Sept. 20, 1960 R. ATWOOD ET AL 2,953,317

SPOOL

Filed March 15, 1955

FIG. 2

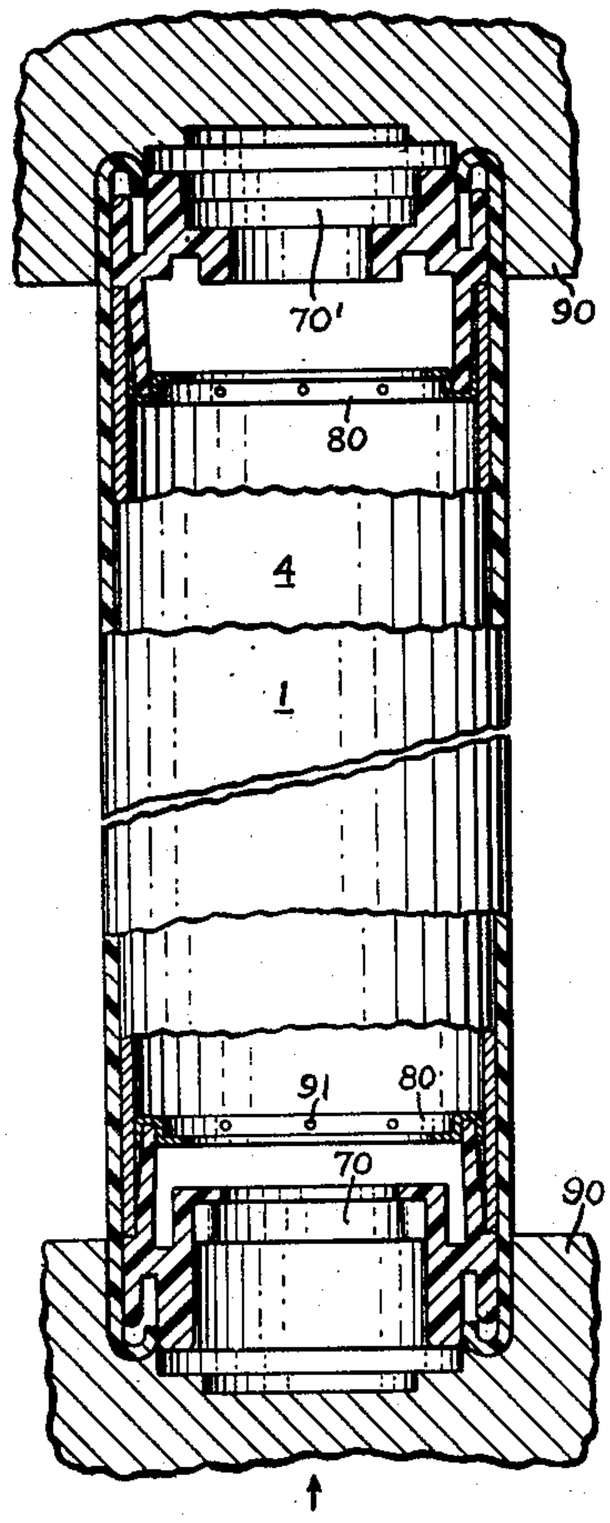


FIG. 3

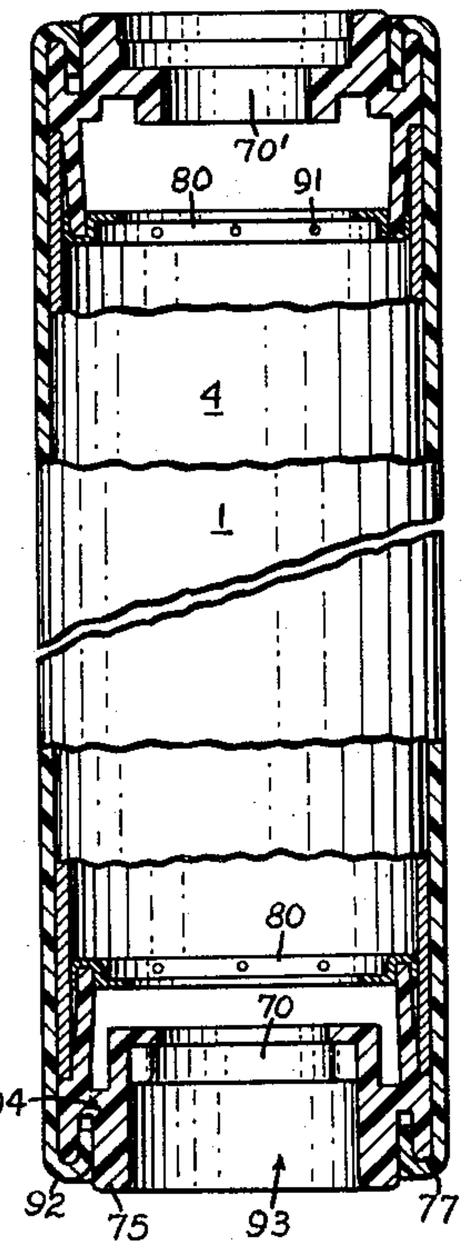


