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APPARATUS FOR WINDING AND UNWINDING FLEXIBLE MEMBERS
OF TEXTILE MACHINES AND THE LIKE

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Fig. 1

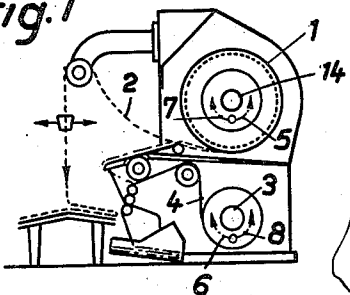


Fig. 3

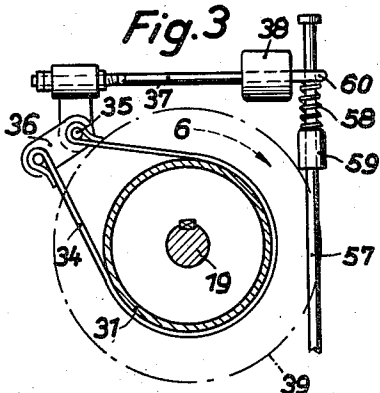


Fig. 4

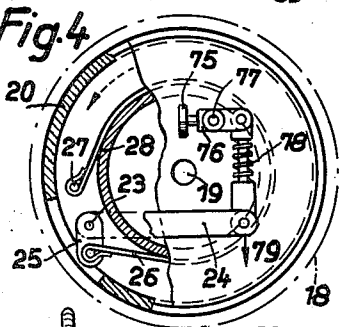


Fig. 5

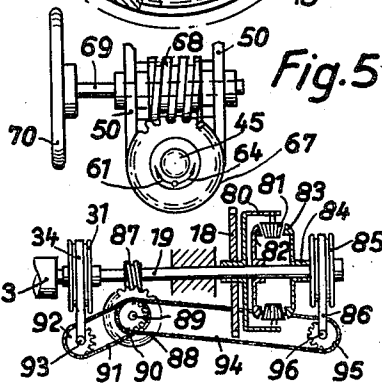
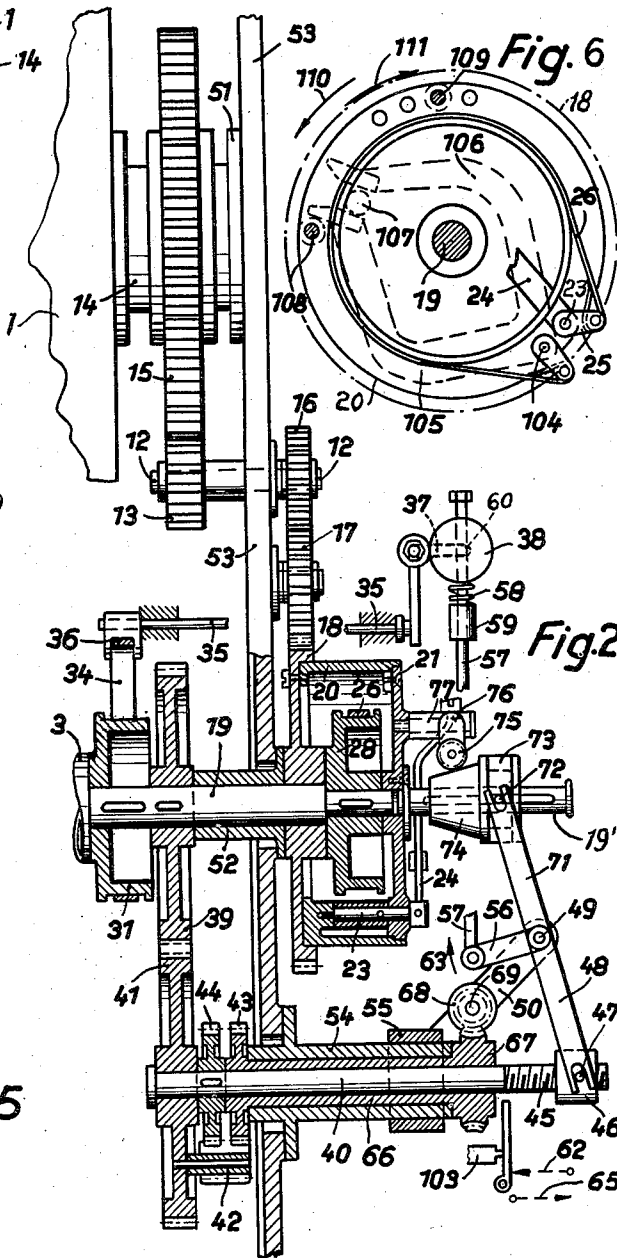
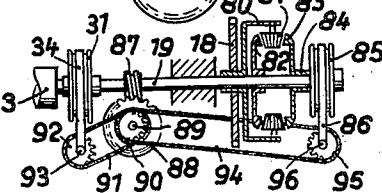


Fig. 7



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APPARATUS FOR WINDING AND UNWINDING FLEXIBLE MEMBERS OF TEXTILE MACHINES AND THE LIKE

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The present invention relates to textile processing apparatus.

More particularly, the present invention relates to apparatus for winding and unwinding flexible members of the type used in decating machines, for example, for processing textiles and the like.

In machines of the above type an elongated flexible member is connected to and wound on a take-up roll and is also connected to a steam roll to be unwound from the take-up roll and wound onto the steam roll together with a fabric to be treated, the flexible member then being unwound from the steam roll and rewound on the take-up roll. As this flexible member is being unwound from the take-up roll, its moment arm on the latter decreases which results in a variation in the tension of the flexible member so that it is loosely wound at some parts of its length on the steam roll and tightly wound thereon at other parts of its length, this lack of uniformity in the winding of the flexible member greatly detracting from the quality of the treatment of the fabric wound together with the flexible member on the steam roll. This flexible member also is non-uniformly rewound on the take-up roll, and this non-uniform winding contributes to the lack of uniformity in the winding of the flexible member onto the steam roll.

One of the objects of the present invention is to overcome the above drawbacks by providing a means for maintaining a constant tension in the flexible member during winding of the same onto the steam roll or the like so that the convolutions of the flexible member on the steam roll are uniformly pressed against each other throughout the thickness of the winding to produce the best possible treatment of the fabric on the steam roll.

