

Dec. 7, 1943.

C. RIBAVARO

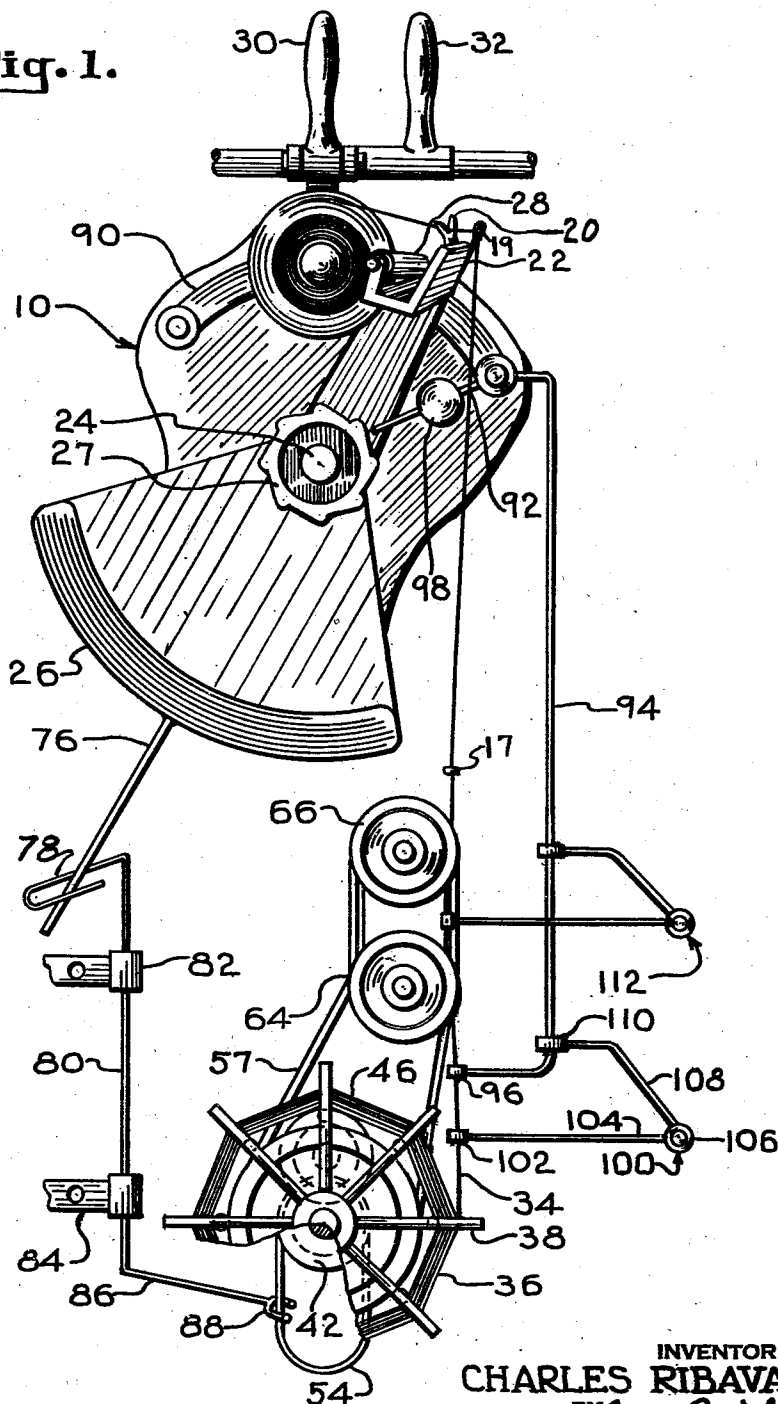
2,335,965

PROCESS AND APPARATUS FOR WINDING

Filed July 21, 1941

2 Sheets-Sheet 1

Fig. 1.



INVENTOR
CHARLES RIBAVARO
BY *John M. Leach*
ATTORNEY

Dec. 7, 1943.

