Jan. 3, 1967 D. G. CRUICKSHANK ET AL 3,295,776

METHOD AND MEANS FOR READYING SUPPLY BOBBINS

Filed Oct. 7, 1964 4 Sheets-Sheet 1

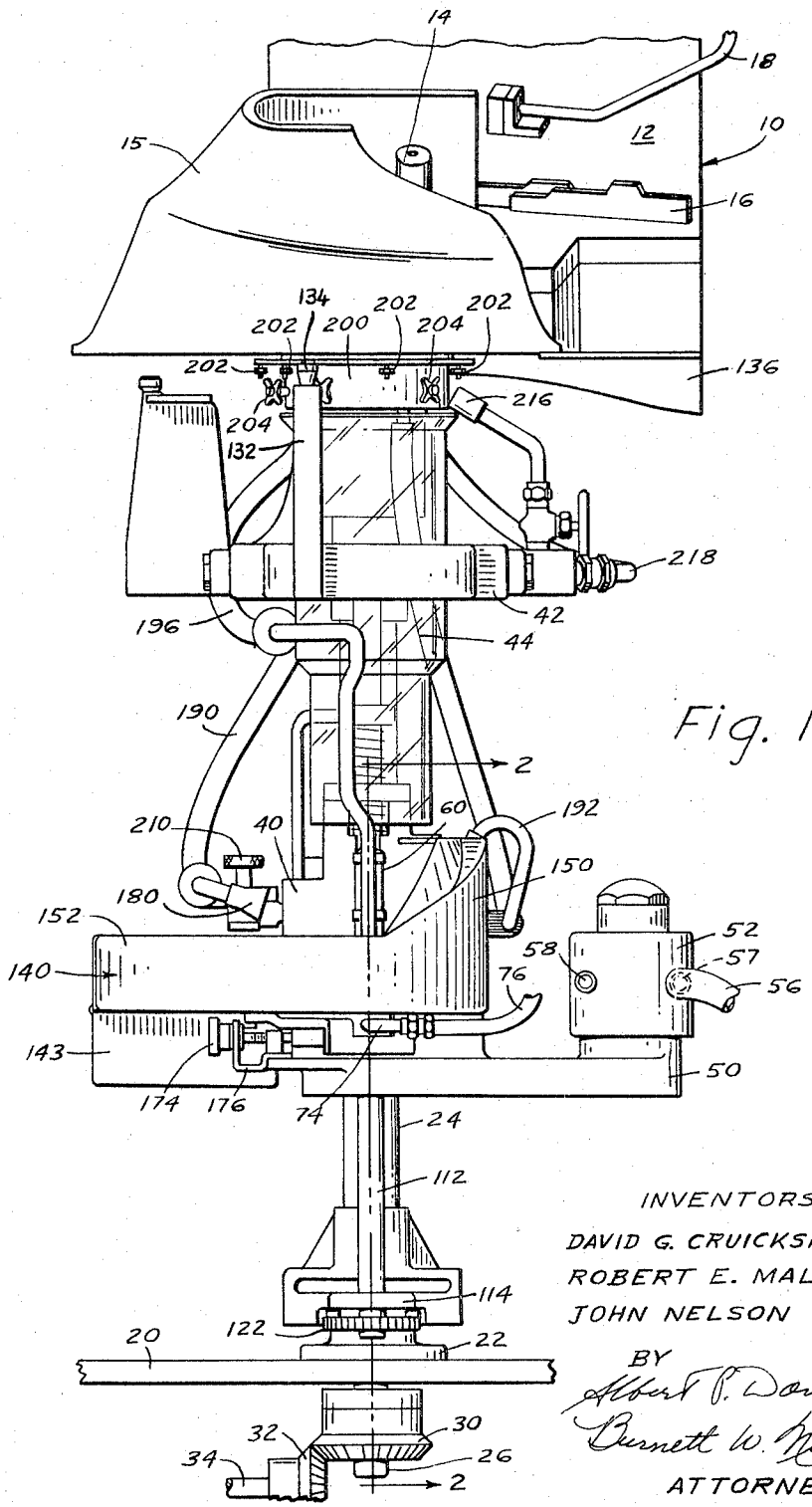

Fig. 1

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Filed Oct. 7, 1964 4 Sheets-Sheet 2

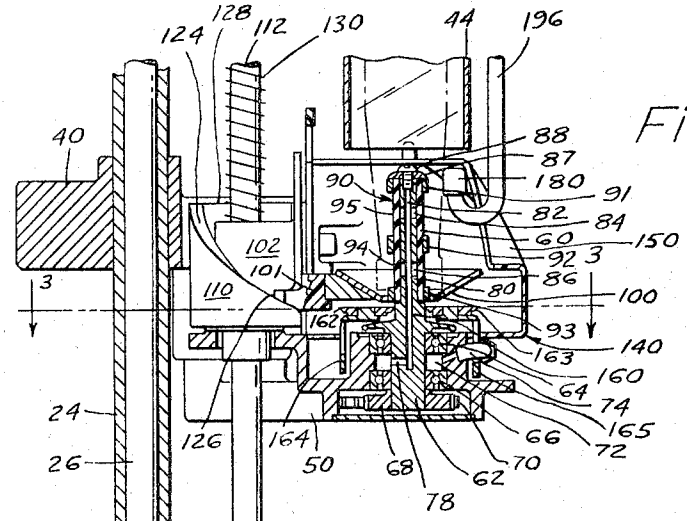
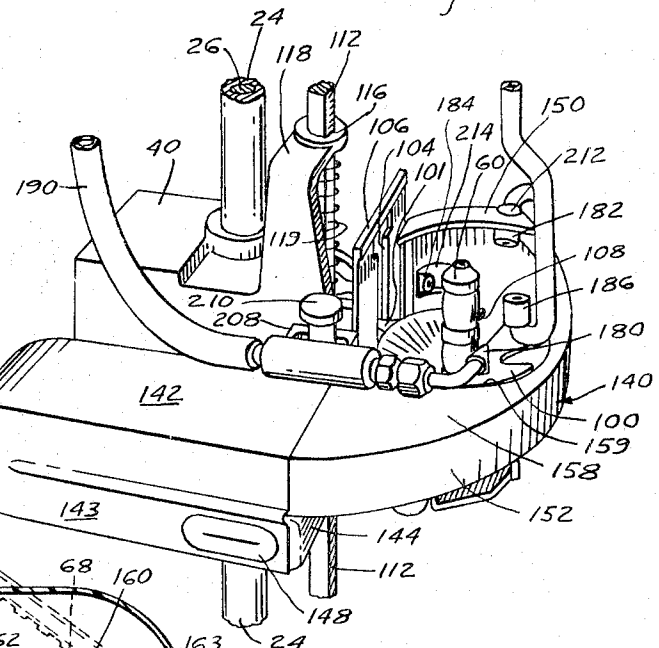