A further object of the present invention is to provide a means for regulating the constant tension which is maintained in the flexible member so as to control the pressure between the convolutions of the winding of the flexible member on the steam roll.

Another object of the present invention is to provide a means for maintaining a constant tension in the flexible member during rewinding thereof onto the take-up roll.

An additional object of the present invention is to provide a means for automatically unwinding the flexible member from the take-up roll and winding the same onto the steam roll as well as unwinding the flexible member from the steam roll and rewinding the same onto the take-up roll.

Yet another object of the present invention is to provide a means for positively driving the take-up roll, during rewinding of the flexible member thereon, and maintaining the tension in the flexible member at a desired constant value.

A still further object of the present invention is to provide an apparatus capable of accomplishing all of the above objects while at the same time being made of simple and ruggedly constructed parts which will give reliable service for a long period of time.

With the above objects in view, the present invention

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mainly consists of a machine for processing textiles and the like, this machine including a support means carrying a pair of rolls which are turnably mounted thereon. An elongated flexible member is wound on one of said rolls and connected to the other of the rolls to be wound onto this other roll upon rotation thereof to pull the flexible member from the said one roll. A brake means is operatively connected to this one roll for resisting rotation thereof so as to tension the flexible member while the latter is pulled from this one roll and wound on the other roll. A drive means is operatively connected to this one roll for turning the latter to rewind the flexible member onto this one roll during unwinding thereof from the other roll, this drive means including a friction clutch for transmitting a drive to this one roll. A control means is operatively connected to the brake means for reducing the braking force thereof at a rate which maintains the braking force at a value which is overcome by a turning moment equal to a constant tension in the flexible member multiplied by the diminishing moment arm produced by unwinding of the flexible member from the said one roll, this control means being operatively connected to the friction clutch of the drive means for decreasing the slip of this friction clutch and increasing the turning moment thereof at a rate which equals the resistance produced by the constant tension in the flexible member multiplied by the increasing moment arm provided by the increasing diameter of the band during rewinding thereof onto the said one roll.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a schematic side view of a machine to which the invention is applied;

Fig. 2 is a fragmentary, partly sectional and partly diagrammatic view of the details of the apparatus of the invention;

Fig. 3 is a fragmentary, partly sectional, side view of a brake apparatus of the invention and part of the control means therefor;

Fig. 4 is a partly diagrammatic, partly sectional, fragmentary side view of a friction clutch constructed in accordance with the present invention;

Fig. 5 is a fragmentary view of an adjusting apparatus forming part of the structure of the invention;

Fig. 6 is a partly diagrammatic, fragmentary side view of another embodiment of a friction clutch constructed in accordance with the present invention; and

Fig. 7 is a fragmentary schematic illustration of another embodiment of an apparatus constructed in accordance with the present invention.

Referring to Fig. 1 of the drawings, the invention is illustrated as applied to a decating machine which includes a steam roll which is, for example, in the form of a perforated drum through which steam is adapted to flow. The fabric 2 is to be treated on the steam roll 1, and a flexible member 4 is adapted to be wound onto and unwound from the steam roll 1 to carry the fabric 2 to and from this steam roll, this flexible member 4 being connected at one end to the steam roll and being wound on a take-up roll 3 when unwound from the steam roll. The flexible member 4 passes back and forth between the rolls 1 and 3 to carry the fabric 2 to and from the treating roll 1. This roll 1 turns in the direction of arrow 5 during winding of the flexible member 4 and fabric 2 therewith onto the roll 1, and during this time the flexible member 4 pulls on the take-up roll 3 to be unwound

therefrom and to turn this roll 3 in the direction of arrow 6. After treatment of the fabric, this fabric 2 is removed from the apparatus by rewinding of the flexible member 4 onto the take-up roll 3, and during this time the roll 1 is driven in the direction of arrow 7 while the take-up roll 3 is driven in the direction of arrow 8.

The drive is derived from an electric motor (not shown) which through any suitable transmission turns the gear 13 (Fig. 2) which is fixed to a shaft 12 that is turnably mounted for rotation about its axis on a side wall 53 of the machine. This gear 13 meshes with a gear 15 fixed to the shaft 14 which carries the steam roll 1 and turns the latter in accordance with the direction of rotation of the reversible electric motor, this shaft 14 being turnably supported by a bearing 51 also fixed to the side wall 53.

A gear 16 is fixed to the shaft 12 for rotation therewith and meshes with an intermediate gear 17 turnably mounted on the side wall 53 to turn a gear 18 meshing with this gear 17. The gear 18 is freely turnable on the shaft 19 supported by bearing 52 for rotation about its axis, this bearing 52 being carried by the side wall 53 and this shaft 19 carrying the take-up roll 3 so that this roll 3 and shaft 19 rotate together.

The turning moment of gear 18 is transmitted to shaft 19 through a friction clutch which in the example illustrated takes the form of a brake drum and brake band located in a housing 20 which is fixed to gear 18 for rotation therewith. This housing 20 includes a cover or plate 21 which turnably supports a pin 23 fixed to arms 24 and 25 to form a lever means therewith, the arm 25 being located within the housing 20 (Fig. 4) while the arm 24 is located outside of the housing 20 (Fig. 2). The arm 25 carries a pin passing through a loop at one end of brake band 26 of this friction clutch while a pin 27 fixed to the housing 20 passes through a loop at the opposite end of this brake band to maintain the latter about and against the brake drum 28 of the friction clutch. This brake drum 28 is fixed to the shaft 19. It is also possible to connect both ends of brake band 26 to a differential tensioning mechanism, as will be described below in connection with Fig. 6. The brake band 26 rotates together with the housing 20 and gear 18 about the shaft 19, and if this brake band 26 is tensioned sufficiently it presses against the brake drum 28 to rotate the latter and the shaft 19 therewith so that a drive is transmitted to this shaft 19 and take-up roll 3 carried thereby. The slippage of brake band 26 with respect to brake drum 28 will depend, on the one hand, upon the tension in the brake band and, on the other hand, upon the resistance presented by take-up roll 3 to turning movement of shaft 19.