C. RIBAVARO

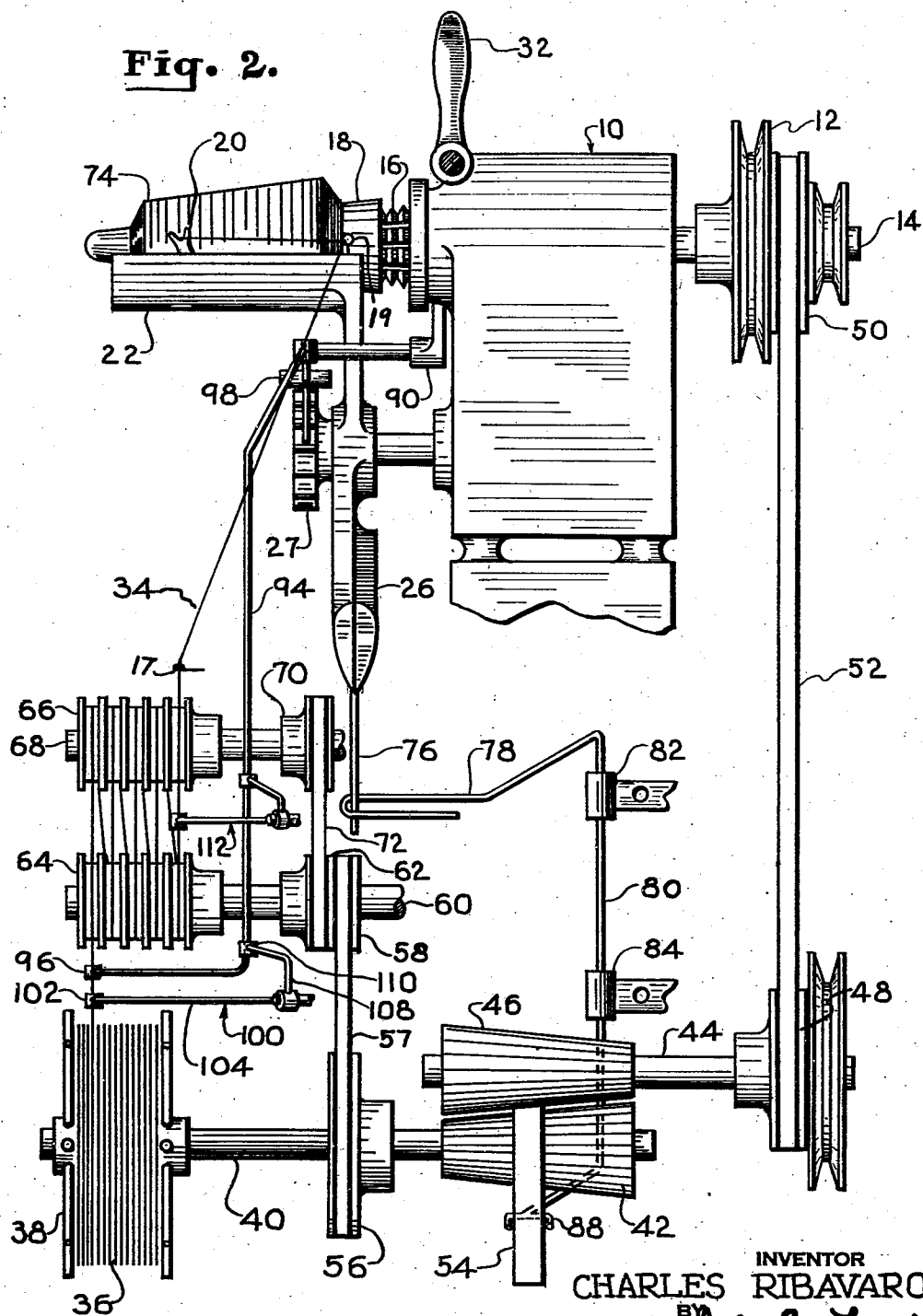
2,335,965

PROCESS AND APPARATUS FOR WINDING

Filed July 21, 1941

2 Sheets-Sheet 2

Fig. 2.



