United States Patent

King et al.

[15] **3,685,755**

[45] **Aug. 22, 1972**

[54] **WINDING MACHINE DRIVE AND TENSION CONTROL SYSTEM**

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[22] Filed: **Nov. 10, 1970**

[21] Appl. No.: **88,260**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 761,779, Sept. 23, 1968, abandoned.

[52] **U.S. Cl.** **242/45,** 242/75.53

[51] **Int. Cl.** **B65h 59/38**

[58] **Field of Search** .....242/18 R, 18 DD, 26, 27, 31, 242/42, 45, 75, 75.3, 75.5, 75.53

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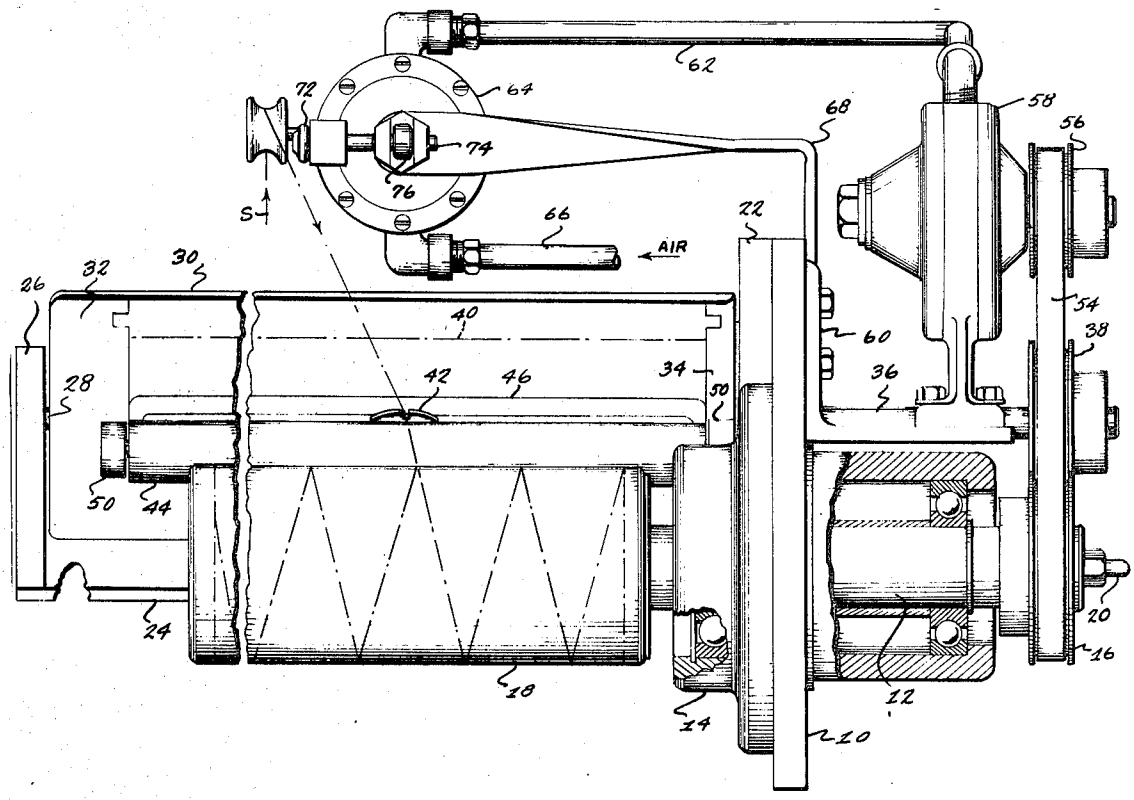
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[57] **ABSTRACT**

A drive and tension control system is provided for a winding machine of the precision type, the drive being fluid-actuated and the actuating fluid being supplied under a modulating influence controlled from the sensing of take-up tension in a manner that maintains such tension substantially constant by compensative regulation of spindle speed. The modulating influence is also specially arranged to act selectively so that the spindle assumes an idling speed whenever an end break releases take-up tension, and so that it stalls harmlessly whenever the end being wound is held against winding.

11 Claims, 11 Drawing Figures



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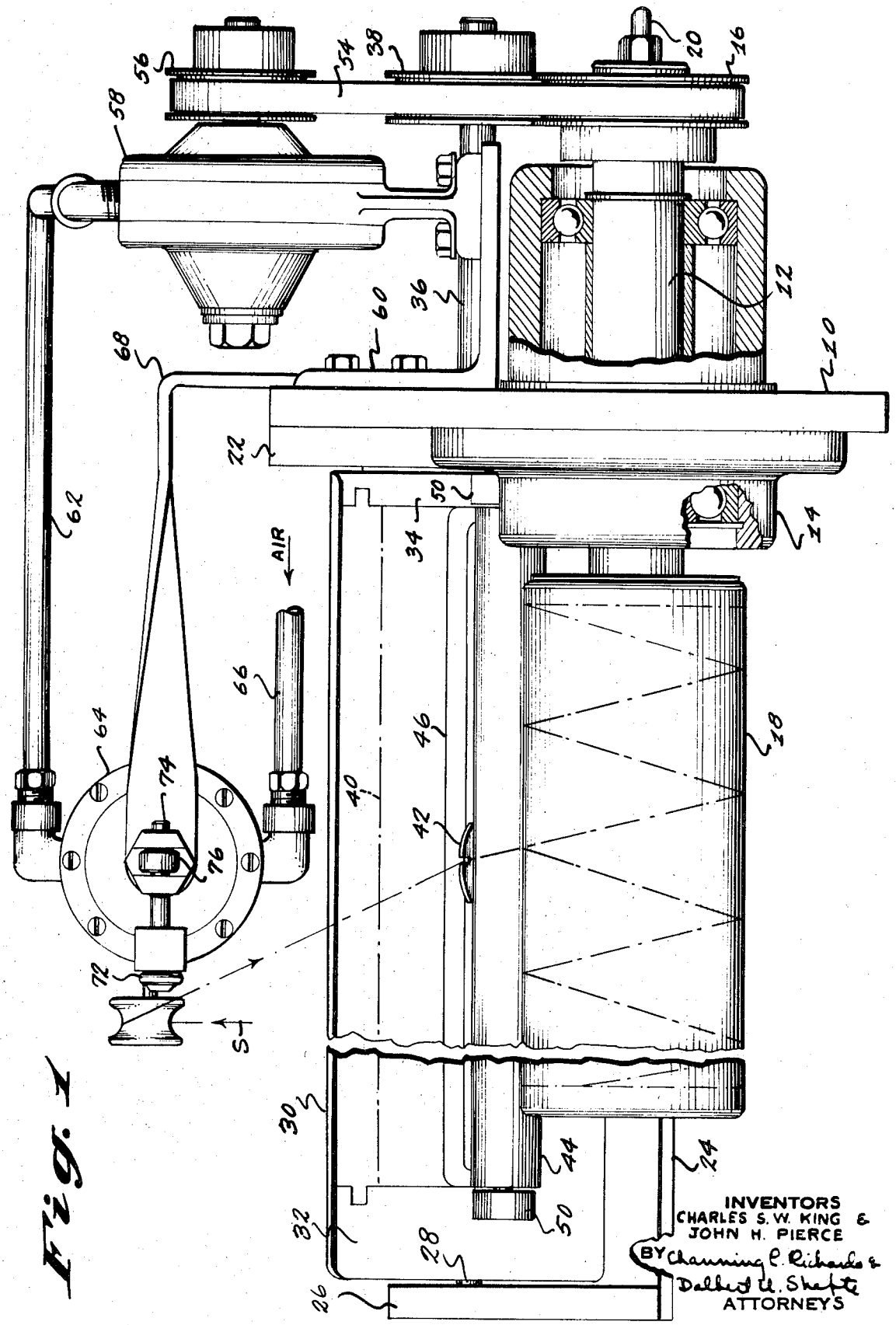