Fig. 2

Fig. 4



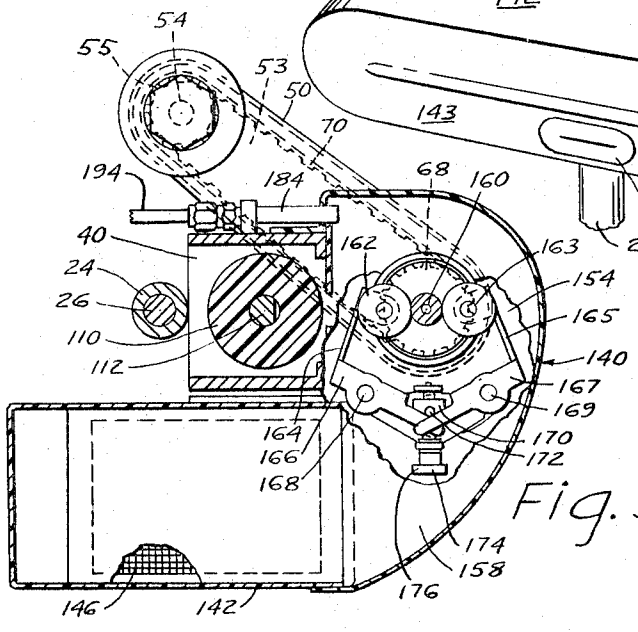


Fig. 3

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METHOD AND MEANS FOR READYING SUPPLY BOBBINS

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Fig. 5

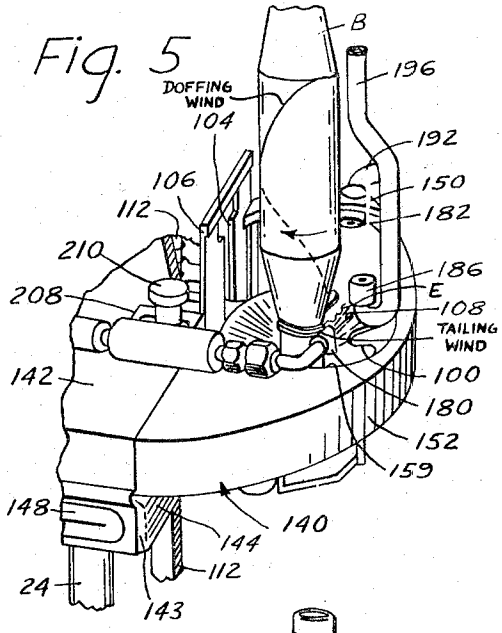


Fig. 6

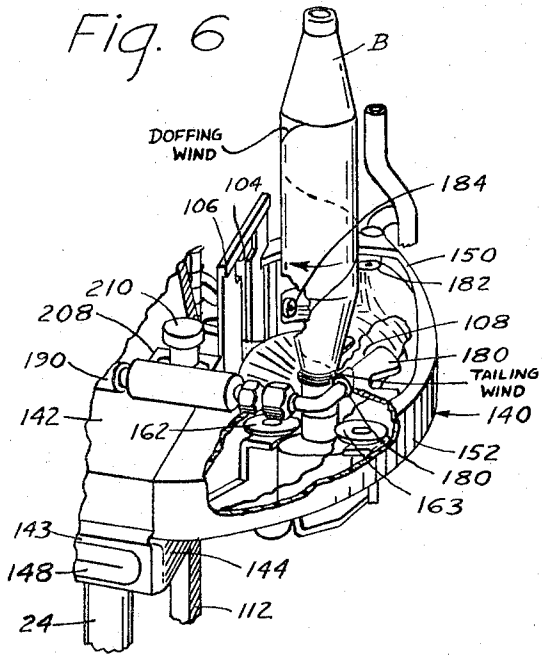
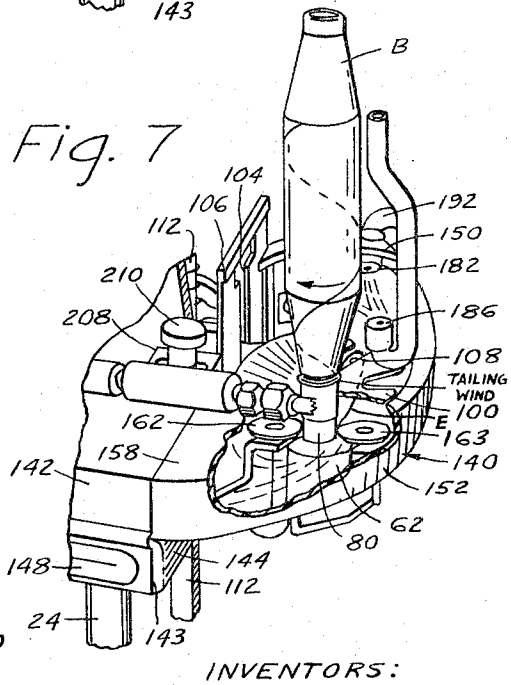