The take-up roll 3 is braked by a brake apparatus which includes the brake drum 31 fixed to shaft 19, this braking action taking place during winding of the flexible member 4 onto the steam roll 1 which produces a pull in the flexible member 4 which rotates the take-up roll 3 and shaft 19 therewith. A brake band 34 is located about and in engagement with the brake drum 31 to cooperate therewith (Figs. 2 and 3), this brake band 34 having one looped end through which a rod 35 passes. This rod 35 is turnably mounted for rotation about its axis on the stationary support means of the machine, as shown in Fig. 2, and a pair of arms 36 and 37 are fixed to the rod 35 for rotation therewith to form a lever means for varying the tension in brake band 34, the arm 37 being bent so as to extend in different directions and being made up of a plurality of interconnected parts, as shown in Figs. 2 and 3, while the arm 36 carries a pin extending through a looped end of band 34 opposite from the looped end thereof through which the rod 35 passes. As is apparent from Fig. 3, the arm 37 has an elongated free end portion distant from brake band 34 and carrying a weight 38 which is shiftable along arm 37 to regulate the size of the braking force.

If the braking force of brake apparatus 31, 34 is constant and not regulated in accordance with the decreas-

ing diameter of the flexible member 4 on take-up roll 3 during unwinding thereof from the take-up roll, the tension in the flexible member 4 will constantly increase in order to overcome the braking force to unwind the flexible member 4 from roll 3 because the diminishing diameter of the winding on roll 3 results in a constantly diminishing moment arm which requires an increased tension in the flexible member to overcome such a constant braking force produced by the brake 31, 34. In accordance with the present invention, however, the brake apparatus 31, 34 is controlled by an apparatus connected to shaft 19 in such a way that the braking force constantly diminishes in correspondence with the diminishing diameter of the winding of flexible member 4 on roll 3, so that a constant tension is maintained in the flexible member 4, this tension being sufficient to overcome the braking force and maintain the roll 3 in rotation. For this purpose, a gear 39 is fixed to the shaft 19 and meshes with a gear 41 which is freely turnable on a control shaft 40 which is parallel to the shaft 19. The turning moment of gear 41 is transmitted to shaft 40 through a differential mechanism which includes a planetary gear 42 turnably carried by gear 41 and meshing, on the one hand, with a gear 44 fixed to the shaft 40 and on the other hand with a gear 43 which is held against rotation, during normal operation of the apparatus, in a manner described below (Fig. 2). The gears 43 and 44 are of the same diameter but have different numbers of teeth. In actual practice one of these gears has one tooth more than the other of these gears, so that during one rotation of planetary gear 42 the gear 44 turns through a distance of one tooth.

The right end portion 45 of shaft 40, as viewed in Fig. 2, is threaded and is in threaded engagement with a nut 46 having a pair of opposite pins 47 fixed thereto and extending therefrom. These pins 47 extend into the slotted ends of a bifurcated lever arm 48 which is fixed to a pin 49 that is turnably carried by a pair of arms 50 which are fixed to a sleeve 55 which is in turn fixedly mounted on a tubular member 54 which is fixed to and carried by the side wall 53. Lever arms 56 and 71 are also fixed to this turnable pin 49 so that the parts 48, 49, 56, and 71 form a lever means which turns about the axis of pin 49 carried by the stationary arms 50. The lever arm 71 forms an extension of the lever arm 48.

Lever arm 56 is linked at its lower end to a control rod 57 which extends upwardly and passes through an eye 60 formed on the free end of lever arm 37, as shown in Fig. 3. A collar 59 is fixed to the control rod 57 and may have its location along the length of this control rod adjusted, and a coil spring 58 extends about rod 57, bears at one end against collar 59 and at the opposite end against eye 60 so that the control rod 57 is in this way interconnected with the lever means 35-37 for controlling the tension in the brake band 34.

The above described apparatus operates as follows:

When the fabric 2 is to be wound onto the steam roll 1 together with the elongated flexible member 4, the steam roll 1 is driven so as to rotate in the direction of arrow 5 and pulls the flexible member 4 from the take-up roll 3 which is set into rotation in the direction of arrow 6 by the pull of the flexible member 4. Since at the beginning of this operation the winding of the flexible member 4 on the take-up roll 3 has, for example, a diameter of approximately 800 mm., the tension of the flexible member 4 acts on the roll 3 with a lever arm, at the beginning of this operation, of approximately 400 mm. and therefore exerts a relatively large turning moment. With a constant tension in the flexible member 4, it is evident that the turning moment acting on the take-up roll 3 will continually reduce with the diminishing diameter of the winding of flexible member 4 on the roll 3 during the time when this flexible member 4 is being wound onto the steam roll 1, so that at the end of this process where the diameter of the winding on the take-up roll has been reduced, for example, to a di-

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ameter of approximately 200 mm., the tension of the flexible member 4 acts at this time only with a relatively small lever arm of approximately 100 mm.

The control of the brake 31, 34 is carried out so that the nut 46 at the beginning of the winding of the member 4 onto the roll 1 is located at the extreme right position shown in Fig. 2. At this time the control rod 57 is in its lowest position at which the full force of weight 38 acts on the lever arm 37 to produce the greatest tension in the brake band 34, so that the braking force is greatest at this time. Because of the rotation of the take-up roll 3 in the direction of arrow 6, this rotation being induced by the pull of the flexible member 4 being wound onto the steam roll 1, the shaft 19 is also rotated in the direction of arrow 6 and causes the brake drum 31 to also rotate together with the roll 3 and shaft 19. At the same time the gear system 39, 41, 42, 43, 44 of the control shaft 40, 45 causes the latter to turn in the direction of arrow 61 of Fig. 5 so that the nut 46 moves in the direction of arrow 62 (Fig. 2) from the illustrated right-hand position toward its leftmost position. This leftmost position of the nut 46 is attained when the desired amount of fabric 2 has been wound together with the flexible member 4 onto the steam roll 1 and when a residual, relatively short length of flexible member 4, which always is located on take-up roll 3, remains thereon.

During this uniform leftward movement of the nut 46, the lever means 48, 56, 71 turns together with the pin 49 in the direction of arrow 63 of Fig. 2 about the axis of pin 49 so as to slowly raise the control rod 57. The spring 58 moves upwardly with the control rod and raises the free end of lever arm 37 against the action of weight 38 and in this way continually reduces the braking force which resists turning of the take-up roll 3. By proper adjustment of the collar 59 this reduction in the braking force can take place in such a way that the tension in the flexible member 4 remains constant from the beginning to the end of the winding of the flexible member 4 onto the steam roll 1, even though the tension in the flexible member 4 acts on the take-up roll 3 with a continually diminishing lever arm.