Fig. 1

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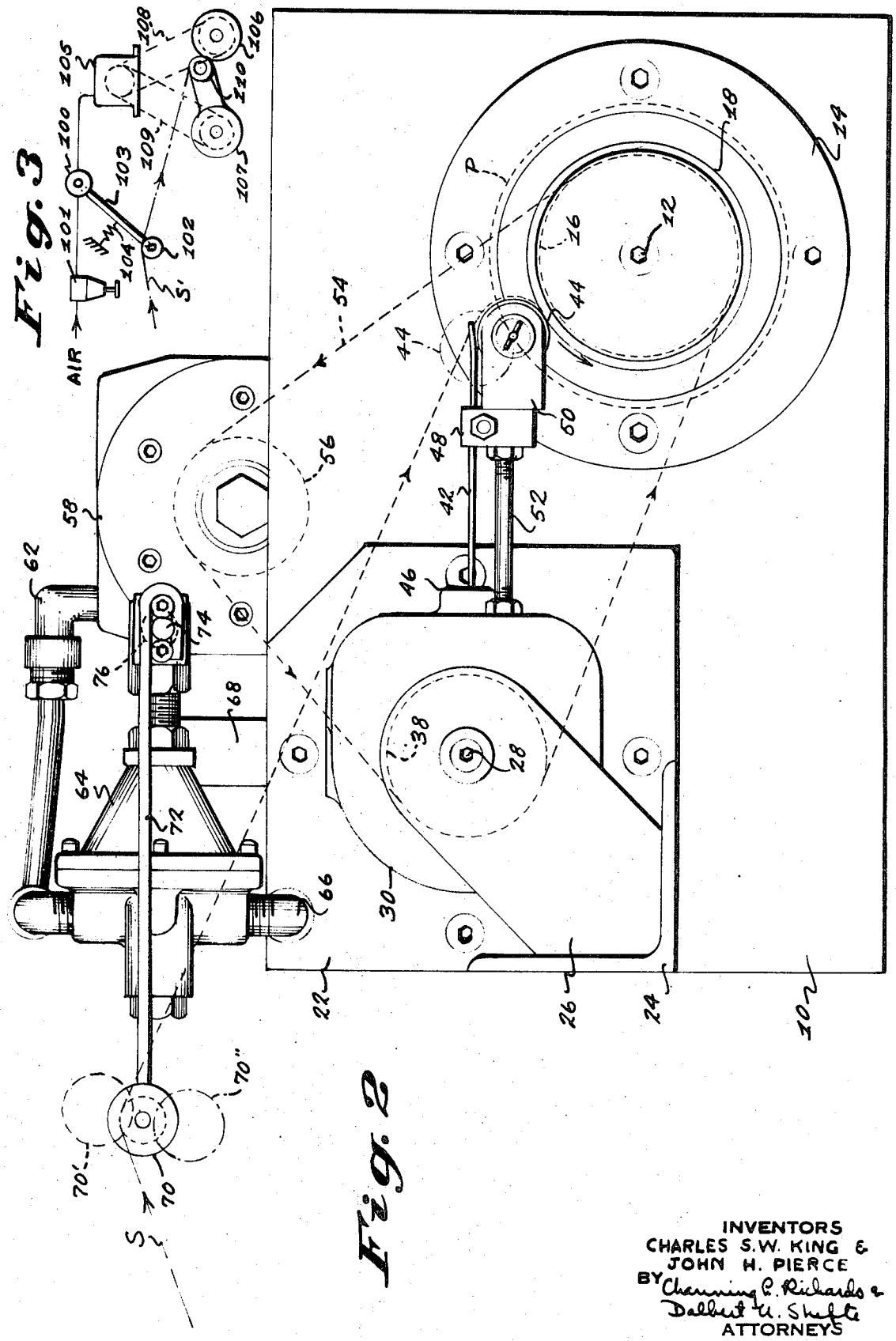


