ABSTRACT: A tubular body, particularly for supporting yarns which has a comparatively light weight as compared with its strength. Each tubular body consists of a tubular wall whose outer surface has the shape of a revolution body and whose inner surface is integrally formed with helically shaped ribs.
This application is a continuation of application Ser. No. 614,461, filed Feb. 7, 1967, now abandoned.

This invention relates to tubular bodies to be used primarily but not necessarily for supporting wound yarns on cops, cylindrical or conical bobbins, reels and the like. More particularly, the present invention relates to supporting bodies for wound yarns, to be manufactured with such materials and methods as to minimize the first cost without prejudicing, but rather improving their efficiency in service so as to obtain "no return" supporting members thus eliminating the necessity of returning and recovering the supporting members for winding another charge or amount of yarn thereon.

The technical and economical advantage of having tubular bodies of a comparatively light weight as compared with their strength is of utmost importance, especially when large supporting members are involved, and which members are subjected to considerable mechanical stresses and other damage.

At present, the cylindrical tubes for cops, which are generally of a heavy, bulky and complex construction comprise a sturdy metallic tubular core, inner metal centering rings, shaped heads for completing the construction and transferring the drive, and plastic material coatings for imparting the necessary characteristics to the supporting members. A lightweight body, advantageous from the transportation viewpoint, as well as the stresses to which the spindles are subjected and the energy absorbed during acceleration. In the case of "no return" supporting bodies the advantage is manifest. As a matter of fact, in spite of the care taken during handling, filling and transportation, a large percentage of the supporting bodies returned to the factory should be rejected or, at least, subjected to costly maintenance operations for replacing component parts. The operations attendant to repacking, return transportation and the inspection thereof for damages are such as to require (which bodies can be reused without upkeep or maintenance operations) considerable expenditure.

Generally, the present invention is directed to a tubular body particularly for supporting yarns, comprising an outer surface constituted as a revolution body and a plurality of helical integral ribs protruding from the inner wall of the body, with each rib having a height of protrusion, radially towards the longitudinal axis of the body which increases from at least one end of the body over the extent of each rib to at least the center of the body, and there being at least six ribs and at least one of the surfaces defining the wall of the tubular body being conical.

In the particular embodiment as a cop core, the supporting member comprises at least a centering and spacer member for centering the supporting member on the spinning spindle and also a plurality of helical ribs, preferably extending in opposite directions in either part of the tube with respect to the outer part thereof on either side of the spacer member.

According to the invention, the manufacture of the tube is achieved by molding a plastic material within a mold having a female part with a cylindrical bore and facing coaxial male mold parts having helical grooves adapted to be withdrawn from the female mold part on completion of the molding stage, by a combined axial and rotational movement coincident with the helical profile of the inner ribs.

Further important objects and advantages of the invention will become more readily apparent to persons skilled in the art from the following detailed specification and annexed drawings and in which drawings:

FIG. 1 is a side elevational view partly broken away of a thread wound on a cop, for a clearer understanding of the operational conditions and the requirements for a supporting tube.

FIG. 2 is a fragmentary view mainly in axial section of a tube embodying the invention.

FIGS. 3 and 4 are cross-sectional views taken along the lines III-III and IV-IV, respectively, of FIG. 2 the views looking in the direction of the arrows, respectively.

FIG. 5 is a view, partly in side elevation and partly in cross section of the inner component parts of a mold in readiness for the production by die casting of a thermoplastic material of the tube shown in FIGS. 2 to 4.

FIG. 6 is a view generally similar to FIG. 5 of the component parts of the mold, when the mold is opened.

FIG. 7 is an exploded view, partly in side elevation and partly in cross section of a cylindrical tubular body to which the component parts of the mold ready for production, and

FIGS. 8 and 9 are fragmentary views partly in elevation and partly in cross section of a reel and a small cylindrical supporting body, respectively.

Referring to FIG. 1, there is illustrated the typical use of a cop tube, generally indicated T which, as customary, is threaded onto a spindle F adapted to be rapidly rotated for receiving a wound thread mass M which assumes the typical configuration as shown. More particularly, in the case of synthetic threads, the tube T, in addition to exhibiting surface characteristics adapted to the reeling and subsequent unreeeling of the yarn, requires a perfect distribution of its mass about the axis to avoid damage resulting from the rapid rotation. In addition, the tube includes means for centering it on the spindle, and engaging members such as teeth, dogs and other conventional driving members arranged at a base B of the spindle, and should possess mechanical strength to withstand all phenomena which result from the subsequent considerable shrinkage of the wound yarn in the course of time.

