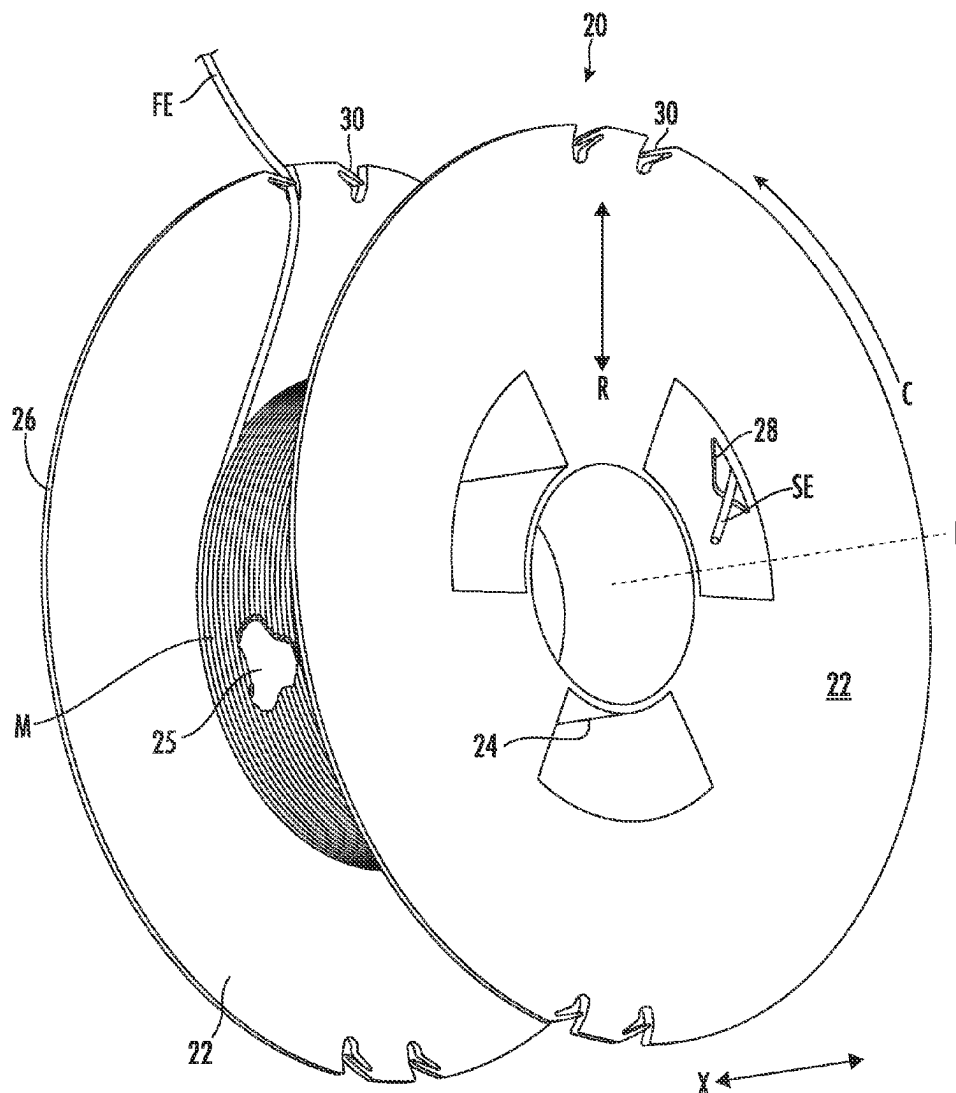




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(19) **United States**(12) **Patent Application Publication**
Baranov(10) **Pub. No.: US 2025/0263267 A1**(43) **Pub. Date: Aug. 21, 2025**(54) **SPOOL HAVING FLANGE WITH TIE-OFF
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B65H 75/28 (2006.01)
B65H 65/00 (2006.01)(57) **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.