Fig. 3

Fig. 2

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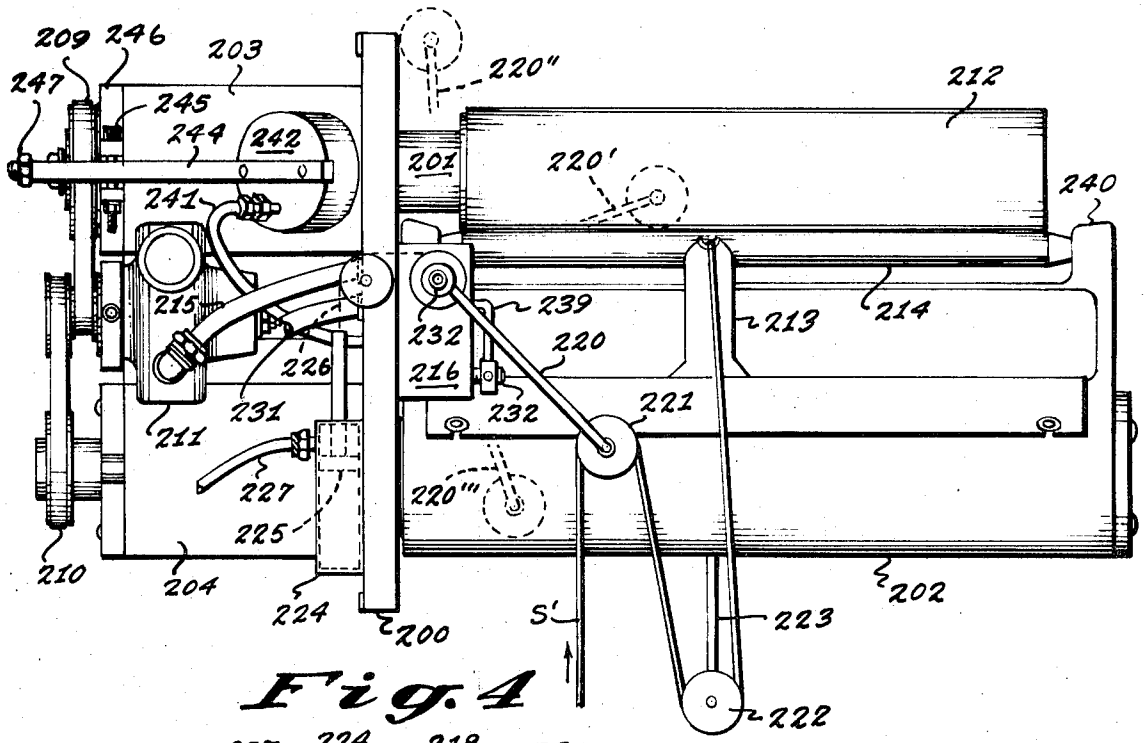


Fig. 4

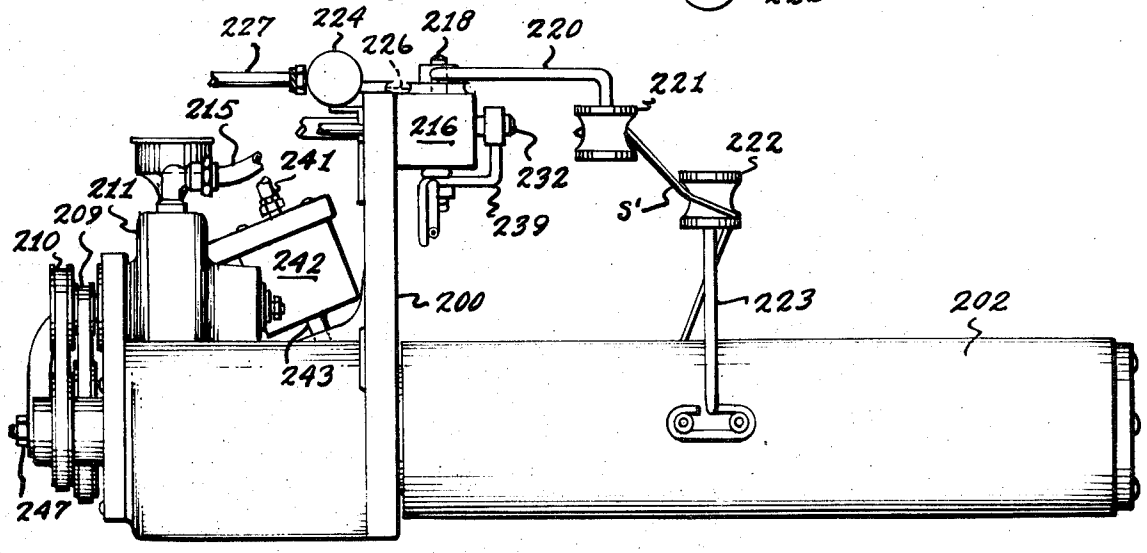


Fig. 5

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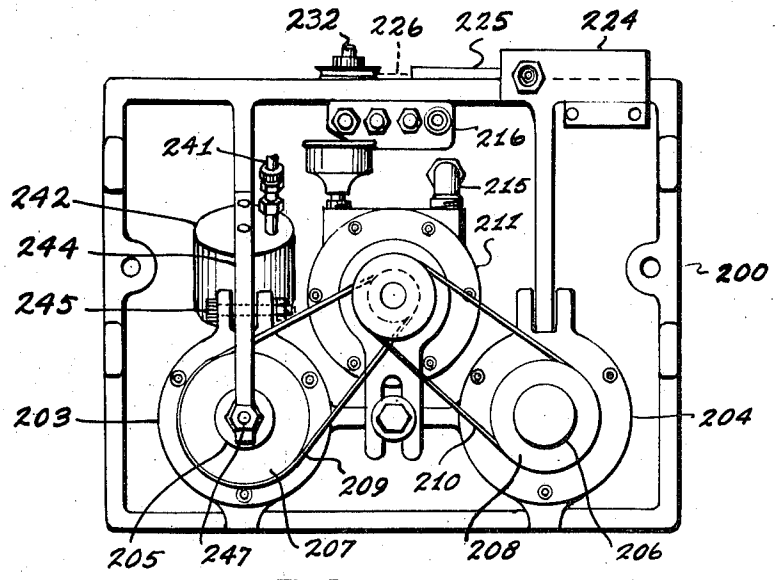


