Claims

1. A tape reel apparatus for a tape and reel component transfer system configured for transferring components onto or off of a flexible linear tape, the tape reel apparatus comprising:

a central hub rotatable about a first axis of rotation;

a plurality of tape reels coupled to the central hub, the plurality of tape reels including a first tape reel and a second tape reel; and

a first actuator coupled to the central hub and configured to rotate the central hub about the first axis of rotation to thereby rotate the first tape reel away from a feeding position while simultaneously rotating the second tape reel toward the feeding position,

wherein the feeding position corresponds to a location at which the flexible linear tape can be fed from the component transfer system to a tape reel positioned thereat, or fed from the tape reel positioned thereat to the component transfer system.

2. The tape reel apparatus of claim 1, further comprising a second actuator configured for spinning the second tape reel about a winding axis or an unwinding axis for respectively winding or unwinding the flexible linear tape about the second tape reel when the second tape reel is disposed at the feeding position.

3. The tape reel apparatus of claim 2, wherein while the second tape reel is disposed at the feeding position and the flexible linear tape is being wound about or unwound from the second tape reel, the first tape reel is offloaded from the tape reel apparatus.

4. A tape reel apparatus for a tape and reel component transfer system configured for transferring components onto or off of a flexible linear tape, the tape reel apparatus comprising:

a multi-arm module comprising:

a central hub rotatable about a first axis of rotation; and

a plurality of arms coupled to the central hub, each of the plurality of arms radially extending away from the central hub, each of the plurality of arms having a reel holder by which a tape reel can be attached to and detached from the arm; and

a first actuator coupled to the central hub and configured for rotating the central hub about the first axis of rotation to thereby collectively rotate the plurality of arms about the first axis of rotation.

5. The tape reel apparatus of claim 4, wherein each reel holder of each arm is rotatable about a second axis of rotation parallel to the first axis of rotation to enable spinning of a tape reel held thereby for winding and/or unwinding of the flexible linear tape about the tape reel.

6. The tape reel apparatus of claim 4 or 5, wherein the first actuator is configured for collectively rotating the plurality of arms about the first axis of rotation such that one of the plurality of arms rotates toward a feeding position simultaneous with rotation of another of the plurality of arms away from the feeding position, wherein the feeding position corresponds to a position of an arm within the plurality of arms at which the flexible linear tape can be fed from the component transfer system to a tape reel carried by the arm, or fed from the tape reel to the component transfer system.

7. The tape reel apparatus of claim 6, wherein while a first arm within the plurality of arms carrying a tape reel is disposed at the feeding position and the flexible linear tape is being wound about or unwound from the tape reel carried by the first arm, a second arm within the plurality of arms disposed away from the feeding position can offload or receive a second tape reel.

8. The tape reel apparatus of claim 6, further comprising a second actuator configured for selectively spinning a tape reel carried by an arm within the plurality of arms when the arm is disposed at the feeding position.

9. The tape reel apparatus of claim 8, wherein the second actuator includes a rotatable shaft for engaging with the reel holder of an arm within the plurality of arms when the arm is disposed at the feeding position.

10. The tape reel apparatus of claim 8 or 9, further comprising a translation mechanism configured for selectively engaging the rotatable shaft with and disengaging the rotatable shaft from a reel holder of an arm when the arm is disposed at the feeding position.

11. The tape reel apparatus of any one of claims 8 - 10, wherein

(a) rotation of the plurality of arms around the first axis of rotation; and

(b) spinning of a tape reel carried by an arm disposed at the feeding position

is controlled by a set of instructions executed by a processing unit.

12. The tape reel apparatus of any of claims 6 – 11, further comprising a support structure configured to maintain the central hub at a predetermined position relative to the feeding position such that a set of tape guide members is receivable between a first flange and a second flange of a tape reel carried by an arm disposed at the feeding position.

13. A method for transferring components carried by a flexible linear tape between a plurality of tape reels and a tape and reel machine, each tape reel configured for receiving a length of the flexible linear tape by way of circumferentially winding the flexible linear tape thereabout, the method comprising:

providing a tape reel assembly having a plurality of arms rotatable about a first axis of rotation corresponding to a central hub structure, each arm within the plurality of arms configured for carrying a tape reel; and

rotating the tape reel assembly about the first axis of rotation such that the plurality of arms collectively rotates to dispose a first arm of the tape reel assembly at a feeding position while simultaneously disposing a second arm of the tape reel assembly away from the feeding position,

wherein the feeding position corresponds to a location at which the flexible linear tape can be loaded onto or offloaded from a tape reel carried by one of the plurality of arms.

14. The method of claim 13, wherein the first arm carries a first tape reel, and wherein the method further comprises spinning the first tape reel about a second axis of rotation while the first arm is disposed at the feeding position, simultaneous with displacement of the flexible linear tape towards or away from the first tape reel to facilitate loading of the flexible linear tape onto or unloading of the flexible linear tape from the first tape reel, respectively.