INVENTOR
CHARLES RIBAVARO
BY *John M. Leach*
ATTORNEY

UNITED STATES PATENT OFFICE

2,335,965

PROCESS AND APPARATUS FOR WINDING

Charles Ribavaro, Trenton, N. J., assignor, by
mesne assignments, to Filatex Corporation,
Trenton, N. J., a corporation of New Jersey

Application July 21, 1941, Serial No. 403,265

13 Claims. (Cl. 242-45)

The present invention relates to winding. More particularly it relates to a process and apparatus for winding elongate material into a package in which the entire length of the material forming the package is uniformly stretched or under uniform tension.

During winding operations in accordance with prior art methods, it has been customary to reduce the speed of the reel, roll, spool or the like which receives the material to be wound into a package as the diameter of the winding forming the package increases to compensate for the resulting increase in circumference of the winding. This is for the purpose of maintaining the material being wound under a substantially uniform stretch or tension throughout the wound length. This reduction in the speed of the wind-up roll has materially increased the time required for winding and has consequently reduced the rate at which materials can be wound. Also, a centrifugal force exists within a rotating winding which tends to increase the diameters of the winding convolutions. This condition can be compensated for when a winding is revolved at a uniform angular velocity by suitably adjusting the stretch applied to the material being wound, but since the magnitude of the centrifugal force is constantly changing when the angular velocity is varied to maintain the peripheral velocity constant as previously explained, this force can not be compensated for and an uneven winding invariably results. These conditions have created a problem which was particularly undesirable in the winding of elastic materials, for example elastic thread formed by either a bare elastic core or such a core covered with one or more layers of inelastic textile material. In the winding of such elastic filaments, it is necessary that they be stretched to some extent to create sufficient tension within the material to hold the package in shape and it is essential that the amount of stretch imparted to the filament during winding be maintained substantially uniform, since there is a tendency on the part of such elastic filaments to take a permanent set after being wound into a package. Unless the permanent set is uniform throughout the winding the characteristics of the elastic filament will vary progressively through the winding with the result that it will be impossible to utilize such a filament to weave, knit, braid or otherwise form articles of uniform quality. Also unless such an elastic textile material is uniformly wound upon a package which serves as a source of supply for a knitting or the like machine, the elastic ma-

terial will hang on the package at intervals and vary the stretch and the tension of the material being knitted and ruin the quality of the knitted article.

5 In the production of such elastic filaments heretofore it has been necessary to wind the covered filament from the skein formed on the covering machine first onto a spool and then onto a cone or the like shipping and handling holder. This extra winding step was made necessary because it was impossible to wind the filament by available winding methods and apparatus directly from the skein to the final package and produce a usable package.

15 It is an object of the present invention to provide a process and apparatus for winding which will overcome all of the foregoing difficulties.

It is another object of the present invention to provide a process of winding in which the elongate material in the final winding is under substantially uniform stretch throughout the entire length of the winding.

It is another object of the present invention to provide a process of winding in which the material being wound can be placed under a substantially uniform stretch throughout the entire package without reducing the rate of winding at any time during the winding operation.

It is an additional object of the present invention to provide a process of winding in which a covered elastic filament can be wound directly from a skein to a final package.

It is also an object of the present invention to provide a process of winding in which the centrifugal force per unit of mass exerted on the package during the winding operation remains substantially uniform.

It is a further object of the present invention to provide an apparatus capable of carrying out all of the features of the process of the present invention.

Other objects and advantages, if not specifically pointed out, will be apparent to those skilled in the art from the following detailed description of what are now considered the preferred forms of the invention.

The process of the invention in general comprises positively rotating a winding of elongate material which may conveniently be termed the supply winding, positively pulling the elongate material from the positively driven winding at a greater rate of speed than the circumferential speed of the positively driven supply winding, feeding the elongate material so removed to a using operation in the form of a positively rotated

wind-up roll driven at a surface speed in excess of the surface speed of the supply winding but less than the rate of speed at which the elongate material is pulled from the supply winding, and varying the surface speed of the supply winding and the rate of positively pulling the elongate material from the supply winding in direct proportion to the increase in diameter of the winding building upon the wind-up roll to maintain a substantially uniform unit stretch throughout the length of the elongate material supplied to the wind-up roll.