In the main, the shrinkage phenomena give rise to a pressure which is directed radially of the outer face of the tube as diagrammatically depicted by radial arrows R. This pressure, imparted by the outer convolutions of the thread to the inner convolutions, causes the outer convolutions to be wedged into the inner convolutions so that the inner convolutions have a tendency to be set apart from one another. Another consequence is the development of a considerable axial stress denoted by arrow A' on the tube. These forces combine and give rise to slanting resultant indicated by arrows O, which are set at a more or less pronounced angle α with respect to the axis of the tube.

The basic concept of this invention comprehends the formation of helical ribs internally of the tubular body of the supporting member, thereby being fully responsive to the service requirements thereon.

As a matter of fact, the slope of the helical ribs can be properly selected so as to match the value of the angle and is preferably between 25° and 50°, and in the case of cop tubes is preferably between 30° and 35° when taking into account the frictional interconvolution drag of the wound threads and other side effects.

Referring to FIG. 2, the tube includes a tubular body 10 having an outer surface 11 and helical ribs 12. Intermediate the ends of the tube, the body 10 is provided with an annular portion 13 having a bore or opening 14 which bore serves for centering the tube at the top of the spindle. It will be noted that the ribs 12 are continuous and extend in opposite directions above and below the annular portion 13. The above continuity ensures a uniform resistance for all of the tube portions stressed by the thread.

Due to the helical outline of the ribs 12, and the fact the ribs are integral with the body 10 of the tube, in each and every point of the cross-sectional areas thereof, both longitudinally (FIG. 2) and transversely (FIGS. 3 and 4), the material of the tube is defined by evenly spaced T-shaped cross-sectional outlines. In other words, the material offers the most favorable conditions for withstanding bending stresses and other more complicated stresses which are experienced in practice as a consequence of the shrinking of the yarn. This ensures, within limits which exceed the working requirements by far, that the outer surface 11 of the supporting body will retain its shape as a revolution body (generally this shape is cylindrical but can possibly be conical as in FIG. 7).

The ends of the multistart helical ribs at the base of the body form a front crenellacion for engaging the driving members at the base B of the spindle (FIG. 1), or other component part onto which the body is slipped for winding a yarn thereon.
In addition, the use of appropriate plastic materials, even inexpensive materials, such as for example polyurethane resins mixed with a high percentage of filling materials, whose inherently low mechanical strength is compensated for by the presence of the specially selected orientation of the helical ribs, has led to the exploitation of surprising commercial advantages so far as the freedom of the yarn from defects is concerned. Fibrous reinforcements and/or coatings can also be employed.

In point of fact, the radial thrusts R (FIG. 1) resulting from the shrinkage of the outermost convolutions of the wound yarn are conductive to compression of the innermost convolutions, with the innermost convolutions consequently undergoing a mechanical stress so that the yarn is deformed and assumes flattened, substantially quadrangular cross-sectional shapes since it is forced to occupy the interstices originally present between the adjoining convolutions of threads having a circular cross-sectional area. This lowered change of the wound yarns can be seen in windings formed about the conventional metal conduits which are virtually undeformable.

In the present tubes, the component plastic material, either as a homogeneous mass or with fibrous reinforcements, even having a virtually uniform outer surface 11, is susceptible to a certain elastic deformation and a permanent set which is manifested by a radial shrinkage. The radial shrinkage ensures, to a degree, that the shrinkage of the wound yarn mass is compensated for. The strength with which the outer convolutions stress the inner convolutions of the wound mass cannot consequently overcome the resistance the plastic material tube is capable of opposing to the shrinkage. Inasmuch as, in actual practice, the magnitude of yarn shrinkage upon winding is very small, it has been ascertained that a radial shrinkage of the tube, of a very small magnitude indeed, is sufficient to overcome, at least a major proportion, the stresses and deformations of the innermost convolutions, thus ensuring the uniform conditions of the whole wound yarn mass.

