ABSTRACT OF THE DISCLOSURE

In the high-speed winding of textile yarn and like materials, the close fit required between confronting bobbin and spindle surfaces, for such purposes as vibration-suppression, is relieved at angularly-spaced positions where the spindle-wrapped yarn will be urged to pass through to its coupling with the usual traveling substantially unjammed condition; yarn-breakage and waste-accumulation tendencies are advantageously decreased, while, at the same time, necessary minute critical looseness is preserved between bobbin-spindle surfaces to avoid bindings which interfere with vibration control, balance, and doffing.

BACKGROUND OF THE INVENTION

The present invention relates to improvements in supports for textile materials and the like, and, in one particular aspect, to novel and improved arrangements wherein the yarn or other material which must pass between a bobbin and a cooperating mated spindle is automatically urged into and accommodated by angularly-spaced radially-relied passageways at the site of close radial fitting between the bobbin and spindle, thereby reducing yarn-breakages, waste accumulations, improper seatings, and resistance to doffing.

In the textile machinery art, it has long been common practice to collect packages of yarn, thread, and so forth, upon tubular cores or bobbins which are mated with and rotated at high speeds by cooperating spindles. Precision-engineered driving spindles may revolve with little vibration or other unsteadiness only so long as the bobbins mounted upon them are properly centered and seated, and any deficiencies in the latter respects also tend to impair delivery of driving torques to the bobbins and to develop excessive numbers of so-called "ends down" (i.e., yarn breakages). Bobbin and spindle assemblies which have evolved over the course of many years in this well-developed art have assumed a variety of structural shapes and have been fabricated of many different kinds of materials, depending upon the intended applications; one currently-preferred construction, as to which the present teachings are particularly applicable with distinct advantage, involves a generally tubular bobbin which is mated with an associated spindle over substantially the greater part of its full length and is slip-fitted in a frictionally-driven relationship with the tip of the spindle. Commonly, such bobbins are slightly tapered, or conically-shaped, and may be made of impregnated paper, wood, or plastic. Large numbers of these bobbins are dropped, empty, onto the numerous upstanding spindles of a winding machine which have short lengths of yarn wrapped around their base or acorn portions, and the spindles are then rapidly accelerated to the very high rotational speeds which are modernly required for heightened productivity. Package build-up on each bobbin is conventionally regulated by a surrounding movable ring-traveller unit through which the yarn is pulled.

The aforementioned vibration or other unsteadiness which results from eccentricities or improper seating of the bobbins on the spindles can be reduced somewhat by seat designs which involve tight interlocking between the bobbin and spindle, but at the expense of difficulty in doffing the bobbin; preferably, however, the seat is of a simple "universal" or ball-and-socket type permitting the bobbin to pivot about the rounded tip of a spindle, and a vibration-suppressing stabilizer insert below the seat establishes a rather close fit which occasions impact-disipation of unwanted vibrational energy. The latter type of construction is described in U.S. Pat. No. 3,167,262, and is of advantage in that the bobbins are relatively free for purposes of easy doffing, a matter which is of relatively great concern when automatic doffing equipment is used. However, even in such instances, the yarn which is normally wrapped about the spindles before bobbins are doffed, so that the winding will commence properly, tends to interfere with the bobbins and to cause first, an undesirable eccentricity in the bobbin-spindle relationship, second, a jamming which makes the yarn more susceptible to breakage, third, an unwanted blocking of the minute impacting needed to dissipate unwanted vibrational energy, and, fourth, a troublesome accumulation of yarn wastes which must be periodically cleaned around the spindles.

SUMMARY

In accordance with certain aspects of the present teachings, it is uniquely recognized that the critical fitted relationships between cooperating spindle and bobbin elements, needed to promote optimum high-speed performance and to facilitate doffing, may be preserved while at the same time accommodating the relatively free passage of even thick yarn between these elements. Further, it is recognized that, in the normal doffing and subsequent doffing of bobbins, the trailing yarn end tends to wrap and take up positions about the spindle which can be readily coordinated with support and relief surfaces serving to prevent troublesome jamming and accumulations of waste. Structural implementations of these concepts are in the form of convenient and inexpensive shaping of those confronting surfaces of the spindle and/ or bobbin which are disposed at the site or sites of close lateral fit between the bobbin and spindle, the shapes affording angularly-spaced radial reliefs in the fit axially coextensive with it, and the fit remaining essentially unaltered over the unrelieved surfaces and thereby preserving the needed bobbin-spindle alignments. Accordingly, it is one of the objects of the present invention to provide novel and improved bobbin-spindle arrangements of inexpensive and uncomplicated construction in which smooth high-speed running and ease of doffing are promoted by yarn-relief passageways. A further object is to provide unique textile-winding units wherein yarn is guided freely between close-fitting parts of mated bobbin and spindle members. Another object is to provide novel and improved bobbin and spindle elements in which cooperating surfaces are shaped to both accommodate yarn between them and to preserve minute lateral spacings required for proper alignments and suppression of vibration. Still further, it is an object to provide textile spindles and bobbins in which unique surface configurations at the sites of close mating fits guide yarn ends to accommodating spaces where jamming and accumulations of waste are minimized.

By way of a summary account of practice of the invention in one of its aspects, an elongated tubular impregnated-paper bobbin member of generally conventional external configuration, and having internal drive provisions near its upper end, is mated with a cooperating substantially cylindrical drive spindle. Lower interior surfaces of the bobbin, which are somewhat larger in diameter than the corresponding diameter of the spindle surfaces oppo-
site which they are disposed, are provided with a tubular bushing affixed concentrically within the bobbin at one position near its lower end but above the level to which the usual acorn or like portion of a mated spindle can project. A minute radial spacing of but a few thousands of an inch is left between the interior of the bushing and the adjacent outermost surfaces of the spindle, except that the outermost surface at the site opposite the bushing are interrupted by a plurality of longitudinally-extending indentations in angularly-spaced relation about the spindle axis. Each of the indentations is of radial depth sufficient to accommodate relatively thick yarn therein and within the confines of the bushing without jamming. Above the level of the indentations, the spindle surfaces are preferably shouldered to a lesser diameter, such that yarn which has been dropped about the spindle prior to dosing of a bobbin tends to drape itself about that shouldered portion and to have its downwardly-extending lengths urged into non-jamming positions within the spindle indentations when a bobbin is lowered into place.

Although the features of this invention which are considered to be novel are expressed in the appended claims, further details as to preferred practices, as well as to further objects and advantages, may be most readily comprehended through reference to the following description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partly cross-sectional view of a mated high-speed bobbin and spindle assembly, together with an associated ring-traveller unit, the spindle being of an improved form wherein external surfaces opposite a tubular bobbin insert are interrupted by longitudinally-extending flax indentations within which the spindle-wrapped yarn passes relatively freely;

FIG. 2 represents a transverse cross-section of the bobbin-spindle assembly of FIG. 1, taken along section line 2—2 thereof;

FIG. 3 depicts another form of improved spindle unit, including a sleeve having alternate projections and indentations which afford yarn relief while preserving small linear clearances with a bobbin, a portion of the latter being shown in a raised position during a dosing operation which leaves a tail of yarn about the spindle;

FIG. 4 provides a partly cross-sectional view of a mated bobbin and spindle such as appear in FIG. 3;

FIG. 5 is a transverse cross-section of the assembly of FIG. 4, taken along section line 5—5 thereof;

FIG. 6 is a partly cross-sectional view of an alternative bobbin-spindle assembly wherein yarn-relief improvements are promoted by recesses inwardly from the exterior surfaces of a substantially cylindrical spindle;

FIG. 7 represents a transverse cross-section, comparable to those of FIGS. 2 and 5, of another construction of bobbin-spindle assembly wherein the spindle surfaces opposite a bobbin bushing are of corrugated form; and

FIG. 8 represents a transverse cross-section, comparable to those of FIGS. 2, 5 and 7, of yet another construction of bobbin-spindle assembly wherein the inner surfaces of a bobbin bushing are alternately projecting and recessed to afford yarn relief.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus portrayed in FIGS. 1 and 2 includes a spindle structure of a known type wherein a substantially cylindrical tubular metal spindle shaft 10 is rotated about a vertical axis 11—11 on the usual inner support bearings (not visible) carried upon the textile machine frame with which such spindles are commonly associated. Near its lower end, the spindle is supported by way of the so-called whirl 12, and, at its upper end or tip, 13, the rotatable spindle is shaped, as by the illustrated rounding, to form a seating surface onto which may be fitted the inner seating surface of an annular insert 14 held within the laminated resin-impregnated tubular paper bobbin 15. The sloping and shaping of these respective seating surfaces are such that a narrow band or small area of contact is developed between them, this being a condition which is of known advantage in permitting the bobbin to be dropped in place and to seat itself accurately on the spindle for rotation thereby, without locking the bobbin in place so tightly as to impair its subsequent dosing. Driving torques are transmitted to the bobbin from the spindle tip, with some relative slippage being possible. In initially using this type of assembly, an attendant insures that a few turns of the to-be-dosed yarn 16 are disposed around the lower portion of the spindle, thus lightly securing in place one end of the yarn being taken from an overhead supply (not illustrated). This yarn is also looped through a lightweight metal traveller 17, which is loosely snapped over the shaped rail of a ring 18. Conventional mechanisms (not shown) raise and lower the ring in a prescribed manner insuring the proper build-up of a yarn package on the bobbin in a predetermined form such as that outlined by dashed line-work 19. Bobbin 15 is equipped with annular metal end caps 15a and 15b at the top and bottom, respectively; bottom end cap 15b may be of an irregular configuration along its lower annular end surface to promote improved yarn pick-up as disclosed in U.S. Pat. No. 3,321,901.

Below the engaged seat 13 and 14, the spindle 10 and bobbin 15 are normally laterally spaced from one another, such that they do not tend to interfere and either prevent proper mating to begin with or make subsequent dosing more difficult. Accordingly, the bobbin 15 is shown to be of generally loose-fitting proportions relative to the spindle. However, excessively loose fits permit the bobbin to wobble eccentrically and to vibrate noisily and rise from the intended seated relationship on the spindle, and these difficulties are minimized through use of a tubular housing 20 within the bobbin 15 generally nearer its lower end. Such bushings may be made of laminated paper tubing, for example, and are particularly effective in suppressing erratic vibration when the annular clearance between their inner peripheries and the cooperating outer peripheries of the spindle is but a few thousandths of an inch. Such minute annular clearance is designated by dimension 21 in the case of the bobbin bushing 20 in FIG. 1. Only that very small clearance is available, yarns which are wrapped around the spindle for the aforementioned purposes tend to become jammed or to be displaced from the intended positions when a bobbin is dosed. This results in the yarn breakages, eccentric bobbin positions, loss of effective vibration-suppression action by the bushing, and undue collection of yarn waste, all as referred to hereinabove. However, the illustrated construction is one wherein the advantages of the minute clearance are preserved by six angularly-arrayed "flats" 22a—22f machined on the otherwise circular spindle section 22 disposed opposite the bobbin bushing 20. These flat indentations from the cylindrical outline of spindle section 22 create six equally-spaced passageways of relatively large radial depth, such as the passageway or space 23, which readies and the yarn 16 to pass between the spindle and bobbin bushing quite freely. The remaining outer portions of the cylindrical outline of spindle section 22 are close enough, anguarily, and are of sufficiently broad area, to maintain the desired minute bobbin-spindle clearance. The spindle diameter above the level of section 22 is somewhat smaller than the largest diameter of section 22, such that the bobbins may be dosed easily. Radial depth of the spindle indentations may be as large as strength factors for the spindle will allow, and, typically, may be about 1/8 inch. Passage of yarn in this fashion should be at least as long as the axial region 24 over which the close clearance is established, this in instance by the tubular bushing 20. As shown, the "flats" in FIG. 1 extend not only along the greater full length 25 of the cylindrical
part of spindle section 23, but also extend into the upper conically-tapered upper end 22' of the spindle section. The latter tapered end merges with the reduced-diameter upper portion 10' of the spindle, where a turn 16' of the yarn is readily accommodated in the clearance space 26 without binding. This tapered shoulder tends both to hold the turn 16' out of an interfering position and also serves to guide the depending yarn into the passageways such as 23. Moreover, the smooth taper of the upper end 22' of the enlarged-diameter spindle section 22 serves to guide donned bobbins into place, without causing them to "hang up" or snag so that they cannot be properly seated. Spindle section 22 may be integral with or affixed to the saddle.

Spindle 10a in FIGS. 3-5 is generally and functionally the same as that of FIGS. 1 and 2, as are also the other elements bearing corresponding reference numerals there distinguished by the subscript a. The spindle section 27 which provides both the needed close fit with bobbin bushing 20a and the needed yarn-relief passageways 23a, includes four angularly-spaced radial projections, 28, between which the reduced diameter of the section affords the relatively large clearance for non-interfering passage of the yarn. In FIG. 3, the bobbin 15a is shown in an unwind position such as occurs when it is loaded and disposed in the direction 29, and the force pressing yarn 16a then naturally wraps itself around the spindle in a spiral pattern. Subsequently, when an unloaded bobbin is donned, to the position shown in FIG. 4, that yarn is caused to lie in the passageways 30 between the projections 28, as desired, where it will not be jammed or interfere with the bobbin-spindle spacing or alignment.

The generally similar bobbin-spindle arrangement illustrated in FIGURE 6 includes elements functionally like those in FIGURES 1-5, and these are therefore marked by the same reference characters, with the distinguishing subscript b applied. In that embodiment, the spindle shaft is provided with longitudinally-extending angularly-spaced grooves, 31, into which the yarn 16b is directed for relief from interference at the site of the closely-fitted bobbin bushing 20b. In FIG. 7, a spindle section 27c has longitudinally-extending surface corrugations 32 which afford both the necessary close fit with a bobbin bushing 20b and a plurality of radially-deep passageways through which yarn may pass. FIG. 8 characterizes a construction in which the outer periphery of a spindle 10d is substantially cylindrical and yarn relief is afforded by shaping of the inner periphery of the bobbin bushing 20d, in this instance by longitudinally-extending corrugations 33.