15. The method of claim 14, wherein the method further comprises disengaging a second tape reel from or receiving a second tape reel onto the second arm of the tape reel assembly simultaneous with the spinning the first tape reel.

16. The method of claim 15, wherein the second arm of the tape reel assembly carries the second tape reel, and wherein the method further comprises rotating the tape reel assembly about the first axis of rotation such that each of the plurality of arms collectively rotates to dispose the second arm of the tape reel assembly and the second tape reel carried thereby at the feeding position, while simultaneously disposing the first arm of the tape reel assembly away from the feeding position.

17. The method of claim 16, further comprising spinning the second tape reel about the second axis of rotation while the second arm is disposed at the feeding position, simultaneous with displacement of the flexible linear tape towards or away from the second tape reel to facilitate loading of the flexible linear tape onto or unloading of the flexible linear tape from the second tape reel, respectively.

18. A method for transferring components carried by a flexible linear tape between a plurality of tape reels and a tape and reel machine, each tape reel configured for receiving

a length of the flexible linear tape by way of circumferentially winding the flexible linear tape thereabout, the method comprising:

(a) selectively rotating each of the plurality of tape reels about a common first axis of rotation to (i) dispose a selected tape reel within the plurality of tape reels at a feeding position at which the selected tape reel can receive the flexible tape from or offload the flexible linear tape to the tape and reel machine, while simultaneously (ii) disposing other tape reels within the plurality of tape reels away from the feeding position;

(b) spinning the selected tape reel about a second axis of rotation to load the selected tape reel with the flexible linear tape or unload the flexible linear tape from the selected tape reel;

(c) identifying a next tape reel within the plurality of tape reels as the selected tape reel; and

(d) repeating each of (a) through (c) on an ongoing basis during tape and reel machine operation.

19. The method of claim 18, further comprising (e) swapping out a tape reel disposed away from the feeding position with another tape reel while the selected tape reel is disposed at the feeding position and the flexible linear tape is being wound about or unwound from the selected tape reel.

Claims

1. A tape reel apparatus for a tape and reel component transfer system configured for transferring components onto or off of a flexible linear tape, the tape reel apparatus comprising:

a central hub having a plurality of arms rotatable about a first axis of rotation;

a plurality of tape reels, each of the plurality of tape reels coupled to each of the plurality of arms, the plurality of tape reels including a first tape reel and a second tape reel;

a first actuator coupled to the central hub and configured to rotate the central hub about the first axis of rotation to thereby rotate the first tape reel away from a feeding position while simultaneously rotating the second tape reel toward the feeding position;

a second actuator having a rotatable shaft for engaging with a tape reel holder of an arm of the plurality of arms and configured for spinning the first or the second tape reel about a second axis of rotation for winding or unwinding of a flexible linear tape when the first or the second tape reel is disposed at the feeding position; and

a translation mechanism configured for displacing the second actuator towards or away from the tape reel holder in a direction along the second axis of rotation such that the rotatable shaft can respectively engage with or disengage with the tape reel holder when the arm is disposed at the feeding position,

wherein the feeding position corresponds to a location at which the flexible linear tape can be fed from the component transfer system to a tape reel positioned thereat, or fed from the tape reel positioned thereat to the component transfer system.

2. The tape reel apparatus of claim 1, wherein the tape reel holder comprises a recess for engagement with the rotatable shaft of the second actuator at the feeding position.

3. The tape reel apparatus of claim 1, wherein while the second tape reel is disposed at the feeding position and the flexible linear tape is being wound about or unwound from the second tape reel, the first tape reel is offloaded from the tape reel apparatus.

4. A tape reel apparatus for a tape and reel component transfer system configured for transferring components onto or off of a flexible linear tape, the tape reel apparatus comprising:

a multi-arm module comprising:

a central hub rotatable about a first axis of rotation; and

a plurality of arms coupled to the central hub, each of the plurality of arms radially extending away from the central hub, each of the plurality of arms having a reel holder by which a tape reel can be attached to and detached from the arm; and

a first actuator coupled to the central hub and configured for rotating the central hub about the first axis of rotation to thereby collectively rotate the plurality of arms about the first axis of rotation;

a second actuator having a rotatable shaft for engaging with a reel holder of an arm of the plurality of arms and configured for spinning a tape reel about a second axis of rotation for winding or unwinding of a flexible linear tape when the tape reel is disposed at the feeding position; and

a translation mechanism configured for displacing the second actuator toward or away from the tape reel holder in a direction along the second axis such that the rotatable shaft can respectively engage with or disengage with the tape reel holder when the arm is disposed at the feeding position,

wherein the feeding position corresponds to a location at which the flexible linear tape can be fed from the component transfer system to a tape reel positioned thereat, or fed from the tape reel positioned thereat to the component transfer system.

5. The tape reel apparatus of claim 4, wherein each tape reel holder of each arm is rotatable about the second axis of rotation parallel to the first axis of rotation to enable spinning of a tape reel held thereby for winding and/or unwinding of the flexible linear tape about the tape reel.

