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SPOOL HAVING FLANGE WITH TIE-OFF FEATURE

Abstract

A spool, spooling system and associated method for winding media onto a spool includes a flange provided with a tie-off feature for retaining a finish end of the media on the spool. The spool includes a barrel and at least one flange extending outwardly from the barrel. The tie-off feature includes a receiving portion for receiving the finish end of the media and a retaining portion for retaining the finish end of the media within the tie-off feature. The tie-off feature may be in the form of a deflecting tab or a flexible membrane. The spooling system includes a feed arm for feeding the media to the spool and a drive unit for rotating the spool to wind the media onto the spool. The method includes winding the media onto the spool and retaining the finish end of the media within the tie-off feature provided on the flange.

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Background/Summary

FIELD OF THE INVENTION

[0001] The present invention relates generally to an apparatus, system and method for retaining the finish end of media wound onto a spool. In various embodiments, a spool for winding a length of a continuous, elongate, flexible media onto the spool has a flange with a tie-off feature for retaining the finish end of the wound media on the flange of the spool. In particular embodiments, the tie-off feature is in the form of a deflecting tab or a flexible membrane.

BACKGROUND OF THE INVENTION

[0002] A generally cylindrical receptacle having an axial through opening and a generally planar rim adjacent at least one end is commonly utilized for winding, storing and subsequently dispensing a length of a continuous, elongate, flexible media. The receptacle may be a reel, hub, bobbin, spindle, spool or the like, and is collectively referred to herein as a spool. The rim adjacent at least one end of the spool may be a collar, ridge, rib, flange or the like, and is collectively referred to herein as a flange. The length of continuous, elongate, flexible media is a relatively thin or small diameter material, such as tape, wire, rope, string, fiber, electrical cable, optical cable or filament. The media is wound onto the spool and then stored on the spool, for example while being inventoried and during transport, prior to being dispensed from the spool. By way of example and not limitation, the media may be a three-dimensional (3D) printing filament that is wound onto the spool and subsequently dispensed from the spool for use in a 3D printing process.

[0003] In many instances it is necessary, or at least desirable, to provide the media wound onto the spool with exterior packaging in the form of at least one layer of stretch wrap. The stretch wrap holds the finish end of the media on the spool to prevent the wound media from unwinding and to protect the wound media from being damaged during storage or transport and prior to use. However, the stretch wrap must be subsequently removed to allow the wound media to be dispensed from the spool, for example to be used in a production process. Manually applying the stretch wrap to the wound media and subsequently removing the stretch wrap from the spool introduces additional time, labor, complexity and cost. The process of applying the stretch wrap may be automated using packaging equipment, such as a stretch wrap applicator, to reduce time and labor. Regardless, applying the stretch wrap increases the complexity and cost of the winding process and removing the stretch wrap increases the time and labor of the subsequent production process.

[0004] Winding equipment for winding a length of continuous, elongate, flexible media onto a spool exists and is commonly referred to as a winder, a spooling machine or a spooler. The winding equipment may be semi-automatic or automatic, such as an automated spooler. Applying stretch wrap to retain the finish end of the wound media on the spool typically requires a stretch wrap applicator in addition to the winder, spooling machine or spooler. An example of a conventional winder or spooling machine including a stretch wrap applicator is known from United States Patent Application Publication No. 2015/0360800 A1. An example of an automated spooler including an optional stretch wrap applicator is known from United States Patent Application Publication No. 2023/0101194 A1. The size, complexity and cost of the winder, spooling machine or spooler is increased by the addition of the stretch wrap applicator and the stretch wrap, while the speed and efficiency of the winding process is reduced. However, as previously mentioned, the stretch wrap must be removed before the wound media is dispensed from the spool for use, likewise increasing the cost, while reducing the speed and efficiency of the corresponding production process. The stretch wrap removed from the spool is not reusable and must be discarded or recycled. Consequently, it is not always necessary, or even desirable, to cover the wound media with stretch wrap. Regardless, it remains necessary, or at least desirable, to retain the finish end of the media on the spool to prevent the wound media from unwinding from the spool and/or being damaged during storage or transport prior to being dispensed from the spool for use.

[0005] Conventional spools have been provided with features, commonly referred to as tie-off

holes, on at least one flange of the spool to retain the finish end of media wound onto the spool. The tie-off holes can be used to eliminate the need for applying stretch wrap to the media wound onto the spool and for removing the stretch wrap from the wound media. However, the known tie-off holes are inconvenient, time consuming and difficult for workers to access and use in a manual winding process and present significant challenges to an automated winding process. Furthermore, the known tie-off holes are likewise inconvenient, time consuming and difficult for end-users to access and use to retain the finish end of the media in a tie-off process after dispensing only a portion of the media from the spool.

[0006] In view of these shortcomings, problems, deficiencies and drawbacks, it is apparent that an improved apparatus, system and method for winding a length of a continuous, elongate, flexible media onto a spool and for retaining the finish end of the media on the spool is needed. A particular need exists for a spool that does not require use of a stretch wrap applicator and stretch wrap to retain the finish end of the media wound onto the spool. A further and more particular need exists for a spool having a flange with a tie-off feature for retaining the finish end of media wound onto the spool. Such a spool would reduce the size, complexity and cost of winding equipment, such as a winder, spooling machine or spooler, while increasing the speed and efficiency of the spooling process. Furthermore, such a spool would eliminate the stretch wrap, thereby reducing packaging cost, and obviate the need to remove the stretch wrap before dispensing the wound media from the spool. A further need exists for a spool that retains the finish end of media wound onto the spool within a tie-off feature formed on a flange of the spool. Such a spool would be convenient and simple for workers to use in a manual winding process as well as for end-users to use in a tie-off process to secure a remaining portion of the media on the spool.

SUMMARY OF THE INVENTION

[0007] The present invention addresses these shortcomings, problems, deficiencies and drawbacks associated with winding a length of a continuous, elongate, flexible media onto a spool and retaining the finish end of the wound media on the spool. In particular, the present invention provides a significant improvement and advantage over known spools, winders, spooling machines and spoolers that utilize a stretch wrap applicator and stretch wrap to retain the finish end of the wound media. In various embodiments, the present invention is a spool having a flange with a tie-off feature for winding a length of a continuous, elongate, flexible media onto the spool and for retaining the finish end of the wound media on the flange within the tie-off feature.

[0008] In one aspect, the present invention is embodied by a spool for winding a length of a media onto the spool and for retaining a finish end of the media on the spool. The spool includes an elongate, generally cylindrical barrel that extends in an axial direction and at least one generally annular flange that extends outwardly from the barrel in a radial direction. The flange is provided with a tie-off feature at an outer periphery of the flange that includes a receiving portion for receiving the media and a retaining portion for retaining the media within the tie-off feature on the flange of the spool. The receiving portion narrows from the outer periphery towards the retaining portion to a transition region between the receiving portion and the retaining portion that is narrower than a diameter of the media.