FIG. 1

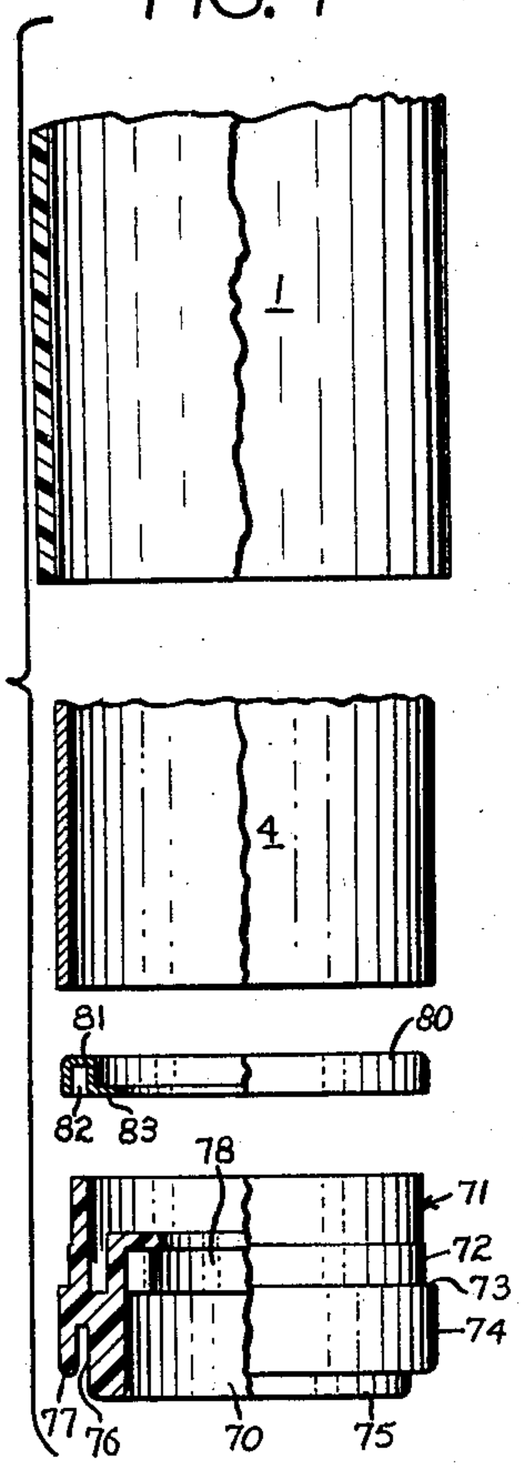


FIG. 4

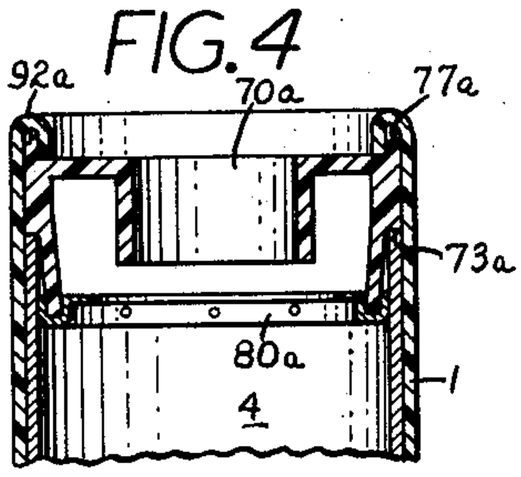
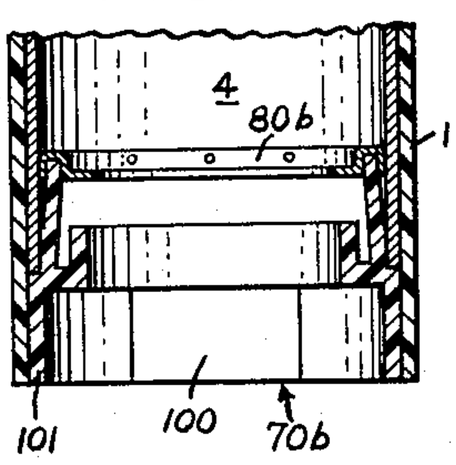