Fig. 6

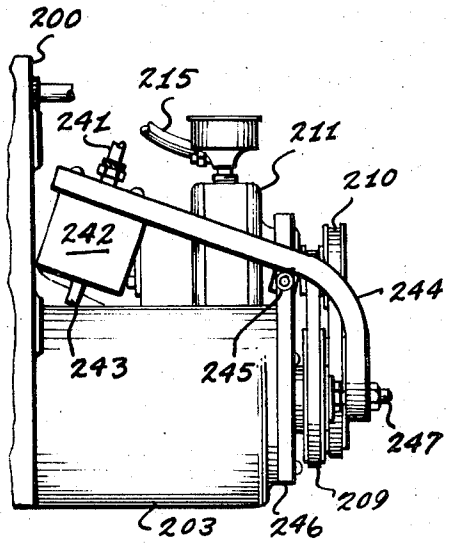


Fig. 7

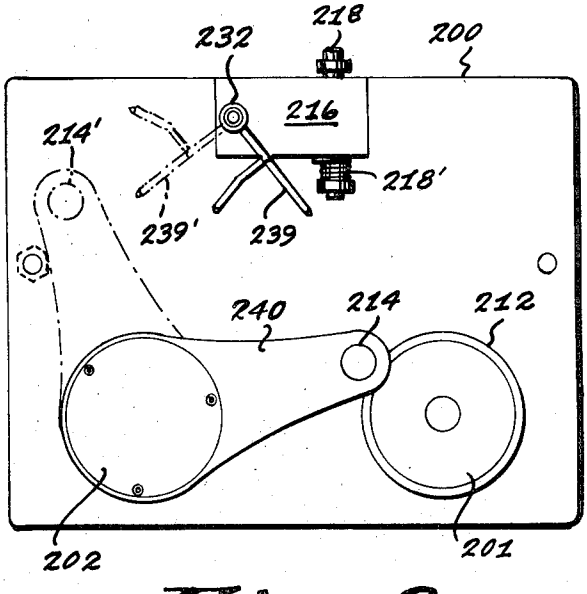


Fig. 8

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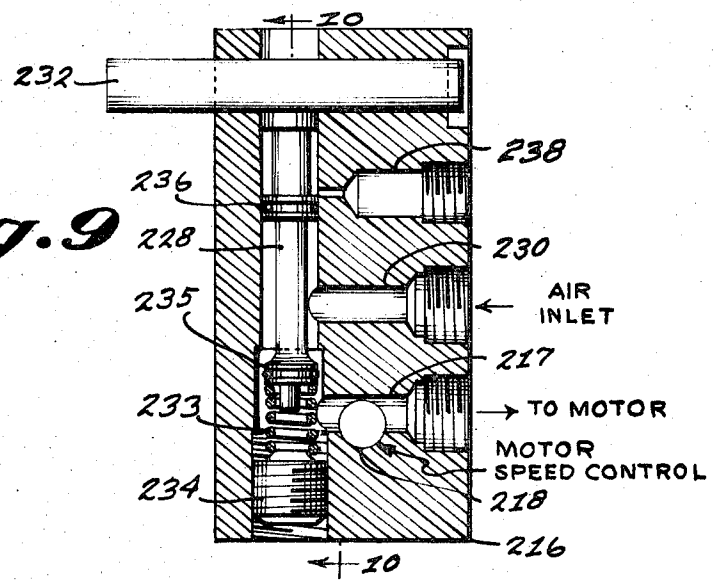


Fig. 9

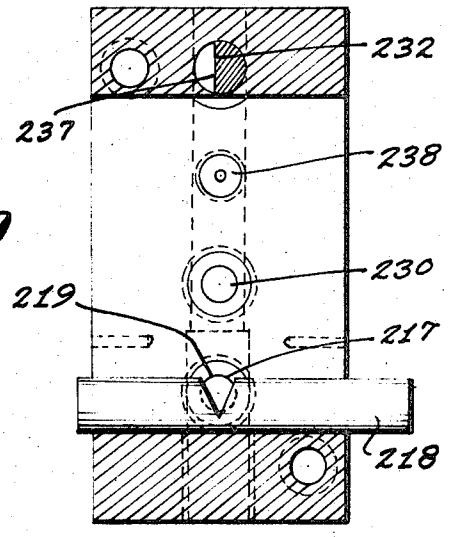


Fig. 10

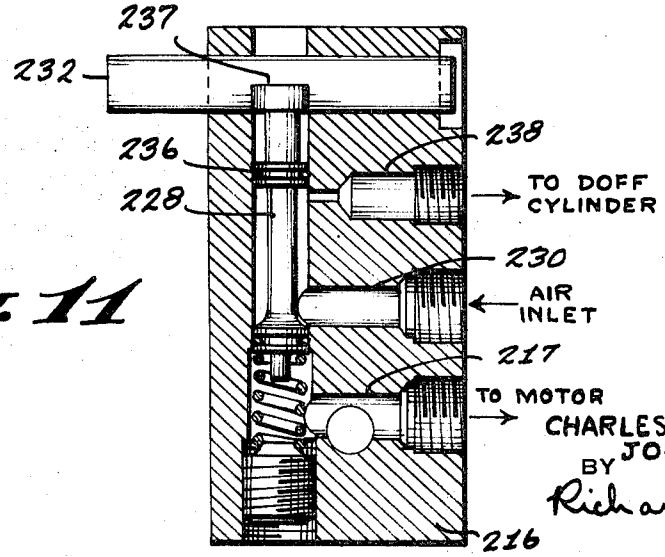


Fig. 11

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WINDING MACHINE DRIVE AND TENSION CONTROL SYSTEM

CROSS-REFERENCES TO RELATED APPLICATIONS

This is a continuation-in-part of copending application Ser. No. 761,779, filed Sept. 23, 1968, which was concurrently abandoned when the present application was filed.

BACKGROUND OF THE INVENTION

Precision winding machines are characterized by a driven winding spindle and an associated traverse mechanism operated at a fixed ratio to the spindle winding speed for directing take-up of a running strand onto a core carried by the spindle to build a cross-wound strand package about the core. Because the winding is done in such machines at a driven spindle, take-up speed will increase substantially as the strand package builds up during the winding operation unless the spindle speed is regulated in a compensating fashion.

Without such compensation, the spindle speed cannot be greater than that which will yield a tolerable take-up speed at the maximum package diameter, which means in turn that the take-up speed will remain considerably below its tolerable level during most of the winding operation. Beyond the inefficiency of this circumstance, it is also be be noted that it is impossible to employ a precision winder to wind strand material from a source delivering at substantially constant speed unless suitable spindle speed compensation is provided.

The prior art has recognized these circumstances and has sought to deal with them. Representative examples are found in U.S. Pat. Nos. 2,509,250; 2,608,355; 2,752,105; 2,754,459; and 3,193,209. All such prior proposals, however, have involved undesirable complication from the standpoints of both cost and operating performance.

SUMMARY OF THE INVENTION

The drive and tension control system of the present invention provides exceptional simplification in the arrangement of a precision winder, as well as improving its operating performance substantially. Briefly characterized, this system employs a fluid-actuated motor for driving the winding spindle and operating the traverse mechanism at the fixed ratio required for precision winding, while controlling the pressure at which fluid is supplied for actuating the motor from a sensing of take-up tension, so that spindle speed is regulated to maintain this tension substantially constant throughout the winding operation and thereby provide for take-up at the best advantage no matter what the source from which material is delivered for the winding.