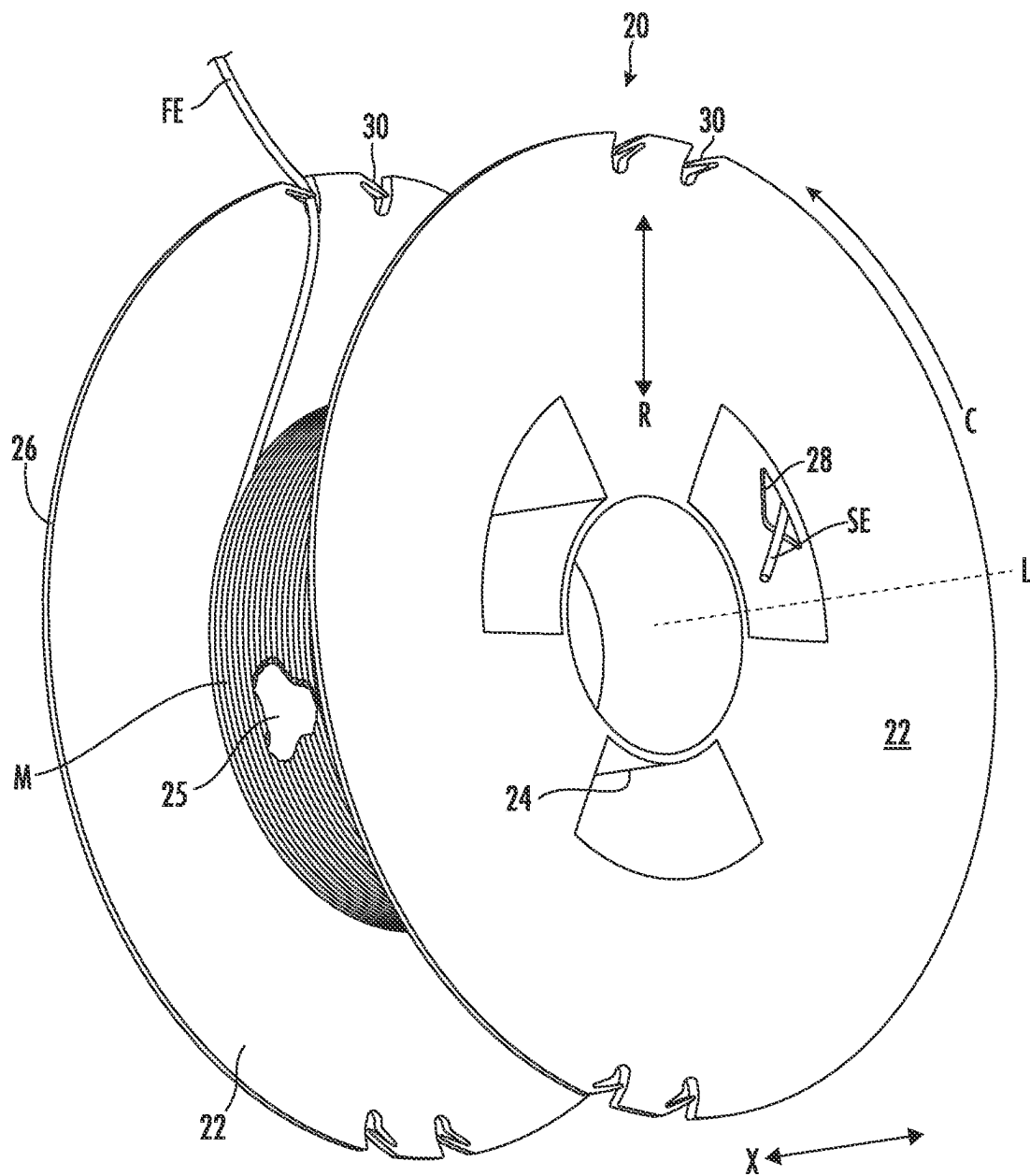


FIG. 1

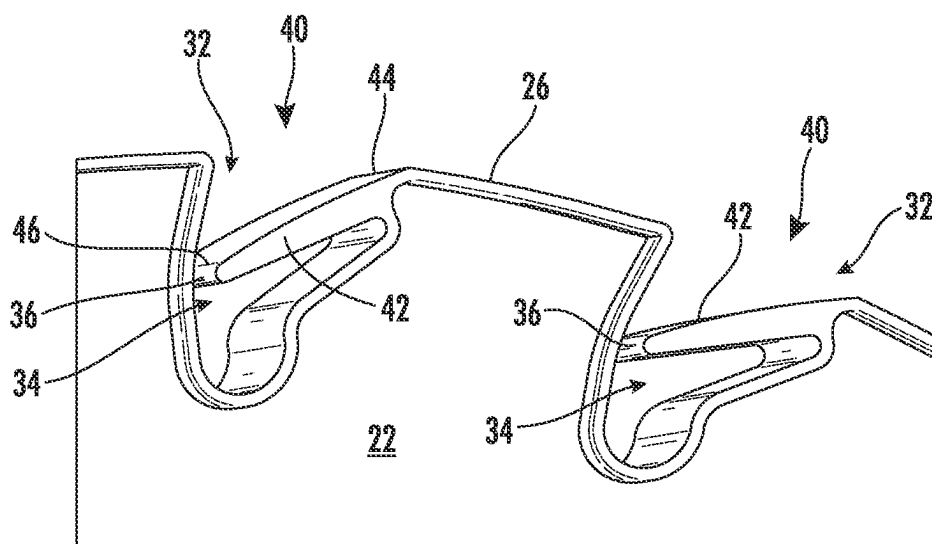


FIG. 2

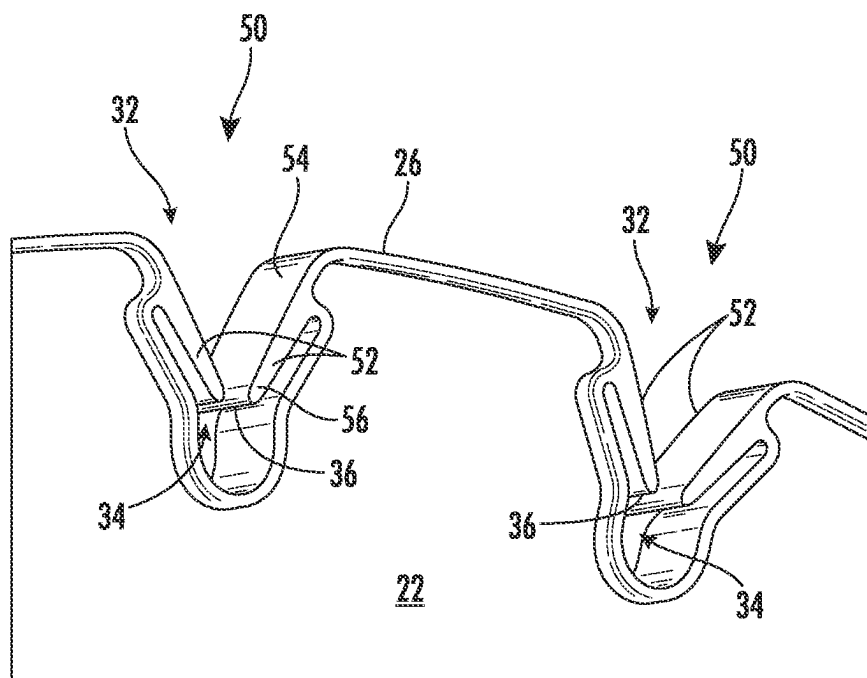


FIG. 3

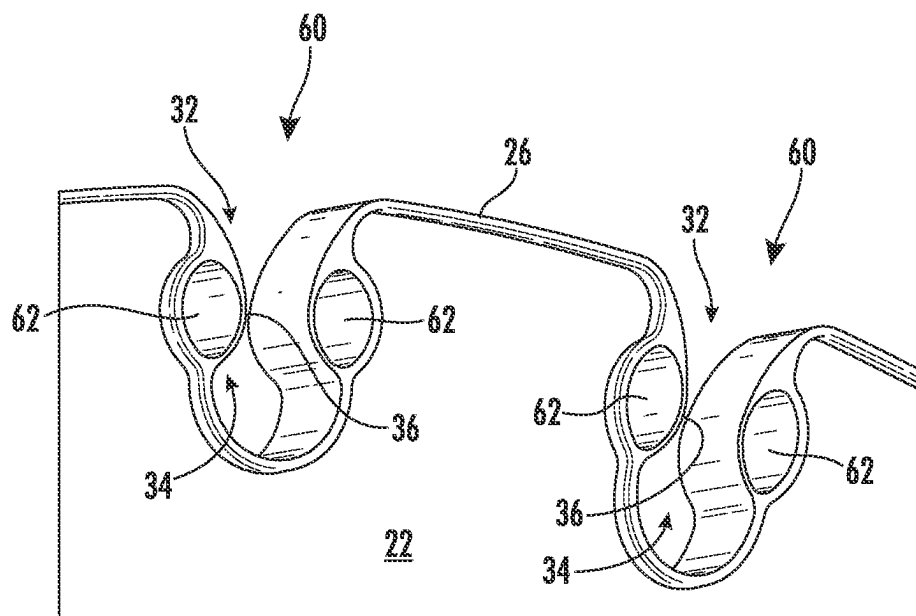


FIG. 4

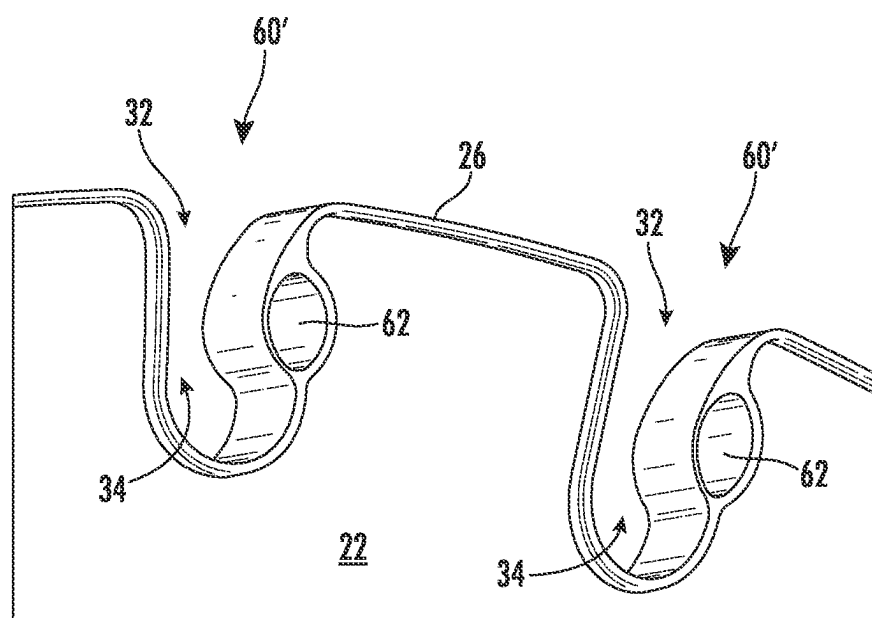


FIG. 4A

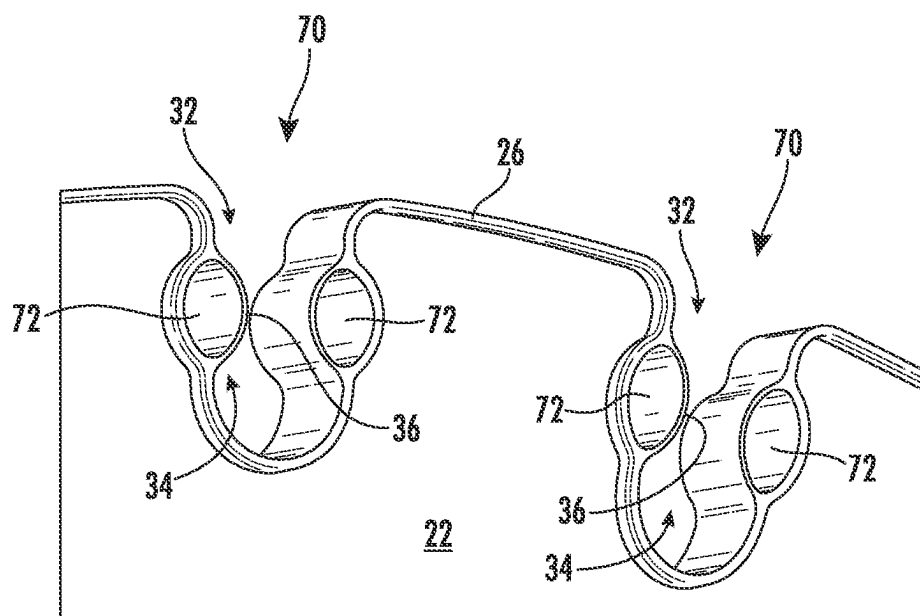


FIG. 5

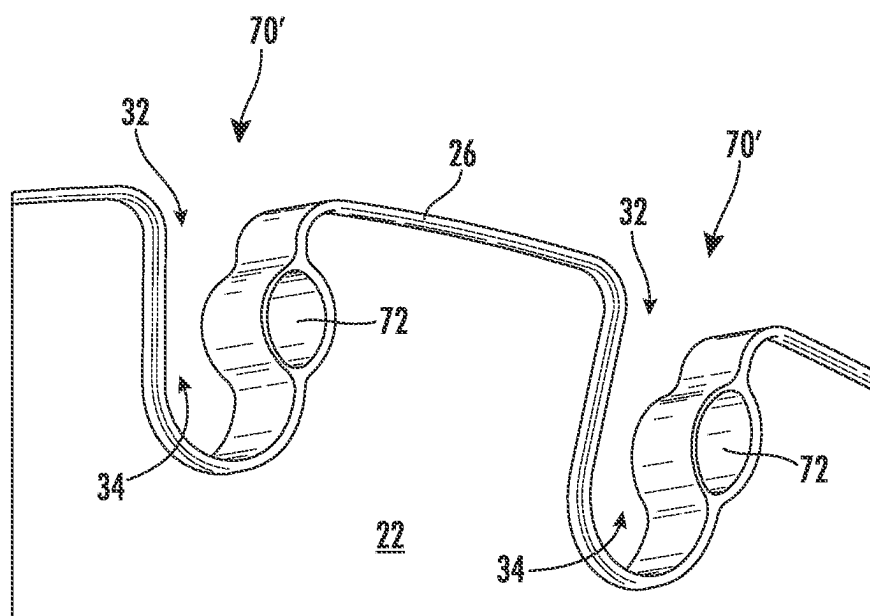


FIG. 5A

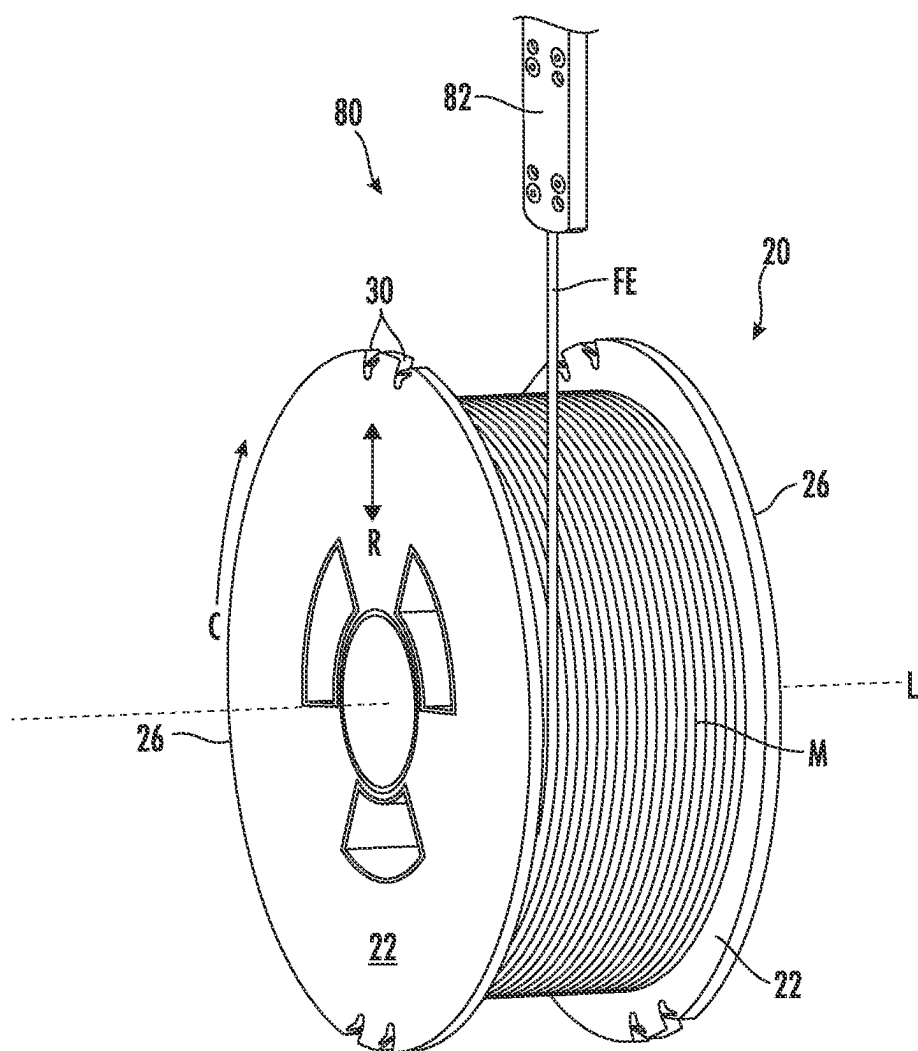


FIG. 6