FIG. 5



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SPOOL

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This invention relates to textile spools, particularly of the flangeless type.

The general object of the invention is to provide a textile spool, of improved durability and utility but which may be manufactured economically.

The invention is applicable to a large variety of spools, which are known by a variety of names, and including so-called pirns, bobbins and tubes, but all of which have the common characteristic that as to one end at least, the structure is substantially flangeless, the maximum outside diameter at the end being that of the barrel surface or approximately this diameter.

The service requirements of textile spools as to strength, concentricity and balance may be quite severe, and dictate the use of barrel elements of steel, aluminum alloy or comparably strong materials. At the same time, the requirements as to surface smoothness, resistance to corrosion and other factors dictate the use of materials of a relatively soft character, such as pasteboard and various plastics, so that a composite barrel structure is highly desirable, if not absolutely necessary. At the same time, the end structure must be such as to permit ready drawing off of the yarn or fiber, without tendency to trap the same and must possess considerable resistance to impact.

Prior proposals have taken a variety of forms, ranging from barrel constructions, such as solid maple or laminated phenolic resins, which structures are homogeneous, to barrel constructions in which the strength and supporting functions are supplied by means of an inner barrel element or assembly of metal or other material and the desired surface is achieved by applying a coating or sleeve of paper, plastic or other suitable material to the barrel structural member.

The problem of providing suitable end structures has been approached in various ways, none of which has been found to be entirely satisfactory in all applications. In our prior application Serial No. 447,942, filed August 5, 1954, we have disclosed a spool structure comprising a barrel element of steel, aluminum or the like, with plastic covering, and which is found to meet service requirements very satisfactorily in certain fields of use. However, the structure there shown is not adapted to certain types of spools, by reason of expense, difficulty of construction and other factors which will be commented on in the following description.

In the just mentioned application, we disclose a structure in which the plastic barrel covering is preferably applied by molding in situ onto the structural barrel member, while in the present application, we disclose a structure in which a plastic covering is preferably applied as a previously formed tube to the barrel structure and one or both end elements are formed by curling or spinning operations, thus adapting the structure to high speed economic mass production, utilizing components generally available on the open market and involving a minimum amount of fabrication.

Constructions embodying the invention in a preferred

form will now be described with reference to the accompanying drawing and the features forming the invention will then be pointed out in the appended claims.

In the drawing:

Fig. 1 is an exploded view partly in side elevation and partly in central axial section, showing certain barrel elements used for forming a spool drive end;

Figs. 2 and 3 are views showing progressive stages in the assembly of the spool utilizing the elements of Fig. 1; and

Figs. 4 and 5 are fragmentary central axial sections showing modified forms of end structure.

Before proceeding with a detailed description of the spool of the invention, it may be noted that the plastic materials of reasonable cost and in the form of thin walled tubular structures are deficient in resistance to collapsing pressure of yarn or fiber wound thereon and also in resisting impact. While they may not break under impact, the extent of deformation which occurs will generally be found to be excessive unless structures of this character are otherwise supported. On the other hand, metal while possessing desirable characteristics of rigidity and high collapsing strength, possesses the disadvantage that while the deformation resulting from impact may be small, it is apt to be permanent and any scratching may produce burrs which will catch or tear yarn or filament pasing thereover. In a plastic covered metal barrel structure, the provision of a separate end fitting presents its own problems, while if either the metal or the plastic is used to form the end surface, the defects of the material which is exposed to impact will necessarily be present and may even aggravated instead of being reduced by the other material. For example, if a spool end consists of a metal barrel with tubular plastic covering ending flush therewith, or substantially so, the barrel is not appreciably protected against deformation by impact and the plastic covering may be subjected to increased damage under impact by being pinched between the metal barrel and another object or surface. Simply rolling the plastic over the metal barrel end or over and into the same does not solve the problem but rather tends to aggravate it, inasmuch as no substantial cushioning for the metal is provided and the plastic is subjected to a shearing or pinching action. The rolling of the plastic in a loose configuration or structure in an effort to form a rounded nose for the spool and a structure in the nature of a tire for absorbing impact will protect the metal but the plastic will go under relatively slight stress, thus destroying the utility of the spool.