[0009] In an embodiment, the tie-off feature is configured in the form of a deflecting tab including a deflecting arm within the receiving portion of the tie-off feature. The deflecting arm is configured and operable to deflect and allow the media to pass through the transition region of the tie-off feature from the receiving portion to the retaining portion.

[0010] In another embodiment, the deflecting tab includes a pair of oppositely disposed deflecting arms within the receiving portion of the tie-off feature. Each of the deflecting arms is configured and operable to deflect and allow the media to pass through the transition region from the receiving portion to the retaining portion.

[0011] In another embodiment, the tie-off feature is configured in the form of a flexible membrane including a pair of oppositely disposed flexing elements within the receiving portion of the tie-off

feature. Each of the flexing elements is configured and operable to flex in a circumferential direction and allow the media to pass through the transition region from the receiving portion to the retaining portion.

[0012] In another embodiment, the receiving portion of the tie-off feature defines a receiving area that is larger than the diameter of the media adjacent the outer periphery of the flange and is smaller than the diameter of the media adjacent the transition region of the tie-off feature.

[0013] In another embodiment, the retaining portion of the tie-off feature defines a retaining area that is at least as large as the diameter of the media adjacent the transition region of the tie-off feature.

[0014] In another embodiment, the tie-off feature includes a first tie-off feature at the periphery of the flange and a second tie-off feature at the periphery of the flange. The first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.

[0015] In another embodiment, the at least one flange is provided adjacent an axial end of the barrel of the spool and the flange is in the form of a substantially planar, relatively thin, generally cylindrical annular disk with the tie-off feature disposed along a circumferential edge or rim of the flange at the periphery of the flange.

[0016] In another embodiment, the tie-off feature is a slot or opening formed in the outer periphery of the flange. The tie-off feature includes a receiving portion that extends from the outer periphery of the flange inwardly towards a longitudinal axis of the spool and a retaining portion that extends from the receiving portion inwardly towards the longitudinal axis of the spool. The receiving portion defines a receiving area that narrows from the outer periphery towards the longitudinal axis of the spool to form a passage at a transition region between the receiving portion and the retaining portion that is narrower than a diameter of the media. The retaining portion defines a retaining area that widens from the transition region between the receiving portion and the retaining portion towards the longitudinal axis of the spool such that the retaining area is at least as wide as the largest diameter of the media.

[0017] In another embodiment, the tie-off feature in the form of a deflecting tab that includes at least one deflecting arm that extends towards the longitudinal axis from a first end at the outer periphery of the flange to a second end opposite the first end within the receiving area adjacent a transition region between the receiving portion and the retaining portion. The deflecting arm is thicker at the first end and thinner at the second end such that the second end bends or deflects relative to the first end in response to an insertion force exerted on the media towards the longitudinal axis.

[0018] In another aspect, the present invention is embodied by a flange for a spool including a tie-off feature formed in an outer periphery of the flange. The tie-off feature includes a receiving portion for receiving a finish end of a length of a media wound on the spool and a retaining portion for retaining the finish end of the length of media on the flange. The receiving portion extends from the outer periphery of the flange towards the retaining portion and narrows from the outer periphery to a transition region between the receiving portion and the retaining portion. The retaining portion retains the finish end of the media on the flange within the tie-off feature after the finish end of the media passes through the transition region from the receiving portion to the retaining portion.

[0019] In an embodiment, the tie-off feature is in the form of at least one deflecting tab including at least one deflecting arm configured and operable to deflect and allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.

[0020] In another embodiment, the tie-off feature is in the form of a flexible membrane including a pair of oppositely disposed flexing elements each configured and operable to flex in a circumferential direction and allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.

[0021] In another embodiment, the tie-off feature includes a first tie off feature at the outer periphery of the flange and a second tie-off feature at the outer periphery of the flange. The first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.
[0022] In another aspect, the present invention is embodied by a spooling system for winding a length of a media onto a spool and for retaining a finish end of the media on the spool. The spooling system includes a flange of the spool provided with a tie-off feature at an outer periphery of the flange. The tie-off feature includes a receiving portion, a retaining portion, and a transition region between the receiving portion and the retaining portion. The receiving portion extends from the outer periphery towards the retaining portion and narrows from the outer periphery to the transition region between the receiving portion and the retaining portion. The receiving portion defines a receiving area larger than a diameter of the finish end of the media adjacent the outer periphery and smaller than the diameter of the finish end of the media adjacent the transition region. The spooling system further includes a feed arm for feeding the media to the spool and for directing the media to the tie-off feature at the outer periphery of the flange and for disposing and inserting the finish end of the media within the retaining portion of the tie-off feature.
[0023] In an embodiment, the tie-off feature is in the form of a deflecting tab including at least one deflecting arm configured and operable to deflect and allow the finish end of the media to pass through the transition region between the receiving portion and the retaining portion.
[0024] In another embodiment, the tie-off feature is in the form of a flexible membrane including a pair of oppositely disposed flexing elements each configured and operable to flex in a circumferential direction and allow the finish end of the media to pass through the transition region between the receiving portion and the retaining portion.
[0025] In another embodiment, the tie-off feature includes a first tie-off feature at the outer periphery of the flange and a second tie-off feature at the outer periphery of the flange. The first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.
[0026] In another aspect, the present invention is embodied by a method for winding a length of media onto a spool and for retaining a finish end of the media on the spool. The method includes providing a spool having a flange provided with a first tie-off feature at an outer periphery of the flange. The tie-off feature includes a receiving portion that extends from the outer periphery towards a retaining portion and a transition region between the receiving portion and the retaining portion. The receiving portion narrows from the outer periphery to the transition region. The method further includes winding the length of the media onto the spool. The method further includes directing the finish end of the media to the first tie-off feature at the outer periphery. The method further includes disposing and inserting the finish end of the media within the receiving portion of the first tie-off feature. The method further includes passing the finish end of the media through the transition region of the first tie-off feature from the receiving portion to the retaining portion. The method further includes retaining the finish end of the media within the retaining portion of the first tie-off feature.
[0027] In an embodiment, the first tie-off feature is in the form of a deflecting tab including at least one deflecting arm and the method further includes deflecting the at least one deflecting arm to allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.
[0028] In another embodiment, the first tie-off feature is in the form of a flexible membrane including a pair of oppositely disposed flexing elements and the method further includes flexing at least one of the pair of flexing elements to allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.
[0029] In another embodiment, the flange of the spool is provided with a second tie-off feature at the outer periphery of the flange including a receiving portion, a retaining portion and a transition

region between the receiving portion and the retaining portion. The method further includes directing the finish end of the media to the second tie-off feature at the outer periphery. The method further includes disposing and inserting the finish end of the media within the receiving portion of the second tie-off feature. The method further includes passing the finish end of the media through the transition region of the second tie-off feature from the receiving portion to the retaining portion. The method further includes retaining the finish end of the media within the retaining portion of the second tie-off feature.