Also, the driven spindle and a traverse cam for the traverse mechanism are mounted for rotation about fixed axes, and the traverse mechanism additionally includes a pressure roll riding a package as it is built on the spindle and under which the material being wound is delivered to the package. This pressure roll is carried by means pivoted at the axis of the traverse cam so that it may be displaced as the package diameter increases during the winding operation, and its arrangement is such that its riding pressure lessens with increasing package diameter.

Additionally, the control for the actuating fluid supply is specially arranged so that the motor, and consequently the spindle, are caused to assume an idling speed whenever an end break releases take-up tension, and are allowed to stall harmlessly whenever the end being wound is held against winding. The control arrangement is also equipped to open up and shut off the actuating fluid supply for starting and stopping the winding operation in response to movement of the previously mentioned pressure roll between active and retracted positions, and to operate an expandible spindle chuck automatically so that a wound package is released for doffing and replacement by an empty package core whenever the winding operation is stopped.

The aggregate result is substantial improvement in soundness of the winding packages obtained, and great operating facility and flexibility, even though the winding machine arrangement is exceptionally simplified as previously mentioned.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation from the spindle side of a winding machine embodying the present invention;

FIG. **2** is a further elevation as seen from the left in FIG. **1**;

FIG. **3** is a schematic illustration of a modified embodiment;

FIG. **4** is a plan view of a further modified embodiment;

FIG. **5** is a front side elevation corresponding to FIG. **4**;

FIG. **6** is a left side elevation corresponding to FIG. **5**;

FIG. **7** is a fragmentary elevation showing the chuck operating means as seen from the left in FIG. **6**;

FIG. **8** is an elevation showing the starting and stopping arrangement as seen from the right in FIG. **6**;

FIG. **9** is a sectional detail of the actuating fluid control means;

FIG. **10** is a section taken substantially at the line **10—10** in FIG. **9**; and

FIG. **11** is a further sectional detail corresponding to FIG. **9** but showing the control means shifted for stopping the winding operation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment illustrated in FIGS. **1** and **2** of the drawings represents a single winding head which may be duplicated for grouping in any multiple desired. For example, this embodiment has been designed in particular for winding slit polypropylene film as it comes from the film line, and in such an instance a separate winding head is provided for each slit film strand being delivered. Any other synthetic strand material can be handled by winding units of the same sort, and these units are especially well adapted for taking-up the output of a producing source from which the strand material is delivered at a substantially constant lineal speed, although they may be employed to good advantage as well in any other instance where precision winding can be useful.

Each winding head or unit of the illustrated embodiment comprises a base or assembly plate **10** on which the several operating elements of the unit are mounted.

The winding spindle is shown at 12 in FIG. 2 carried in a bearing mount 14 that is secured on the base plate 10 with the spindle 12 extending therethrough for fitting with a pulley 16 at one end (i.e., at the right in FIG. 1) and for supporting a package core 18 along the portion extending to its other end at the opposite side of base plate 10. It will be understood that this core supporting portion of the spindle 12 is equipped with a suitable chuck structure (not shown) for holding the core 18 in place, and that a chuck operating pin 20 may conveniently be arranged to extend through the spindle 12 and project sufficiently from its pulley end for inward displacement by endwise pressure to collapse or retract the chuck mechanism whenever a full package or an empty core needs to be removed or installed.

The traverse mechanism is mounted on the base plate 10 at a bearing plate 22 that is secured thereto and from which a frame arm 24 extends horizontally to support an outboard standard 26 that rises at an inclination to bear a pivot pin 28 for a traverse cam housing 30. This housing 30 includes an outboard bearing block portion 32 in which an adjacent traverse cam journal (not shown) is supported, and an inboard bearing block portion 34 that is formed with a central hub portion (not shown) which is pivotally or rotatively seated in the bearing plate 22, and through which a shaft 36 extends from the traverse cam to carry a pulley 38 aligned at the other side of the base plate 10 with the spindle pulley 16. The upper outline of the traverse cam within the housing 30 is indicated by the broken line at 40 in FIG. 1.

The traverse mechanism is completed by a traverse guide 42 and pressure roll 44 that control the lay of a running strand S as it is delivered onto a core 18 on the winding spindle 12 in building a package. The traverse guide 42 is associated with the traverse cam 40 in the usual manner as a follower that is reciprocated by cam rotation. A guide slot structure 46 is formed on the traverse cam housing 30 to define the reciprocation path of the traverse guide 42 and a supporting guide structure 48 is arranged as part of the pressure roll support to stabilize the guide 42 adjacently. The support for the pressure roll 44 otherwise comprises a pair of yoke arms 50 that extend from the supporting guide structure 48 to carry the pressure roll 44 for rotation, and a pair of studs 52 extending from the traverse cam housing 30 and forming shanks by which the pressure roll 44 is positioned to ride the package core 18 and a strand package as it is built thereon.

As thus arranged, the reciprocating traverse guide 42 directs the winding pattern of the running strand S, while the strand S is delivered under the pressure roll 44 to the package being built about the core 18. Because the traverse cam housing 30 is pivotally or rotatively supported in the bearing plate 22 and at the outboard standard 26, the pressure roll 44 is gravity biased in riding relation at the core 18 and the running strand S delivered thereunder is thereby added to the package being built in an exceptionally sound manner. The gravity bias at the pressure roll 44 may, of course, be modified for particular conditions by supplementary weighting or counter weighting or by auxiliary spring biasing, but in any event it is also to be noticed that as a strand package builds up on the core 18, as to an extent such as is indicated at P in FIG. 2, the riding pressure roll 44 will be displaced about the pivot axis of traverse cam housing 30 to a corresponding extent, as indicated at 44' in FIG. 2. The result of such displacement, because of the geometry involved, is to reduce in relative magnitude the vertical component of the riding bias on pressure roll 44, so that its riding pressure lessens as the strand package increases in diameter during the winding operation and the package density is thereby continually lightened as the package builds even though the strand tension is maintained substantially constant.

Rotation of the winding spindle 12 and related operation of the traverse mechanism at the fixed ratio previously mentioned is accomplished through a driving connection 54, suitably a timing belt, running to the spindle and traverse cam pulleys 16 and 38 from the pulley 56 of a drive motor 58 carried by a mounting bracket 60 on the base plate 10. The driving connection 54 may be either a single one running about both driven pulleys 16 and 38 as indicated in FIG. 2, or separate drive connections may be provided to the spindle and traverse cam 40 as indicated in the FIG. 3 embodiment which is described further below. In either case, the pulley ratios are arranged in the usual manner so that the reciprocating stroke produced by the traverse cam 30 is somewhat out of step with an even number of spindle revolutions to avoid ribboning of the strand convolutions as the strand package builds up.