The apparatus of the present invention in general comprises a rotatable holder for a supply winding, variable speed means for driving the supply winding holder, means for pulling elongate material from the supply winding at a greater rate than the surface speed of the supply winding, means for coordinating the speeds of the means for pulling the elongate material from the supply winding and the means for driving the supply winding holder, a rotatable wind-up roll holder, means for driving the wind-up roll holder and means including an element in contact with the surface of the winding as it builds up on the wind-up roll for varying the speed of the supply winding holder rotating means in direct proportion to the rate of increase in diameter of the wind-up winding.

The term "wind-up roll" as used throughout this specification and the claims is to be construed as covering a spool, reel, cone, cop, drum, bottle or any other desired type of winding form.

The invention accordingly comprises the several steps and the relation of one or more such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

For a more complete understanding of the present invention reference is made to the following detailed description taken in connection with the accompanying drawings, in which

Fig. 1 is a fragmentary front elevation of the apparatus of the present invention, with parts broken away for the purpose of more clearly illustrating the invention, and

Fig. 2 is a fragmentary side elevation of the apparatus illustrated in Fig. 1.

The apparatus of the present invention may be applied to any existing type of winding apparatus or may be embodied in such apparatus during manufacture without appreciably modifying the form or complexity of the apparatus or the mode of its production.

By way of explanation and not in limitation of the invention, the winding machine manufactured by the Universal Winding Company of Boston, Massachusetts, and designated as "Leesona winder No. 50" will be referred to as representing one of the many types of winding apparatus to which the apparatus of the present invention may be applied or within which the apparatus of the present invention may be embodied during manufacture of the winding machine.

The conventional type of winding machine referred to above is illustrated in the drawings to the extent only which is necessary to properly illustrate the present invention, and comprises a winding head generally designated by reference character 10. The winding head 10 includes a

drive pulley 12 which is rotated by a belt from a suitable prime mover (not shown), for example, an electric motor. It is usual, although not essential, for a number of such winding heads to be positioned in proper alignment on a suitable supporting frame and for all of the winding heads to be driven from the same prime mover by a common belt. The pulley 12 rotates a shaft 14 which carries at its opposite end a winding form holder 16 for receiving a suitable winding form such as the cone 18.

The shaft 14 also drives a suitable mechanism (not shown) contained within the head 10 for traversing a yarn guide 20 backwards and forwards along the length of the yarn holder 18. The yarn guide 20 is supported for reciprocation on a traverse frame 22 mounted for rotation about a shaft 24 and counterbalanced by a suitable weight 26. The shaft 24 is suitably rotated from within the head 10 and rigidly carries a stopping lever wheel 27.

The traverse frame 22 has mounted thereon a freely rotatable roller 28 which is urged first against the cone 18 and then the winding as it builds up on the cone by the force of the counterweight 26 acting through the traverse frame 22.

Suitable actuating handles 30 and 32 control a suitable belt shifter and brake (not shown) to start and stop the winding machine.

For the purpose of illustrating the invention and not in limitation thereof the process and apparatus of the invention will be described as used in connection with the winding of an elastic filamentary material of the type previously described, although it is to be understood that both the process and the apparatus may be used to wind other types of elongate material, for example webs of elastic material, webs of paper, webs of non-fibrous material, such as Cellophane, metallic wires and foils, and textile materials in general. Even though some of these materials may be limited in their capacity to stretch, it is frequently essential that they be wound under a uniform tension throughout the wound length, for example, in the case of rubber elongate materials having a low maximum stretch, and the present invention makes it possible to properly wind these materials.

The elastic filamentary material 34 is carried in the form of a winding 36 by a swift or the like 38. The winding 36 may conveniently be the winding formed by a conventional type of rubber thread covering machine which applies one or more inelastic covers to a bare elastic core and then forms the completely covered elastic material into a winding, which when removed from the covering machine and placed upon a swift or the like 38, will permit each convolution to relax and assume a substantially uniform length per convolution throughout the winding.