At the end of this part of the process, and after treatment of the fabric 2, the direction of the drive is reversed so that the steam roll 1 is turned in the direction of the arrow 7 and the take-up roll 3 is driven in the direction of the arrow 8, and the control shaft 40 also turns in an opposite direction, that is, in the direction of arrow 64 shown in Fig. 5. The nut 46 therefore moves to the right during this phase of the process, in the direction of arrow 65 of Fig. 2, and the lever arms 48, 56 return to the position illustrated in Fig. 2.

An adjusting apparatus is provided to adjust the turning stroke of the lever arms 48 and 56 so that this stroke exactly corresponds with the winding and unwinding of the flexible member 4 onto and off from the steam roll 1. This adjusting apparatus takes the form of an elongated sleeve 66 fixed to and extending from the hub of gear 43 and terminating in a worm wheel 67 or being fixedly connected to such a worm wheel, this worm wheel 67 meshing with a worm 68 (Figs. 2 and 5). This worm 68 is fixed to a shaft 69 which is turnably carried by the stationary arms 50 and which is fixed to a hand wheel 70. During operation of the apparatus, the hand wheel 70 and worm 68 may be turned to turn the worm wheel 67, sleeve 66, and gear 43 so as to turn the shaft 40 with respect to the gear 41 to provide the above adjustment. It will be noted that the worm wheel 67 and worm 60 form a self-locking apparatus which prevents rotation of gear 43 except during such an adjustment.

The above-described apparatus can also serve the purpose of decreasing the slippage in the friction clutch 26, 28 (Figs. 2 and 4), during rewinding of member 4 onto the take-up roll 3, at a rate corresponding to the increasing diameter of the winding on roll 3 so as to

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maintain a constant tension in the member 4 during this phase of the operation also. The lever arm 71, which forms an extension of lever arm 48, is provided with a top bifurcated end having slots into which pins 72 extend, these pins being fixed to a control sleeve 73 which is axially shiftable along the shaft 19' coaxial with shaft 19 and fixed to plate 21 of housing 20 for rotation therewith, as shown in Fig. 2. This sleeve 73 is connected to a conical control member 74, and a roller 75 bears against the outer surface of this conical member 74 which is shiftable together with sleeve 73 along the shaft 19'. The roller 75 is turnably mounted on the end of a lever 76 which is turnably mounted on a pin 77 fixed to the cover 21 of the housing 20, the end of lever 76 distant from roller 75 engaging a spring 78 which is located between lever 76 and lever arm 24, so that in this way the tilting of lever 76 about the axis of pin 77 is transmitted to the lever arm 24. As is shown in Fig. 4, a pin which is pivotally connected to the right end of lever 76 extends through the spring 78 and extends slidably into a bore of a member pivotally connected to the right free end of lever arm 24, as viewed in Fig. 4, so that motion is transmitted to lever arm 24 from lever 76 only through the spring 78.

It is believed to be apparent that if the shaft 19 were rotated with a constant turning moment during rewinding of member 4 onto roll 3, the increasing diameter of the winding on the take-up roll 3 would result in an increasing tension in the flexible member 4, and at the same time the diminishing circumferential speed of the winding leaving the steam roll 1, resulting from the decrease in the diameter of this latter winding, also would result in an increase in the tension of member 4 during rewinding thereof, which would cause the convolutions of the winding of member 4 on the take-up roll 3 to be pressed toward each other with an increasing force as the diameter of the winding on take-up roll 3 increases. In contrast to this undesirable operation, the apparatus of the invention operates as follows:

At the beginning of the rewinding the control sleeve 73 is located in its unillustrated right end position, as viewed in Fig. 2, so that the roller 75 is located at the left end of conical member 74, as viewed in Fig. 2, this roller 75 being maintained in engagement with the outer surface of conical member 74 by the spring 78. This is the position of the apparatus when the rewinding starts, and at this position the spring 78 exerts only a relatively weak force against the lever arm 24 so that the brake band 26 of the friction clutch is only tensioned to a relatively small degree. This relatively low tension is, however, adjusted so as to be sufficient to produce a desired tension in the flexible member 4 which is connected to the almost empty take-up roll 3 with a relatively small lever arm. The control apparatus of the invention causes the tension in the brake band 26 to be gradually increased as the rewinding stage of the process proceeds so that the slippage between members 26 and 28 decreases as the diameter of the winding on take-up roll 3 increases to provide the tension in the member 4 with a constantly increasing lever arm. This result is produced by movement of the nut 46 to the right along threaded portion 45 of control rod 40 which turns the lever arms 48, 71 in a counterclockwise direction about the axis of pin 49, as viewed in Fig. 2, to shift control sleeve 73 and conical member 74 to the left, as viewed in Fig. 2, to the illustrated leftmost position thereof so that the roller 75 comes in contact with portions of conical member 74 which are increasing in diameter. This results in a turning of lever 76 which, through the spring 78, causes a continual turning of lever arm 24 in the direction of arrow 79 of Fig. 4 so as to tension the brake band 26 to reduce the slippage of the latter with respect to the drum 28. In this way the friction clutch 26—28 transmits to the shaft 19 a constantly increasing turning moment during this rewinding phase

of the operation and in this way also the tension in the flexible member 4 is maintained constant.