The drive motor 58 employed according to the present invention is of the fluid-actuated type. The illustrated embodiments provide for pneumatic actuation, and this is preferred on the whole because the compressible nature of air produces a softer regulating action, but hydraulic actuation is entirely feasible in comparable fashion and might be used effectively under any circumstances that made it desirable. Drive motor 58 is connected for air actuation by an air line 62 running from a pressure regulator 64 that is fed through an air supply line 66. The pressure regulator 64 is positioned by a support bracket 68 extending from the base plate 10 to carry a dancer roll 70 for sensing the take-up tension in the running strand S as it approaches the traverse guide 42. The dancer roll 70 is arranged at the extending end of a purchase arm 72 which is pivoted at 74 on the pressure regulator 64 to dispose a coaxial eccentric 76 in controlling relation with its regulating stem (not shown).

As the regulating stem of a pressure regulator, such as 64, has the function of setting spring bias on a diaphragm of the regulator to obtain the regulated pressure desired, this spring bias has the effect in the present instance of also biasing the dancer roll 70, through the eccentric 76 and purchase arm 72, to ride the running strand S at the take-up tension to which it may be subjected. Consequently, any slackening of take-up tension results in movement of the dancer roll 70 upwardly toward the broken line 70' position in FIG. 2, which in turn eases off the diaphragm bias of regulator 64 to increase the pressure at which the air supply is delivered through line 62 so that the speed of drive motor 58 is correspondingly increased with like increase in winding speed to counteract the sensed tension slackening.

Upon increase of take-up tension, as occurs progressively due to the increase in winding speed as the strand

package grows in diameter, the dancer roll **70** is caused to react oppositely toward the broken line **70''** position with consequent throttling of the pressure on the motor actuating air supply to provide a compensative winding speed reduction. In this manner a continual tension sensing is maintained in control of the winding speed so that take-up tension is regulated at a substantially constant level throughout the winding operation in extremely simple fashion.

FIG. **3** shows a modified embodiment in which the arrangement for tension regulation is even simpler. Here the air supply line contains a flow regulating valve **100**, such as a needle valve, beyond the pressure regulator **101**, and the dancer roll **102** is arranged on a purchase arm **103** to control the setting of this flow regulating valve **100** from tension sensing at the running strand S' which the dancer roll **102** is caused to ride under the bias of a tension spring **104**. The pressure under which actuating air is supplied to the drive motor **105** is thus regulated for controlling the winding speed in a manner fully comparable to that noted previously in describing the first embodiment. As before, the drive motor **105** is connected for driving the winding spindle **106** and traverse mechanism **107** at a fixed ratio, with separate driving connections **108** and **109** being indicated in this instance as a matter of choice, and with a pressure roll **110** supported in extending relation from the traverse mechanism **107** to ride a strand package being built on the winding spindle **106** with a lessening pressure as the package grows in diameter.

A winding head assembly embodying the present invention is operable to good advantage at speeds up to about 600 meters per minute, so as to have ample capacity for handling the constant speed output of synthetic strand production lines which tend to run in the range of 300 to 400 meters per minute. A particular advantage of the fluid-actuated drive and control system employed is that it is usable without hazard in explosive atmospheres such as sometimes obtain in the vicinity of synthetic strand production units. Also, a fluid-actuated motor always operates at maximum torque for the pressure conditions under which the actuating fluid is supplied so as to react well to the tension sensing control and to operate effectively at relatively slow speeds whenever that is necessary.

The further modified embodiment illustrated in FIGS. **4** through **11** of the drawings is particularly notable for the specially arranged means provided for controlling or modulating the actuating fluid supply. In this embodiment, the single winding head illustrated follows generally the form of those previously described in that it comprises an assembly or base plate **200** on which a winding spindle **201** and a transverse mechanism **202** are carried in respective bearing mounts **203** and **204** at the back face of base plate **200**. Winding spindle and traverse mechanism shafts **205** and **206** extend beyond the bearing mounts **203** and **204** to carry pulleys **207** and **208** that are connected, as seen at **209** and **210**, for driving from a fluid actuated motor **211**, suitably an air motor, to operate the winding spindle **201** and the traverse mechanism **202** at the fixed ratio required for precision winding.

At their respective extents from the front face of the base plate **200**, the winding spindle **201** is equipped with a suitable chuck structure for holding a winding core **212** in place, and the traverse mechanism **202** includes a traverse guide **213** and pressure roll **214** by which the lay of a running strand S' is controlled as it is built into a package on the winding core **212** in the manner previously described.

The air motor **211** is supplied with actuating fluid through a conduit **215** extending thereto from a valve body **216** carried at the front face of base plate **200** and arranged in the special fashion illustrated by FIGS. **9–11**. As seen in FIG. **9**, the valve body **216** is formed with a first channel **217** at which the conduit **215** is connected for supplying the motor **211**, and through which an actuating fluid supply is directed as long as the FIG. **9** valve setting is maintained. The valve body **216** is additionally fitted with a rotatable shaft **218** intersecting the channel **217** in transverse relation and notched transversely at **219** in relation to the point of intersection (compare FIGS. **9** and **10**).

The channel **217** is circular in cross section, while the shaft **218** is cylindrical and of larger cross section and located to intersect the channel **217** in offset relation so as to fall slightly short of crossing the full channel diameter. In a typical arrangement, the channel **217** was formed with a ¼ inch diameter, and a shaft **218** of about ⅜ inch diameter was employed at an intersecting location offset so that its cylindrical cross section fell short of crossing the full channel diameter (i.e., short of reaching the channel outline in FIG. **9**) by about one thirty-second inch, while the shaft notch **219** was formed with the illustrated V-shape to a depth and from a width equal to the ¼ inch channel diameter.

