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WINDING APPARATUS

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Fig. 2.

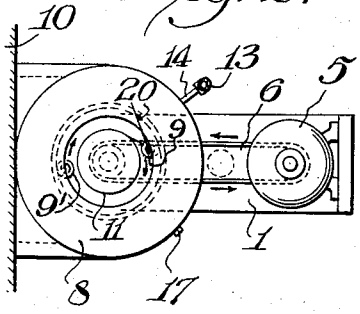


Fig. 4.

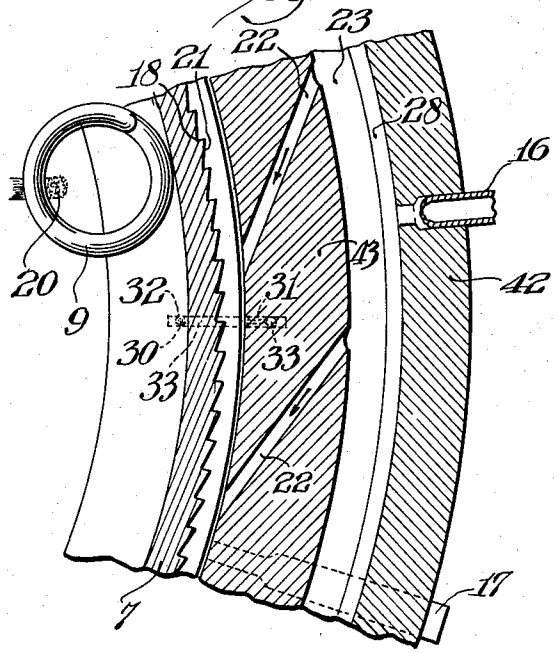


Fig. 1.

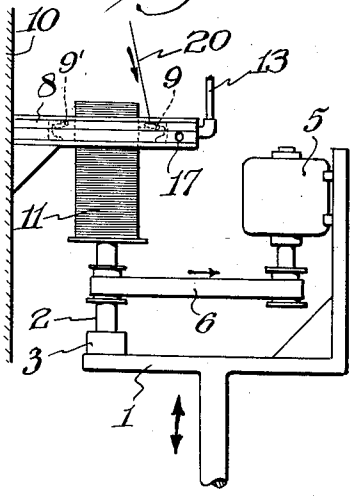
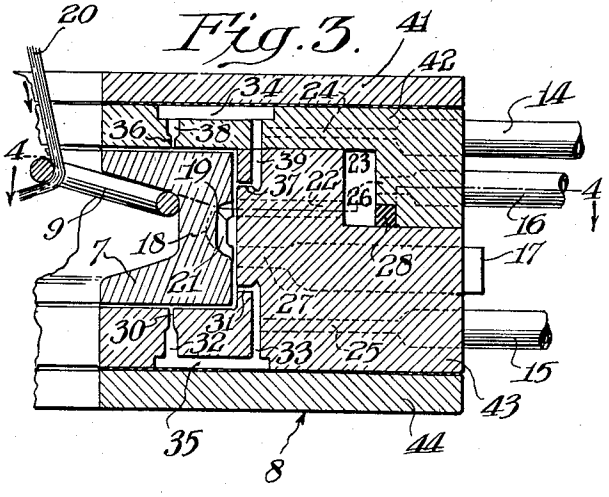


Fig. 3.



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WINDING APPARATUS

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3 Claims. (Cl. 57—75)

This invention relates to the winding of yarn or other strand material, as onto a spool, especially at high winding rates; it particularly concerns apparatus for high-speed winding.

Winding rates of yarn or the like in conventional manner onto or away from spools or similar package cores supported on a central spindle are limited by practicalities of balance and wear of the mechanical parts and by centrifugal action of the yarn at high rotational speeds. Excessive maintenance requirements and improper formation of the yarn package at rotations exceeding several thousand revolutions per minute and windages of several thousand yards per minute have demonstrated the necessity for improvement in winding methods and means.

A primary object of this invention is provision for increased winding rates without increased speed or wear demands upon winding mechanism. Another object is construction of apparatus operable at winding rates of the order of many thousands of yards per minute. Other objects will be apparent from the following description and the accompanying diagrams.

Figure 1 is a side elevation of apparatus useful according to this invention. Figure 2 is a plan view of the apparatus of Figure 1. Figure 3 is a vertical cross-section through a portion of the mechanism of Figure 1. Figure 4 is a substantially horizontal cross-section through a portion of the mechanism of Figure 1 taken on line 4—4 of Figure 3.