The swift 38 is mounted for rotation by and with a shaft 40 journaled in a suitable frame structure of the winding machine (not shown) and carrying a cone 42 for rotation therewith. A second suitably journaled shaft 44 rigidly carries a cone 46 disposed adjacent to and axially parallel with the cone 42. The shaft 44 also rigidly carries a pulley 48 which is driven by a belt 52 from a selected pulley of a series of pulleys forming a cone pulley 50, within which the pulley 12 is either included or with which the pulley 12 is rigidly connected.

A flat belt 54, which is preferably formed of some elastic or semi-elastic material such as rubber or a rubberized fabric, is positioned to run

between the cones 46 and 42 so as to frictionally drive cone 42 from cone 46.

A pulley 56 rigidly carried by the shaft 40 drives by means of a belt 57 a pulley 58 rigidly carried by a suitably journaled shaft 60 which also rigidly carries a pulley 62 and a grooved drum 64. A grooved drum 66 is rigidly carried by a suitably journaled shaft 68 which rigidly carries a pulley 70 of the same size as and is positively driven from the pulley 62 by a belt 72. The size of the pulleys 56 and 58 are suitably selected so that the surface speed of the grooved drums 64 and 66 will be in excess of the surface speed of the supply winding carried by the swift 38. The amount of the excess in the surface speed of the drums 64 and 66 over the surface speed of the winding 36 will be varied in accordance with the type of material employed, having regard for its size, modulus of elasticity, maximum stretch, etc. It has been found that an excess in surface speed of the drums 64 and 66 over the surface speed of the winding 36 sufficient to stretch the elastic material between the drums and the winding 36 in the neighborhood of 150 to 180 per cent will give satisfactory results. This stretch insures that the elastic yarn will be effectively pulled from the winding 36 so that there will be no tendency for buried convolutions of the elastic yarn to stick on the winding and reversely wind the elastic yarn back onto the swift and thereby break it and produce a stoppage.

The elastic yarn 34 is passed several times around the drums 64 and 66 to fill several or all of the grooves therein and is then passed through a guide 17 carried by some suitable portion of the frame. From the guide 17 the filament 34 is passed to a guide 19 carried by the traverse frame 22 and is then passed over the yarn guide 20 and then onto the cone 18 where it builds up into a wind-up winding 74. The guide 19 is positioned near the base of the winding 74 so that the increase in the run of the filament between the guide 20 and the guide 19 as the guide 20 goes toward the small end of the cone will cause less filament to be fed to the small end of the cone than to the large end and thereby compensate for the difference between the diameters at the small end and the large end. The surface speed of the drums 64 and 66 is also selected so that the elastic yarn passing from the upper drum to the winding 74 will be permitted to partially relax but will still be stretched to a definite extent as it is applied to the winding 74. The amount of stretch in the elastic yarn which goes into the winding 74 may be varied as desired to produce a so called soft or hard winding 74. In general, it is advisable to make the amount of stretch of the yarn forming the winding 74 as low as possible and still produce a winding 74 which will maintain its shape during handling incidental to packing, shipping and use on various machines such as knitting machines, looms, braiding machines and the like. A stretch of between 10 and 20 per cent for the elastic yarn forming the winding 74 has been found satisfactory for most purposes. This produces a package which readily and uniformly releases the elongate material from the package when it is used as a source of supply for a knitting or other using machine and thereby increases the quality of the fabricated article made therefrom.

As the winding 74 increases in size, the amount of yarn supplied to the winding per revolution must be increased since the rate of rotation of

the shaft 14 is maintained substantially uniform. The increase in the rate of supply of the elastic yarn 34 supplied to the winding 74 without varying the amount of stretch in the yarn so supplied is accomplished by the following mechanism.