In most cases, it is desirable that the spool be capable of taking impact such as involved in dropping onto concrete from six feet or so, and the constructions now about to be described are designed to withstand abuse of this character.

The spool of the invention is made up of an outer tubular plastic cover **1**, an inner structural barrel element **4**, and fittings **70**, **70'** and retainer member fitting **80**, as described below. The plastic covering **1** may be made of a variety of materials as discussed further and more specifically below, but it may be noted for the present that any of a variety of commercially available tubing may be used and that the preliminary processing for producing the tube of the invention will ordinarily involve the cutting of such tubing at length.

While, as stated above, a variety of plastics may be used for the barrel cover **1**, styrenes are very suitable by reason of their economy, ease of working, good surface and reasonable cost. Styrene acrylonitrile copolymer, marketed under the trademark "Kralastic," has been found very suitable, but other materials may be used where preferred. These plastics also may be obtained in a variety of colors, permitting ready identification of

spools according to manufacturer, type of spool and type of fiber.

The surface provided is to all intents and purposes ideal, as it is smooth and shows no tendency to catch or interfere with the winding, unwinding or drawing off of the fiber. In addition, when scored or cut the material does not form objectionable burrs. This is of importance, as the unused remnant of a fiber on a spool is removed by drawing a knife axially along the barrel, necessarily involving some scoring of the barrel surface. Wherever this occurs with a barriel covered with the plastic indicated, the score line may be burnished down by rubbing a rounded object over it, again restoring the surface to completely satisfactory and useable condition.

The tubing 1 will normally be produced by extrusion and may have some variation in wall thickness as well as diameter, and by reason of its relatively elastic properties is difficult to specify as to dimensions in the terms customarily used with metal or similar rigid material. The wall thickness may vary within considerable limits, but for a pirn or spool of the type shown which typically is about one foot or so long and one and a half or two inches in diameter, a plastic covering with a wall thickness of about $\frac{1}{32}''$ is found satisfactory. The diameter may be controlled by gaging with reference to a barrel member, as, for example, holding the length 1 of Fig. 1 within limits such that it may be slid by hand between one-third to two-thirds of the way onto the barrel. It is found that the completion of the sliding of the tube 1 onto the barrel may be accomplished without difficulty with a fit of this type, and at the same time there is no objectionable tendency for the tube 1 to creep or twist on a supporting tube 4. In certain cases, one or more spots of adhesive may be applied between these two elements and, in particular, where the end curls on the covering 1 are formed after the application thereof to the metal supporting structure, as described below.

The constructions previously provided will be found satisfactory in a great variety of applications, but do not represent the ultimate in impact protection, principally by reason of the fact that the end fittings generally are formed by stamping and similar operations of sheet metal or other sheet material, and leave the edge of the metal tube substantially unaltered at or closely adjacent to a likely point of impact. Moreover, in the case of impact against a surface where the line of application of force is more or less axial, the end fitting itself may be damaged. In Figs. 1 to 5, there is illustrated a structure providing substantially complete protection, and utilizing end fittings which essentially modify the conditions at the end of the barrel over those obtaining when the metal barrel end itself is closely adjacent the end of the spool. In the construction of these figures, the metal barrel 4 may be unaltered, apart from being somewhat shorter for the spool in the same overall length than in the structures of previous designs. End fittings, such as the element 70 shown in Fig. 1 are used and are made of material such as molded nylon having desirable characteristics of strength and resiliency.