In general, the objects of this invention are brought about by utilizing a spindle-supported spool rotated in one direction and a guide ring supported on air bearings and driven in the opposite direction about the spool. During winding, yarn from an external source of supply passes through the guide and onto the spool while these two elements are counter-rotating. One of the elements may be traversed axially as is customary for proper laydown of the yarn on the spool. The driving forces may be transmitted to the guide ring and to the spindle in any suitable way, many of which are well known in the art. The diagrams show one form of apparatus useful according to this invention.

Figure 1 shows the apparatus viewed from the side. Support **1**, which is movable vertically, carries bearing **3** for spindle **2** at one end and motor **5** attached by brackets to a vertical extension of the support at its other end. The spindle and the shaft of the motor carry a pulley apiece, about which passes belt **6**. Spool **11** mounted on the spindle extends vertically within holder **8** affixed to wall **10**. Pipe **13** feeds air to the holder; vent **17** in the holder is an exhaust for part of the air supply. Yarn is visible surrounding part of the spool, and an end of yarn **20** disappears within the holder from above.

Figure 2 gives the appearance of the apparatus of Figure 1 when viewed from above, showing several elements not so visible in Figure 1. Ring guides **9** and **9'** are partly exposed from underneath the inner edge of the ring holder. The yarn passes through guide **9** and onto the spool. Feeder pipe **14** from the air supply pipe leads

to the holder. Details of these elements are shown in the subsequent figures.

Figure 3 is a vertical section through ring and holder at one of the guide locations. Ring **7** is channel shaped with the guides affixed to the under side of the top leg of the channel, which faces inward toward the ring center. The course of the yarn downward at a moderate angle to the vertical, through the ring, and then horizontally inward toward the spool surface is clarified further by this view. Indentation of the peripheral surface of the ring to form turbine blade **21** is apparent; the outer edge of the blade curves to form recess **19** and the inner edge curves to form seat **18** of the blade. The inner edge of the ring is flush with the inner edge of the holder. For simplicity of construction, the holder is made of several pieces: flat top **41** and bottom **44**, L-shaped piece **42** next to the top piece, and an inverted unsymmetrical T-shaped piece **43** between the L and bottom pieces. These may be bolted or otherwise fastened together; means for holding them have been omitted from the diagrams for clarity. The top and bottom pieces are solid plates, but the two intermediate pieces have various passages cut into them. Annular passage **23** formed between holder pieces **42** and **43** is fed by pipe **16** terminating in duct **26**, and the passage is connected to the inner face of the holder by duct **22**. Packing **28** notched into piece **42** prevents escape of air to the outside from between the two intermediate pieces. Pipes **14** and **15** supply air through ducts **24** and **25** to vertical passages **39** and **33**, respectively. Orifice **37** permits escape of air from passage **39** against the upper part of the peripheral surface of the ring, above the turbine blades; while orifice **31** permits escape of air from passage **33** against the lower part of the peripheral surface of the ring, below the turbine blades. Duct **36** communicates with the top surface of the ring through passage **38** which is joined to passage **39** by channel **34**; similarly, duct **30** communicates with the bottom surface of the ring through passage **32**, which is joined to passage **33** by channel **35**. Passage **27** joins the inner surface of the holder opposite the turbine blades to the exhaust pipe.

Figure 4 is a sectional plan taken on line 4—4, through the view of Figure 3. Visible are blades **21**, ring **9**, and pipe **16**. The annular shape of passage **23** and of packing **28** is apparent. Passage **22** appears cut through piece **43** at an angle with the radius so as to direct the air upon the turbine blades. The exhaust outlet is visible near the bottom of this drawing. The various air passages and ducts may be repeated at intervals about the ring holder to promote uniformity of the air supply and of ring reaction to the air flow.

Operation of the apparatus of this invention is quite simple. An end of yarn is strung from an external source through appropriate guides to prevent entanglement or breakage, as through a guide supported axially well above the spool, then through one of the guides on the ring, thence onto the spool. The motor turns the spool counter-clockwise (as viewed from above) through the belt drive. Air flowing from the supply pipe into the feeder pipes rotates the ring clockwise and supports it in a cushion of air escaping about the ring top, bottom, and side. The absolute and relative rates of rotation are easily controllable, and winding proceeds from a full stop to maximum very quickly.