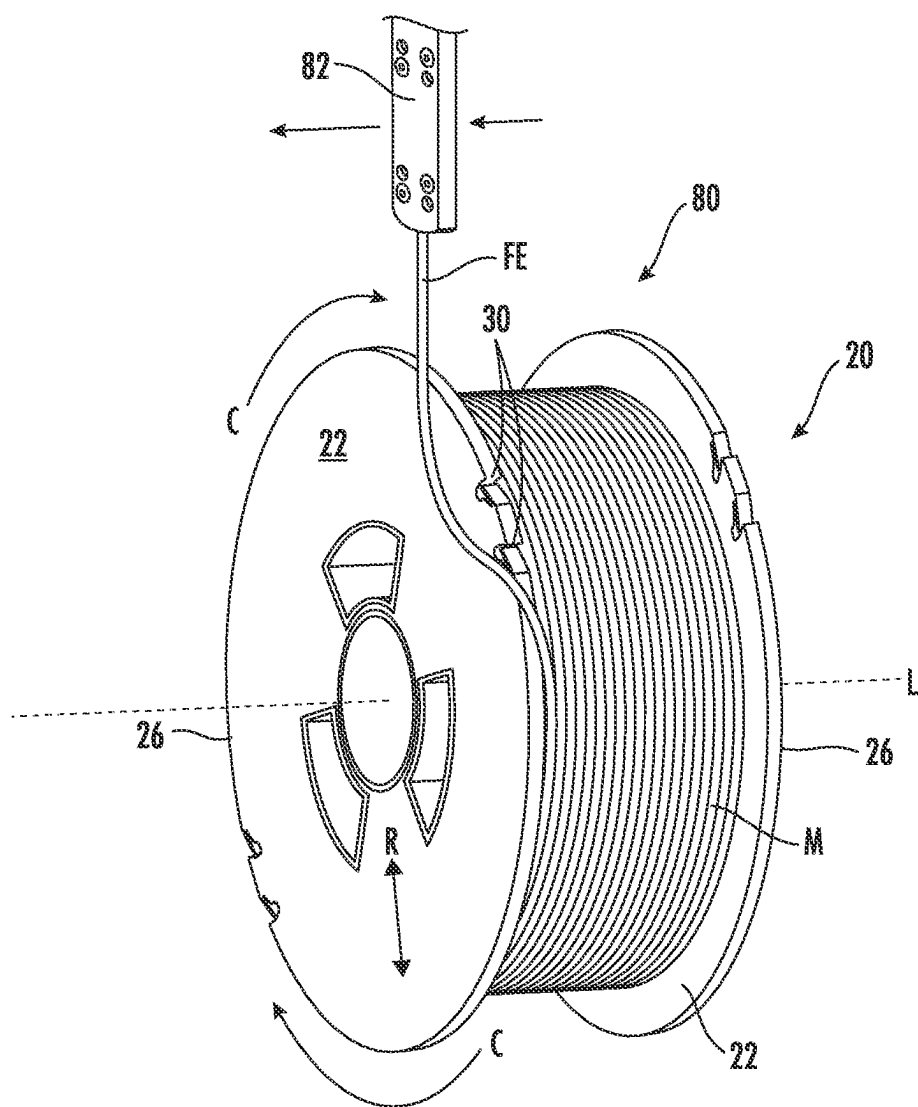


FIG. 7

X ← →

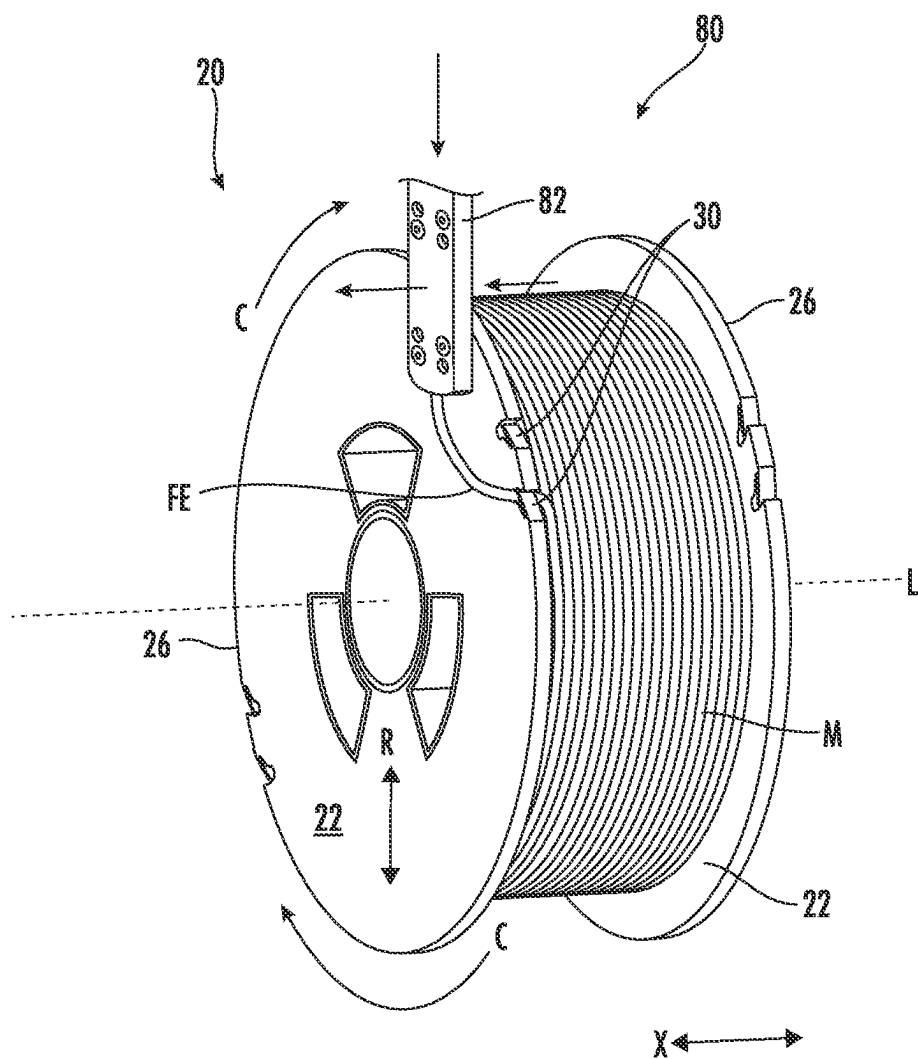


FIG. 8

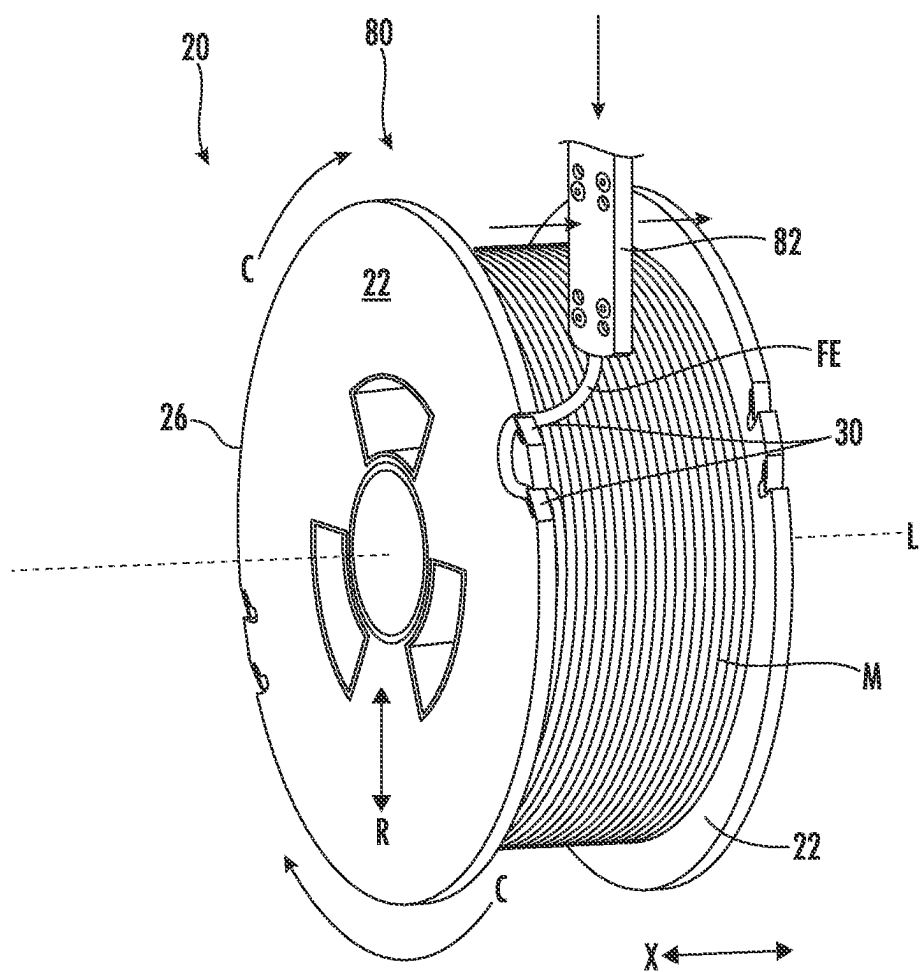


FIG. 9

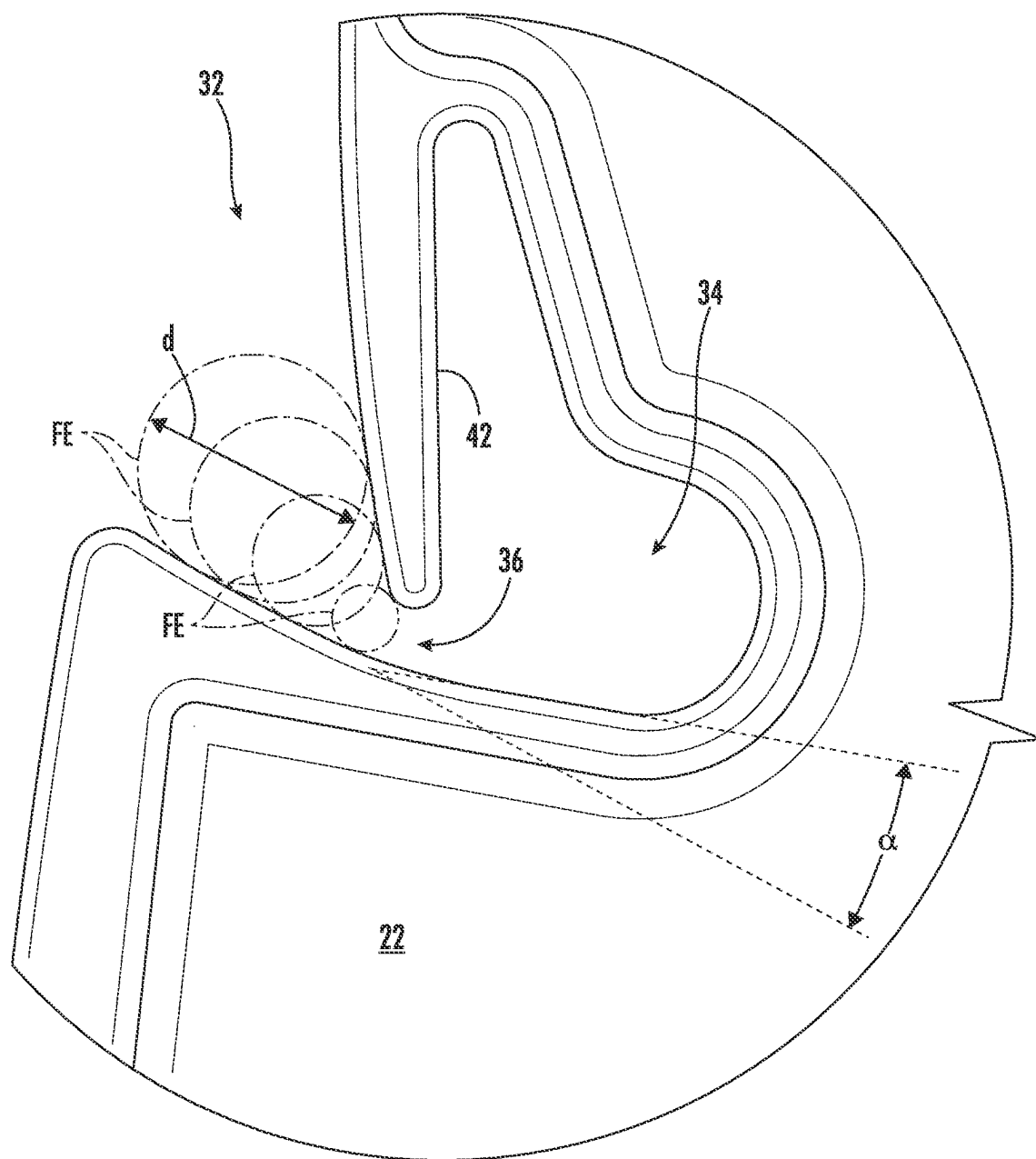