As the winding increases in diameter, the roller 28 will be moved in a clock-wise direction as viewed in Fig. 1 and will rock the traverse frame 22 about the shaft 24 and thereby move a stud 76 pending from the counterweight 26 carried by the traverse frame 22 to the left. The stud 76 is received within a bifurcated arm 78 carried by a shaft 80 suitably journaled at 82 and 84 in the frame structure for the winding machine. The lower end of the shaft 80 is rigidly connected to an arm 86 which extends from the shaft at substantially a right angle and carries a bifurcated element 88 at its extremity which straddles the belt 54 and forms a belt shifter. As the winding 74 increases in diameter, the bifurcated element 88 is moved in a counterclockwise direction as viewed in Fig. 1 and to the left as viewed in Fig. 2 to shift the belt from the large end of the cone 42 to the small end of this cone and to shift the belt from the small end of the cone 46 to the large end of this cone and thereby progressively increase the rate of rotation of the shaft 40. The increase in the rate of rotation of the shaft 40 causes an increase in the surface speed of the winding 36 and an increase in the surface speed of the drums 64 and 66 so as to pull the elastic yarn from the winding 36 under a constant stretch although at a greater rate of speed and in turn feed the elastic yarn to the winding 74 under a constant stretch although at a greater rate of speed.

Winding machines of the type illustrated are conventionally provided with stop mechanisms for stopping the machine in the event of breakage of the filament being wound. Such a stop mechanism conventionally comprises a segment 90 which is suitably pivoted to the winding head 10 and has pivoted thereto at one extremity a stopping lever 92 which is rigidly connected to a breakage arm 94 which extends downwardly and is provided at its lower extremity with an eyelet 96 through which the filament 34 passes. The stopping lever 92 and the breakage arm 94 are normally urged to rotate in a counterclockwise direction as viewed in Fig. 1 by an adjustable counterweight 98 carried by the stopping lever 92. The rotation of these levers is prevented by the run of the filament as long as the filament 34 passes through the eyelet 96. Upon breakage of the filament 34 the filament is no longer capable of overcoming the biasing effect of the counterweight 98 and the brake lever arm 92 is rotated to a position where it is struck by one of the projections of the stopping lever wheel 27 which cams the lever 92 upwardly in a clockwise direction as viewed in Fig. 1 and thereby rotates the segment 90 about its pivotal point and through a mechanism (not shown) releases the belt tightener and applies the brake to instantaneously stop the winding operation.

In order to prevent the inclusion of tangles and other imperfect portions, frequently termed "slubs," in the elastic filament winding, the apparatus of the present invention is provided with slub catchers at at least two points. The slub catchers are preferably positioned to cooperate with the filament where it is maintained under its greatest tension and to this end the first slub catcher 100 is positioned so that its eyelet 102 through which the elastic filament runs falls between the winding 36 and the first of the

grooved drums 64. The eyelet 102 is carried by arm 104 which is pivoted at 106 to a suitable portion of the machine frame (not shown) and rigidly carries an arm 108 which carries an eyelet 110 at its upper end which receives the breakage arm 94. The second slub catcher 112 is identical in all respects to the first slub catcher 100 and is positioned so that its eyelet encircles the filament passing from drum 64 to drum 66. Upon the occurrence of an imperfection which causes an abnormal increase in the size of the filament, the imperfection or slub will catch in the eyelet 102 and rotate the arms 104 and 108 in a clockwise direction as viewed in Fig. 1 and thereby move the breakage lever 94 in a counterclockwise direction which moves the breakage lever 92 so that it will be struck by one of the projections on the breaking lever wheel 27 to stop the machine and apply the brakes. In the event the slub should for some reason go through the eyelet of the first slub catcher 100, the second slub catcher 112 will intercept it since the filament is stretched less at this point and the imperfections will accordingly be larger.

The process and apparatus of the present invention make it possible to individually vary the rate of application of elastic filament to each of a number of winding machines, all driven from the same prime mover without disturbing the operation of the entire group. This is true even though each of the winding machines of the group is winding yarn into a package at a different instantaneous speed, although all are operating at the same uniform average winding speed.