In all of the preferred constructions, the yarn-relief passageways extend at least fully the length of the sections which are closely fitted, although it is not necessary that these passageways be perfectly linear. It would be appreciated that the passageways need not be of uniform depth, and that they may be formed by a variety of recesses and projections, such as those developed by spines, slots, and the like. Accordingly, it should be understood that the embodiments and practices described and portrayed have been presented by way of disclosure rather than limitation, and that various modifications, substitutions and combinations may be effected by those skilled in the art without departure from the spirit and scope of this invention in its broader aspects.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A yarn-relief bobbin-spindle structure in which yarn is drawn from an elongated upright rotatable spindle member and is packaged upon an elongated tubular bobbin member proportioned to fit in closely-spaced relationship with the lower portion of the mated spindle member, comprising an elongated tubular bobbin member having a seat therein near the upper portion thereof and an upper portion of an elongated spindle member, an elongated rotatable spindle member having an upper portion shaped to engage and apply driving torques to said seat of said bobbin member, said bobbin member having interior peripheral surfaces near a lower portion thereof and said spindle member having exterior peripheral surfaces near a lower portion thereof which are respectively disposed radially opposite one another in the mated condition of said members and are respectively proportioned to produce a close radial fit with minute radial clearance therebetween of the mated condition of said members, one of said peripheral surfaces including alternate portions which project radially outwardly and inwardly in relation to the longitudinal axis of the mated members at alternate arcuate positions about said axis, whereby said yarn is urged into non-interfering positions in the spacings of greater radial depth which exist between said peripheral surfaces of said members in mated conditions of said members.

2. A yarn-relief bobbin-spindle structure as set forth in claim 1 wherein said one of said peripheral surfaces comprises outer surfaces of a tubular sleeve affixed concentrically with said spindle member near the lower portion thereof, said sleeve being tapered upwardly along said spindle member to a smaller diameter of said spindle member at positions above the location of said sleeve.

3. A yarn-relief bobbin-spindle structure as set forth in claim 1 wherein said one of said peripheral surfaces comprises outer surfaces of said spindle member.

4. A yarn-relief bobbin-spindle structure as set forth in claim 3 wherein said one of said peripheral surfaces comprises a plurality of radial protrusions from said spindle member angularly arrayed about said axis, said protrusions being of substantially the same radial depth and being angularly spaced by arcuate amounts which freely accommodate passage of yarn therebetween and wherein said internal peripheral surfaces of said bobbin member are substantially cylindrical, said protrusions in said array producing said minute radial clearance with said cylindrical internal surfaces of said bobbin member.

5. A yarn-relief bobbin-spindle structure as set forth in claim 3 wherein said peripheral surfaces of said spindle member are of a maximum diameter in direction transverse to said axis which is greater than the diameter of said spindle member at positions above the location of said peripheral surfaces having said portions which project outwardly and inwardly.

6. A yarn-relief bobbin-spindle structure as set forth in claim 5 wherein said peripheral surfaces of said spindle member are tapered upwardly along said spindle member to the smaller diameter of said spindle member at positions above said location.

7. A yarn-relief bobbin-spindle structure as set forth in claim 3 wherein said external peripheral surfaces of said spindle member include substantially cylindrically-shaped arcuate peripheral surfaces angularly spaced by non-cylindrical peripheral surfaces of lesser radius in relation to said axis, said interior peripheral surfaces of said bobbin member being substantially cylindrical.

8. A yarn-relief bobbin-spindle structure as set forth in claim 7 wherein said minute radial clearance is established between said cylindrical interior surfaces of said bobbin member and said cylindrically-shaped arcuate peripheral surfaces of said spindle member and is but a few thousandths of an inch, wherein said bobbin member includes a tubular bushing in said lower portion thereof, said cylindrical interior surfaces comprising interior surfaces of said bushing, wherein said noncylindrical surfaces of said lesser radius extend longitudinally of said spindle member for at least a distance equal to the axial length of said cylindrical interior surfaces of said bushing, and wherein said seat and the cooperating upper portion of said spindle member together form a ball-and-socket type connection between said spindle and bobbin members.

9. A yarn-relief bobbin-spindle structure as set forth in claim 8 wherein said non-cylindrical surfaces of said lesser radius are substantially flat.
10. A yarn-relief bobbin-spindle structure as set forth in claim 9 wherein said non-cylindrical surfaces of said lesser radius are surfaces of slots recessed into said spindle member.

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