As a result, the tubes or in any event the tubular supporting bodies for wound yarns, made in accordance with the invention demonstrate in addition to their cheapness which allows the use of a "no return" member (even overlooking the possible recovery of materials which, as is known, can be made for using plastic material scraps for the same kind of production or for like uses), and the mechanical and geometrical features required for the particular intended use, the inherent advantage over the present supporting bodies which are susceptible of virtually undetectable elastic and permanent deformations, of ensuring improved conditions for the storage of the wound yarns.

In the embodiment shown in FIGS. 2-4, the multistart helical ribs (in this example, there are eight starts), have their height gradually increased from the tube ends towards the annular portion 13. The cross-sectional area of the ribs in question also gradually increases, with the same being true of the thickness of the tubular body 10, in a direction consistent with the increase of the rib cross-sectional area.

These facts are such as to permit the achievement of the twofold objective of inflicting to the artifact a mechanical resistance which is proportionally enhanced in its central portions, consistently with the magnitude of the locally obtaining stresses due to the characteristic shape of the wound yarn A, and of facilitating the removal of the male component parts of the producing molds.

The ribs 12 terminate adjacent the upper end of the body so as to allow the insertion of a conventional identification and closure cap.

According to a typical embodiment of a molding assemblage (FIGS. 5 and 6), the latter comprises at least a female mold part 20 defining a cylindrical cavity 22 on whose surface the outer surface 11 of the tube is to be molded. The surface 22 of the cavity can be smooth or have thin ridges or preselected surface deformation or roughness, if necessary to encourage adherence or winding of the yarn. The female mold part cooperates with male mold parts 24 and 26 defined by substantially conical bodies to obtain the desired thickness increase of the cylindrical body 10 and having helical ribs 28 and 30, respectively, of a cross-sectional area substantially corresponding to the cross-sectional area of the ribs 12. The latter cross-sectional area is gradually increased from the ends towards the center of the tube. The male mold parts are so designed with respect to their size so that their facing ends or heads 32 and 34 respectively are spaced apart from one another in the closed mold position (FIG. 5), to such an extent as to provide a gap or hiatus 36 in which the annular portion 13 is to be formed. The end 32 is provided with an axial cylindrical boss 38 which coaxes with a corresponding cylindrical recess or depression 40 in the end 34 for introducing a centering bore for the annular portion 13 formed in the hiatus 36.

The moulding assemblage also includes one or more passageways 42 for injecting or feeding the plastic material. Obviously, the introduction of the plastic material can be effected through a plurality of passageways, an annular port or, by adopting conventionally known means for ensuring the rapid and complete filling of the mold cavities. The component parts may be provided with conventional preheating means preparatory to the molding operation per se and also with cooling means for rapidly dissipating the heat of the injected plastic material.

According to an important aspect of the invention, at least one part of the mold, such as for example the male mold part 26, is provided with a passageway 44 for introducing a pressurized fluid into the mold, and more particularly in the area in which mold parts are in facing relationship.

The introduction of a pressurized fluid, either liquid or gaseous, within the plastic material injected into the mold cavity, when the material has attained a viscosity which is sufficient to prevent further flow and displacements in the cavity while still retaining a plasticity sufficient to permit deformation, ensures the expansion of the injected material towards the outside and its continuous adherence to the surface 22 thus counteracting the shrinkage of the plastic material during the progress of setting. The above permits the outer surface 11 of the artifact to retain the geometrical cylindrical shape defined by the inner surface 22, with the known deformations due to the shrinkage differentials between portions of different thickness in molded articles of thermoplastic material being efficiently prevented.

In actual practice, the mold cavity, as illustrated in FIG. 5, serves for initially presetting the plastic mass in the desired shape, when the setting process is incipient. In the final stage of the process, the function of the male and female mold parts is, so to speak, replaced by that of the pressurized fluid injected within the tubular ribbed plastic material, and the said pressure compels the plastic mass to separate from the surfaces of the of the male mold parts while still closely adhering to the surface of the female mold part.

This separation, as it is obvious, is such as to encourage the withdrawal of the male mold parts as the mold is opened and the molded and set article is withdrawn therefrom. The unthreading of the male mold parts 24 and 26 can be effected and facilitated by the pressure of the fluid fed into the passageway 44 or by other equivalent means. To do so, additional pressurized fluid can be fed into the mold during the opening stage.

The same concepts could obviously be adopted for the formation of supporting bodies for wound yarns of a different kind. For example, for the production of conical tops, such as that designated generally at 50 in FIG. 7, a molding assemblage can be used which comprises a female mold part 52 defining the outer tapered surface of the top and a single conical male mold part 56 having helical grooves 58 for the formation of the inner portion of the top with specially provided continuous helical ribs 60. Upper shaped end 62 of the top is formed between a shaped bottom portion 64 and an end or head portion 66 of the male and female mold parts respectively. Also, in this case, pressurized fluid could be introduced at...
the end of smaller diameter of the mold cavity, for example through a passageway 68 formed through the shaped bottom portion 64 of the female mold part, that is, at a point in which the axial separation of the mold parts takes place during the mold opening operation.

Similar technical expedients could be adopted for applying the invention to the production of other supporting bodies such as a reel 70 illustrated in FIG. 8, and whose cylindrical core 72 is provided on the inside thereof with helical ribs or lands 74 extending in a uniform direction throughout the entire length of the core, or in opposite directions in its two symmetrical halves, according to convenience in production. Flanges 76 of the reel can be applied subsequently or also formed integrally with the core 72. If such is the case, dismemberable female mold parts should be used to enable the practical withdrawal of the article.

FIG. 9 illustrates an embodiment of the invention employing small tubular cores 80 for supporting sewing and darning thread. The cores consist of a cylindrical (or more or less tapered) body 82 having inner helical ribs 84.

Obviously, for each of the items, the molding assemblage could be made to permit the introduction of fluid pressure within the injected plastic body during the progress of setting, so as to obtain the desired effects.

In addition, while the invention has been described with specific reference to supporting bodies for wound yarns, it could be used and adapted for different applications such as the production of tubular members to be used as structural components and for other uses.

1 claim:

1. A tubular body for supporting yarns comprising wall means having an outer surface constituting a revolution body and an inner surface, a plurality of continuously extending spiral integral ribs protruding from said inner surface, each rib having a free end and a root end, the distance between the root end and the free end of each rib increasing from at least one end of said body over the extent of each of said ribs to at least the center of said body, and the distance between the inner and outer surfaces of the wall means increasing in thickness from at least one end of said body to at least the center of said body.

2. The tubular body as claimed in claim 1 in which centering means is provided for the spindle protruding a greater distance inwardly than the ribs.

3. The tubular body as claimed in claim 1 in which the inner surface of said wall means if provided with a centering ring, and the inner diameter of the centering ring being less than the inner diameter of any of the ribs.

4. The tubular body as claimed in claim 1 in which there are an even number of ribs.

5. The tubular body as claimed in claim 1 in which the ribs have a slope with respect to the axis of the body between 25° and 50°.

6. The tubular body as claimed in claim 1 in which the ribs have a slope with respect to the axis of the body between 30° and 35°.

7. The tubular body for supporting yarns as claimed in claim 1 in which said inner surface of the wall means is conical.

8. A tubular body for supporting yarns comprising wall means having an outer surface constituting a revolution body and an inner surface, a plurality of continuously extending spiral ribs integral with and protruding from said inner surface, at least the inner surface tapering from at least one end of the body to at least the center of the body whereby the inner diameter of the body decreases from said at least one end to at least the center thereof, and the ribs having a protrusion height from said inner surface towards the center axis of the tubular body which increases from at least said one end to at least the center.

9. A tubular body for supporting yarns comprising wall means having an outer surface constituting a revolution body and an inner surface, said outer and inner surfaces tapering from at least one end of the body to at least the center of the body whereby the inner diameter of the body decreases from said at least one end to at least the center thereof, a plurality of continuously extending spiral ribs integral with and protruding from the inner surface of said wall means, and the ribs having a protrusion height from said inner surface towards the center axis of the tubular body which increases from at least said one end to at least the center.

10. The tubular body for supporting yarns as claimed in claim 9 in which said inner surface tapers from one end of the body to the other end of the body whereby the inner diameter of the body decreases from one end to the other end.