It should be noted that at the start of the rewinding operation, when the take-up roll 3 is provided with the shortest length of member 4 and has a diameter, for example, of about 200 mm., the drive passing from gear 18 through the friction clutch 26, 28 to the shaft 19 is still sufficient to rotate the take-up roll 3 with a peripheral speed which is greater than that with which the flexible member leaves the steam roll 1, since otherwise it would not be possible to provide any tension in the flexible member 4 during rewinding thereof. At this time the band 26 is lightly tensioned since the transmission ratio between the diameter of drum 28 and the relatively small diameter of roll 3 requires only a small force to produce the desired and required tension in the flexible member 4 at the beginning of the rewinding thereof. At the start of the rewinding phase, the brake band 34 is at its lowest tension and provides almost no resistance to the turning of roll 3 and shaft 19. As the rewinding phase continues, the drive transmitted to the take-up roll tends to provide the latter with an increasing peripheral speed due to the increasing diameter of the winding on this take-up roll. This is not possible, however, because the directly driven steam roll 1 cannot unwind the flexible member 4 at an increasing rate of speed and instead unwinds the member 4 at a decreasing rate of speed because of the constantly diminishing diameter of the flexible member 4 on the steam roll 1 during this rewinding phase. This action would result in an increasing tension in the flexible member 4 and would necessarily produce a nonuniform winding on the take-up roll in spite of the fact that the drive is transmitted to the shaft 19 through a friction clutch operating with slip, if this friction clutch provided a constant turning moment. In order, however, to maintain the tension in the flexible member 4 constant during this phase of the operation, the turning moment transmitted to the take-up roll 3 is continually influenced and changed by the increasing tension in the band 26 so that a desired tension is maintained in the member 4 depending on the manner in which the band 26 is tensioned.

The turning force transmitted to the shaft 19 and roll 3 must be increased during operation of the brake 31, 34 by an amount corresponding to the energy which is used up by this brake. This increase of turning force would be unnecessary if the brake apparatus 31, 34 were provided with a one-way drive which rendered the braking force ineffective during the rewinding phase. During this rewinding phase, the band 26 rotating with the gear 18 slips on the drum 28 and at the same time the stationary brake band 34 slips with respect to the brake drum 31, which in the illustrated example is not provided with any one-way drive.

This process continues until the flexible member 4 is rewound onto the take-up roll 3. During this rewinding phase, because the brake 31, 34 has no one-way drive, it has been turned through the control apparatus of the invention to its maximum braking force required for the succeeding winding of the flexible member 4 onto the steam roll 1, and this required maximum braking force can be easily determined by experiment. The tensioning of band 26 to decrease the slippage in the friction clutch takes place simultaneously and automatically from the same control apparatus which controls the brake apparatus 31, 34.

When the fabric 2 is to be wound together with the flexible member 4 onto the steam roll 1, the drive apparatus would turn the take-up roll 3 with a peripheral speed greater than that of the steam roll 1, if the friction clutch were fully engaged so as to operate without slip and if no braking force were applied at this time, and this would produce a slack in the flexible member 4 before the latter arrives at the steam roll 1. This undesirable result is prevented, however, by controlling the

brake 31, 34 in the above described manner and also through the above described control of the friction clutch 26, 28. Actually, the friction clutch is not essential during the winding of the flexible member 4 onto the steam roll 1, and this friction clutch could be disconnected during this phase of the operation by any suitable one-way drive mechanism, if desired. However, where a particularly delicate fabric is to be treated, a softness in the winding of the flexible member on the steam roll is desired and can only be obtained by a tension in the flexible member 4 which is below that tension which is required to overcome the minimum braking force acting on the take-up roll 3 in order to prevent any undesirable rotation of the take-up roll 3 after the machine is stopped. For this reason, a continuous drive on the take-up roll 3, even during the winding of the flexible member 4 onto the steam roll 1, is of advantage, even if the driving force is relatively low.

Fig. 6 schematically illustrates a particularly desirable form of friction coupling which is capable of providing a smaller driving force on take-up roll 3 when the flexible member 4 is being wound onto the steam roll 1 than when this flexible member is being rewound onto the take-up roll 3. According to this embodiment of the invention, the pin 27 shown in Fig. 4 is replaced by a pivot pin 104 which is turnably carried by the housing 20 and which is fixed to a two-armed lever 105, 106 located outside of the housing 20, this pin 104 being turnably mounted on the housing 20 and the cover 21 thereof in the same way as the pin 23 which is fixed to the arms 24 and 25. With the embodiment of the invention shown in Fig. 6, the housing 20 and its cover 21 are not fixed to the gear 18 for rotation therewith and instead are freely turnable on the shaft 19. Turning movement is transmitted to the housing 20, 21 through the medium of a pin 107 which is fixed to the gear 18 and which cooperates with the free ends of the arms 105 and 106 of the lever 105, 106, as shown in dotted lines in Fig. 6. Depending upon the the direction of rotation of gear 18, the pin 107 will engage one or the other of the arms 105 and 106 to urge these arms respectively against the stops 108 or 109 fixed to the housing 20 so that in this way the rotation of gear 18 is transmitted to the housing 20. The lever means 23, 24, 25 operates in this embodiment of the invention in the same way as in the embodiment illustrated in Figs. 2 and 4. As is shown in Fig. 6, the housing 20 is provided with several openings to receive the stop member 109 so that the position of this stop member is adjustable.

The turnable pin 104, in addition to being fixed to the level 105, 106 is also fixed to a lever arm carrying a pin which extends through a looped end of the band 26. Therefore, with the apparatus in the position illustrated in Fig. 6, where the arm 105 is located against the stop 108, the band 26 is tensioned and the housing 20 rotates together with the gear 18 in the direction of arrow 110, this being the direction of rotation during the rewinding of the flexible member 4 onto the take-up roll 3. When the apparatus operates to wind the flexible member 4 onto the steam roll 1, the apparatus of Fig. 6 rotates in the direction of arrow 111, the arm 106 engaging the stop 109 at this time, and it is apparent that the pin 104 together with the arm connected to band 26 and the lever 105, 106, will be turned through a predetermined angle in a clockwise direction about the axis of pin 104, as viewed in Fig. 6, from the position shown in Fig. 6 so that the band 26 will be loosened substantially during this phase of the operation, and at this time a very small drive is transmitted through the friction clutch to the shaft 19, the turning force delivered by this friction clutch at this time being always below the predetermined minimum braking force of the brake 31, 34, and contributing to the desired low tension in the flexible member 4 which is required to obtain a soft winding of this flexible member on the steam roll 1. It is apparent

that this form of friction clutch may easily be adapted to the widest variations in the size of the braking force of the brake 31, 34, and it is immaterial whether or not the control apparatus adjusts the braking force within wide limits.