The end fitting 70 comprises a plug portion fitting within the barrel and including a reduced diameter section 71 and a large diameter section 72 which terminates in a shoulder 73 beyond which is a generally cylindrical portion 74 of outer diameter equal to that of the barrel 4. Axially beyond and radially inward of this portion 74 is a projecting central part 75 and a groove 76 is formed between the portions 74 and 75. The upstanding rim or skirt 77 outwardly of the groove 76 has a rounded edge surface, as shown. The interior configuration of the fitting 70 may take any of a variety of forms, being, for example, formed with an inner section 78 to fit a spindle base provided with the usual drive key or lugs. The inward (upper in the figure) portion of the portion 71 is, however, of tubular form, as indicated. A ferrule or fitting 80 is used in conjunction with the end fitting 70 and is preferably of sheet metal. This fitting comprises a doubly bent rim 81 forming an annular groove 82, with generally cylindrical portions radially inward and outward of this groove, and has a flat or planar internal flange 83 which tends to stiffen the entire structure in its own plane. In assembly, the ferrule 80 is first applied to the tubular inner end 71 on the end fitting 70 and then the assembly is driven into the barrel 4 into the position shown at the bottom of Fig. 2. An upper end fitting 70', which is substantially identical to the lower end fitting just described apart from differences in shape which do not affect the present invention, is also provided. The outer covering tube 1 is positioned over the barrel 4 with both ends of the tube 1 protruding, and these ends are then curled around by means of curling dies 90, as indicated in Fig. 2, until they seat against the rounded edge 77 and are tucked into the groove 76, as shown in Fig. 3. The curling die configuration is generally similar to that used in forming other plastic covered spools and the outer barrel 1 will normally be clamped at both ends to the metal barrel 4 to prevent sliding or creeping during the curling, by suitable clamping means, not shown.

Either prior to the application of the ferrule 80 to the fitting 70 or during this application, a number of nibs or other securing means 91 may be pressed into the metal of the member 80, as indicated in Fig. 2, for the purpose of holding the ferrule 80 to the member 70 both axially and circumferentially.

It will be observed that the completed structure of Fig. 3 now approximates the structure of our previously filed application above referred to, and in which the plastic covering is molded in situ, although in the present case the plastic end structure is composite and is made up of the tubular cover element 1 and end fitting 70.

The rim around the groove 76 forms a relatively flexible cantilever type support for the curled around end 92 for the cover tube 1. Impact is thus gradually transmitted to the more solid part of the end member 70 at the base or inward end of the groove, so as to be transmitted to and carried by the end fitting 70 almost entirely and to the exclusion of the edge of the metal barrel 4 adjacent the point of impact.

It has heretofore not been found practical to use a nylon end plug of the desired general form in a flangeless spool subjected to severe service conditions, by reason of the shrinkage encountered with otherwise suitable molded nylon parts, which shrinkage may tend to cause a loosening, with passage of time, of the nylon plug originally inserted with a driving fit. The ferrule or fitting 80 is utilized to counteract this tendency, and is formed with an outside diameter slightly greater than the inside diameter of the metal barrel 4, and is driven into the barrel with a force fitting, an outer diameter of about .01 inch greater than the inside diameter of the barrel being suitable. The nylon end member 70 in its portion 72 is made of diameter equal to the inside diameter of the barrel 4 and is reduced at 71 so as to take the ferrule 80. In the application of the ferrule 80 to the fitting 70, since pressure is applied to the same to embed nibs 91 into the nylon and hold it securely, the exact sizing of the fitting 80 preliminary to driving into the barrel member 4 is readily and automatically accomplished. The end 75 of the end part 70 extends slightly upward beyond the rim 77 and beyond the cover tube 1 wrapped therearound, as shown in Fig. 3.

It is found with the construction just described that extremely high protection against impact damage is afforded and that this is true regardless of the direction of impact. If the spool is dropped vertically downward so that its axis is perpendicular to a concrete or other floor when it strikes, the impact is taken entirely by the projecting part 75 of fitting 70. This part has considerable flexibility by reason of the material of which it is composed and by reason of its tubular or columnar form, since it has the shape of a tube section or wall

within the groove **76** and surrounding the central opening **93** which accommodates the spindle base. This part of the end fitting is, in turn, supported by the section **94** which has the form of a generally radial web connecting the inner and outer parts of the end fitting, and which, again, has flexibility. No tendency has been observed for impact of the character just mentioned to drive the member **70** into the barrel **4** and displace the shoulder **73** with reference to the end of the barrel.