Fig. 7



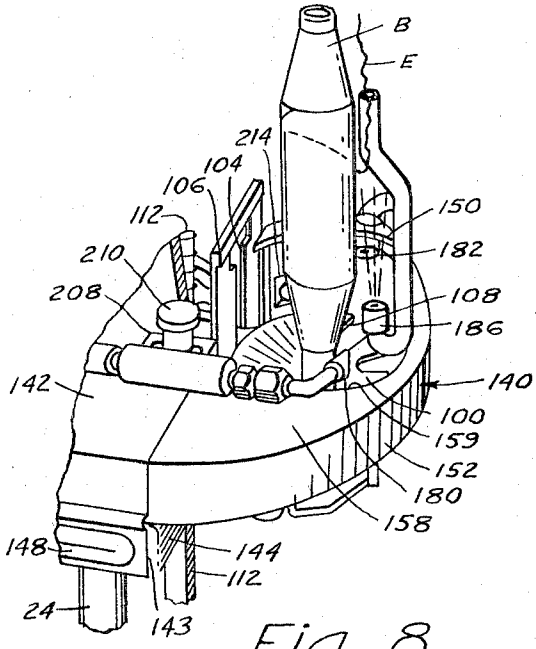


Fig. 8

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METHOD AND MEANS FOR READYING SUPPLY BOBBINS

Filed Oct. 7, 1964 4 Sheets-Sheet 4

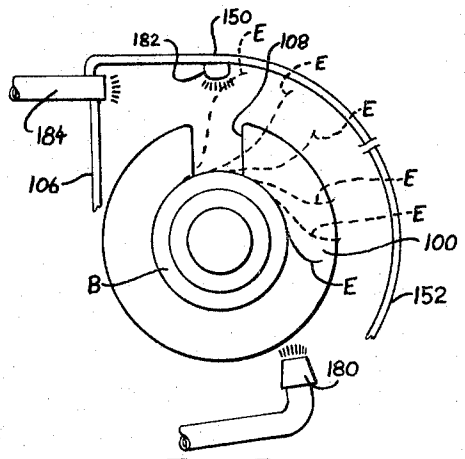

FIG. 5a

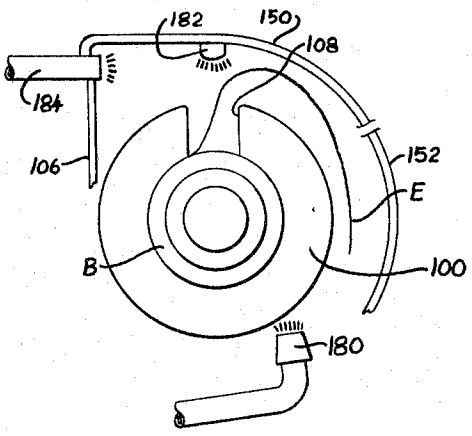

FIG. 6a

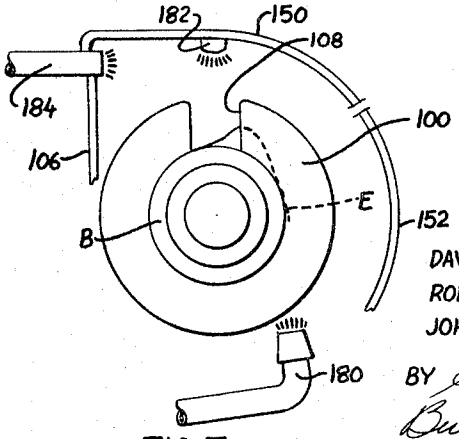

FIG. 7a

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3,295,776

METHOD AND MEANS FOR READYING SUPPLY BOBBINS

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Filed Oct. 7, 1964, Ser. No. 402,096
17 Claims. (Cl. 242—35.6)

The present invention relates to winding machines of the automatic type wherein yarn is wound from supply bobbins into packages and relates, more particularly, to method and means for readying supply bobbins for rewinding into take-up packages on an automatic winding machine.

In U.S. Patent 2,764,362 to William V. Goodhue et al. entitled "Winding Machine" and issued September 25, 1956 there is disclosed and claimed a fully automatic winding machine for winding yarn or the like into various forms of take-up packages, especially cones. Commonly assigned United States patent application S.N. 230,051 of John P. Kieronski filed October 12, 1962, now Patent No. 3,217,235, discloses method and means for automatically preparing a supply bobbin for use in an automatic winding machine of the type set forth in the cited Goodhue patent. In essence, the structure of the Kieronski patent application consists of an automatically indexing yarn carrier for controlled movement to doff a spent bobbin therefrom and bring a fresh supply bobbin, transferred to said carrier from a reserve magazine, to an active unwinding position; a rotatable arbor for rotating said fresh bobbin in a controlled manner; and fluid means for extricating the outer end of yarn from the fresh supply bobbin and presenting said end for uniting with the loose outer yarn end of the take-up package being wound on the automatic winding machine.

Supply bobbins of the type employed for rewinding on a winding machine of the type disclosed in the Goodhue et al. patent commonly are wound so that the final windings of the service wind of the bobbin are at or near the top or apical end of the bobbin as the bobbin is positioned on a spinning frame. However, as a final incident in the operation of the frame winding these bobbins, the yarn guide means of the frame is lowered to the lower butt end or base of the bobbin in a relatively rapid motion at which time winding of the bobbin is stopped. This final motion of the yarn guiding means, e.g., a ring rail and companion traveller, produces a rather steep helical turn, or possible several steep helical turns of yarn over the outer wraps of yarn on the service wind. The one or more steep helical turns extending from the top to the bobbin of the service wind are known in the trade as the "doffing wind" and this term will be employed herein to describe these yarn wraps. Since the bobbin is still rotating and yarn is being wound thereon, after the doffing wind has been formed and with the ring rail at the base of the bobbin, a terminal cluster or bunch of yarn windings is produced on the base of the bobbin. These windings or coils of yarn placed on the base bobbin after the doffing wind, i.e., the cluster of yarn coils placed on the butt end of the bobbin as a final step in the winding operation as the ring rail of the frame reaches its lowermost position, are known in the trade as a "tailing wind" and this term will be applied hereinafter in connection with the aforesaid yarn bunch at the base of the bobbin. As just stated, the tailing wind is a continuation of the doffing wind which, in turn, is a continuation of the main or service wind of the bobbin and is formed as an incident of the operation of the frame on which such supply bobbins are wound. Since the machine of the Goodhue et al. patent contemplates "over-end" unwinding of the supply bobbins, i.e., withdrawal of the yarn over the apical end of the supply bobbin, it is rather obvious that the tailing wind must be removed prior to using the bobbin as a supply source for the winding machine. If this is not done, any attempt to withdraw the yarn off over the apical end of the bobbin would only result in breaking the yarn.

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The method and apparatus of the cited Kieronski patent application provides automatic means directed to accomplishing the foregoing desideratum. However, in practice with the invention of the Kieronski application it may occur that an excessively long length of yarn or a rather large number of coils of yarn, exceeding the length of the tailing wind and even the doffing wind, may be stripped off the bobbin during the end-finding and readying cycle. This possibility is presented since the fluid means employed in locating the loose outer end of the supply bobbin exerts a pressure stream along the outer yarn wraps of a part of the service wind as well as the tailing wind on the bobbin, urging these wraps downward to a cutting means where the yarn is severed. Thus, depending on such factors as the pressure of the fluid and the characteristics of the yarn wound on the bobbin it will be appreciated that instances may arise with the Kieronski apparatus where excessive amounts of yarn, i.e., a portion of the service wind, might be stripped off the supply bobbin or, at least, undesirably disturbed during the end-finding cycle thereof in the absence of rather stringent controls.

From these considerations it will be apparent immediately that it is highly desirable to provide method and means for readying a bobbin automatically for unwinding wherein the amount of yarn unwound from the bobbin and severed prior to joining the supply bobbin yarn end with the take-up package yarn end is controlled and wherein the wraps of yarn of the service wind are left undisturbed. To the ends then, the instant invention is directed to improvements in the apparatus of the Kieronski application.