[0030] In another embodiment, the first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.

[0031] In another embodiment, the method includes providing a spool having an elongate barrel that extends in an axial direction and at least one generally annular flange that extends outwardly from the barrel in a radial direction, wherein the flange is provided with a first tie-off feature at an outer periphery of the flange. The method further includes winding the media onto the spool. After winding the media onto the spool, the method further includes directing the media to the first tie-off feature provided at the outer periphery of the flange. The method further includes engaging the media with the first tie-off feature to retain the finish end of the media within the first tie-off feature.

[0032] In another embodiment, the method further includes providing the first tie-off feature and/or the second tie-off feature with a pair of the deflecting tabs and/or with a pair of the flexible membranes.

[0033] In yet another aspect, the invention is embodied by a method for winding a length of a continuous, elongate, flexible media onto a spool having a flange provided with a tie-off feature and for retaining a finish end of the wound media on the spool within the tie-off feature. The method includes providing a spooling system that includes a feed arm configured and operable for feeding the media onto the spool and a drive unit operable for rotating the spool while the feed arm is feeding the media to the spool to wind the media onto the spool. The method further includes using the feed arm to feed the media onto the spool until a desired amount of the media is wound onto the spool. After the desired amount of the media is wound onto the spool, the method further includes transferring the finish end of the media from a position inside the spool adjacent to the flange to a position outside the spool adjacent to the flange. The method further includes using the drive unit to rotate the spool in a circumferential direction until the finish end of the media is engaged with the tie-off feature provided at the outer periphery on the flange of the spool. The method further includes using the feed arm to insert the media within the tie-off feature to retain the media on the flange of the spool.

[0034] In yet another aspect, the invention is embodied by a method for winding a length of a continuous, elongate, flexible media onto a spool and for retaining a finish end of the media on the spool. The method includes providing a spool having at least one flange provided with at least one tie-off feature at an outer periphery of the flange. The method further includes winding the media onto the spool. The method further includes directing the finish end of the media to a position outside the flange of the spool. The method further includes engaging the media with the tie-off feature at the outer periphery of the flange and inserting the media within the tie-off feature to retain the finish end of the media within the tie-off feature.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] FIG. **1** is an environmental perspective view of a spool having a flange provided with a tie-off feature according to an aspect of the present invention.

[0036] FIG. **2** is a detailed perspective view showing a first embodiment of a tie-off feature in the

form of a deflecting tab for the flange of the spool of FIG. **1**.
[0037] FIG. **3** is a detailed perspective view showing a second embodiment of a tie-off feature in the form of a deflecting tab for the flange of the spool of FIG. **1**.
[0038] FIG. **4** is a detailed perspective view showing a first embodiment of a tie-off feature in the form of a flexible membrane for the flange of the spool of FIG. **1**.
[0039] FIG. **4**A is a detailed perspective view showing an alternative embodiment of the tie-off feature in the form of a flexible membrane of FIG. **4**.
[0040] FIG. **5** is a detailed perspective view showing a second embodiment of a tie-off feature in the form of a flexible membrane for the flange of the spool of FIG. **1**.
[0041] FIG. **5**A is a detailed perspective view showing an alternative embodiment of the tie-off feature in the form of a flexible membrane of FIG. **5**.
[0042] FIG. **6** is a perspective view of a spooling system for winding a length of a continuous, elongate, flexible media onto a spool having a flange provided with a tie-off feature and for retaining a finish end of the media on the spool within the tie-off feature according to another aspect of the present invention.
[0043] FIG. **7** is a perspective showing the spooling system of FIG. **6** transferring the finish end of the media in an axial direction outside the flange of the spool.
[0044] FIG. **8** is a perspective view showing the spooling system of FIG. **6** disposing and inserting the finish end of the media within a first tie-off feature provided on the flange of the spool to retain finish end of the media within the first tie-off feature.
[0045] FIG. **9** is a perspective view showing the spooling system of FIG. **6** disposing and inserting the finish end of the media within a second tie-off feature provided on the flange of the spool to retain the finish end of the media within the second tie-off feature and transferring the finish end of the media back inside the flange of the spool.
[0046] FIG. **10** is a detailed plan view illustrating media having different diameters being retained within the tie-off feature of FIG. **2**.
[0047] FIG. **11** is a detailed plan view illustrating a finish end of media being disposed, inserted and retained within the tie-off feature of FIG. **2**.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS OF THE INVENTION

[0048] Referring now to the accompanying drawings, in which like reference characters refer generally to the same or similar parts, FIG. **1** is a perspective view of an apparatus, indicated generally by reference character **20**, according to an aspect of the present invention. By way of example and not limitation, the apparatus **20** may be a reel, hub, bobbin, spindle, spool or the like, and is collectively referred to herein as a "spool." Spool **20** is configured and operable for winding a length of an elongate, flexible media, indicated generally by reference character M, onto the spool **20** and for storing, transporting and subsequently dispensing the media M from the spool **20**. By way of example and not limitation, the media M may be tape, wire, string, rope, fiber, electrical cable, optical cable or filament. In an advantageous embodiment, the media M is a 3D printing filament for use in a subsequent 3D printing process. Accordingly, the media M may also be referred to as "wound media," "winding material" or "filament." The spool **20** is configured for retaining a finish end, indicated generally by reference character FE, of the media M on the spool **20** following the winding process during storage and transport prior to use in a subsequent production process or manual tie-off process.
[0049] As shown in FIG. **1**, spool **20** has at least one flange **22** and a bore **24** that define a central longitudinal axis L extending in an axial direction X. The spool **20** further has an elongate barrel **25** disposed outwardly of and concentric with the bore **24**, and therefore with the longitudinal axis L. Consequently, spool **20** likewise defines the longitudinal axis L. The barrel **25** is configured for receiving the media M on spool **20** during the winding process. The barrel **25** may have any suitable cross-sectional shape, for example, square, rectangular, triangular, elliptical, etc. Typically, as shown herein, barrel **25** has a circular cross-section such that the barrel is in the form of an

elongate cylinder that extends in the axial direction X. The spool **20** may have any number of flanges **22** disposed at any location along the length of the barrel **25** in the axial direction X. In the exemplary embodiment shown herein, spool **20** has at least one flange **22** adjacent an axial end of barrel **25**. Flange **22** likewise may have any suitable shape, for example, square, rectangular, triangular, elliptical, etc. Typically, and as shown herein, flange **22** has a circular shape such that the flange **22** is in the form of a substantially planar, generally cylindrical, relatively thin, annular disk. The flange(s) **22**, the bore **24** and/or the barrel **25** of the spool **20** may be made of a plastic or composite material, a paper (cardboard or corrugated) material, a wood material, or combinations thereof. The spool **20** may be an injection molded or 3D printed one-piece, two-piece or three-piece plastic spool, or alternatively, may be a three-piece paper or wooden spool.