Irrespective of whether the friction clutch of Fig. 2 or that of Fig. 6 is used, the control apparatus operates in the same manner as was described above, so that the braking force provided by the brake 31, 34 constantly diminishes during winding of flexible member 4 onto the steam roll 1 and so that the band 26 of the friction clutch of Fig. 2 or Fig. 6 constantly slips to an increasing extent during this phase of the operation, and in this way during the entire time that the flexible member 4 is being wound onto the steam roll 1, the tension in this flexible member is maintained at a desired value and furthermore the clutch and brake assume, at the end of the winding of the flexible member 4 onto the steam roll 1, a position which is required for the start of the rewinding operation. At the end of the winding of the flexible member 4 onto the steam roll 1, the nut 46 reaches its leftmost position and engages and actuates the operating member 103 which mechanically or electrically either reverses the drive of the apparatus or shuts it off. In this way, the desired unwinding of flexible member 4 from take-up roll 3 is guaranteed, and the proper operation of the control apparatus is assured.

Fig. 7 of the drawings diagrammatically illustrates a further embodiment of the apparatus for controlling the take-up roll 3. The embodiment of Fig. 7 includes, in the same way as the above described structure, the take-up roll 3 which is carried by the turnably supported shaft 19 which also has fixed thereto the brake drum 31 which cooperates with a brake band 34. This shaft 19, however, is not driven through a friction clutch. Instead a differential mechanism is provided to transmit a drive to the shaft 19. The gear 18 of Fig. 7 is driven in the same way as the gear 18 of Fig. 2 but has supporting arms 80 fixed thereto, these arms 80 turnably carrying the planetary bevel gears 81 which mesh, on the one hand, with a sun gear 82 fixed to the shaft 19 and, on the other hand, with a sun gear 83 which is freely turnable on the shaft 19. This latter sun gear 83 is fixed to an elongated sleeve 84 which carries a brake drum 85, comprising a friction clutch, which cooperates with a pair of brake shoes or with the brake band 86 which is shown in the structure of Fig. 7.

The apparatus for controlling the operation of brake 31, 34 and the differentially driven brake 85, 86 includes a worm 87 fixed to the shaft 19 for rotation therewith and meshing with a worm wheel 88. This worm wheel is carried by a shaft 89 to which a sprocket wheel 90 is fixed, and a chain drive 91 extends from the sprocket wheel 90 to the sprocket wheel 92 which is carried by the turnable shaft 93 which produces the desired adjustment in the tensioning of the brake band 34 or in a pair of brake shoes which may replace this brake band, if desired. For example, the shaft 93 may have oppositely threaded portions cooperating with a pair of nuts, respectively, which are respectively connected to opposite ends of the brake band 34 so that during rotation of shaft 93 these nuts move toward or away from each other to respectively loosen or tension the band 34.

The apparatus is so arranged that during winding of flexible member 4 onto the steam roll 1, the shaft 19 is turned in the direction of arrow 6 of Fig. 1 by the pull of this flexible member so as to turn the worm 87 to cause the braking force of the brake 31, 34 to decrease so that with a decreasing diameter of the windings on the take-up roll, resulting in a decreasing turning moment produced by the tensioned flexible member 4. A decreasing braking force is required to be overcome by the flexible member 4, and therefore the tension in this flexible member is held constant during the entire duration of this phase of the operation.

A second chain drive 94 extends from another sprocket wheel 90 fixed to the shaft 89 to the sprocket wheel 95 which is fixed to a shaft 96 which is turnably mounted for rotation about its axis and which may have oppositely threaded portions cooperating with nuts connected respectively to the opposite ends of band 86 for tensioning or loosening this band in the same way that band 34 of Fig. 6 is loosened or tensioned when the shaft 93 is turned in opposite directions. This control is so arranged that the brake band 86 is only lightly tensioned to provide a relatively small braking force at the beginning of the rewinding of the flexible member 4 onto the take-up roll 3 and as a result only a small turning moment is transmitted from the driven gear 18 to the sun gear 82 which is fixed to the shaft 19 so as to rotate the take-up roll 3 at a speed sufficient to produce the desired tension in the flexible member 4 which is only wound to a very small extent on the take-up roll 3 at this time.

If the force of brake 85, 86 were maintained constant during rewinding of the flexible member 4 onto the take-up roll 3, then the turning force transmitted to the shaft 19 during this rewinding would be insufficient to maintain the desired constant tension in the flexible member 4 and would cause the outer convolutions of the windings to become progressively looser. This would cause the winding of the take-up roll to be pulled together during the succeeding winding of the flexible member 4 onto the steam roll 1 and would cause the convolutions to undesirably shift and rub against each other, and also the tension in the flexible member would be impossible to control under these circumstances so that a non-uniform winding on the steam roll 1 would result and produce an undesirable processing of the fabric.

These disadvantages are avoided with the structure of the invention because the control of the brake band 86 causes the latter to become increasingly tensioned as the diameter of the winding on the take-up roll 3 increases so as to reduce the slippage between brake band 86 and brake drum 85 and so as to gradually increase the turning moment transmitted to shaft 19 and take-up roll 3 through the sun gear 82. This result is produced because as the braking force of brake 85, 86 increases, the sun gear 83 resists rotation to a greater degree so that a larger turning moment is transmitted to the sun gear 82. In this manner the tension in the flexible member 4 can be maintained constant during the entire operation of the machine.

Although it is possible to use apparatus different from that described above to accomplish the desired results, the brake 31, 34 and the provision of a friction clutch in the form of a brake band and brake drum have proved to be particularly successful. With this friction clutch, which includes the drum 28 and band 26, it is essential that this band rotate in the same direction as the drum 28 so that only a small relative difference in the rotation speeds of drum 28 and band 26 will produce the desired braking action.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of apparatus for winding and unwinding flexible members differing from the types described above.

While the invention has been illustrated and described as embodied in apparatus for winding and unwinding flexible members of textile machines and the like, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this inven-

tion and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a machine for processing textiles, in combination, support means; a roll turnably mounted on said support means; an elongated flexible member wound on said roll and adapted to be pulled from and rewound on said roll; brake means operatively connected to said roll for resisting rotation thereof so as to tension said flexible member while the latter is pulled from said roll; drive means operatively connected to said roll for turning the latter to rewind said flexible member, said drive means including a friction clutch for transmitting a drive to said roll; and control means operatively connected to said brake means and said friction clutch for gradually decreasing the braking force of said brake means during unwinding of said flexible member from said roll so as to maintain the tension in the flexible member substantially constant, and for gradually decreasing the slippage in said friction clutch during rewinding of said flexible member onto said roll so as to also maintain the tension in said flexible member substantially constant during rewinding thereof onto said roll.