The process and apparatus of the present invention make it possible to wind elastic yarn and other elongate materials at a high speed and under a uniform stretch into a well bodied winding. The wound elastic yarn may then be stored as long as desired since any permanent set which takes place in the yarn will also be uniform throughout the length of the winding and will not thereby detract from the quality of the yarn. The packages so formed are uniform in texture throughout because of having been wound under a constant centrifugal force and the accurate control of the stretch made possible by the present invention enables packages of substantially any degree of hardness desired to be formed. These features denote marked advances in the art since users of the elastic yarn, for example, knitters and weavers, are supplied with a commodity having uniform characteristics which increases the quality of the textile structures made from the yarn, and also increases the rate of production of such textile structures since less adjustment of the knitting and weaving machines and the like is required throughout a given run and fewer rejects and seconds are produced.

Since certain changes in carrying out the above process, and certain modifications in the article which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. An apparatus for winding elastic filaments comprising means for rotatably supporting a supply winding of elastic filament, a wind-up roll, means for rotatably supporting the wind-up roll, means for driving the wind-up roll, means for driving the supply winding supporting means,

means for pulling elastic yarn from the supply winding at a greater rate than the peripheral velocity of the supply winding, means in contact with the winding on the wind-up roll to increase the rate of rotation of the supply winding and the rate of operation of the means for pulling the elastic yarn from the supply winding in direct proportion to the increase in diameter of the winding which builds up on the wind-up roll.

2. An apparatus for winding elongate material comprising means for rotatably supporting a supply winding of the material, a wind-up roll, means for rotatably supporting the wind-up roll, means for driving the wind-up roll, means for driving the supply winding supporting means, means for pulling elongate material from the supply winding at a greater rate than the peripheral velocity of the supply winding, and means in contact with the winding which builds up on the wind-up roll to increase the rate of rotation of the supply winding driving means and the means for pulling elongate material from the supply winding in direct proportion to the increase in diameter of the winding which builds up on the wind-up roll.

3. An apparatus for winding elastic filamentary material comprising means for rotatably supporting a supply winding of the elastic filamentary material, means for positively rotating said supporting means, means for pulling elastic filamentary material from the supply winding, means for driving the pulling means in unison with the means for rotating the supplying winding supporting means, a wind-up roll, means for positively driving the wind-up roll at a substantially uniform speed, means in contact with the winding which builds up on the wind-up roll which is displaced by an increase in diameter of the winding, and means actuated by the means in contact with the winding on the wind-up roll to progressively increase the rate of rotation of the supply winding supporting means and thereby progressively increase the rate of operation of the means for pulling the elastic filamentary material from the supply winding.

4. A winding apparatus comprising a winding head, a support for a winding form rotatably supported on and rotated by said winding head, means for rotatably supporting a supply winding of elastic filamentary material, variable speed mechanism for driving the supporting means for the supply winding, a roller for receiving one or more turns of the elastic material coming from the supply winding to pull the elastic filamentary material from the supply winding, means for driving the roller from the variable speed mechanism, means for driving the variable speed mechanism at a definite rate relative to the operation of the winding head, means in position to contact the winding of elastic filamentary material which is received from the said pulling-off roller and which builds up on said winding form, said last-named means being displaced in proportion to the increase in diameter of the said winding and cooperating with the variable speed mechanism to actuate the latter to progressively increase the rate of rotation of the supply winding and the pulling-off roller in direct proportion to the rate of increase in diameter of the winding on the winding form.

5. An apparatus for winding elastic filamentary material comprising a reel for supporting a supply winding of material, variable speed means for positively rotating the reel, a pulling-off roller positioned to receive one or more turns of the

elastic filamentary material coming from the supply winding, means for rotating the pulling-off roller from the variable speed mechanism at a greater peripheral velocity than the peripheral velocity of the supply winding, a wind-up roll positioned to receive elastic filamentary material from said pulling-off roller, means for rotating the wind-up roll at a lower peripheral velocity than the pulling-off roller but at a greater peripheral velocity than the supply winding, means for driving the variable speed mechanism in unison with the wind-up roll rotating means, means rotatably mounted in position to contact the winding which builds up on the wind-up roll and thereby be moved in a direction generally away from the axis of the said winding as the latter increases in diameter, and means actuated by said last-named means to vary the speed of the variable speed mechanism to thereby increase the peripheral velocity of the supply winding and the pulling-off roller in direct proportion to the increase in diameter of the winding which builds up on the wind-up roll.