[0050] Regardless, flange **22** of spool **20** is provided with at least one tie-off feature **30** at an outer periphery of the flange **22** for securing an outermost free end of winding material that is wound onto the spool **20**. In particular, the tie-off feature **30** is configured and operable for retaining the finish end FE of the media M at an outer periphery **26** of the flange **20**. The tie-off feature **30** retains the wound media M on the spool **20** during storage and transport prior to use, and in some cases, retains a remaining portion of the media M on the spool **20** after use. As shown herein, spool **20** has a pair of tie-off features **30** at the outer periphery **26** of the flange **22** with the pair of tie-off features **30** spaced apart in a circumferential direction C about the longitudinal axis L defined by the spool **20**, for a purpose to be described hereafter.

[0051] In the exemplary embodiment shown herein, spool **20** comprises a barrel **25** extending in the axial direction X and a pair of flanges **22** disposed at opposed ends of the barrel **25**. Each flange **22** extends outwardly from the barrel **25** of the spool **20** in a radial direction R relative to the longitudinal axis L. Each flange **22** is disposed adjacent an axial end of the barrel **25** with the flanges **22** spaced apart in the axial direction X so that the media M is wound onto the barrel **25** of the spool **20** between the flanges **22**. Each flange **22** is configured as a substantially planar, generally cylindrical, relatively thin, annular disk with a pair of tie-off features **30** at the outer periphery **26** of the flange **22**. The tie-off features **30** are formed in flange **22** along an outer circumferential edge or rim of the flange **22** and spaced apart in the circumferential direction C. In this manner, spool **20** can be provided to a manual winder, spooling machine or automated spooler and the media M wound onto the spool **20** in either axial direction X (i.e., from left-to-right or from right-to-left). Regardless, the finish end FE of the media M is retained within at least one tie-off feature **30** on the outer periphery **26** of one of the flanges **22** of the spool **20**. The spool **20** is typically provided with at least one start hole **28** formed through the flanges **22** and/or the barrel **25** for receiving an innermost free end of the media M, referred to herein as the start end SE of the media M, to be wound onto the spool **20**. In the embodiment shown herein, the spool **20** has a start hole **28** disposed at each axial end of the barrel **25** adjacent the corresponding flange **22** for receiving start end SE of media M so that the media M can be wound onto the spool **20** in either axial direction X.

[0052] In an embodiment, the tie-off feature **30** defines a winding material receiving opening, or slot, formed in the circumferential edge or rim of the annular flange **22**. The tie-off feature **30** is provided at the outer periphery **26** of the flange **22** of the spool **20** for receiving and retaining the finish end FE of the media M on the spool **20**. Specifically, the tie-off feature **30** comprises a receiving portion **32** that extends inwardly from the outer periphery **26** of the flange **22** generally towards the center of the flange **22** and the longitudinal axis L of the spool **20**. The tie-off feature **30** further comprises a retaining portion **34** that extends inwardly from the receiving portion **32** generally towards the center of the flange **22** and the longitudinal axis L of the spool **20**. The tie-off feature **30** further defines a transition region **36** between the receiving portion **32** and the retaining portion **34** for a purpose to be described hereafter.

[0053] The opening or slot of the receiving portion **32** narrows from the outer periphery **26** of the flange **22** towards the transition region **36**. As a result, the receiving portion **32** defines a receiving

area that is wider than a diameter d (see FIG. **10**) of the media M at the outer periphery **26** of the flange **22**, while the transition region **36** between the receiving portion **32** and the retaining portion **34** is narrower than the diameter d of the media M. The retaining portion **34** of the tie-off feature **30** defines a retaining area that is wider than the transition region **36** and at least as wide as the diameter d of the media M. Accordingly, media M is retained within the retaining area defined by the retaining portion **34** after passing through transition region **36**. In particular, the retaining area defined by the retaining portion **34** is larger than the largest diameter d of the media M to be wound onto the spool **20**. Furthermore, the tie-off feature **30** may be molded with the flange **22** or the spool **20**, or alternatively, may be an insert that is formed separately and affixed to the flange **22** at the outer periphery **26** of the flange **22** of the spool **20**.

[0054] A first embodiment of a tie-off feature **30** in the form of a deflecting tab **40** for the flange **22** of the spool **20** is shown in FIG. **2**. The deflecting tab **40** comprises a movable deflecting arm **42** that extends inwardly from the circumferential edge or rim of the flange **22** towards the longitudinal axis L at a relatively small angle with respect to the outer periphery **26**. The deflecting arm **42** is larger (thicker) at a first end **44** adjacent the outer periphery **26** of the flange **22** and is smaller (thinner) at a second end **46** opposite the first end **44** of the deflecting arm **42** at the transition region **36** of the tie-off feature **30**. The flange **22**, and therefore the deflecting tab **40**, may be made of a relatively soft polyolefin material, such as polyethylene, polypropylene, polyisobutylene, polymethyl pentene, and mixtures thereof. However, deflecting tab **40** may also be made of any other material that allows sufficient deflection of deflection arm **42**, for example styrene plastics and the like. Regardless, deflecting arm **42** is flexible and elastic enough to allow an insertion force exerted on the media M to deflect the deflecting arm **42** of deflecting tab **40** sufficiently to permit media M to pass through the transition region **36** of the tie-off feature **30** from the receiving area defined by the receiving portion **32** to the retaining area defined by the retaining portion **34**. As shown in FIG. **2**, flange **22** (or flanges **22**) may be provided with a pair of tie-off features **30** each having a deflecting tab **40** formed at the outer periphery **26** of the flange **22** and spaced apart in the circumferential direction C for a purpose to be described hereafter. As shown herein, the pair of tie-off features **30** having deflecting tabs **40** are identical in configuration, i.e., in size and shape. However, deflecting tabs **40** may have different configurations if desired for any other reason or purpose, such as improved functionality, manufacturability or cosmetic appearance.