With such an arrangement, the pressure under which actuating fluid is supplied to the air motor **211** through the conduit **215** is made subject to rotative positioning of the shaft **218** by reason of the consequent angular disposition of shaft notch **219** in relation to channel **217**, the greatest supply pressure being allowed when the axis of notch **219** is parallel with that of channel **217** (as in FIG. **10**) and the supply pressure being throttled progressively as the shaft **218** is rotated through 90° in either direction to shift the angularity of notch **219** correspondingly. The resulting control of actuating fluid supply pressure, which governs the operating speed of air motor **211**, is made subject in turn to take-up tension in the running strand S' by sensing such tension through a dancer arm **220** fixed on the shaft **218** for pivoting therewith and carrying a roll **221** about which the running strand S' is looped prior to take-up. The looping is suitably arranged by training the running strand S' backwardly from the dancer roll **221** around a guide roll **222**, supported on a standard **223** fixed at the front of the traverse mechanism **202**, before it is led to the traverse guide **213** for direction beneath the pressure roll **214** to the package being built.

The dancer arm **220** and roll **221** are caused to sense the take-up tension and rotatively position the shaft **218** correspondingly through an imposed bias tending to pivot the same in opposition to the take-up tension. Such a bias may be imposed in a number of ways, such as by fitting the shaft **218** with a torsion spring as indicated at **218'** in FIG. **8**, but a preferred arrangement is that illustrated in FIGS. **4–6** which comprises a fluid pressure cylinder **224** fixed at the back face of base plate **200** and housing a piston **225** connected by a flex-

ible tension strand, as indicated at **226**, to bias the shaft **218** and dancer arm **220** from a level fluid pressure applied to the piston **225** through a cylinder supply line **227**. This arrangement has the advantage not only of maintaining a constant bias on the dancer arm **220**, as compared with the varying bias that results from flexing a spring, but it also allows the biasing pressure to be supplied from a manifold that may likewise serve any number of winding heads in a group and thereby maintain an even tension control among all of the winding heads of the group.

The foregoing arrangement of motor control shaft **218** and tension sensing dancer arm **220** provides a uniquely selective action in controlling the winding operation. In particular, when the setting is such that the control shaft **218** is positioned for releasing actuating fluid at maximum supply pressure, and consequently operating motor **211** at highest speed, when the dancer arm assumes a position about as indicated in dotted lines at **220'** in FIG. **4**, then a substantially constant take-up tension will be maintained on the running strand S' as a strand package is being built by forward pivoting of the dancer arm toward the full line **220** position, and consequent throttling of the supply pressure, as the package builds up in diameter and requires slowing of the winding speed assuming that the strand S' is being delivered from a constant speed source. If a constant speed is not imposed on the strand delivery, the dancer arm will still sense the take-up tension similarly and maintain it substantially constant within the speed range allowed by the delivery source.

If, however, the strand S' should break during the winding operation so as to allow pivoting of the dancer arm to the dotted **220''** position in FIG. **4**, the result will be to position the control shaft **218** so that the motor **211** is throttled to an idling speed that will wind up the broken end to prevent its entanglement in any way and then allow continued idling of the winding spindle **201** until the broken end is repaired. Conversely, it is desirable at times to hold the strand S' against running, as when a group of winding heads are to be laced up from a common source and the lacing of all heads should be completed before winding at any head is allowed to commence. In such an instance, the effect of the held strand S' after lacing will be to pivot the dancer arm to the dotted **220''** position in FIG. **4** at which the control shaft **218** will be positioned to stall the motor **211** with just enough actuating fluid bleeding harmlessly therethrough to make the winding spindle **201** keep the laced strand S' taut until it is released to run in normal fashion, upon which event all of the winding heads of the laced group will commence winding operation together.

The valve body **216** is further arranged (as seen in FIGS. **9–11**) to control starting and stopping of the motor **211** through a valve stem **228** that is disposed in a bore **229** extending laterally through the valve body **216** in relation to the motor control channel **217**. A second channel **230** is provided in the valve body **216** for connection of a conduit **231** (see FIG. **4**) from an actuating fluid supply source (not shown), and both the first and second channels **217** and **230** open into the bore **229** in spaced relation so as to be in communication as long as the FIG. **9** valve setting is maintained.

This setting results from positioning of the valve stem **228** by a camshaft **232** rotatably housed in the valve body **216** to intersect the bore **229** adjacent one end and contain the stem **228** therein against the bias of a compression spring **233** bottomed on a screw plug **234** installed at the other bore end and sealing the same. The compression spring **233** and screw plug **234** are arranged in bore portions of enlarged diameter, as illustrated, and a first O-ring fitting **235** on valve stem **228** is likewise maintained in the same enlarged diameter portion with the compression spring **233** at the FIG. **9** setting, while a second O-ring fitting **236** is spaced on the valve stem **228** to seal the bore **229** beyond the second channel **230**. The camshaft **232**, however, is notched transversely to form a flat portion **237** (compare FIGS. **10** and **11**) aligned with the bore **229** so that, when camshaft **232** is turned to present the flat portion **237** for receiving the adjacent end of valve stem **228** under the bias of spring **233** (as seen in FIG. **11**), the result is to shift the valve stem O-ring fittings **235** and **236** within bore **229** to block communication between the first and second valve body channels **217** and **230** and thereby stopping motor **211**, while opening a path from the second channel **230** to a third channel **238** which is provided for a purpose that will be noted further presently.

Rotative positioning of camshaft **232** to shift valve stem **228** in the foregoing manner for starting and stopping motor **211** is accomplished through a yoke member **239** fixed thereto exteriorly of valve body **240** by which the pressure roll **214** is carried for pivoting about the axis of traverse mechanism **202** (compare FIGS. **4**, **5**, and **8**). By virtue of this arrangement the starting and stopping of motor **211** is effected automatically as the pressure roll **214** is respectively lowered to and lifted away from operating position at the beginning and end of a winding operation, the lowered position of pressure roll **214** and starting position of yoke member **239** being illustrated by full lines in FIG. **8** and the corresponding retracted and stopping positions in broken lines at **214'** and **239'**.

Chucking and unchucking of the winding core **212** on the winding spindle **201** is also made automatic as an incident of the motor starting and stopping. For this purpose, the previously mentioned third channel **238** in valve body **216** has a conduit **241** connected thereat that runs to a fluid pressure cylinder **242** from which a plunger **243** is extended whenever cylinder **242** is pressurized. The cylinder **242** is mounted at one end of a lever arm **244** that is fulcrumed at **245** on a back cover member **246** for the winding spindle bearing mount **203** and carries an adjustable abutment stud **247** at its other end in line with the winding spindle axis at which a chuck operating pin projects in the usual manner for inward displacement to collapse the winding spindle chuck mechanism which is normally biased in expanded winding core gripping condition.