6. The tape reel apparatus of claim 4 or 5, wherein the first actuator is configured for collectively rotating the plurality of arms about the first axis of rotation such that one of the plurality of arms rotates toward a feeding position simultaneous with rotation of another of the plurality of arms away from the feeding position, wherein the feeding position corresponds to a position of an arm within the plurality of arms at which the flexible linear tape can be fed from the component transfer system to a tape reel carried by the arm, or fed from the tape reel to the component transfer system.

7. The tape reel apparatus of claim 6, wherein while a first arm within the plurality of arms carrying a tape reel is disposed at the feeding position and the flexible linear tape is being wound about or unwound from the tape reel carried by the first arm, a second arm within the plurality of arms disposed away from the feeding position can offload or receive a second tape reel.

8. The tape reel apparatus of claim 7, wherein

(a) rotation of the plurality of arms around the first axis of rotation; and

(b) spinning of a tape reel carried by an arm disposed at the feeding position is controlled by a set of instructions executed by a processing unit.

9. The tape reel apparatus of claim 8, further comprising a support structure configured to maintain the central hub at a predetermined position relative to the feeding position such that a set of tape guide members is receivable between a first flange and a second flange of a tape reel carried by an arm disposed at the feeding position.

10. A method for transferring components carried by a flexible linear tape between a plurality of tape reels and a tape and reel machine, each tape reel configured for receiving a length of the flexible linear tape by way of circumferentially winding the flexible linear tape thereabout, the method comprising:

providing a tape reel assembly having a plurality of arms rotatable about a first axis of rotation corresponding to a central hub structure, each arm within the plurality of arms configured for carrying a tape reel;

rotating the tape reel assembly about the first axis of rotation such that the plurality of arms collectively rotates to dispose a first arm of the tape reel assembly at a feeding position while simultaneously disposing a second arm of the tape reel assembly away from the feeding position; and

engaging or disengaging a second actuator with a tape reel in a direction along a second axis of rotation by a translation mechanism such that a rotatable shaft of the second actuator can respectively engage or disengage with the tape reel holder of a tape reel when the arm is disposed at the feeding position,

wherein the feeding position corresponds to a location at which the flexible linear tape can be loaded onto or offloaded from a tape reel carried by one of the plurality of arms.

11. The method of claim 10, wherein a first arm carries a first tape reel, and wherein the method further comprises spinning the first tape reel about the second axis of rotation while the first arm is disposed at the feeding position, simultaneous with displacement of the flexible linear tape towards or away from the first tape reel to enable loading of the flexible linear tape onto or unloading of the flexible linear tape from the first tape reel.

12. The method of claim 11, wherein the method further comprises disengaging a second tape reel from or receiving a second tape reel onto the second arm of the tape reel assembly simultaneous with the spinning the first tape reel.

13. The method of claim 12, wherein the second arm of the tape reel assembly carries the second tape reel, and wherein the method further comprises rotating the tape reel assembly about the first axis of rotation such that each of the plurality of arms collectively rotates to dispose the second arm of the tape reel assembly and the second tape reel carried thereby at the feeding position, while simultaneously disposing the first arm of the tape reel assembly away from the feeding position.

14. The method of claim 13, further comprising spinning the second tape reel about the second axis of rotation while the second arm is disposed at the feeding position, simultaneous with displacement of the flexible linear tape towards or away from the second tape reel to facilitate loading of the flexible linear tape onto or unloading of the flexible linear tape from the second tape reel, respectively.

15. A method for transferring components carried by a flexible linear tape between a plurality of tape reels and a tape and reel machine, each tape reel configured for receiving a length of the flexible linear tape by way of circumferentially winding the flexible linear tape thereabout, the method comprising:

(a) selectively rotating each of the plurality of tape reels about a first axis of rotation by a first actuator to (i) dispose a selected tape reel within the plurality of tape reels at a feeding position at which the selected tape reel can receive the flexible tape from or offload the flexible linear tape to the tape and reel machine, while simultaneously (ii) disposing other tape reels within the plurality of tape reels away from the feeding position;

(b) engaging a second actuator with a tape reel holder by a translation mechanism configured for displacing the second actuator towards or away from a tape reel holder in a direction along the second axis of rotation such that a rotatable shaft of the second actuator can engage with the tape reel holder when the arm is disposed at the feeding position;

(c) spinning the selected tape reel about a second axis of rotation by the second actuator to load the selected tape reel with the flexible linear tape or unload the flexible linear tape from the selected tape reel;

(d) identifying a next tape reel within the plurality of tape reels as the selected tape reel; and

(e) repeating each of (a) through (c) on an ongoing basis during tape and reel machine operations,

wherein the rotatable shaft is configured for engagement or disengagement with a recess of the tape reel holder rod when located at the feeding position.

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16. The method of claim 15, further comprising (f) swapping out a tape reel disposed away from the feeding position with another tape reel while the selected tape reel is disposed at the feeding position and the flexible linear tape is being wound about or unwound from the selected tape reel.