Accordingly, one object of the present invention is to provide a method for readying a supply bobbin automatically for joining of outer end thereof with the outer yarn end of a companion take-up package.

Another object of the present invention is to provide means for extricating the outer yarn end of a bobbin automatically and to present said yarn end for joining with the outer yarn end of a companion take-up package.

A further object of the present invention is to provide means for exerting a force tangentially against the zone of a bobbin having the outer yarn end of the bobbin embedded therein to extricate the end therefrom, the force acting in plane in which the yarn wraps are disposed, and means for acting on this outer yarn end after its extrication to manipulate it for joining with the outer yarn end of a companion take-up package.

Yet, an additional object of the present invention is to provide fluid means for locating the outer yarn end

of a supply bobbin, fluid means for introducing the yarn into a zone where, by cooperation of a positive fluid stream and negative pressure the tailing wind of the bobbin is unwound and severed, and the outer end of yarn attached to the bobbin is delivered for uniting with the outer yarn end of a companion take-up package.

Still, another object of the present invention is to provide method and means for locating the outer yarn end of a supply bobbin automatically which is simple in operation and design, yet which is durable and reliable in performance.

These and other objects of the present invention will appear from the following detailed description when read in connection with the accompanying drawings, in which:

FIG. 1 is a front elevational view of the present invention incorporated in an automatic winding machine;

FIG. 2 is a view taken along lines 2—2 of FIG. 1;

FIG. 3 is a view taken along lines 3—3 of FIG. 2;

FIG. 4 is an enlarged perspective view of the bobbin carrier portion of the present invention;

FIG. 5 is a perspective view similar to FIG. 4 showing the operation of the transverse jet at the initial stage of extricating the outer yarn end of the bobbin;

FIG. 5*a* is a diagrammatic view illustrating the path of the air from the transverse jet and the course assumed by the yarn end during the readying stage of FIG. 5;

FIG. 6 is a view similar to FIG. 5 showing the yarn end as it is acted on by the down-jet and cross-jet;

FIG. 6*a* is a diagrammatic view illustrating the path of the air from the transverse jet, down-jet, and cross-jet, and the course assumed by the yarn end in response thereto at the end-finding stage of FIG. 6;

FIG. 7 is a view similar to FIG. 5 showing the yarn end engaged in severing means;

FIG. 7*a* is a diagrammatic view illustrating the path of air from the transverse jet, down-jet, and cross-jet as the yarn end is positioned as shown in FIG. 7; and

FIG. 8 is a view similar to FIG. 5 showing the yarn end being conveyed axially of the bobbin by the up-jet.

Before proceeding with a detailed description of the invention, it will serve to explain that the improvements of the present invention are essentially confined to the yarn carrier zone of the apparatus of the Kieronski patent application, earlier cited. As the other sections of that apparatus form no part of the present invention they will be neither described nor illustrated herein, except insofar as their inclusion will contribute to over-all clarity in understanding the instant invention. Similarly, it has already been pointed out that the Kieronski apparatus has particular utilization with the winding machine of U.S. Patent 2,764,362. Here again, the winding machine of that patent forms no real part of the present invention per se and, except insofar as the inclusion of some portions of that machine are presented to provide correlation between that machine and the present invention, the details of that patented machine are omitted. It will be understood that the parts of that patented machine which are omitted herein will ordinarily be present in the complete working apparatus and may be the same as are shown and described in said patent.

From a broad or general viewpoint, the present invention may be characterized as comprising a yarn carrier arranged for translation around a vertical axis, with a rotatable, inflatable arbor supported on the yarn carrier. The arbor serves to support a supply yarn bobbin thereon and to rotate the bobbin in a direction opposite to the direction of the yarn winding thereof. Centering means are provided to guide the central bore of the bobbin onto the arbor. With the supply bobbin rotating, means are operative to direct a transverse fluid stream against the lower end of the bobbin in a manner such that the fluid stream impinges on the yarn winds of the bobbin at a point tangent to the axis of the bobbin. Moreover, the force of the fluid stream is directed in the plane of the yarn coils, that is to say, normal to the axis of the bobbin on which the yarn is wound. By virtue of this fluid pressure the outer yarn end, normally constituting the tailing wind, is freed from the lower end of the bobbin and extended from the bobbin generally within the confines and direction of flow of the transverse fluid stream. Thereafter fluid means are operative to provide a positive pressure against the outer end of yarn to move it into a zone for severing, the positive pressure stream in said zone being directed in a path to create a vortex, the cavity of which forms about the severing means. Thus, the cooperative effect of positive and negative pressures is operative to position the outer yarn end for severing. As the bobbin is rotated the tailing wind of the supply bobbin is, thusly, severed. In consequence thereof a free end of the supply bobbin is provided which is conveyed by fluid pressure means to a servicing section of the winding machine to be joined with the yarn end extending from the take-up package.

Referring now in detail to the accompanying drawings and with particular reference firstly to FIG. 1, the numeral **10** designates the lower front section of a yarn winding machine which section may be an element of the frame for containing various operative members of the yarn servicing assembly as disclosed in the Goodhue et al. patent earlier identified. Thus, the upper part of section **10** is covered by a flat supporting plate **12** on which is disposed various yarn servicing elements including a yarn sensing and tensioning device **14**, the construction and operation of which is fully described in U.S. Patent 3,081,045 issued March 12, 1963 to T. E. Pitts, et al. A bonnet **15** is provided to generally enclose the forward end of section **10**, as fully described in the earlier cited Kieronski patent application. Additionally, plate **12** serves as a support for a conventional slub catcher **16**, and a yarn guiding bail **18**.

A rail **20** is situated beneath the front end of section **10** of the machine. This rail **20** constitutes a part of the frame of the winding machine and is supported in fixed, spaced relationship to the floor or other surface on which the machine rests, the support therefore not being illustrated herein. A pedestal bearing **22** is mounted on the upper surface of rail **20**. Screws **23** serve to hold the pedestal bearing in place on said rail. A hollow, tubular and rotatable shaft **24** is journalled at its lower end in the pedestal bearing **22**. At its upper end shaft **24** projects into the interior of section **10**.