In the case of impact with a surface parallel to the spool axis, the blow is taken by the covering **1** over the cylindrical part of the barrel **4**, the stress being well distributed and no harmful effects being observed. A major proportion of impacts, however, will occur along a line at an angle to the axis of the spool, which angle may be acute of obtuse. It is found that the rim **77** and covering **92** thereover will take and dissipate impact at obtuse angles without difficulty. Where, however, the angle of impact is acute, so as to be exerted largely in the axial direction against the rim **77**, damage may occur by reason of the diminished flexibility of the elements in this direction. The projecting central part of the plug **75** provides protection against such impact at an acute angle, as it will be apparent that once the line of impact is at an angle of about 45° or less to the axis, the projection **75** will absorb part or all of the impact.

It will be observed that an impact against the spool end at a sufficiently obtuse angle may occur along a line passing outside the end of the metal barrel **4** and tending to create a considerable turning or rocking moment of the member **70** about an axis at right angles to the axis of the spool. A rocking movement would, of course, tend to separate the fitting **70** from the end of barrel **4**, unseating the shoulder **73** at one side and loosening up the structure. It has been found, however, that the driven fit of the fitting **80** prevents any observable effect of this type under all normal impact conditions.

Fig. 4 illustrates a modified form of end fitting, in this case an upper or undriven end fitting. The fitting **70***a* is formed, so far as its engagement with the barrel **4** is concerned, similarly to the fitting **70** just discussed and has a similar driven ferrule or fitting **80***a*. The space inside the rim **77** of the axially extending flange or lip over which the plastic cover tube is curled, as indicated at **92***a*, is open instead of being occupied by a projecting central portion such as the portion **75** discussed above. This permits the insertion of identifying tags, and the turned over end **92***a* will remain in the indicated position particularly where heating is employed in the curling or spinning operation.

The nylon end fitting as just discussed may also be used in a modified form, such as illustrated in Fig. **5**, and in which a polygonal drive connection section **100** is used. In this case, the fitting indicated at **70***b* is again secured to the barrel member **4** in the manner just discussed, but its projecting part is modified so as to consist of a generally cylindrical extension or wall **101**, the plastic outer tube **1** being cut flush with this wall instead of being curled thereover, and a hexagonal configuration being molded into the interior of this section

of the fitting **70***b*. The construction has improved impact resistance by reason of the yieldability of the wall **101** which has been substituted for the end of the barrel **4** at the lower end of the spool or pirn.

As indicated above, the various end fittings of Figs. 1 to 5 are preferably formed by molding and they are preferably made of thermoplastic or synthetic resins, such as nylon for reasons of economy. So long as the essential characteristics of the portions of the end fitting which engage the other parts and which take impact are preserved, the fittings may be varied indefinitely to suit particular service requirements and conditions or particular molding techniques, as by partly or completely filling internal annular spaces or forming radial reinforcing webs or ribs therein, as is common technique in molding operations. Where preferred, the metal fitting **81** may be secured to the plastic end fitting by molding or casting therewith as an insert and apertures or othe desired holding means, following known and conventional practice may be substituted for the nibs **91**.

From the standpoint of serviceability alone, the best presently available plastic tubing **1** for use in the structure of the invention is perhaps nylon, but this material is relatively expensive. Considering both serviceability and economy, material such as extruded tubing sold under the tradename "Kralastic" is found to be perhaps the most suitable of presently available materials.

What is claimed is:

1. A textile spool comprising a tubular barrel member, a relatively resilient plastic end plug fitting therefor having a tubular portion extending into and fitting within the barrel member, a coupling member for holding the end plug fitting inside the barrel comprising an annular metal element having an annular recess receiving and surrounding the inner tip of the tubular portion of the plug and having a driven fit inside the barrel, the end plug having a shoulder abutting the end of the tubular barrel member, and a tubular covering for the barrel and end plug.

2. A textile spool according to claim 1, in which the said end plug has a rim extending beyond but in alignment with the tubular barrel and in which the tubular covering is curled over the said rim.

3. A textile spoon according to claim 2, in which the said tubular covering is formed of plastic material and in which the said end plug has a central portion extending beyond the said tubular covering for taking impact in alignment with the spool axis and throughout an acute angle thereto.

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