6. An apparatus for winding elastic yarn comprising a wind-up roll, means for driving the wind-up roll, a rotatably mounted frame, a roller carried by the frame in position to contact the winding which builds up on the wind-up roll, means for biasing the frame so as to hold the roller in contact with said winding, a rotatably mounted reel for supporting a supply winding, variable speed means for positively driving the reel, a pair of pull-off rollers for receiving one or more turns of elastic yarn and for pulling the same from the supply winding and passing it to the wind-up roll, means for driving the pull-off rollers at all times at a greater peripheral velocity than the supply winding so as to stretch the elastic yarn between the supply winding and the pull-off rollers, means for positively driving the variable speed mechanism from the wind-up roll driving means so that the elastic yarn is stretched between the supply winding and the pull-off rollers and is permitted to relax between the pull-off rollers and the wind-up rolls but is still in a stretched condition when supplied to the wind-up roll, and means actuated by rotation of the rotatably mounted frame to actuate the variable speed mechanism to progressively increase the speed of rotation of the supply reel and the pull-off rollers in direct proportion to the rate of increase in the diameter of the winding which builds up on the wind-up roll.

7. A process of winding elongate material comprising rotating a supply winding of the material to let off the material from the supply winding, forming a new winding from the material let off of the supply winding, sensing the increase in diameter of the new winding by positive contact with the winding, and increasing the rate of let-off of the elongate material from the supply winding in direct proportion to the increase in diameter of the new winding.

8. A process of winding an elastic filament comprising rotatably supporting a supply winding of the filament, positively rotating the supply winding to let elastic filament off therefrom, forming a new winding from the let-off elastic

filament, sensing the increase in diameter of the new winding by direct contact with the same and increasing the rate of rotation of the supply winding in direct proportion to the rate of increase in diameter of the new winding.

9. A process of winding elastic filamentary material comprising positively rotating a supply winding of elastic filament, pulling elastic filament from the positively rotated supply winding at a greater rate than the rate of rotation of the supply winding, forming the elastic filament so removed from the supply winding into a new winding, and increasing the rate of rotation of the supply winding and the rate of pulling elastic filament therefrom in direct proportion to the increase in diameter of the winding, whereby the elastic filament is supplied to the new winding under a substantially constant stretch throughout the length being wound.

10. A process of winding elastic yarn comprising positively rotating a supply winding of the yarn, pulling elastic yarn therefrom at a greater velocity than the peripheral velocity of the supply winding, forming the elastic yarn so removed into a new winding while tensioning the elastic yarn, sensing the increase in diameter of the new winding by positively contacting the same, and increasing the rate of rotation of the supply winding and the rate of pulling the elastic yarn therefrom in direct proportion to the increase in diameter of the new winding, whereby the elastic yarn supplied to the new winding will always be under a constant tension.

11. A process of winding elongate material comprising positively removing elongate material from a supply winding, forming the elongate material so removed into a new winding at a constantly varying rate, sensing the increase in diameter in the new winding by physical contact therewith and increasing the rate of removal of the elongate material from the supply winding in direct proportion to the rate of increase in diameter of the new winding.

12. A process of winding elastic filamentary material comprising positively removing elastic filamentary material from a supply winding, forming the elastic filamentary material so removed into a new winding at a constantly varying rate, sensing the increase in diameter of the new winding by physically contacting the same, and increasing the rate of removal of the elastic filamentary material from the supply winding in direct proportion to the rate of increase in diameter of the new winding.

13. In an apparatus for winding filamentary material, the combination of a supply winding of filamentary material, means for rotating said supply winding, a wind-up roll, means for rotating said wind-up roll, a roller rotatable by surface contact with the winding on the wind-up roll and displaced by increase in diameter of said winding, means actuated by the displacement of said roller to progressively increase the rate of rotation of the supply winding in direct proportion to the diameter of the winding which builds up on the wind-up roll.

CHARLES RIBAVARO.