. A spiral conveyor as in claim 27 wherein the ridge tapers linearly in the upper segment.

29. A spiral conveyor as in claim 25 wherein each drive member includes a lower segment at the bottom of the drive tower and wherein the ridge extends vertically along the drive tower above the lower segment and is angled off vertical in the lower segment.

30. A spiral conveyor as in claim 25 wherein each drive member includes a lower segment at the bottom of the drive tower and wherein the ridge in the lower segment is tapered along a portion of its length.

31. A spiral conveyor as in claim 30 wherein the distance of the ridge from the vertical axis in the lower segment is constant below the portion that is tapered.

32. A spiral conveyor as in claim 25 wherein the ridge is continuous in length with a lower segment and an upper segment connected by an intermediate segment and wherein the distance of the ridge from the vertical axis in the intermediate segment is a constant distance, the distance of the ridge from the vertical axis in the upper segment decreases toward the top of the drive tower from the constant distance to zero, and distance of the ridge from the vertical axis in the lower segment decreases toward the bottom of the drive tower from the constant distance to a lesser distance.

33. A spiral conveyor as in claim 25 wherein the ridge has a profile from bottom to top that defines a first constant distance from the vertical axis, increasing to a greater second distance from the vertical axis, then remaining constant at the second distance, and finally decreasing in distance from the vertical to the top of the drive tower.

34. A spiral conveyor as in claim 33 wherein the ridge whose profile is constant at the first constant distance is angled off vertical.

35. A spiral conveyor as in claim 25 further comprising a conveyor belt positively driven on a helical path around the drive tower by the ridges of the drive members engaging an inside edge of the conveyor belt.

36. A spiral conveyor as in claim 25 wherein the drive tower has an upper portion with a first diameter and a skirt portion tapered outwardly away from the vertical axis toward the bottom of the drive tower.

37. A spiral conveyor as in claim 36 wherein the skirt portion includes a bottom portion with a second diameter greater than the first diameter and a tapered portion connecting the bottom portion to the upper portion.

CLAIMS

1. A conveyor belt (20) comprising:

a series of rows of belt modules (44) having a top side and a bottom side and hingedly linked together between consecutive rows along hinge joints (94) defining hinge axes extending perpendicular to a conveying direction (96) from a first side edge of the rows to an opposite second side edge of the rows, wherein the hinge joints (94) have play in the conveying direction (96) to allow the rows to collapse together at the first side edge (66) when the first side edge is at the inside of a turn in a conveying path, the first side edge including a drive face; characterised in that the conveyor belt further comprises

a plurality of teeth (62), each tooth projecting outward from the first side edge (66) of one of the rows to a distal end (80) and having a guide surface (78,79) oriented to guide an end of an external drive member (14) between the teeth and into driving contact with the drive face (89A, 89B) of the row or a consecutive row to drive the conveyor belt in the conveying direction wherein it is only the inside edge of the belt that positively engages the external drive member (14) to drive the belt in its conveying direction.

2. A conveyor belt as in claim 1 wherein each tooth (62) extends upward from the top side (68) of the row, downward from the bottom side (69) of the row, or radially outward from the first side edge (66) of the row.

3. A conveyor belt as in claim 1 wherein each tooth is diamond-prism-shaped (82) with four guide surfaces (88A-D) or is tent-shaped with two guide surfaces (78, 79).

4. A conveyor belt as in claim 1 wherein each tooth has a pair of guide surfaces converging with distance from the distal end (80).

5. A conveyor belt as in claim 1 wherein the tooth has rounded drive surfaces.

6. A conveyor belt as in claim 1 comprising multiple teeth projecting outward from the first side edge (66).

7. A conveyor belt as in claim 1 wherein each tooth is removably

attachable to the first side edge (66) or is unitarily formed with the first side edge(66).

8. A spiral conveyor comprising:

a rotating cylindrical drive tower (10) having an axis of rotation and an outer periphery (16) extending from a bottom (18) to a top (19) with a belt entry level (120) proximate the bottom (18) for an upgoing spiral or proximate the top (19) for a downgoing spiral;

a plurality of parallel drive members (14) extending in length on the periphery(16) of the drive tower (10), each having a ridge (28) projecting radially outward from a bottom end (118) to a top end (119);

a conveyor belt (20) advancing up or down in a conveying direction along a helical conveying path (50) around the outer periphery (16) of the rotating cylindrical drive tower (10), the conveyor belt (20) including a plurality of rows of belt modules (44) having a top side and a bottom side and hingedly linked together between consecutive rows along hinge joints (94) defining hinge axes extending perpendicular to the conveying direction from a first side edge of the rows to an opposite second side edge of the rows, wherein the hinge joints (94) have play in the conveying direction to allow the rows (44) to collapse together at the first side edge when the first side edge is at the inside of the helical conveying path, and wherein the first side edge include a drive face (89A,89B) on each row, characterised in that the bottom ends (118) of the ridges (28) are indented a first distance upward from the belt entry level (120) for an upgoing spiral or the top ends of the ridges (28) are indented a first distance downward from the belt entry level (120 for a downgoing spiral; and wherein the first side edge of the conveyor belt (20) includes a series of outwardly extending teeth(62) with guide surfaces (78,79) oriented to guide the bottom ends (118) of the ridges (28) in an upgoing spiral or the top ends (119) of the ridges (28) in a downgoing spiral between the teeth (62) and position the ridges (28) into driving contact with the drive faces to drive the conveyor belt in the conveying direction along the helical conveying path such that it is only the inside edge of the belt that positively engages the drive members (14) to drive the belt in its conveying direction.

9. A spiral conveyor as in claim 8 wherein the first distance is great enough to allow enough contact between the conveyor belt (20) and the periphery of the cylindrical drive tower (10) for the first edge of the conveyor belt (20) to collapse before the conveyor belt engages the bottom or top ends of the drive members (14).

10. A spiral conveyor as in claim 8 wherein the guide surfaces (78,79) on the teeth (62) guide the ridges (28) into driving contact with the drive faces (89A,89B) from the bottom side of the rows in a downgoing spiral or from the top side of the rows in an upgoing spiral.

11. A spiral conveyor as in claim 8 wherein the ridges (28) are slanted off vertical.

12. A spiral conveyor as in claim 8 wherein each drive member (14) includes an upper segment (54) at the top of the drive tower (10) wherein the ridge (28) in the upper segment tapers down toward the top of the drive tower (10) or wherein each drive member (14) includes a lower segment (38) at the bottom of the drive tower (10) and wherein the ridge (28) tapers down toward the bottom of the drive tower (10).

13. A spiral conveyor as in claim 8 wherein the drive tower (10) has an upper portion (182) with a first diameter and a skirt portion (184) tapered outwardly away from the axis of rotation toward the bottom (18) of the drive tower (10).

14. A spiral conveyor as in claim 13 wherein the skirt portion (184) includes a bottom portion (196) with a second diameter greater than the first diameter and a tapered portion (197) connecting the bottom portion to the upper portion.