The stud **247** on lever arm **244**, however, is brought to bear on the chuck operating pin whenever yoke member **239** is moved to motor stopping position, because the valve stem **228** is then shifted to open the actuating fluid supply source through the third valve body channel **238** and conduit **241** to pressurize cylinder **242** for extending plunger **243** against the winding spindle bearing mount **203** and forcing lever

arm 244 to displace the chuck operating pin inwardly to release the winding core 212. The chuck mechanism will be maintained in this releasing condition as the yoke member 239 remains in stopping position so that a full package can be removed or an empty core installed readily on the winding spindle whenever the motor 211 is stopped without any necessity for independent manipulation of the chuck mechanism.

The present invention has been described in detail above for purposes of illustration only and is not intended to be limited by this description or otherwise to exclude any variation or equivalent arrangement that would be apparent from, or reasonably suggested by, the foregoing disclosure to the skill of the art.

We claim:

1. In a winding machine of the type incorporating a driven winding spindle and a traverse mechanism operated at a fixed ratio to the spindle speed for directing take-up of a running strand onto a core carried by the spindle to build a cross-wound strand package about said core, the improvement which comprises a fluid-actuated motor connected for driving said spindle and for operating said traverse mechanism at said fixed ratio, means for supplying fluid under pressure to said motor for actuating the same, means interposed in said supplying means for modulating the pressure under which actuating fluid is supplied to said motor, and means sensing the take-up tension on said running strand and controlling said modulating means from such sensing for causing said motor to drive said spindle and operate said traverse mechanism so that the take-up tension on said running strand is maintained substantially constant as a strand package is built, said spindle and a traverse cam for said traverse mechanism being mounted for rotation about fixed axes, said traverse mechanism also including a pressure roll riding a strand package as it is built on said spindle and under which the strand take-up is delivered to said package, and said pressure roll being carried by means pivoted at the axis of said traverse cam and being arranged so that its riding pressure lessens as the diameter of said package increases during the winding operation.

2. In a winding machine, the improvement defined in claim 1 and further characterized in that the fluid supplied for actuating said motor is air.

3. In a winding machine of the type incorporating a driven winding spindle and a traverse mechanism operated at a fixed ratio to the spindle speed for directing take-up of a running strand onto a core carried by the spindle to build a strand package about said core, improvement which comprises a fluid-actuated motor connected to for driving said spindle and for operating said traverse mechanism at said fixed ratio, means for supplying fluid under pressure to said motor for actuating the same, means interposed in said supplying means for modulating the pressure under which actuating fluid is supplied to said motor, and means sensing the take-up tension on said running strand and acting on said modulating means to control the same from such sensing, said modulating means in turn acting selectively under the control of said sensing means to modulate the actuating supply pressure to said motor for causing said motor to maintain the take-up tension on said running strand substantially constant as a strand package is being built, to assume an idling speed whenever a strand break occurs, and to stall harmlessly whenever the strand is held against running until the strand is allowed to run.

4. In a winding machine, the improvement defined in claim 3 and further characterized in that said modulating means comprises a valve body formed with a channel and fitted with a rotatable shaft intersecting said channel in transverse relation, said shaft having a cross section at least equal to that of said channel and being notched transversely in relation to the point of intersection with said channel, means for directing actuating fluid through said channel to said motor, and means causing rotative positioning of said shaft under the control of said sensing means.

5. In a winding machine, the improvement defined in claim 4 and further characterized in that said channel has a circular cross section, in that said shaft is cylindrical and has a cross section exceeding that of said channel, in that said shaft intersects said channel in offset relation so as to fall slightly short of crossing the full channel diameter, and in that the notched configuration in said shaft is V-shaped to a depth and from a width equal to the channel diameter.

6. In a winding machine, the improvement defined in claim 4 and further characterized in that said sensing means is a dancer arm fixed on said shaft for pivoting therewith and carrying a roll at its extending end about which said running strand is looped prior to take-up, and in that said last mentioned means imposes a bias on said shaft and dancer arm tending to pivot the same in opposition to take-up tension on said running strand.

7. In a winding machine, the improvement defined in claim 6 and further characterized in that said last mentioned means comprises a fixed cylinder housing a piston, means imposing a level fluid pressure on said piston in said cylinder, and means connecting said piston for imposing said bias on said shaft and dancer arm.

8. In a winding machine, the improvement defined in claim 4 and further characterized in that said modulating means valve body is further formed with a second channel, and with a bore extending laterally with respect to said first and second channels and into which said channels open in spaced relation, and in that means is provided for supplying actuating fluid to said valve body through said second channel and a valve stem is disposed in said bore in relation to means for shifting said stem axially therein for selectively opening and blocking communication between said first and second channels.

9. In a winding machine, the improvement defined in claim 8 and further characterized in that the means for selectively shifting said stem in said bore comprises spring means housed adjacent one end of said bore for biasing said stem toward the other end, a camshaft rotatably housed in a second valve body bore transversely intersecting said first mentioned bore adjacent its other end, and means connected with said camshaft exteriorily of said body for selectively rotating the same.

10. In a winding machine, the improvement defined in claim 9 and further characterized in that said winding spindle and a traverse cam for said traverse mechanism are mounted for rotation about fixed axes and said traverse mechanism includes a strand package pressure roll carried by means pivoted at the axis of

said traverse cam, and in that said means connected with said camshaft comprises a yoke member disposed in the pivoting path of said pressure roll carrying means as the same is lifted away from or lowered to operating position.

11. In a winding machine, the improvement defined in claim **10** and further characterized in that said winding spindle is equipped with expandible chucking means normally maintained in expanded condition, in that means are provided for collapsing said chucking means to allow removal of a strand package from said spindle, and in that said valve body is additionally formed with a third channel opening into said first mentioned valve body bore and through which actuating fluid supplied to said valve body is diverted to actuate said chuck collapsing means when said stem is shifted to block communication between said first and second channels.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,685,755 **Dated** August 22, 1972

Inventor(s) Charles S. W. King; John H. Pierce

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 46, "220" " should read -- 220''' --; Column 8, line 30, after "body" insert -- 216 and disposed in the pivoting path of the supporting structure --; Column 9, line 51, before "improvement" insert -- the --; Column 9, line 52, after "connected" delete -- to --; Column 10, line 59, before "body" insert -- valve --.

Signed and sealed this 30th day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents