Jan. 11, 1966 I. S. ROBERTS 3,228,617

YARN WINDING MACHINE

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FIG. 1.

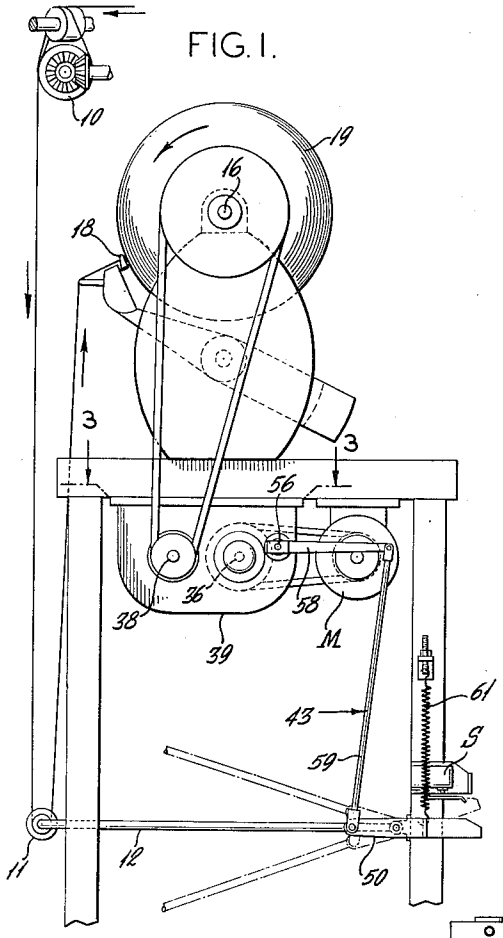


FIG. 2.

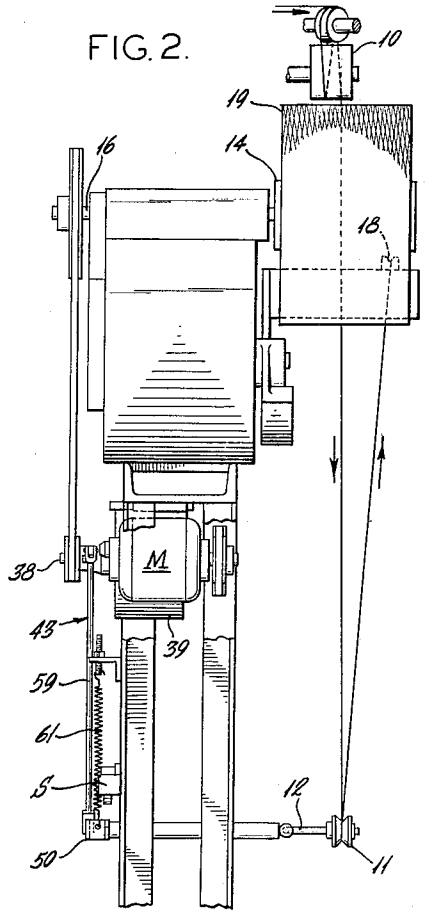
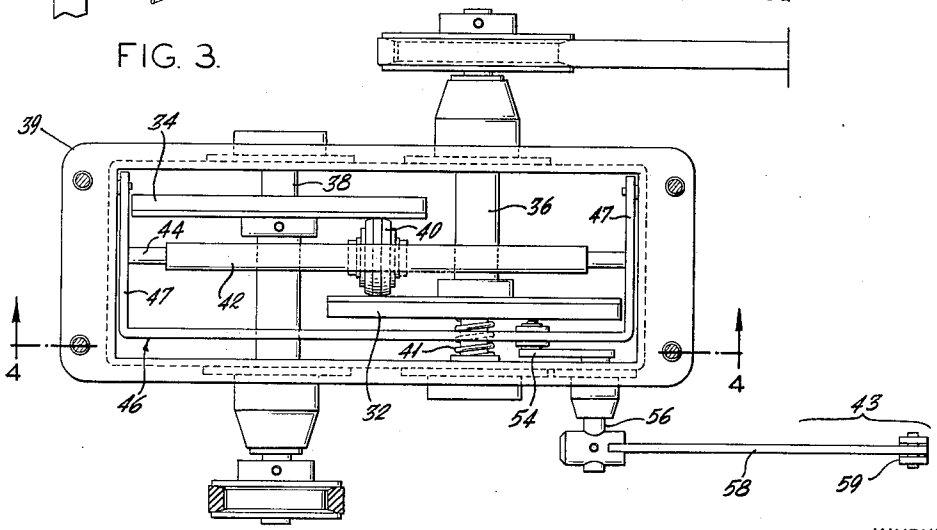


FIG. 3.



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FIG. 4.

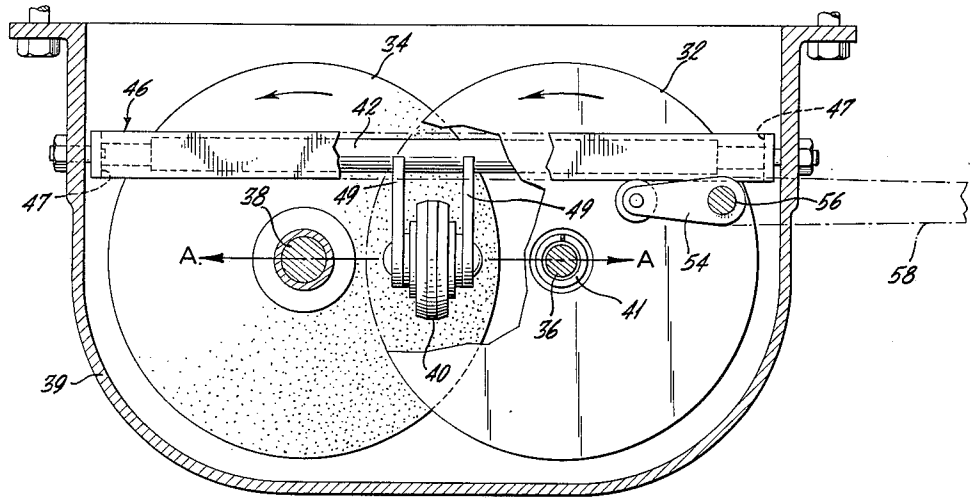


FIG. 6.

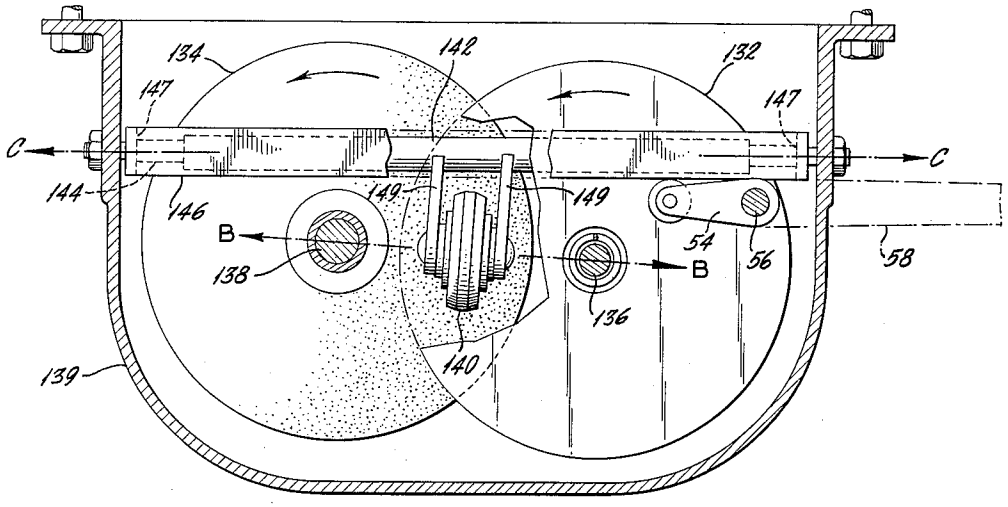
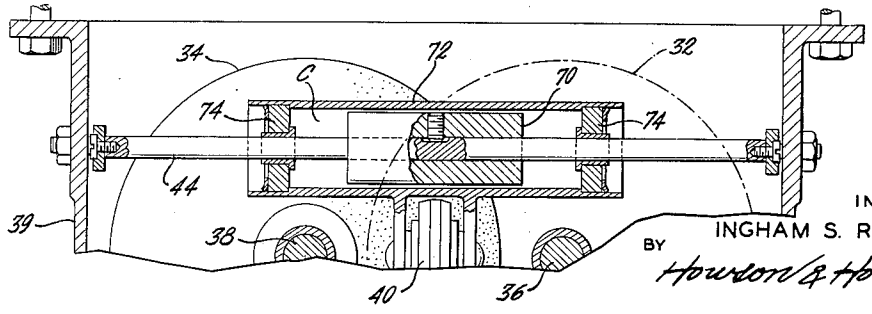


FIG. 5.



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YARN WINDING MACHINE

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FIG. 7.

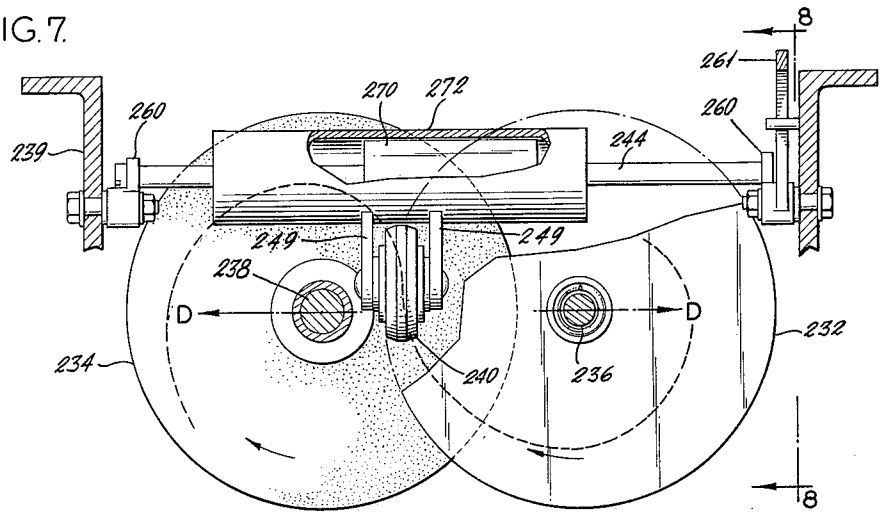


FIG. 8

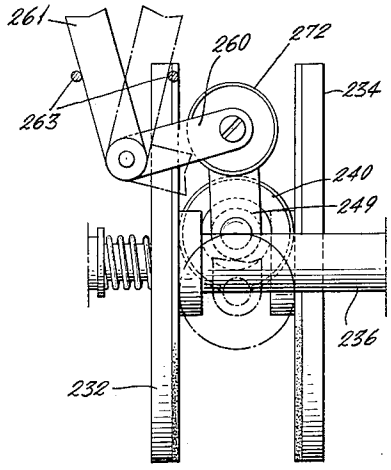
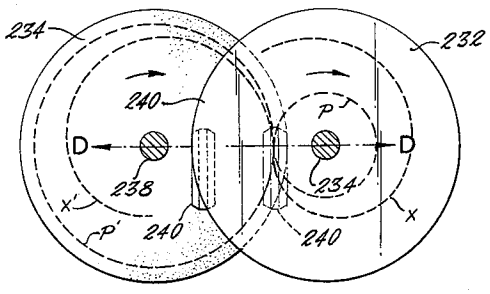


FIG. 9.



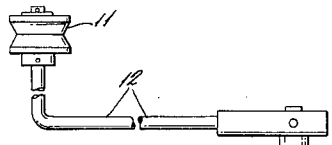


FIG. 10.

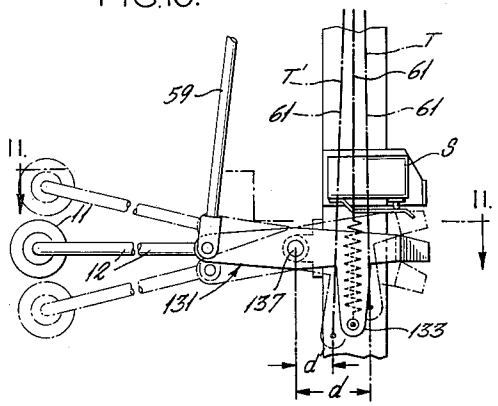
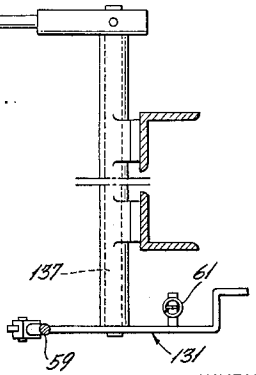


FIG. 11.



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3,228,617

YARN WINDING MACHINE

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Filed June 6, 1962, Ser. No. 200,501
8 Claims. (Cl. 242—45)

The present invention relates to new and useful improvements in yarn winding machines. More particularly the present invention relates to a yarn winding machine having a speed changing mechanism for selectively controlling the take up of the yarn during package formation.

The present invention is an improvement on the yarn winding machine shown in my prior Patent No. 2,509,250, entitled "Tension Control for Winding Machines." In my prior yarn winding machine, the speed of an electric motor drive element is controlled by varying the voltage on the motor by changing the impedance of a coil in series with the motor. Even though this control arrangement is satisfactory for some applications, it has disadvantages when used with others. For example, the speed change ratio of preferred induction type motors is limited to about four to one so that if the maximum speed is 1600 r.p.m., the minimum operable speed is about 400 r.p.m. and this speed range is insufficient when large packages must be wound on small tube or cone centers. Also, the control is not quickly responsive at slow speeds and the motor tends to overrun and "hunt." Also, a complete system including motor and controller must be used with each yarn winding machine and the initial cost and maintenance costs of multiple installations are high.

The yarn winding machine of the present invention eliminates the foregoing disadvantages and drawbacks of my prior yarn winding machine. To this end, the present yarn winding machine embodies a constant speed drive means and a sensitve but simple and inexpensive speed changing mechanism.

Speed change ratios of up to ten to one are easily obtained whereby large packages may be wound on small tube or cone centers. Moreover the control is quickly responsive at all speeds and there is no tendency to overrun and hunt. Further the speed changing mechanism of each of a plurality of yarn winders is adapted to be actuated from a common source of power thereby resulting in a substantial saving in initial cost and lower maintenance costs.

Moreover, the present yarn winding machine operates to control accurately the rate of take up of the yarn during package formation and the control provided is substantially uniform for each package wound whereby the package characteristics of each of a series of packages wound on the machine or on a plurality of similar machines winding the same type of yarn are substantially identical.

With the foregoing in mind, an object of the present invention is to provide a speed changing mechanism for a yarn winding machine adapted to selectively control the rotary speed of the package so as to maintain its surface speed substantially equal to the supply speed of the yarn continously throughout formation of the package.

Another object of the present invention is to provide a speed changing mechanism for a yarn winding machine which operates to gradually reduce the tension in the yarn at a desired rate during package formation and wherein the momentary tension in the yarn may be maintained at a predetermined desired value.

Still another object of the present invention is to provide a yarn winding machine having speed changing mechanism which in certain forms of the invention includes damping means operable to minimize any tendency

for the transmission mechanism to "over correct" or "hunt" thereby providing for closer control of the package characteristics during package formation.

A further object of the present invention is to provide a yarn winding machine having speed changing mechanism operable to control accurately the rate of take up of the yarn onto the winding machine during package formation so that each of a series of packages wound on the machine or on a plurality of similarly adjusted machines will be substantially identical.

A still further object of the present invention is to provide a yarn winding machine having speed changing mechanism wherein a series of winding machines may be actuated from a common power source and each mechanism functions independently to control winding of the yarn in its respective winding machine in a predetermined desired manner.

All of the objects of the invention and the various features and details of the construction and operation thereof are more fully set forth hereinafter with reference to the accompanying drawings, wherein:

FIG. 1 is a side elevational view of a yarn winding machine embodying speed changing mechanism in accordance with the present invention;

FIG. 2 is an end elevational view of the yarn winding machine shown in FIG. 1;

FIG. 3 is an enlarged sectional view taken on line 3—3 of FIG. 1 showing the details and arrangement of a first embodiment of speed changing mechanism in accordance with the present invention;

FIG. 4 is an enlarged sectional view taken on line 4—4 of FIG. 3 with parts broken away so that the details of the speed changing mechanism may be seen more clearly;

FIG. 5 is a fragmentary sectional view of speed changing mechanism similar to that shown in FIG. 4 including damping means for minimizing the tendency of the mechanism to "hunt";

FIG. 6 is a sectional view showing a second embodiment of speed changing mechanism in accordance with the present invention;

FIG. 7 is a fragmentary sectional view of a third embodiment of speed changing mechanism in accordance with the present invention;

FIG. 8 is a sectional view taken on line 8—8 of FIG. 7;

FIG. 9 is a schematic arrangement of the discs and friction wheel of the mechanism shown in FIG. 7;

FIG. 10 is an enlarged fragmentary side elevational view of a form of linkage for the yarn winding machine shown in FIGS. 1 and 2 for use with the speed changing mechanism of FIG. 6; and

FIG. 11 is a sectional view taken on line 11—11 of FIG. 10.

Referring now to the drawings and with reference particularly to the yarn winding machine illustrated in FIGS. 1 and 2 thereof, yarn is delivered at a constant linear speed from a feed roll, prior process or other source, which is indicated by and hereinafter referred to as feed roll **10**, to the yarn winding machine which includes yarn take up means for winding the yarn into a package.

As shown, the yarn passes around a dancer roll **11** carried by a pivotally mounted arm **12** and is laid on a package center **14** supported on a rotatable winding spindle **16** by an oscillating traverse guide **18** to form a package **19**. The winding spindle **16** is driven in the direction indicated in FIG. 1 by a motor M which is controlled by the normally closed switch S.

In accordance with the present invention, a speed changing mechanism is provided which connects the con-

stant speed motor M to the winding spindle **16** and operates to adjust the rotational speed of the winding spindle in a predetermined manner relative to the linear supply speed of the yarn to compensate for gradual increase in diameter of the package during formation of the package.

In accordance with the embodiment of the invention illustrated in FIGS. 1–4 inclusive, the speed changing mechanism includes driving and driven members, in the present instance, discs **32** and **34** mounted on shafts **36** and **38** respectively which are journalled in spaced apart relation in a housing **39**. The shafts **36** and **38** are connected by suitable transmission means, in the present instance, friction belts to the motor M and winding spindle **16** respectively. An element in the form of a friction wheel **40** is mounted between the driving and driven discs **32** and **34** in simultaneous engagement with overlapping portions of the discs and adapted for movement relative to the discs to vary the speed of the driven disc **34** relative to the driving disc **32**. The driving disc **32** is biased by means of a spring **41** toward the driven disc **34** to maintain the friction wheel **40** in engagement with the discs and the confronting faces of the discs and the peripheral surface of the friction wheel **40** are preferably made of a material to provide a high co-efficient of friction between the friction wheel and the discs. In the present instance, the axes of rotation of the driving and driven discs lie in a common plane A—A and the friction wheel **40** is adapted for movement in a direction both perpendicular and parallel to the plane A—A with the axis of rotation of the friction wheel **40** remaining parallel to the plane A—A.

The friction wheel **40** is mounted for movement relative to the discs by means of a U-shaped frame **46** which is pivotally mounted at the free outer ends of the leg portions **47** of the frame to the end walls of the housing **39**, a bar **44** carried between the leg portions **47** and a tubular cylindrical carriage **42** which is mounted on the bar **44** for limited movement axially thereof and which supports along its length a depending bracket **49** rotatably supporting the friction wheel **40**. In the present instance, the U-shaped frame **46** pivots in a direction perpendicular to the plane A—A and is normally urged to pivot downwardly with respect to FIG. 4 when the discs are rotating in the direction indicated due to the direction of the thrust forces of the driving and driven discs **32** and **34** acting on the friction wheel **40**. Pivotal movement of the U-shaped frame **46** is controlled by a linkage **43** operatively connecting the U-shaped frame **46** to a lever **50** carried by the dancer roll arm **12**. The linkage **43** includes a short follower arm **54** which mounts at one end a roller engaging the underside of the U-shaped frame **46** and is connected at its opposite end to a stub shaft **56** rotatably mounted in the side wall of the housing **39**.

A transfer link **58** is secured at one end to the stub shaft **56** and is pivotally connected at its other end to a vertical link **59** which in turn is pivotally connected at its lower end to the inner end of the lever **50**. By this linkage arrangement, a comparatively large displacement of the dancer roll **11** acts through the linkage **43** to effect a small displacement of the U-shaped frame **46**, which in turn results in a small displacement of the rotational axis of the friction wheel **40** relative to the plane A—A.

In operation of the yarn winding machine, yarn delivered at a constant linear speed from the yarn supply roll **10** is looped around the dancer roll **11** and fed to the traverse guide **18** for winding onto the package center **14** to form the package **19**. In the present instance, operation of the winding machine is controlled by raising the dancer roll arm **12** from the inclined position shown in broken lines in FIG. 1 toward a horizontal position whereby the outer end of the lever **50** disengages the contact of the switch S to start the constant speed motor M. The motor M actuates the driving disc **32** which through the friction wheel **40** rotates the driven disc **34** which in turn actuates the winding spindle **16** and package center **14**.

During the formation of the package **19** on the package center **14**, the package gradually increases in diameter and since the yarn feed roll **10** supplies yarn at a constant linear speed, it is necessary that the rotary speed of the package **19** decrease gradually during formation of the package **19**. The speed changing mechanism of the present invention affects this gradual decrease in the rotary speed of the package.

For example, if the package **19** rotates too fast and is taking up the yarn faster than it is being supplied, the yarn raises the dancer roll arm **12** which through the linkage **43** pivots the free end of the follower arm **54** downwardly permitting the frame **46** to pivot downwardly since as noted above, the forces acting on the friction wheel **40** normally tend to urge it in a downward direction. Accordingly the rotational axis of the friction wheel **40** is displaced to a position below the plane A—A whereby the friction wheel **40** tends to follow spiral paths on the driving and driven discs which effect movement of the friction wheel **40** and carriage **42** to the right whereby the speed of the driven disc **34** is decreased relative to the speed of the driving disc **32** and accordingly the rotary speed of the package **19** is decreased. Conversely, if the package **19** rotates to slowly and does not take up the yarn as fast as it is being supplied, the slack in the yarn permits the dancer roll arm **12** to drop, which through the linkage **43** pivots the free end of the follower arm **54** upwardly to raise the U-shaped frame **46** and thereby move the friction wheel **40** above the plane A—A. In this position, the friction wheel **40** tends to follow spiral paths on the discs which move it to the left whereby the speed of the driven disc **34** is increased relative to the driving disc **32** and accordingly the rotary speed of the package **19** is increased. It is noted that when the rotational axis of the friction wheel **40** is positioned on either side of the plane A—A and the friction wheel **40** moves generally radially relative to the discs, this radial movement is limited by abutment of the ends of the carriage **42** with the leg portions **47** of the U-shaped frame **46** to limit travel of the friction wheel **40** between the overlapping portions of the discs.

Further when the rotational axis of the friction wheel **40** lies in the plane A—A, there is no tendency of the friction wheel **40** to move to the left or right and the relative speed of the discs remains constant. It is noted that when the rotational axis of the friction wheel **40** lies in the plane A—A, the dancer roll arm **12** is disposed in approximately a horizontal position.

Accordingly it may be seen that the speed changing mechanism of the present invention adjusts the rotary speed of the package **19** throughout its formation to a value whose corresponding surface speed is approximately equal to the linear speed of the yarn being supplied by the supply means **10**.

During formation of the package **19**, it is desirable to provide a predetermined initial tension in the yarn which gradually decreases during the winding operation to prevent bulging of the package and provide a more satisfactorily wound package. In the present instance, this is accomplished by providing a coil spring **61** which is connected to the frame of the winding machine at one end and to the lever **50** at its other end and which normally tends to rotate the dancer roll arm **12** in a counterclockwise direction with respect to FIG. 1 counter to the direction which the forces on the friction wheel **40** acting through the linkage **43** tend to rotate the dancer roll arm **12**. The tension in the spring **61** is selectively adjustable so that the initial tension for winding may be varied selectively depending on the type of yarn being wound.

This arrangement provides for a gradual decrease in yarn tension during formation of the package **19** in the following manner.

Since the diameter of the package **19** gradually increases, the friction wheel **40** moves gradually to the

right toward the inner periphery of the driving disc **32** during formation of the package and the downward thrust of the discs **32** and **34** on the friction wheel **40** being a function of torque increases as the friction wheel **40** moves to the right. Since this downward thrust on the friction wheel **40** which acts through the linkage **43** is counter to the force of the spring **61**, the net reaction force at the dancer roll **11** which determines tension in the yarn is decreased. It is noted that the dancer roll arm **12** remains in an approximately horizontal position during package formation except for small displacements to vary package rotary speed as noted above whereby the reaction force of the spring **61** remains substantially constant. Accordingly there is a gradual decrease in tension in the yarn during package formation which is desirable to prevent bulging of the package. The rate of decrease in the yarn tension may be varied by changing the linkage **43** to increase or decrease the effect of the downward thrust force on the friction wheel **40** relative to the force of the spring **61**. It is noted that at any instant during the winding operation as described above there is a balance between the forces which tend to raise and those which tend to lower friction wheel **40** and that the only force required to upset this balance and to effect a speed change is the small amount required to overcome the friction in the pivot points of the linkage system.

It is also noted that the force which changes the position of the dancer roll **11** and raises or lowers friction wheel **40** to effect a speed change is a tension differential in the yarn and it is an important advantage of the described speed changing mechanism as applied to yarn winding that only small tension differentials are required to secure speed compensation and that there is therefore no significant fluctuation in yarn tension.

There is shown in FIG. 5 a modified form of the speed changing mechanism described above including damping means adapted to minimize the tendency of the friction wheel **40** to "over correct" or "hunt" during formation of package. To this end there is provided a tubular cylindrical carriage **72** of an enlarged internal diameter greater than the diameter of the bar **44** and having axial end walls **74** providing a chamber C of a predetermined axial length. A piston **70** is mounted interiorly of the carriage **72** and is fixed to the bar **44** at approximately the mid point thereof. The piston **70** is shorter than the chamber C to permit axial movement of the carriage **72** and friction wheel relative to the piston **70** and bar **44**. The chamber C may be filled with a compressible or a non-compressible fluid. In operation therefore as the carriage moves for example to the right with respect to FIG. 5, the fluid is metered through the annular clearance between the piston **70** and carriage from the right hand end of the chamber C to the left hand end thus serving as a buffer slowing down movement of the carriage. By this arrangement "hunting" of the friction wheel **40**, for example due to slight movements of the dancer roll arm **12** resulting from oscillating movement of the traverse guide **18** are minimized.

It is noted that the range of longitudinal movement of the friction wheel **40** to the right or left is limited by abutment of the end face of the piston and the end walls of the carriage whereby the range of movement of the friction wheel **40** is confined to the overlapping portions of the discs. The amount of damping is determined by choice of clearance between the piston **17** and carriage and/or choice of a particular fluid.

Another embodiment of speed changing mechanism in accordance with the present invention is illustrated in FIG. 6 which is adapted for use in a yarn winding machine of the type shown in FIGS. 1 and 2 to control the rate of take up of the yarn during package formation in a predetermined manner. The basic elements of the mechanism are identical to those of the speed changing mechanism shown in FIGS. 3 and 4 and include driving and driven discs **132** and **134** mounted on shafts **136** and **138** respectively which are journalled in spaced apart relation between the side walls of a housing **139**. A friction wheel **140** is mounted between the driving and driven discs for movement relative to the discs to vary the speed of the driven disc **132** relative to the driving disc **134**.

The means mounting the friction wheel **140** includes a U-shaped frame **146** pivotally mounted between the end walls of the housing **139**, a bar **144** supported between the leg portions **147** of the U-shaped frame **146** and a tubular cylindrical carriage **142** which is mounted on the bar **144** for limited movement axially thereof and which supports along its length a dependent bracket **149** rotatably supporting the friction wheel **140**.

The axes of rotation of the disc **132** and **134** are disposed in a common plane B—B and the axis of rotation of the friction wheel **140** is parallel to the plane B—B. However, in accordance with this embodiment of the invention, the plane B—B is inclined relative to bar **144** whereby during longitudinal movement of carriage **142** on bar **144** the rotational axis of friction wheel **140** is moved transverse to plane B—B. Transverse motion of the rotational axis of friction wheel **140** relative to plane B—B is also produced by rotational movement of the U-shaped frame **146** about its pivotal axis C—C. The pivotal movement of the U-shaped frame **146** is controlled by a linkage similar in arrangement to the linkage **43**. However, in the present instance a lever **131** of the type shown in FIGS. 10 and 11 having a depending leg **133** is employed in lieu of the lever **50**. The vertical link **59** of the linkage **43** is connected to the inner end of the lever **131** and the lower end of the spring **61** is connected to the lower end of the leg **133**. This arrangement provides for a desired decrease in tension in the yarn during package formation as discussed in detail hereinafter.

In the operation of a yarn winding machine incorporating the embodiment of speed changing mechanism of FIG. 6, the yarn delivered from the supply roll **10** is looped around the dancer roll **11** and fed to the traverse guide **18** which lays the yarn on the package center to form the package **19**. Operation of the winder is started by raising the dancer roll arm **12** to close the switch S to start the motor M. It is noted that in the present instance the dancer roll arm assumes the position in broken lines in FIG. 10 below the horizontal position at the start of the winding operation and that in this position the friction wheel **140** is nearest its left-hand limit position with respect to FIG. 6. Thereafter during formation of the package, if the package rotates too fast and is taking up yarn faster than it is being supplied, the yarn raises the dancer roll arm **12** which through the linkage **43** pivots the free end of the follower link **54** downwardly permitting the U-shaped frame **46** to be displaced downwardly.

Accordingly, the rotational axis of the friction wheel **140** moves to a position below the plane B—B whereby the friction wheel **140** tends to follow spiral paths on the discs which effect movement of the friction wheel **140** and carriage **142** to the right whereby the speed of the driven disc relative to the speed of the driving disc is decreased and accordingly the speed of the package is decreased. In the present instance the friction wheel **140** in moving to the right, intercepts the plane B—B prior to maximum movement of the friction wheel to the right whereby there is no further movement of the friction wheel and the relative speed of the disc becomes constant. Conversely, if the rotational axis of the friction wheel **140** is moved above the plane B—B, for example, when the package rotates too slowly and is not taking up yarn as fast as it is being supplied, the friction wheel **140** and carriage move to the left with respect to FIG. 6, until the rotational axis of the friction wheel **140** intercepts the plane B—B. By this inclined arrange-

ment of the plane B—B relative to bar **144**, an inherent damping action is provided. It is noted that the carriage and friction wheel move rapidly in response to displacement of the rotational axis of the wheel with respect to the plane B—B but there is no over running or "hunting" when the desired relative speed of the discs is obtained. Preferably, in order to obtain optimum damping, transverse displacement of the friction wheel **140** relative to the plane B—B is limited to a range wherein the rotational axis of the wheel **140** lies in the plane B—B when the carriage is at extreme limit positions.

In employing the speed changing mechanism described above in a yarn winding machine of the type shown for example in FIGS. 1 and 2, it may be seen that during formation of the package, the friction wheel **140** moves from left to right whereby as shown in FIG. 10, the dancer roll arm **12** moves from the broken line position below the solid line horizontal position, to the broken line position above horizontal and whereby the lever **131** is rotated in a clockwise direction about its pivotal axis **137**. Accordingly the spring **61** is extended by pivotal movement of the lever **131** whereby the tension in the spring increases from a predetermined value T at the start of the winding operation, to a final increased value of T' at the finish of the winding operation. However the moment arm of the spring **61** relative to the pivotal axis **137** of the lever decrease from *d* to *d'* during package formation and accordingly the moment of the spring tending to rotate the dancer roll arm **12** in a counterclockwise direction about the pivotal axis **137** of the lever tends to decrease during package formation. Moreover the decrease in the counterclockwise moment of the tension in spring **61** about the pivotal axis **137** due to shortening the moment arm during package formation is greater than the increase in this moment due to elongation of the spring during this period and the net result is that the tension applied to the yarn by the spring decreases during package formation.

Therefore the embodiment of FIGS. 6 and 10 provides dual facilities for decreasing the yarn tension during package formation. The amount of this decrease can be determined by adjusting the linkage ratio which fixes the movement of friction wheel **140** relative to that of the dancer roll **11** as with the previous embodiment or by adjusting the configuration of lever **131** and/or the characteristics of spring **61**.

A further embodiment of speed changing mechanism in accordance with the present invention is illustrated in FIGS. 7–9 inclusive. The basic elements of the mechanism are identical to the form of the invention shown in FIG. 5 and include driving and driven discs **232** and **234** mounted on shafts **236** and **238** respectively which are journalled in spaced apart relation in a housing **239** and a frictional wheel **240** mounted between the discs in simultaneous engagement with overlapping portions of the discs and adapted for movement relative to the discs to vary the speed of the driven disc **234** relative to the driving disc **232**. The friction wheel **240** is supported in a bracket **249** which depends from a carriage **272** identical to the carriage **72** of FIG. 5, the carriage **272** being mounted for axial movement on a bar **244**. A piston **270** is mounted on the bar **244** to provide damping means as discussed above in connection with the speed changing mechanism shown in FIG. 5. The axes of rotation of the driving and driven discs lie in a common plane D—D and the rotational axis of the friction wheel is parallel to the plane D—D and adapted for movement in a direction both perpendicular and transverse to the plane D—D.

In the present instance, a link **260** is pivotally mounted at each opposite end wall of the housing **239** and the bar **244** is supported between the outer free ends of the links **260**.

One of the links has a handle **261** for limited movement between stops in the form of pins **263** projecting from the end wall of the housing in the path of movement of the handle **261**. Accordingly it may be seen that by this arrangement the friction wheel **240** may be moved relative to the plane D—D by manipulation of the handle **261** to vary selectively the rotary speed of the driven disc **234** relative to the driving disc **232**. If desired, the handle **261** may be connected to control mechanism which is responsive to pressure, temperature and other variables thereby to control the rotary speed of an output shaft relative to that of an input shaft. Link **260**, handle **261** and stop pins **263** may be similarly applied to the speed changing mechanism of FIG. 6. This arrangement is particularly advantageous when a definite relationship is desired between the position of handle **261** and the position of friction wheel and its corresponding ratio of output to input speed of the speed changing mechanism.

FIG. 9 shows schematically the paths the friction wheel **240** tends to follow on the driving and driven discs when the rotational axis of the friction wheel is disposed at various positions relative to the common plane D—D. When the discs **232** and **234** are rotating in the direction indicated in FIG. 9, friction wheel **240** rolls downward relative to the contact surface of driving disc **232** and upward relative to the contact surface of driven disc **234**. If the rotational axis of friction wheel **240** lies in plane D—D of axes of the discs, the periphery of the friction wheel **240** follows a circular path P on disc **232** and a circular path P' on disc **234** and there is no force urging the friction wheel to move to the right or to the left along the plane D—D. However, if the rotational axis of the friction wheel **240** is parallel to plane D—D but positioned below it as shown in FIG. 9, the path of the periphery of friction wheel **240** is directed outward relative to the circular path P and inward relative to circular path P' whereby the friction wheel **240** tends to follow spiral paths X on disc **232** and spiral path X' on disc **234**. In following these paths, friction wheel **240** moves from right to left until it reaches a limit position or until its rotational axis is raised to or above plane D—D. If the rotational axis of the friction wheel **240** is positioned above plane D—D as shown in FIG. 7, the friction wheel **240** tends to follow spiral paths indicated whereby the friction wheel **240** moves to the right. In FIG. 4, the rotational direction of the driving disc **32** and of the driven disc **34** are reversed relative to FIG. 9 and positioning friction wheel **40** below plane A—A causes the friction wheel to move to the right as mentioned previously.

While particular embodiments of the invention have been illustrated and described herein, it is not intended to limit the invention and changes and modifications may be made therein within the scope of the following claims.

I claim:

1. In a yarn winding machine, rotatable take up means for winding yarn into a package, yarn supply means for feeding yarn to said take up means at a substantially constant linear speed, constant speed drive means for said take up means, a speed changing mechanism operatively connecting said drive means to said take up means and adapted to adjust the rate of rotation of the yarn take up means relative to the rate of yarn supply to compensate for increase in the diameter of the package during package formation, said speed changing mechanism comprising driving and driven disc members mounted for rotation about axes disposed in a common plane, a friction wheel mounted for rotation about an axis parallel to said common plane and in simultaneous engagement with said disc members, means connecting said driving disc member to said drive means for rotation thereby, means connecting said driven disc member to said take up means to actuate the same, mounting means mounting said friction wheel for movement on opposite sides of said common plane whereby said friction wheel tends to move in one direction generally radially relative to the

disc members when the rotational axis of the friction wheel is disposed on one side of said common plane thereby to increase the speed of rotation of the driven disc member relative to the driving disc member and whereby said friction wheel tends to move generally radially relative to the disc members in a direction opposite said one direction when the rotational axis of the friction wheel is disposed on the side of said common plane opposite said one side thereby to decrease the speed of rotation of said driven disc member relative to said driving disc member, and means operable to actuate said mounting means to displace the rotational axis of said friction wheel to said one side of said common plane when yarn is taken up slower than it is being fed and operable to actuate said mounting means to displace the rotational axis of said friction wheel to the side of said common plane opposite said one side when yarn is taken up faster than it is being fed and damping means operable to minimize the tendency of said friction wheel to hunt during formation of the package.

2. Speed changing mechanism comprising a rotatable driving disc member, a driven disc member mounted for rotation about an axis disposed in a common plane with the axis of rotation of said driving disc member, an element interengaged between said driving and driven disc members and movable relative thereto to vary the speed of the driven disc member relative to the driving disc member, said element when disposed on one side of said common plane tending to move in one radial direction relative to said disc members thereby to increase the speed of rotation of the driven disc member relative to the driving disc member and said element when disposed on the opposite side of said common plane tending to move in a generally radial direction opposite said one direction thereby to decrease the speed of rotation of said driven disc member relative to said driving disc member and means mounting said element for movement in a direction transverse to said common plane and at an angle to said common plane to selectively vary the relative speed of rotation of said driving and driven disc members whereby said element is adapted to intercept said common plane between the axes of rotation of said driving and driven disc members when said element is disposed on either side of said common plane.

3. A speed changing mechanism as claimed in claim 2 wherein said element comprises a friction wheel mounted for rotation about an axis parallel to said common plane.

4. Speed changing mechanism comprising a housing, driving and driven disc members mounted for rotation in said housing about axes disposed in a common plane, a friction wheel mounted for rotation about an axis parallel to said common plane and engaging overlapping portions of said driving and driven disc members and movable relative thereto to vary the speed of the driven disc member relative to the driving disc member, said friction wheel when disposed on one side of said common plane tending to move in one radial direction relative to said disc members thereby to increase the speed of rotation of the driven disc member relative to the driving disc member and said friction wheel when disposed on the opposite side of said common plane tending to move in a generally radial direction opposite said one direction thereby to decrease the speed of rotation of said driven disc member relative to said driving disc member and a supporting frame mounted in said housing supporting said friction wheel for movement in a direction transverse to said common plane and at an angle to said common plane to selectively vary the relative speed of rotation of said driving and driven disc members whereby said friction wheel is adapted to intercept said common plane between the axes of rotation of said driving and driven disc members when said element is disposed on either side of said common plane.

5. Speed changing mechanism comprising driving and driven disc members mounted for rotation about axes disposed in a common plane and having parallel confronting surfaces, a shaft member parallel to the confronting surfaces of said disc members and disposed in non-parallel relationship to said common plane, a friction wheel interengaged between the confronting surfaces of said disc members and mounted for rotation about an axis parallel to said common plane, means mounting said friction wheel for longitudinal movement relative to said shaft member, means mounting said shaft member for movement relative to said disc members operable to displace the rotational axis of said friction wheel in a direction transverse to said common plane, said friction wheel tending to move in one direction longitudinally of the shaft member and at an angle to said common plane to increase the speed of rotation of the driven disc member relative to the driving disc member when the rotational axis of said friction wheel is disposed on one side of said common plane and said friction wheel tending to move in a longitudinal direction relative to said shaft member opposite said one direction and at an angle to said common plane to decrease the speed of rotation of the driven disc member relative to the driving disc member when said friction wheel is disposed on the side of said common plane opposite said one side.

6. Speed changing mechanism comprising driving and driven disc members mounted for rotation about axes disposed in a common plane and having parallel confronting surfaces, a shaft member parallel to the confronting surfaces of said disc members and disposed in non-parallel relationship to said common plane, biasing means urging the confronting surfaces of said disc members toward one another, a friction wheel interengaged between the confronting surfaces of said disc members and mounted for rotation about an axis parallel to said common plane, means mounting said friction wheel for longitudinal movement relative to said shaft member, means mounting said shaft member for movement relative to said disc members operable to displace the rotational axis of said friction wheel in a direction transverse to said common plane, said friction wheel tending to move in one direction longitudinally of the shaft member and at an angle to said common plane to increase the speed of rotation of the driven disc member relative to the driving disc member when the rotational axis of said friction wheel is disposed on one side of said common plane and said friction wheel tending to move in a longitudinal direction relative to said shaft member opposite said one direction and at an angle to said common plane to decrease the speed of rotation of the driven disc member relative to the driving disc member when said friction wheel is disposed on the side of said common plane opposite said one side.

7. In a yarn winding machine, rotatable take up means for winding yarn into a package, means to feed yarn at a constant speed to said take up means, constant speed drive means for said take up means, speed changing mechanism between said constant speed drive means and said take up means comprising driving and driven disc members mounted for rotation about axes disposed in a common plane and having parallel confronting surfaces, a shaft member parallel to the confronting surfaces of said disc members and disposed in non-parallel relationship to said common plane, a friction wheel interengaged between said disc members and mounted for rotation about an axis parallel to said common plane, means mounting said friction wheel for longitudinal movement relative to said shaft member, means mounting said shaft member for movement relative to said disc members operable to displace the rotational axis of said friction wheel in a direction transverse to said common plane, said friction wheel tending to move in one direction longitudinally of the shaft member and at an angle to said common plane to increase the speed of rotation of the driven disc member relative to the driving disc member when the rotational axis of said friction wheel is disposed on one side of said common

plane and said friction wheel tending to move in a longitudinal direction opposite said one direction relative to said shaft member and at an angle to said common plane to decrease the speed of rotation of the driven disc member relative to the driving disc member when said friction wheel is disposed on the side of said common plane opposite said one side.

8. In a yarn winding machine as claimed in claim 7 including a dancer roll arm pivotally mounted at a point along its length having a dancer roll at one end thereof and a depending leg at the opposite end thereof, said yarn being feed from said feed means around said dancer roll to said pickup means, biasing means connected adjacent the outer end of said depending leg for normally pivoting said dancer roll arm in one direction and operable to provide a predetermined initial tension in said yarn, and means including a linkage connecting said means mounting said friction wheel and said dancer roll arm whereby pivotal movement of said dancer roll arm from a predetermined position in said one direction actuates said friction wheel in a direction transverse to said common plane whereby said friction wheel moves gradually toward the

axis of rotation of said driving disc member during formation of the package and said dancer roll arm pivots through a predetermined arc in a direction opposite said one direction whereby the moment of said spring effecting tension in the yarn gradually decreases thus effecting a gradual decrease in tension in the yarn during package formation.

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