A second shaft **26** extends longitudinally within tubular shaft **24**, and is held concentrically therewithin by suitable bushings, not illustrated. At its lower end internal shaft **26** passes downwardly through pedestal bearing **22** and rail **20**, the lowermost end of said shaft **26** having a bevel gear **30** affixed thereon. A further bevel gear **32** is suitably supported on a power shaft **34** for rotation and is positioned to enmesh with gear **30**. Power shaft **34** extends rearwardly from rail **20** beneath the machine and is connected at its opposing end to a suitable power source, not shown herein, so that, during operation of the machine, shaft **34** undergoes constant rotation and transmits that rotation to internal shaft **26** through bevel gears **30**, **32**. Clutch means, not shown, but which may be of the type set forth in the cited Kieronski patent application are operative periodically to transmit the drive from internal shaft **26** to external tubular shaft **24** to thereby rotate this external shaft through one full revolution. In consequence thereof certain elements of the apparatus which are connected to external shaft **24** are rotated around the axis of shaft **26** as part of the over-all end-finding cycle. These elements include a yarn carrier bracket **40** and a support **42** for a rockable balloon restricting tube **44**.

The foregoing elements do not constitute a part of the instant invention per se but, rather, are presented in the interests of providing a full and clear understanding of the present invention. For further particulars of the construction and operation of the foregoing instrumentalities

reference is made to the Goodhue et al. patent considered in conjunction with the patent application of Kieronski, both cited earlier.

With attention once again directed to FIG. 1, bracket 40 is seen to have a stepped-down section 50 which lays in a horizontal plane radially outward from shaft 24. A conventional air motor 52 is affixed on the upper surface of section 50 and toward the outer margin thereof. Section 50 is hollow so as to provide a cavity at 53 (see FIG. 3). The armature 54 of air motor 52 extends downward into cavity 53 and has a pulley 55 secured to the lowermost end thereof. Pressurized air is introduced to air motor 52 via air hose 56 to effect rotation of armature 54. Air hose 56 may be connected to either of a pair of opposite ports 57, 58 to admit air to either side of motor 52. In this fashion the direction of rotation of motor 52 can be controlled. Obviously, the port not selected to feed air into motor 52 will serve as a vent.

Air motor 52 acts as the driving means for an inflatable arbor 60. Thus, the lower end of arbor 60 is provided with a whorl 62 which is supported in a pair of spaced anti-friction bearings 64, 66 for rotation. The bearings 64, 66 are press-fitted into a bore through section 50 (see FIG. 2). The lower end of whorl 62 is enlarged to form a pulley 68. An endless timing belt 70 passes about pulleys 55 and 68 so that, as air motor 52 is driven, arbor 60 will be rotated.

With reference now to FIG. 2, it will be observed that the zone between bearings 64 and 66 forms an annular cavity or interspace 72. A port 74 (FIG. 1), for the admittance of air into interspace 72 is drilled through the side of section 50. An air line 76 is connected by a suitable fitting to port 74 and is attached at its opposite end to an air supply source through a main air control valve to be described in more detail hereafter. The whorl 62 of arbor 60 has a radial air passage 78 therein, which said passage extends internally to the center of the whorl. The blade 80 of arbor 60 is drilled longitudinally to provide an air passage at 82, said passage intersecting with passage 78. Transverse branches 84, 86 are bored inwardly of blade 80 and intersect with longitudinal passage 82. The upper portion of said passage 82 is sealed against the leakage of air by a cap 87, and screw 88 which threadedly engages with blade 80.

The periphery of blade 80 is enclosed by a cylindrical bladder 90 of rubber or similar extensible material. Bladder 90 is sealed in air tight relationship with blade 80 at its upper, mid-section, and lower end by means of annulus rings 91, 92 and 93 respectively. Thus, the arbor 60 is comprised, in essence, of two separate bladder portions 94 and 95, the portion 94 being defined between rings 91 and 92, while portion 95 is bounded by rings 92 and 93. By virtue of the contraction of arbor 60, as just described, a bobbin B may be deposited so that its central bore is received on the arbor. Air is thereupon admitted through port 74, into interspace 72, through passages 78 and 82 and outward through branches 84 and 86 to inflate bladder portions 94 and 95. The bladder, thus inflated, grips bobbin B securely whereby the bobbin can be rotated with the arbor as a part of the over-all yarn end-finding cycle.

In the prior cited Kieronski patent application there is disclosed reserve bobbin supply magazine means and a bobbin centering mechanism cooperable therewith. The magazine means is operative to release a bobbin for free fall toward the yarn carrier, and the centering means is operative to receive the bobbin during its gravitation and center it so that its central bore aligns with the bobbin receiving arbor whereby to seat the bobbin thereon. The present invention includes a modification of the centering means. Thus, a concave member or plate 100 is mounted on an arm 101, this arm, in turn, being slidably held in a dove-tail slider 102 engaged for sliding movement in a vertical slot 104 of a guide 106. As is best seen in FIGS. 2 and 4, guide 106 and its slot 104 are parallel to arbor 60 and are affixed to bracket 40 by means such as screws (not shown). Member 100 is provided with a rather wide radial slot 108 which extends from the margin inwardly to the center of said member. At the center of member 100, slot 108 flares to provide a clearance between arbor 60 and the member so that said member 100 can slide vertically of the arbor 60 without interference therefrom. Member 100 is thereby movable from a lower position with arm 102 bearing on the lower end of slot 104 at which position said member 100 encircles the lower end of spindle blade 80 to a raised or elevated position with member 100 situated in a plane above arbor 60.

Member 100 is actuated longitudinally of arbor 60 by means of a cam 110 which engages with slider 102. Cam 110 is mounted fast on a vertical rod 112 by means of a D-shaped hub which mates with a D-shaped section 119 of rod 112. Said rod 112 is rotatably journalled at its lower end in a bracket extension 114, (FIGS. 1 and 2), provided as an integral part of pedestal bearing 22. The upper section of rod 112 is carried for rotation in a bearing 116 mounted at the uppermost end of an arm 118 projecting vertically from bracket 40. Said slider 102 has a bore through its central hub somewhat larger in size than the diameter of rod 112 whereby said slider is supported on the rod 112 for slidable movement axially therealong.

Viewing FIGS. 1 and 2 it will be observed that pedestal bearing 22 has a flange-like section cast integral therewith, said flange having gear teeth formed therein to provide a sun wheel 120. The lower end of rod 112 has a planetary gear 122 secured tightly thereon. The diameters of the sun wheel 120 and planetary gear 122 are the same so as to provide a 1:1 ratio therebetween. As shaft 24 is rotated planetary gear is likewise rotated to revolve cam 110. With shaft 24 rotating, if it be assumed that member 100 is in its starting position slider 102 will ride up the inclined edge 124 of cam 110 to lift slider 102 and, hence, plate 100 upwardly. When the lowermost edge 126 of slider 102 rides up on horizontal edge 128 of cam 110 member 100 is caused to dwell in its uppermost position. Continued rotation of shaft 24 causes edge 126 of slider 102 to fall off edge 128 thereby abruptly dropping the slider 102 to its lowermost position as shown in FIG. 2. A spring 130 surrounds rod 112 and is compressed between bearing 116 (FIG. 4) and the upper surface of slider 102 for the purpose of biasing the slider downwardly into engagement with cam 110.