[0055] A second embodiment of a tie-off feature **30** in the form of a deflecting tab **50** for the flange **22** of the spool **20** is shown in FIG. **3**. The deflecting tab **50** comprises a pair of oppositely disposed movable deflecting arms **52** that each extend inwardly from the circumferential edge or rim of the flange **22** towards the circumferential axis L at a relatively large angle with respect to the outer periphery **26** of the flange **22**. Each deflecting arm **52** is larger (thicker) at a first end **54** adjacent the outer periphery **26** and is smaller (thinner) at a second end **56** opposite the first end **54** of the deflecting arm **52** at the transition region **36** of the tie-off feature **30**. The flange **22**, and therefore the deflecting tab **50**, may be made of a relatively soft polyolefin material, such as polyethylene, polypropylene, polyisobutylene, polymethyl pentene, and mixtures thereof. However, deflecting tab **50** may also be made of any other material that allows sufficient deflection of deflection arms **52**, for example styrene plastics and the like. Regardless, deflecting arms **52** are flexible and elastic enough to allow an insertion force exerted on the media M to deflect the deflecting arms **52** of deflecting tab **50** sufficiently to permit media M to pass through the transition region **36** of the tie-off feature **30** from the receiving area defined by the receiving portion **32** to the retaining area defined by the retaining portion **34**. As shown in FIG. **3**, flange **22** (or flanges **22**) may be provided with a pair of tie-off features **30** each having a deflecting tab **50** formed at the outer periphery **26** of the flange **22** and spaced apart in the circumferential direction C for a purpose to be described hereafter. As shown herein, the pair of tie-off features **30** having deflecting tabs **50** are identical in configuration, i.e., in size and shape. However, deflecting tabs **50** may have different configurations if desired for any other reason or purpose, such as improved functionality,

manufacturability or cosmetic appearance.

[0056] A first embodiment of a tie-off feature **30** in the form of a flexible membrane **60** for the flange **22** of the spool **20** is shown in FIG. **4**. The flexible membrane **60** comprises a pair of oppositely disposed movable flexing elements **62** that each extend inwardly in the circumferential direction C within the receiving area defined by the receiving portion **32** of the tie-off feature **30**. Each flexing membrane **62** is larger (thicker) adjacent the outer periphery **26** of the flange **22** and is smaller (thinner) at the transition region **36** between the receiving portion **32** and the retaining portion **34** of the tie-off feature **30**. The flange **22**, and therefore the flexible membrane **60**, may be made of a relatively soft polyolefin material, such as polyethylene, polypropylene, polyisobutylene, polymethyl pentene, and mixtures thereof. However, flexible membrane **60** may also be made of any other material that allows sufficient deflection of flexing elements **62**, for example styrene plastics, elastic polymers (e.g. polyisoprene, latex, natural rubber, etc.), synthetic rubbers and the like. Regardless, flexing elements **62** are flexible and elastic enough to allow an insertion force exerted on the media M to deflect the flexing elements **62** of flexible membrane **60** sufficiently to permit media M to pass through the transition region **36** of the tie-off feature **30** from the receiving area defined by the receiving portion **32** to the retaining area defined by the retaining portion **34**. As shown in FIG. **4**, flange **22** (or flanges **22**) may be provided with a pair of tie-off features **30** each having a flexible membrane **60** formed at the outer periphery **26** of the flange **22** and spaced apart in the circumferential direction C for a purpose to be described hereafter. As shown herein, the pair of tie-off features **30** having flexible membranes **60** are identical in configuration, i.e., in size and shape. However, flexible membranes **60** may have different configurations if desired for any other reason or purpose, such as improved functionality, manufacturability or cosmetic appearance.

[0057] An alternative embodiment of the tie-off feature **30** in the form of a flexible membrane **60** of FIG. **4** is shown in FIG. **4**A and is indicated therein by reference character **60**′. The flexible membrane **60**′ is the same as the flexible membrane **60** in all respects except that flexible membrane **60**′ comprises only a single movable flexing element **62** that extends inwardly in the circumferential direction C within the receiving area defined by the receiving portion **32** of the tie-off feature **30**. The flexing element **62** is larger (thicker) adjacent the outer periphery **26** of the flange **22** and is smaller (thinner) adjacent the retaining portion **34** of the tie-off feature **30**. The flexing element **62** is made of a relatively soft material that is flexible and elastic enough to allow an insertion force exerted on media M to deflect the flexing element **62** of flexible membrane **60**′ sufficiently to permit the media M to pass from the receiving area defined by the receiving portion **32** of the tie-off feature **30** to the retaining area defined by the retaining portion **34**. As shown in FIG. **4**A, flange **22** (or flanges **22**) may be provided with a pair of tie-off features **30** each having a flexible membrane **60**′ formed at the outer periphery **26** of the flange **22** and spaced apart in the circumferential direction C for a purpose to be described hereafter. As shown herein, the pair of tie-off features **30** having flexible membranes **60**′ are identical in configuration, i.e., in size and shape. However, flexible membranes **60**′ may have different configurations if desired for any other reason or purpose, such as improved functionality, manufacturability or cosmetic appearance.

[0058] A second embodiment of a tie-off feature **30** in the form of a flexible membrane **70** for the flange **22** of the spool **20** is shown in FIG. **5**. The flexible membrane **70** comprises a pair of oppositely disposed movable flexing elements **72** that each extend inwardly in the circumferential direction C within the receiving area defined by the receiving portion **32** of the tie-off feature **30**. Each flexing membrane **72** is smaller (thinner) at the transition region **36** between the receiving portion **32** and the retaining portion **34** of the tie-off feature **30**. Each flexing membrane **72** further has a relatively small radius within the receiving area defined by the receiving portion **32** between the outer periphery **26** and the transition region **36** of the tie-off feature **30**. The flange **22**, and therefore the flexible membrane **70**, may be made of a relatively soft polyolefin material, such as polyethylene, polypropylene, polyisobutylene, polymethyl pentene, and mixtures thereof. However, flexible membrane **70** may also be made of any other material that allows sufficient deflection of

flexing elements **72**, for example styrene plastics and the like. Regardless, flexing elements **72** are flexible and elastic enough to allow an insertion force exerted on the media M to deflect the flexing elements **72** of flexible membrane **70** sufficiently to permit media M to pass through the transition region **36** of the tie-off feature **30** from the receiving area defined by the receiving portion **32** to the retaining area defined by the retaining portion **34**. As shown in FIG. **5**, flange **22** (or flanges **22**) may be provided with a pair of tie-off features **30** each having a flexible membrane **70** formed in the outer periphery **26** of the flange **22** and spaced apart in the circumferential direction C for a purpose to be described hereafter. As shown herein, the pair of tie-off features **30** having flexible membranes **70** are identical in configuration, i.e., in size and shape. However, flexible membranes **70** may have different configurations if desired for any other reason or purpose, such as improved functionality, manufacturability or cosmetic appearance.