FIG. 10

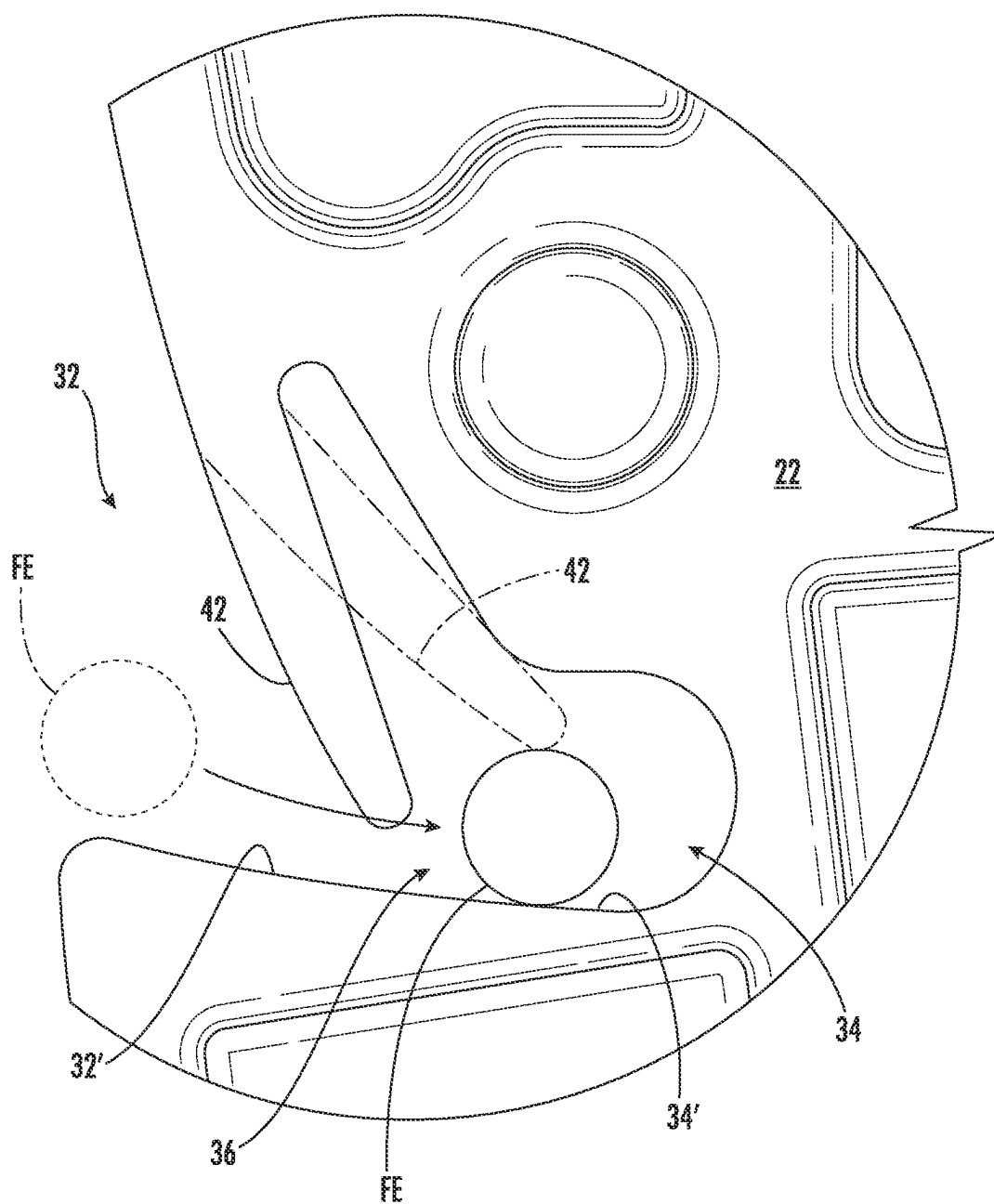


FIG. 11

SPOOL HAVING FLANGE WITH TIE-OFF FEATURE

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.

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. 4A 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. 5A 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. 4A 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. 4A, 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. 5A 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. 5A, 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 area 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 deflecting 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.

That which is claimed is:

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.

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