2. In a machine for processing textiles, in combination, support means; a roll turnably mounted on said support means; an elongated flexible member wound on said roll and adapted to be pulled from and rewound on said roll; brake means operatively connected to said roll for resisting rotation thereof so as to tension said flexible member while the latter is pulled from said roll; drive means operatively connected to said roll for turning the latter to rewind said flexible member on said roll, said drive means including a friction clutch for transmitting a drive to said roll; and control means operatively connected to said brake means for reducing the braking force thereof at a rate which maintains the braking force at a value which is overcome by a turning moment equal to a constant tension in said flexible member multiplied by the diminishing moment arm produced by unwinding of said flexible member from said roll, said control means also being operatively connected to said friction clutch for decreasing the slip thereof and increasing the turning moment thereof at a rate which equals the resistance produced by the constant tension in said flexible member multiplied by the increasing moment arm provided by the increasing diameter of said flexible member during rewinding thereof on said roll.

3. In a machine for processing textiles, in combination, support means; a roll turnably mounted on said support means; an elongated flexible member wound on said roll and adapted to be pulled from and rewound on said roll; brake means operatively connected to said roll for resisting rotation thereof so as to tension said flexible member while the latter is pulled from said roll; drive means operatively connected to said roll for turning the latter to rewind said flexible member on said roll, said drive means including a friction clutch for transmitting a drive to said roll, said friction clutch being in the form of a brake drum fixed to said roll for rotation therewith and a brake band frictionally engaging said brake drum; and control means operatively connected to said brake means for reducing the braking force thereof at a rate which maintains the braking force at a value which is overcome by a turning moment equal to a constant tension in said flexible member multiplied by the diminishing moment arm produced by unwinding of said flexible member from said roll, said control means being operatively connected to said brake band for tensioning the latter and increasing the turning moment of said friction clutch at a rate which equals the resistance produced by the constant tension in said flexible member multiplied by the increasing moment arm

provided by the increasing diameter of said flexible member during rewinding thereof on said roll.

4. In a machine for processing textiles, in combination, support means; a roll turnably mounted on said support means; an elongated flexible member wound on said roll and adapted to be pulled from and rewound on said roll; brake means operatively connected to said roll for resisting rotation thereof so as to tension said flexible member while the latter is pulled from said roll; drive means operatively connected to said roll for turning the latter to rewind said flexible member on said roll, said drive means including a friction clutch for transmitting a drive to said roll, said friction clutch being in the form of a brake drum fixed to said roll for rotation therewith and a brake band frictionally engaging said brake drum; and control means operatively connected to said brake means for reducing the braking force thereof at a rate which maintains the braking force at a value which is overcome by a turning moment equal to a constant tension in said flexible member multiplied by the diminishing moment arm produced by unwinding of said flexible member from said roll, said control means being operatively connected to said brake band for tensioning the latter and increasing the turning moment of said friction clutch at a rate which equals the resistance produced by the constant tension in said flexible member multiplied by the increasing moment arm provided by the increasing diameter of said flexible member during rewinding thereof on said roll, said control means comprising a first lever means connected to said brake band for regulating the tension therein, a spring engaging said first lever means, a second lever means engaging said spring for actuating the same to regulate the position of said first lever means and thereby control the tension in said brake band, and a conical member mounted on the machine for movement along an axis parallel to the axis of rotation of said roll and engaging said second lever means for controlling the compression of said spring.

5. In a machine as defined in claim 3, said roll being mounted on a shaft which is turnably mounted on the machine for rotation about its axis and said brake drum being fixed to said shaft, a plate connected to said drive means to be rotated thereby and being freely turnable on said shaft next to said brake drum, a first lever means turnably mounted on said plate and being connected to said brake band for regulating the tension thereof, a second lever means turnably mounted on said plate and located opposite said first lever means, a spring located between said first and second lever means to be compressed by said second lever means for turning said first lever means, a second shaft coaxial with said first-mentioned shaft and fixed to said plate to rotate therewith, and a conical member mounted on said second shaft for free axial movement therealong, said conical member engaging said second lever means for turning the latter during shifting of said conical member along said second shaft, said first and second lever means, spring, and conical member all forming part of said control means.

6. In a machine for processing textiles, in combination, support means; a shaft turnably mounted on said support means; a roll fixed to said shaft for rotation therewith; an elongated flexible member mounted on said roll and adapted to be pulled from and rewound on said roll; a drive gear freely mounted on said shaft for rotation thereabout; drive means comprising a first sun gear fixed to said shaft, a pair of planetary gears meshing with said first sun gear and being carried by said drive gear for rotation therewith, a second sun gear meshing with said planetary gears and being located on said shaft for free rotation with respect to the same, and a friction clutch comprising a brake drum fixed to said second sun gear for turning movement therewith and a brake band located against said brake drum; brake means operatively con-

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ected to said roll for resisting rotation thereof so as to tension said flexible member while the latter is pulled from said roll; and control means operatively connected to said brake means for reducing the braking force thereof at a rate which maintains the braking force at a value which is overcome by a turning moment equal to a constant tension in said flexible member multiplied by the diminishing moment arm produced by unwinding of said flexible member from said roll, said control means being also operatively connected to said brake band for increasing the pressure thereof against said brake drum at a rate which resists turning movement of said second sun gear to turn said first sun gear with an increasing turning moment equal to the resistance produced by the constant tension in said flexible member multiplied by the increasing moment arm provided during rewinding of said flexible member on said roll.

7. In a machine as defined in claim 6, transmission means interconnecting said shaft and control means for operating the latter by rotation of said shaft carrying said roll.

8. In a machine as defined in claim 2, a first shaft turnably mounted on the machine and carrying said roll, said control means comprising a second shaft parallel to said first shaft and rotatably mounted on the machine, a first gear freely turnable on said second shaft and being operatively connected to said first shaft to be rotated thereby, a second gear fixed to said second shaft, a third gear carried by said first gear for free rotation thereon about an axis parallel to said second shaft and for turning movement therewith about the axis of said second shaft, said third gear meshing with said second gear, a fourth gear located on said second shaft for free rotation thereabout and meshing with said third gear, and self-locking worm and worm wheel means operatively connected to said fourth gear for turning the latter and for maintaining the same stationary when said worm and worm wheel means is not operated.