Plate 100 has already been said to act as a centering device. That is to say, a supply bobbin is released from a supply bobbin magazine of the type, for example, fully described in the cited Kieronski patent application, and enters tube 44 butt-first. Since this operation is achieved at the point where plate 100 is in its elevated position the butt end of the bobbin comes to rest on the plate 100. By virtue of the concavity of plate 100 the butt of the bobbin moves so that its central bore is aligned with the central hole through plate 100. Thus, as plate 100 falls downwardly over arbor 60, in response to downward movement of slider 102, the arbor enters into the bore of the bobbin.

It should be brought out at this time that plate 100 fulfills the further purpose of doffing the spent bobbin. This operation is effected as said plate 100 is elevated in response to rotation of shaft 24. In consequence thereof, the bobbin situated on arbor 60 is elevated above the arbor. As more fully described in the cited Kieronski patent application, bracket 42 has an upright arm 132 thereon, see FIG. 1, the upper portion of which carries a roller 134. During rotation of shaft 24 this roller 134 is moved into engagement with camming surface of a cam member 136 to rock tube 44 and sweep the spent bobbin off member 100, the bobbin being free to fall out of the tube and away from the yarn carrier.

With attention now particularly to FIGS. 4–8 arbor 60 is seen to be partially enclosed by a generally semi-circular casing or duct 140 which acts to control the movement of pressurized air in a manner to be related more fully hereafter. Duct 140 is affixed to bracket 40 and extends from a position with its rear wall abutting against and enclosed by guide 106 to a diametric position where said duct connects with a mating U-shaped air passage 142. The outer or remote section 143 air passage 142 is sealed by a wall 144, and the lower side of said section 143 is cut away and enclosed by a waste collecting screen 146 (see FIG. 3). Thus, air is exhausted through air passage 142 while waste materials conducted therealong in the path of the air are collected at screen 146. A resilient sealing element or flap 148 having an expandable aperture encloses an opening through the side wall of section 143 proximate to screen 146. A cleaning instrument can be inserted conveniently through the aperture to remove the waste collected on screen 146.

Turning again to duct 140, the right-hand side-wall 150 (FIG. 1) is formed to be arcuate and is relatively high so as to extend above the upper extreme of arbor 60. It will be observed that this high side-wall 150 extends only partially around arbor 60, this wall then inclining downwardly to join with a lower arcuate side-wall 152 which extends around to connect with air passage 142. Further, duct 140 has a lower wall or floor 154 which fits closely against the raised portion of section 50 containing the whorl 62 of arbor 60. Duct 140 thereby provides a substantially complete enclosure surrounding the upper region of arbor 60. A top wall or cover is provided on duct 140. Said cover 158 encloses the section of duct 140 between plate 100 and the forward end of air passage 142. The edge 159 of cover 158 adjacent plate 100 is formed concentrically around a portion of arbor 60 and is configured to conform essentially to the circumferential dimension of the portion of plate 100 which adjoins therewith so that, when plate 100 is in its lowermost position, it acts generally as a continuance of upper wall 158. In view of the fact that the clearance hole in plate 100 which accommodates arbor 60 is only slightly larger than the diameter of the arbor, it will be appreciated that said plate 100 is effective to more or less deter the rapid escape of air upwardly past arbor 60 when this member is lowered around the arbor. Hence, with plate 100 in its lower position, duct 150 affords a generally enclosed air conduit around the lower section of arbor 60 extending to air passage 142 (see FIG. 4).

Within the confines of the duct 150 arbor 60 is provided with an annulus 160 of tool steel. As best seen in FIG. 3 a pair of opposing cutting wheels 162, 163, are mounted for rotation on respective fingers 164, 165, for movement relative to annulus 160. Each said finger is supported on a respective arm 166, 167 which is, in turn, rockable about an associated stud 168, 169 embedded in the upper surface of bracket section 50. The ends of arms 166, 167 remote from fingers 164, 165 are suitably joined by a pin 172 to an adjusting nut 170 engaged with a screw 174. The screw 174, in turn, is threaded through a clip 176 attached to bracket section 50 and upstanding therefrom. By virtue of this arrangement axially movement of screw 174 acts to shift the position of adjusting nut 170 causing arms 166, 167 to rock on their studs 168, 169 and move cutter wheels 162, 163 relative to annulus 160. In operation the cutter wheels, desirably, are set snugly against annulus 160 to rotate by frictional engagement therewith and to cut yarn introduced therebetween.

For purposes of readying the yarn from the freshly donned bobbin on arbor 60 for delivery to the winding machine several fluid jets are provided to the arbor. These may be referred to appropriately as a transverse jet 180, a down-jet 182, a cross-jet 184 and an up-jet 186. Each said jet 180–184 is connected through an appropriate air hose 190, 192, 194 and 196, respectively, to a main air control valve 200 which is, in turn connected to a central air source, not shown, and which may be the same type of air control valve fully described in the Kieronski patent application referred to earlier herein. Since valve 200 is fully described and its operation completely set forth in that patent application further details thereof will not be set forth herein. However, it will serve to note that valve is operable cooperatively with a plurality of trip dogs 202 to admit air through the various jets in a programmed manner as desired and each trip dog is adjustable to control the on-off status of each of the plurality of valves 204 and therefore the flow of air through each of the jets 180–184. It is well within the scope of one skilled in the art to which this invention pertains to adapt the valve of the Kieronski patent application to the requirements of the present invention.

Again considering transverse jet 180, this jet is joined with its air hose 190 through a connection 206 which has a slotted block 208 cast integral therewith along one side thereof. A clamp screw 210 is passed through the slot in block 208 and threadedly engages in a slidable nut in the slot (not shown), in the top side of bracket section 50. An enlarged shoulder portion of screw 210 binds on the top of block 208 to clamp the block in any desired position within the limits of the slot. Thus, by moving block 208 transverse jet 180 can be suitably positioned to deliver pressurized air to strike the outer yarn coils or windings at the lower end of the bobbin at a point tangent to the axis of said bobbin, see FIG. 5. In consequence thereof, the air delivered by transverse jet is operable to raise the outer end of yarn from the donned bobbin and cause this end to unwind from the bobbin as said bobbin is rotated on arbor 60. The target area for the outer yarn end blown by transverse jet 180 is against the interior side of side wall 150 at the point thereof where the open end of slot 108 lies proximate thereto, the end thus entering into the path of the air emitted from down-jet 182.