The materials of construction of this apparatus are not unusual, and suitable compositions for all the components will be obvious to one skilled in the winding art. In particular, the rotatable ring may be constructed of a light metal or alloy; while the attached guides normally will be ceramic. The ring should be well-balanced to avoid uneven operation at high speeds and, with the holder, should be machined closely to provide a satisfactory fit for good bearing operation on the escaping

air. Ordinary ball, roller, or sleeve bearings and the like are not satisfactory at the high peripheral speeds attained by the ring, whose least diameter normally is about 10 inches. At a rotational rate of about 10,000 r.p.m., ring speed may exceed 50,000 ft. per minute. A turbine drive, which is particularly convenient in an arrangement utilizing air bearings, offers the added advantage of eliminating all solid contact with the ring, being similar in this respect to an electric drive wherein the ring constitutes the rotor of a motor (an arrangement permitting operation at high efficiency and close speed control); however, the ring may be adapted to a belt or gear drive if desired.

The initial laydown of yarn on a spool 4 inches in diameter when the ring and spindle are rotated at 5,000 r.p.m. (in opposite directions) approximates 3500 yards per minute; speeds twice as high and even higher are obtainable by the arrangement of this invention. The centrifugal effect on the yarn is no greater than if only the spindle were rotated at the existing speed, while the winding rate is effectively doubled. Other advantages of proceeding as here described will come readily to mind. Various changes may be made in the described apparatus without departing from the principle of the invention.

What is claimed is:

1. Apparatus for packaging yarn passed through a yarn guide means onto a rotating spindle comprising vertical spindle means mounted for rotation and adapted to support and rotate a yarn package core, yarn guide means affixed to a horizontally rotatable ring having turbine blades on its outermost surface and mounted co-axially about the spindle in a holder having air passages terminating about the ring, said yarn guide means and rotatable ring being located near the point of contact of the yarn being packaged and the spindle drive means for rotating the spindle in one direction, and means for supplying air through the passages in the holder to the blades of the ring so as to rotate the guide means in a direction opposite to the spindle rotation and through additional passages in the holder to form a ring-supporting cushion of air escaping between the top and the bottom surfaces of the ring and the adjacent wall of the holder.

2. In the packaging of yarn in helical form, the improvement comprising constraining the yarn at two separate points located therealong at fixed radii with respect to the packaging axis but traveling with respect to the length of yarn to counter-rotate substantially coaxially with one another and with the packaging axis, the radius of one of the rotating points of constraint being the radius of the packaging form and being less than the radius of the other rotating point of constraint, and supporting the point of constraint having the greater radius on a cushion of air while driving said point by means of an air blast at a rotational rate of at least about 5,000 revolutions per minute, whereby the packaging rate is at least about 3,500 yards per minute.

3. Apparatus comprising a vertically movable member adapted to support a vertical spindle means, said spindle means being mounted for rotation and adapted to support and rotate a yarn package core, said vertically movable member being further adapted to support a drive means for rotating said vertical spindle means in one direction, a yarn guide means attached to a horizontally rotatable channel-shaped ring having turbine blades on its outermost peripheral surface and mounted coaxially about said spindle in a holder, said holder comprising a top and a bottom plate, two intermediate pieces respectively adjacent to said top and bottom plates, an annular passage between these two intermediate pieces, said piece adjacent to the top plate having at least one duct connecting the annular passage with a source of air under high pressure, said piece adjacent to said bottom plate having a plurality of air ducts leading from said annular passage to the turbine-bladed face of the channel-shaped ring to drive said ring in a direction opposite to the direction of spindle rotation, each intermediate piece further having at least one vertical passage connected with a supply of air under pressure, each said passage having at least one orifice permitting escape of air against the peripheral surface of the ring, a horizontal channel connecting each vertical passage with an additional orifice allowing air to escape around the top and bottom surface of said ring to provide a cushion of air between the intermediate pieces and the ring, said intermediate piece adjacent to said bottom plate having an additional passage joining the inner face of said intermediate piece opposite the turbine-bladed ring to an exhaust pipe.

References Cited in the file of this patent

UNITED STATES PATENTS

794,866	Klein	July 18, 1905
930,848	De Ferranti	Aug. 10, 1909
1,000,695	Scharer-Nussbaumer	Aug. 15, 1911
1,919,928	Briggs	July 25, 1933
1,949,621	Pool	Mar. 6, 1934
2,796,726	Klein	June 25, 1957

FOREIGN PATENTS

327,991	France	June 15, 1903
563,746	Germany	Nov. 9, 1932