9. In a machine as defined in claim 8, a portion of said second shaft being threaded and said control means including a lever system turnably mounted on the machine and a nut threadedly engaging said threaded portion of said second shaft and being connected to said lever system for operating the latter during rotation of said second shaft.

10. In a machine as defined in claim 9, second control means for controlling said drive means and being located in the path of movement of said nut to be actuated by the latter.

11. In a machine for processing textiles, in combination, support means; a roll turnably mounted on said support means; an elongated flexible member wound on said roll and adapted to be pulled from and rewound on said roll; brake means operatively connected to said roll for resisting rotation thereof so as to tension said flexible member while the latter is pulled from said roll; drive means operatively connected to said roll for turning the latter to rewind said flexible member on said roll, said drive means including a friction clutch for transmitting a drive to said roll, said friction clutch being in the form of a brake drum fixed to said roll for rotation therewith and a brake band frictionally engaging said brake drum and being carried by said drive means for rotation in the same direction as said brake drum; and control means operatively connected to said brake means for reducing the braking force thereof at a rate which maintains the braking force at a value which is overcome by a turning moment equal to a constant tension in said flexible member multiplied by the diminishing moment arm produced by unwinding of said flexible member from said roll, said control means being operatively connected to said brake band for decreasing the tension therein and decreasing the turning moment of said friction clutch during pulling of said flexible member from said roll and for tensioning said brake band and increasing the turn-

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ing moment of said friction clutch at a rate which equals the resistance produced by the constant tension in said flexible member multiplied by the increasing moment arm provided by the increasing diameter of said flexible member during rewinding thereof on said roll.

12. In a machine as defined in claim 11, means supporting both ends of said brake band for adjustable movement, said control means being operatively connected to one of said ends of said brake band, and an adjusting means operatively connected to the other of said ends of said brake band for changing the tension therein when the direction of the rotation of said roll and said brake drum therewith changes.

13. In a machine as defined in claim 12, said roll and brake drum being fixed on a shaft turnably mounted on the machine and said drive means comprising a gear freely turnable on said shaft and located adjacent said brake drum and a brake housing also freely turnable on said shaft and located about said brake drum, said adjusting means comprising a lever turnably mounted on said housing and connected to said other end of said brake band, stop means for limiting the turning movement of said lever with respect to said housing, and a pin fixed to said gear and engaging said lever for turning the latter in opposite directions with respect to said housing when the direction of rotation of said gear changes.

14. In a machine for processing textiles, in combination, support means; a first shaft turnably mounted for rotation about its axis on said support means; a roll fixed to said first shaft for rotation therewith; an elongated flexible member wound on said roll and adapted to be pulled from and rewound on said roll; a brake drum fixed to said first shaft for rotation therewith; a brake band having opposite free ends and being located about and in engagement with said brake drum; a rod mounted for rotation about its axis on said support means and being connected to one of said free ends of said brake band; first lever means fixed to said rod for rotation therewith, having one free end connected to the other of said ends of said brake band, and having an elongated opposite free end portion located distant from said brake band; a weight mounted on said elongated opposite free end portion of said first lever means for tensioning said brake band; a second shaft turnably mounted for rotation about its axis on said support means and being parallel to said first shaft, said second shaft having a threaded portion; means for pulling said flexible member from said roll so as to turn the latter and said first shaft therewith against the action of said brake drum and brake band; transmission means interconnecting said first and second shafts to turn the latter upon rotation of said first shaft; a nut mounted on said threaded portion of said second shaft for movement therealong during rotation thereof; and second lever means interconnecting said first lever means with said nut for turning said first lever means against the action of said weight during unwinding of said flexible member from said roll to gradually reduce the friction between said brake band and brake drum.

15. In a machine as defined in claim 14, a gear mounted on said first shaft for free rotation with respect to the same and being connected to said drive means to be rotated thereby about said first shaft; a housing fixed to said gear for rotation therewith and being located about said first shaft; a second brake drum located within said housing and being fixed to said first shaft for rotation therewith; a second brake band located in said housing about and in engagement with said second brake drum and having opposite free ends one of which is connected to said housing; third lever means turnably mounted on said housing and being connected to the other of said ends of said second brake band; and control means operatively connected to said third lever means for gradually reducing the friction between said second brake band and second brake drum during unwinding of said flexible member

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from said roll and for gradually increasing the friction between said second brake band and second brake drum during rewinding of said flexible member onto said roll so as to transmit a drive to said roll for rewinding said flexible band thereon, said control means being operatively connected to said second lever means to be actuated thereby.

16. In a machine as defined in claim 15, said control means comprising a third shaft coaxial with said first shaft and fixed to said housing for rotation therewith, a conical member freely mounted on said third shaft for shifting movement therealong and being connected to said second lever means to be shifted thereby along said third shaft, fourth lever means turnably mounted on said housing, being located opposite said third lever means, and having a free end portion engaging said conical member to be turned during shifting movement of the latter along said third shaft, and a spring located between and engaging said third and fourth lever means for transmitting movement of the latter to said third lever means.

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667,474
839,261
1,549,585
1,654,800
1,716,879
1,786,917
1,849,383
2,091,756
2,199,594
2,228,710
2,271,049
2,401,982
2,555,162
2,680,573
2,693,322

866,687

16

References Cited in the file of this patent

UNITED STATES PATENTS

Wilson Feb. 5, 1901
Beraud et al. Dec. 25, 1906
Marcellus Aug. 11, 1925
Garbutt Jan. 3, 1928
Dworsky June 11, 1929
Oehmichen Dec. 30, 1930
Richardson et al. Mar. 15, 1932
Fodor Aug. 31, 1937
Kent May 7, 1940
Shaw Jan. 14, 1941
Treckmann et al. Jan. 27, 1942
Springhorn June 11, 1946
Stanford May 29, 1951
Monkley June 8, 1954
Mercier Nov. 2, 1954

FOREIGN PATENTS

Germany Feb. 12, 1953