As seen, for example, in FIG. 4 down-jet 182 is secured in an opening through side wall 150 of duct 140 by a collar 212 which is press-fitted into the opening. Down-jet 182 is aligned in the vertical plane of and at the outer open end of slot 108 so that the air discharged therefrom flows downward and intersects the path of the yarn delivered by transverse jet 180. This intersecting zone occurs in the region of slot 108 in plate 100. Thus, transverse jet 180 and down-jet 182 are cooperative to the end that the outer yarn end which is initially retrieved from the bobbin by the transverse jet is delivered into the air stream from down-jet 182. The yarn end is thereupon blown downwardly below plate 100 and into the interior cavity of duct 140, there being ample clearance between plate 100 and side wall 150 for this movement of the yarn. It has been found in practice that the yarn end will migrate to the region within duct 140 without assistance from the pressure of down-jet 182 and will be duly transferred by the cross-jet to be next described. Yet, down-jet 182 is provided to the end that prompt and rapid delivery of the yarn end into the duct will be achieved.

Cross-jet 184 is secured in an aperture 214 through the lower section of side wall 150 and extends into duct 140 below the plane of cover 158. Cross-jet 184 is aligned to deliver air along the interior wall of duct 140 (see FIG. 3), the air current therefrom conforming generally to the contour of this interior wall and circulating vertically around the lower region of arbor 60 due to the arcuate configuration of side walls 150 and 152. By virtue of this advantageous arrangement the yarn end of the tailing wind is carried between cutter wheels 162, 163 and annulus 160 to be severed.

Once the desired amount of yarn has been severed, i.e., the length constituting the tailing wind, the up-jet 186 provides a blast of air to move the yarn, that is to say, the doffing wind plus possibly a length of the service wind,

upward to the winding machine. To this end up-jet 186 is provided as the upturned end of stiff depending air hose 196, the opposite end of said air hose being fitted into a valve 202 of main air control valve 200.

It will be appreciated that there may be additional auxiliary air jets provided for controlling the yarn during its upward movement to the zone enclosed by bonnet 15 and into position for uniting with the yarn end from the take-up package. These jets may include an auxiliary jet 216 receiving pressurized air through a suitable air tube 218 connected to a valve in air control valve 200. Such auxiliary jets are fully described in the patent application of Kieronski and reference is directed thereto for further particulars thereof.

The operation of the present invention will now be summarized. In FIG. 1 the arbor is shown in its active unwinding position. As described in the Kieronski patent application, external shaft 24 is rotated by instrumentalities referred to therein to achieve one full revolution of the external shaft. Hence, assuming a bobbin or arbor has been unwound by virtue of its having delivered its supply to a take-up package on the winding machine, shaft 24 will rotate in a counterclockwise direction (FIG. 3) in consequence whereof a trip dog 202 is carried into contact with an appropriate star wheel 204 to shut off the air to arbor 60 and thereby release the spent bobbin. Simultaneously therewith, cam 110 which is fixed on shaft 24 is rotated to bring its inclined edge 124 into engagement with slider 102. As a result slider 102 is caused to ride up in slot 104 thereby elevating member 100. Since the base of the spent bobbin on arbor 60 resides on or closely adjacent plate 100, this plate, as it rises, operates to elevate the bobbin off the arbor. Continued rotation of shaft 24 causes roller 134 to move into contact with camming surface 136 resulting in tube 44 being rocked counterclockwise (FIG. 1). Thereby, the spent bobbin falls down through tube 44 to be ejected. Doffing of the bobbin is completed after about 130° of rotation of shaft 24, assuming the shaft 24 to be at zero degrees when arbor 60 is in its active unwinding position as shown in FIG. 1.

Continued rotation of shaft 24 presents plate 100 beneath a reserve bobbin magazine of the type, for instance, shown and described in the Kieronski patent application where a reserve bobbin B is dropped into tube 44 and held at its base on plate 100. This operation occurs after shaft 24 has indexed about 180°. At this time member 100 will be dwelling in its uppermost position as edge 126 of slider 102 rides along edge 128 of cam 110. Further rotation of external shaft 24 will cause edge 126 to fall off said cam edge 128, the plate 100 falling abruptly to its lowermost position (FIG. 2) and the bore of the bobbin sliding over and encircling bladder portions 94, 95. At this time the reserve supply bobbin is donned and ready to undergo the end-finding cycle.

As shaft 24 continues to rotate an appropriate trip dog 202 engages a star wheel 204 to admit air through air line 76 thereby inflating bladder 90 and causing it to expand against the wall of the central bore of the bobbin B. This occurs after shaft 24 has rotated about 185°. With the bobbin B secured on arbor 60 a further trip dog 202 operates to rotate a related star wheel 204 associated with a valve to admit air through air hose 56 to drive air motor 52 and, in turn, rotate bobbin B opposite to the direction in which the yarn is wound thereon. Immediately thereafter, i.e., after shaft 24 has rotated in the order of 190°, further trip dogs 202 operate to admit air through appropriate valves in main valve 200, through air hoses 190, 192 and 194 to activate transverse jet 180, down-jet 182, and cross-jet 184, respectively. As has already been stated, transverse jet 180 is aligned to direct its air blast against the tailing wind (see FIGS. 5, 5*a*) at the base of bobbin B and to strike this tailing wind at a point tangent to the axis of the bobbin and generally in the plane of the yarn windings on the bobbin in order to extricate the outer end E of yarn off the adjoining yarn wraps of the tailing wind, the operation being illustrated in FIGS. 5 and 5*a*. Since the force of the air pressure is in the same plane as the windings on the bobbin, the wraps or coils of yarn on the bobbin are left undisturbed except for the outer yarn end residing in the tailing wind.

Once the outer end of yarn E has been pulled up from the bobbin it will obviously extend generally radially away from the bobbin, following in the air stream from transverse jet 180, the target area therefor being the interior side of side-wall 150, at the position thereagainst proximate to the opening in slot 108 until the end becomes caught in the stream of air from down-jet 182. The end of yarn E is then blown downward toward floor 154 and, more particularly, at the margin thereof where side wall 150 joins therewith. The end of yarn E is thereby disposed within the confines of duct 140. At this time air from cross-jet 184 is operable to blow the yarn end E downstream toward air passage 142. The yarn end E is thereby extended from bobbin B, through slot 108, and along duct 140, see FIG. 7. Due to the fact that the yarn will naturally tend to be drawn in a straight line, it will move into the zone of cutter wheels 162, 163 as it extends between slot 108 and the downstream end of duct 140 adjacent air passage 142. Further, since the current of high pressure air from cross-jet 184 moves along arcuate walls 150, 152 it has a whirling or circular motion imparted thereto tending to form a cavity or vortex at the base of arbor 60 and in the zone of cutter wheels 162, 163. This cavity or negative pressure zone at the center of circulating air from cross-jet 184 creates a pressure differential within duct 140 acting to draw the yarn end E blown downstream by the air from the cross-jet, and engaged of the edge of slot 108, between the cutter wheels and annulus 160, see FIGS. 6 and 6*a*. As a result the tailing wind is severed by the cutter wheels 162, 163 which rotate by frictional engagement with the annulus. The clipped or severed ends of tailing wind are carried away in the stream of air flowing into air passage 142, see FIGS. 7, 7*a*. These ends eventually come to rest on screen 146.

The amount or length of yarn which will be cut from the bobbin will, of course, depend on the duration of the air flow from, particularly, transverse jet 180 and cross-jet 184 combined with the continuance of rotation of the bobbin. Hence, by turning off the air to transverse jet 180 and cross-jet 184 the downstream movement of the yarn along duct 140 is stopped. These movements coincide with the removal of the tailing wind from bobbin B and are accomplished by positioning appropriate trip dogs 202 to strike suitable star wheels 204 thereby closing the valves which control air movement to transverse jet 180 and cross-jet 184. Simultaneously therewith, air to down-jet 182 is shut off by closing the appropriate control valve in main air valve 200 by further trip dog 202. The tailing wind is severed, and jets 180–184 are turned off after generally 250° of indexing of shaft 24.

An appropriate air valve in control valve 200 is actuated by a trip dog 202 to admit air to up-jet 186 immediately after jets 180–184 are shut off. In consequence thereof the doffing wind is blown upwardly (see FIG. 8) into the zone beneath bonnet 15 to be controlled by instrumentalities associated with control section 10 of the winding machine to unite the supply yarn with the yarn from the take-up package. These means are fully described in the cited Kieronski patent application and U.S. Patent 2,764,362 and reference may be had thereto for further details of these instrumentalities. The up-jet 186 and air motor 52 are shut off after about 350° of rotation of shaft 24.

From the foregoing it will be appreciated that by virtue of the present invention it is possible to extricate the outer end of the tailing wind of a supply bobbin, unwind this tailing wind and sever it from the service wind of the bobbin whereafter the doffing wind and the service wind can be delivered for uniting with a companion yarn end from an associated take-up package. Moreover, it will be readily evident that the end of the tailing wind is extricated while avoiding displacement of the coils of yarn on the bobbin thereby obviating chance of damage to these coils. Additionally, the tailing wind end is manipulated to cutting means where only the tailing wind need be cut from the bobbin prior to movement of the supply yarn end to the winding machine for joining with the take-up package end. As a result, a highly efficient supply bobbin readying unit is provided which achieves significant economies in operation.

In this application there is shown and described only the preferred embodiment of the invention simply by way of illustration of the preferred mode of carrying out the invention. It will be readily apparent, however, that the drawings and detailed description herein are merely illustrative in nature and are not intended by way of limitation of the scope of the invention.

What is claimed is:

1. A method of preparing a bobbin wound with yarn for unwinding comprising the steps of, applying a force to the yarn on said bobbin to extend the outer yarn end from said bobbin in a plane substantially normal to the axis of the bobbin, providing severing means for cutting said outer yarn end, directing a fluid stream in a path to move the extended outer yarn end to said severing means, and severing said outer yarn end to produce a free yarn end connected to said bobbin.

2. A method as set forth in claim 1 including the step of directing the fluid stream in a path to create a vortex in the zone of said severing means to induce said outer yarn end into engagement with the severing means.

3. A method as set forth in claim 1 including the step of applying a force to the outer yarn end to induce said extended yarn end into the path of said fluid stream.

4. A method as set forth in claim 1 including the step of rotating the bobbin in a direction opposite to the direction in which yarn is wound thereon as said force is applied to said yarn.

5. A method as set forth in claim 1 including the step of directing the free yarn end axially of said bobbin.

6. Apparatus for preparing a bobbin wound with yarn for unwinding comprising, support means for positioning said bobbin, first fluid delivery means located to deliver a fluid stream against the yarn on said bobbin in a path substantially normal to the axis of said bobbin to extend the outer yarn end therefrom, severing means operable to sever said outer yarn end extending from said bobbin, and second fluid delivery means for directing a fluid stream against said outer yarn end in a path to induce said end to said severing means for severing to thereby produce a free yarn end connected to said bobbin.

7. Apparatus as set forth in claim 6 including a downjet for directing a fluid stream against said outer yarn end to induce said end into the path of said stream emitted by said second fluid delivery means.

8. Apparatus as set forth in claim 6 including means for rotating said bobbin in a direction opposite to the direction in which yarn is wound thereon as said stream from said first fluid delivery means is directed thereto.

9. Apparatus as set forth in claim 6 including a conduit for guiding said stream emitted by said second fluid means, said conduit being arranged to circulate said last mentioned stream in a path to create a vortex in the zone of said severing means.

10. Apparatus as set forth in claim 6 including an upjet for emitting a fluid stream to move said free yarn end axially of said bobbin.

11. Apparatus for preparing a bobbin for unwinding comprising support means for positioning said bobbin for unwinding, conduit means having a side wall for partially surrounding said support means, first fluid delivery means located to deliver a fluid stream against the yarn on said bobbin in a path substantially normal to the axis of the bobbin to extend the outer yarn end therefrom, and against the side wall of said conduit means, severing means positioned within the confines of said conduit means and operable to sever the yarn end extending from said bobbin, and second fluid delivery means positioned to emit a fluid stream along said conduit side wall in a path to induce said end to said severing means for severing to produce a free yarn end connected to said bobbin.

12. Apparatus as set forth in claim 11 including means for rotatably positioning said support means, and a motor for rotating said support means in a direction opposite to the direction in which yarn is wound on the bobbin as the stream from said first fluid delivery means is directed to the bobbin.

13. Apparatus as set forth in claim 11 wherein the conduit side wall is arcuate to thereby circulate the fluid from said second fluid stream in a path to create a vortex in the zone of said severing means.

14. Apparatus as set forth in claim 11 including an upjet for emitting a fluid stream to move said free yarn end axially of said bobbin.

15. Apparatus as set forth in claim 11 including a waste collector associated with said conduit means for receiving the yarn severed by said severing means.

16. Apparatus as set forth in claim 12 including centering means for locating said bobbin on said support means, and means associated with said support means to hold said bobbin in position thereon.

17. Apparatus as set forth in claim 12 wherein said severing means includes cutter wheel means, and adjustment means to locating said wheels to be driven in response to rotation of said support means.

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