[0059] An alternative embodiment of the tie-off feature **30** in the form of a flexible membrane **70** of FIG. **5** is shown in FIG. **5**A and is indicated therein by reference character **70′**. The flexible membrane **70′** is the same as the flexible membrane **70** in all respects except that flexible membrane **70′** comprises only a single movable flexing element **72** that extends inwardly in the circumferential direction C within the receiving area defined by the receiving portion **32** of the tie-off feature **30**. The flexing element **72** is smaller (thinner) between the receiving portion **32** and the retaining portion **34** of the tie-off feature **30**. The flexing element **72** further has a relatively small radius within the receiving area defined by the receiving portion **32** between the outer periphery **26** and the retaining portion **34** of the tie-off feature **30**. The flexing element **72** is made of a relatively soft material that is flexible and elastic enough to allow an insertion force exerted on media M to deflect the flexing element **72** of flexible membrane **70′** sufficiently to permit the media M to pass from the receiving area defined by the receiving portion **32** of the tie-off feature **30** to the retaining area defined by the retaining portion **34**. As shown in FIG. **5**A, flange **22** (or flanges **22**) may be provided with a pair of tie-off features **30** each having a flexible membrane **70′** formed at the outer periphery **26** of the flange **22** and spaced apart in the circumferential direction C for a purpose to be described hereafter. As shown herein, the pair of tie-off features **30** having flexible membranes **70′** are identical in configuration, i.e., in size and shape. However, flexible membranes **70′** may have different configurations if desired for any other reason or purpose, such as improved functionality, manufacturability or cosmetic appearance.

[0060] FIG. **6** is a perspective view showing a system, indicated generally by reference character **80**, for winding a length of a continuous, elongate, flexible media M onto a spool **20** having a flange **22** provided with a tie-off feature **30** and for retaining a finish end FE of the media M on the spool **20** within the tie-off feature **30** according to another aspect of the present invention. FIGS. **7-9** further illustrate an associated method for retaining the finish end FE of the media M on spool **20** within at least one tie-off feature **30** according to another aspect of the present invention. The system **80** is generally referred to herein as a spooling system for use in a corresponding spooling process to wind winding material, media or filament, such as 3D printing filament, onto a spool for storage or transport prior to being dispensed from the spool for use in a subsequent production process. However, it should be noted that the present invention is equally applicable to a manual winding process and to a conventional winder, spooling machine or automated spooler.

[0061] As shown in FIG. **6**, the spooling system **80** comprises a feed arm **82** configured and operable for feeding a length of a continuous, elongate, flexible media M from a source of the media M to be wound onto a spool **20**. The spool **20** defines a central longitudinal axis L and has at least one flange **22** provided with at least one tie-off feature **30** formed at an outer periphery **26** of the flange **22**. The spooling system **80** further comprises a drive unit or other suitable means (not shown) configured and operable for rotating spool **20** about the longitudinal axis L as the feed arm **82** feeds the media M onto the spool **20**. The feed arm **82** feeds the media M until the media M is wound onto spool **20** with a finish end FE of the media M adjacent a flange **22** of the spool **20**. In an embodiment, spool **20** has at least one start hole **28** on at least one flange **22** and/or the barrel **25**

of the spool **20** for receiving a start end SE of the media M, as previously described. However, it should be noted that the present invention is equally applicable to manual winding and/or manual rotating of a spool **20** by an individual, as well as winding and rotating a spool **20** by a conventional winder, spooling machine or automated spooler.

[0062] FIG. **7** is a perspective view showing the wound media M on spool **20** and the feed arm **82** of the spooling system **80** directing the finish end FE of the media M to the tie-off feature **30**. In particular, the feed arm **82** transfers (moves) the finish end FE of the media M in an axial direction X from a position inside the spool **20** (between the flanges **22**) adjacent a flange **22** to a position outside the spool **20** adjacent the flange **22**. As a result, the finish end FE of the media M lies over the circumferential edge or rim of flange **22** at the outer periphery **26** of the flange **22**. The spool **20** is then rotated in the circumferential direction C, for example manually or by the drive unit of the spooling system **80**, so that the finish end FE of the media M is transferred along the outer periphery **26** of the flange **22** towards the tie-off feature **30**. However, it should be noted that in a manual winding process, an individual may manually transfer (move) the finish end FE of the media M to the tie-off feature **30**.

[0063] FIG. **8** is a perspective view showing the finish end FE of the media M being disposed and inserted within the tie-off feature **30** provided at the outer periphery **26** of the flange **22** of the spool **20**. With the finish end FE of the media M disposed and inserted within the receiving area defined by the receiving portion **32** of the tie-off feature **30**, the feed arm **82** of the spooling system **80** transfers (moves) the finish end FE of the media M in a radial direction R from the receiving area of the receiving portion **32** to the retaining area defined by the retaining portion **34** of the tie-off feature **30**. As previously described, the finish end FE of the media M passes through transition region **36** from the receiving portion **32** of the tie-off feature **30** into the retaining portion **34** of the tie-off feature **30**.

[0064] FIG. **9** is a perspective view showing the finish end FE of the media M optionally being directed to, disposed and inserted within a second tie-off feature **30** provided at the outer periphery **26** of the flange **22** of the spool **20**. As shown herein, flange **22** has a first tie-off feature **30** and a second tie-off feature **30′** formed in the circumferential edge or rim of flange **22**. Each tie-off feature **30**, **30′** has a receiving portion **32** defining a receiving area and a retaining portion **34** defining a retaining area with a transition region **36** therebetween, as previously described. Spool **20** is rotated again in the circumferential direction C, for example by the drive unit of the spooling system **80**, until the finish end FE of the media M is at a position outside the spool **20** adjacent the second tie-off feature **30′** at the outer periphery **26** of the flange **22**. The feed arm **82** of the spooling system **80** then transfers (moves) the finish end FE of the media M in the opposite axial direction X until the finish end FE is disposed and inserted within the second tie-off feature **30′** provided at the outer periphery **26** of the flange **22** and the finish end FE of the media M is once again at a position inside the spool **20** adjacent the flange **22**.

[0065] With the finish end FE of the media M disposed and inserted within the receiving area defined by the receiving portion **32** of the second tie-off feature **30′**, the feed arm **82** of the spooling system **80** transfers (inserts) the finish end FE in a radial direction R from the receiving area of the receiving portion **32** to the retaining area defined by the retaining portion **34** of the second tie-off feature **30′**. As previously described, the finish end FE of the media M passes through the transition region **36** from the receiving portion **32** of the second tie-off feature **30′** into the retaining portion **34** of the second tie-off feature **30′**. It should be noted that the first tie-off feature **30** and/or the second tie-off feature **30′** formed at the outer periphery **26** of the flange **22** of the spool **20**, may have any of the deflecting tab **40**, deflecting tab **50**, flexible membrane **60** or flexible membrane **70**.

[0066] FIG. **10** is a detail plan view illustrating a plurality of media M each having a different diameter d being retained within the tie-off feature **30** of FIG. **2**. As described with reference to FIG. **2**, the tie-off feature **30** has deflecting tab **40** comprising flexible and elastic deflecting arm

42. As illustrated in FIG. **10**, the finish end FE of the media M is disposed and inserted within the receiving portion **32** of the tie-off feature **30**. The receiving area of the receiving portion **32** is at least as large (wide) as the largest diameter d of the media M to be retained by the retaining are defined by the retaining portion **34** of the tie-off feature **30**. Regardless of the diameter d of the media M, the insertion force exerted on the media M is sufficient to deflect the deflecting tab **42** enough to allow the finish end FE of the media M to pass through the transition region **36** from the receiving area defined by the receiving portion **32** to the retaining area defined by the retaining portion **34** of the tie-off feature **30**. As previously mentioned, the retaining area of the retaining portion **34** is at least as large (wide) as the largest diameter d of the finish end FE of the media M to be retained within the tie-off feature **30**. The reference character a in FIG. **10** depicts an angle at the transition region **36** of the tie-off feature **30** between a supporting surface **32**′ (FIG. **11**) of the receiving portion **32** and a supporting surface **34**′ (FIG. **11**) of the retaining portion **34** for guiding the media M from the receiving portion **32** into the retaining portion **34**.

[0067] FIG. **11** is a detailed plan view illustrating a finish end FE of media M being disposed, inserted and retained within the tie-off feature **30** of FIG. **2**. As described with reference to FIG. **2**, the tie-off feature **30** has deflecting tab **40** comprising a flexible and elastic deflecting arm **42**. As shown in FIG. **11**, the deflecting arm **42** is cantilevered from the outer periphery **26** of the flange **22**. Accordingly, the second end **46** of the deflecting arm **42** can bend and thereby deflect relative to the first end **44** of the deflecting arm **42**. The deflecting arm **42** may be bent and deflected in response to an insertion force exerted on the media M by a winder, a spooling machine, or an automated spooler in a manual, semi-automatic or automatic winding and retaining process. Alternatively, the deflecting arm **42** may be bent and deflected in response to an insertion force exerted by an individual retaining the finish end FE of the media M within the tie-off feature **30** in a tie-off process. Regardless, the deflecting arm **42** of the deflecting tab **40** bends and deflects sufficiently for the finish end FE of the media M having a diameter d to pass through the transition region **36** of the tie-off feature **30** from the receiving area of the receiving portion **32** to the retaining area of the retaining portion **34**. As previously mentioned, the retaining area of the retaining portion **34** is at least as large (wide) as the diameter d of the media M to be retained within the tie-off feature **30**. After the media M passes through the transition region **36** from the receiving portion **32** into the retaining portion **34** of the tie-off feature **30**, the absence of any external force allows the deflecting arm **42** of the deflecting tab **40** to return to its unbiased initial position. Consequently, the finish end FE of the media M is blocked by the deflecting arm **42** and remains within the retaining area defined by the retaining portion **34** of the tie-off feature **30**. The finish end FE of the media M can be removed from the tie-off feature **30** by feeding or pulling the finish end FE of the media M backwards out of the retaining portion **34** of the tie-off feature **30**.

[0068] In a particular aspect of the invention, the spooling system **80** is an automated spooler and the media M is a plastic filament, such as a three-dimensional (3D) printing filament, useful in a three-dimensional (3D) printing process. The 3D printing filament may be formed by an extrusion production and wound onto a spool **20** by the automated spooler **80**. A finish end FE of the 3D printing filament wound onto the spool **20** is retained within at least one tie-off feature **30** provided at an outer periphery **26** of a flange **22** of the spool **20** during storage and transport until the filament is subsequently dispensed from the spool **20** for use in the 3D printing process. Persons having ordinary skill in the art will readily understand and appreciate that the spool **20** is manufactured independent of the media M to be wound onto the spool, except that the construction of the spool **20**, including without limitation its materials, dimensions, geometry, reinforcement elements, etc., may be influenced by the type of the media M to be wound onto the spool **20**. Furthermore, the automated spooler **80** and/or spool **20** according to the present invention may be utilized with other media M, winding materials and other types of filaments, as well as in various other applications without departing from the scope of this disclosure.

[0069] The exemplary embodiments of a spool **20**, spooler system **80** and associated method shown

and described herein are configured for use with continuous, elongate, flexible media M, winding material and filament having any desired cross-sectional shape (e.g., round, square, rectangular), diameter and/or size. Regardless, it is intended that the present invention be interpreted and construed broadly to encompass manual, semi-automatic and automatic winders, spooling machines and automated spoolers configured for winding or spooling continuous, elongate, relatively thin or small diameter, flexible media M, including winding materials and filaments, onto spools, reels, hubs and the like, as well as other suitable articles of manufacture, collectively referred to herein as a spool **20**, and for retaining the wound media M on the spool **20**, without unreasonable exception, alteration or undue experimentation.

[0070] The foregoing description in conjunction with the accompanying drawing figures has disclosed one or more exemplary embodiments of a spool, spooling system and associated method for winding a length of a continuous, elongate, flexible media and for retaining the media on the spool during storage and transport prior to use, or subsequent to use in a tie-off process. In exemplary embodiments, the spool has a flange with a tie-off feature at an outer periphery of the flange for retaining a finish end of the media within the tie-off feature. The spooling system includes a feed arm configured and operable for feeding the media to the spool. The spooling system further includes a drive unit for rotating the spool to wind the media onto the spool. The feed arm directs and transfers the media to dispose and inserts the finish end of the media within the tie-off feature. The method includes winding the media onto the spool, directing the media to the tie-off feature, disposing and inserting the media within the tie-off feature, and retaining the media within a retaining portion of the tie-off feature. The tie-off feature may be in the form of a defecting tab or a flexible membrane.

[0071] The foregoing description in conjunction with the accompanying drawing figures has disclosed exemplary embodiments of a spool having at least one flange provided with at least one tie-off feature for retaining a finish end of a length of a continuous, elongate, flexible media, including winding material and filaments. The tie-off feature includes a receiving portion for receiving the finish end of the media and a retaining portion for retaining the finish end of the media within the tie-off feature. The tie-off feature may further include a transition region between the receiving portion and the retaining portion. The tie-off feature may be in the form of a deflecting tab or a flexible membrane. The flange of the spool may be provided with a pair of tie-off features on a circumferential edge or rim of the flange and spaced apart along the outer periphery in a circumferential direction. The spool having a flange provided with a tie-off feature eliminates a stretch wrap applicator and obviates the need to apply and subsequently remove stretch wrap from the spool to thereby reduce the complexity, cost, time and labor, while increasing the efficiency of a winding process or spooling process.

[0072] While exemplary embodiments of the invention have been described and shown in the accompanying drawing figures, those of ordinary skill in the art will readily acknowledge and appreciate that the apparatus, systems and methods of the present invention may be embodied in numerous other forms and manners without departing from the broad intended scope of this disclosure. Accordingly, it is to be understood that this disclosure and any appended claims are to be interpreted given their broadest reasonable interpretation consistent with the forgoing written description and the accompanying drawings.

Claims

1. A spool for winding a length of a media onto the spool and for retaining a finish end of the media on the spool, comprising: a barrel; and a flange extending outwardly from the barrel, the flange provided with a tie-off feature at an outer periphery of the flange; wherein the tie-off feature comprises a receiving portion for receiving the media and a retaining portion for retaining the media within the tie-off feature on the flange of the spool; and wherein the receiving portion

narrows from the outer periphery towards the retaining portion to a transition region between the receiving portion and the retaining portion that is narrower than a diameter of the media.

2. The spool according to claim 1, wherein the tie-off feature is in the form of a deflecting tab comprising a deflecting arm within the receiving portion of the tie-off feature, and wherein the deflecting arm is configured and operable to deflect and allow the media to pass through the transition region from the receiving portion to the retaining portion.

3. The spool according to claim 2, wherein the deflecting tab comprises a pair of oppositely disposed deflecting arms within the receiving portion of the tie-off feature, and wherein each of the deflecting arms is configured and operable to deflect and allow the media to pass through the transition region from the receiving portion to the retaining portion.

4. The spool according to claim 1, wherein the tie-off feature is in the form of a flexible membrane comprising a pair of oppositely disposed flexing elements within the receiving portion of the tie-off feature, and wherein each of the flexing elements is configured and operable to flex in a circumferential direction and allow the media to pass through the transition region from the receiving portion to the retaining portion.

5. The spool according to claim 1, wherein the receiving portion defines a receiving area that is larger than the diameter of the media adjacent the outer periphery of the flange and is smaller than the diameter of the media adjacent the transition region of the tie-off feature.

6. The spool according to claim 1, wherein the retaining portion defines a retaining area that is at least as large as the diameter of the media adjacent the transition region of the tie-off feature.

7. The spool according to claim 1, wherein the tie-off feature comprises a first tie-off feature at the periphery of the flange and a second tie-off feature at the periphery of the flange, and wherein the first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.

8. A flange for a spool comprising: a tie-off feature formed in an outer periphery of the flange, the tie-off feature comprising a receiving portion for receiving a finish end of a length of a media wound on the spool and a retaining portion for retaining the finish end of the media on the flange; wherein the receiving portion extends from the outer periphery of the flange towards the retaining portion and narrows from the outer periphery to a transition region between the receiving portion and the retaining portion; and wherein the retaining portion retains the finish end of the media on the flange within the tie-off feature after the finish end of the media passes through the transition region from the receiving portion to the retaining portion.

9. The flange according to claim 8, wherein the tie-off feature is in the form of at least one deflecting tab comprising at least one deflecting arm configured and operable to deflect and allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.

10. The flange according to claim 8, wherein the tie-off feature is in the form of a flexible membrane comprising a pair of oppositely disposed flexing elements each configured and operable to flex in a circumferential direction and allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.

11. The flange according to claim 8, wherein the tie-off feature comprises a first tie off feature at the outer periphery of the flange and a second tie-off feature at the outer periphery of the flange, and wherein the first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.

12. A spooling system for winding a length of a media onto a spool and for retaining a finish end of the media on the spool, comprising: a flange of the spool provided with a tie-off feature at an outer periphery of the flange, the tie-off feature comprising a receiving portion, a retaining portion, and a transition region between the receiving portion and the retaining portion, the receiving portion extending from the outer periphery towards the retaining portion and narrowing from the outer periphery to the transition region between the receiving portion and the retaining portion, the

receiving portion defining a receiving area larger than a diameter of the finish end of the media adjacent the outer periphery and smaller than the diameter of the finish end of the media adjacent the transition region; a feed arm for feeding the media to the spool and for directing the media to the tie-off feature at the outer periphery of the flange and for disposing and inserting the finish end of the media within the retaining portion of the tie-off feature.

13. The spooling system according to claim 12, wherein the tie-off feature is in the form of a deflecting tab comprising at least one deflecting arm configured and operable to deflect and allow the finish end of the media to pass through the transition region between the receiving portion and the retaining portion.

14. The spooling system according to claim 12, wherein the tie-off feature is in the form of a flexible membrane comprising a pair of oppositely disposed flexing elements each configured and operable to flex in a circumferential direction and allow the finish end of the media to pass through the transition region between the receiving portion and the retaining portion.

15. The spooling system according to claim 12, wherein the tie-off feature comprises a first tie-off feature at the outer periphery of the flange and a second tie-off feature at the outer periphery of the flange, and wherein the first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery.

16. A method for winding a length of media onto a spool and for retaining a finish end of the media on the spool, the method comprising: providing a spool having a flange provided with a first tie-off feature at an outer periphery of the flange, the tie-off feature comprising a receiving portion that extends from the outer periphery towards a retaining portion and a transition region between the receiving portion and the retaining portion, the receiving portion narrowing from the outer periphery to the transition region; winding the length of the media onto the spool; directing the finish end of the media to the first tie-off feature at the outer periphery; disposing and inserting the finish end of the media within the receiving portion of the first tie-off feature; passing the finish end of the media through the transition region of the first tie-off feature from the receiving portion to the retaining portion; and retaining the finish end of the media within the retaining portion of the first tie-off feature.

17. The method according to claim 16, wherein the first tie-off feature is in the form of a deflecting tab comprising at least one deflecting arm, and wherein the method further comprises deflecting the at least one deflecting arm to allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.

18. The method according to claim 16, wherein the first tie-off feature is in the form of a flexible membrane comprising a pair of oppositely disposed flexing elements, and wherein the method further comprises flexing at least one of the pair of flexing elements to allow the finish end of the media to pass through the transition region from the receiving portion to the retaining portion.

19. The method according to claim 16, wherein the flange of the spool is provided with a second tie-off feature at the outer periphery of the flange comprising a receiving portion, a retaining portion and a transition region between the receiving portion and the retaining portion, and wherein the method further comprises: directing the finish end of the media to the second tie-off feature at the outer periphery; disposing and inserting the finish end of the media within the receiving portion of the second tie-off feature; passing the finish end of the media through the transition region of the second tie-off feature from the receiving portion to the retaining portion; and retaining the finish end of the media within the retaining portion of the second tie-off feature.

20. The method according to claim 19, wherein the first tie-off feature and the second tie-off feature are spaced apart in a circumferential direction along the outer periphery of the flange.