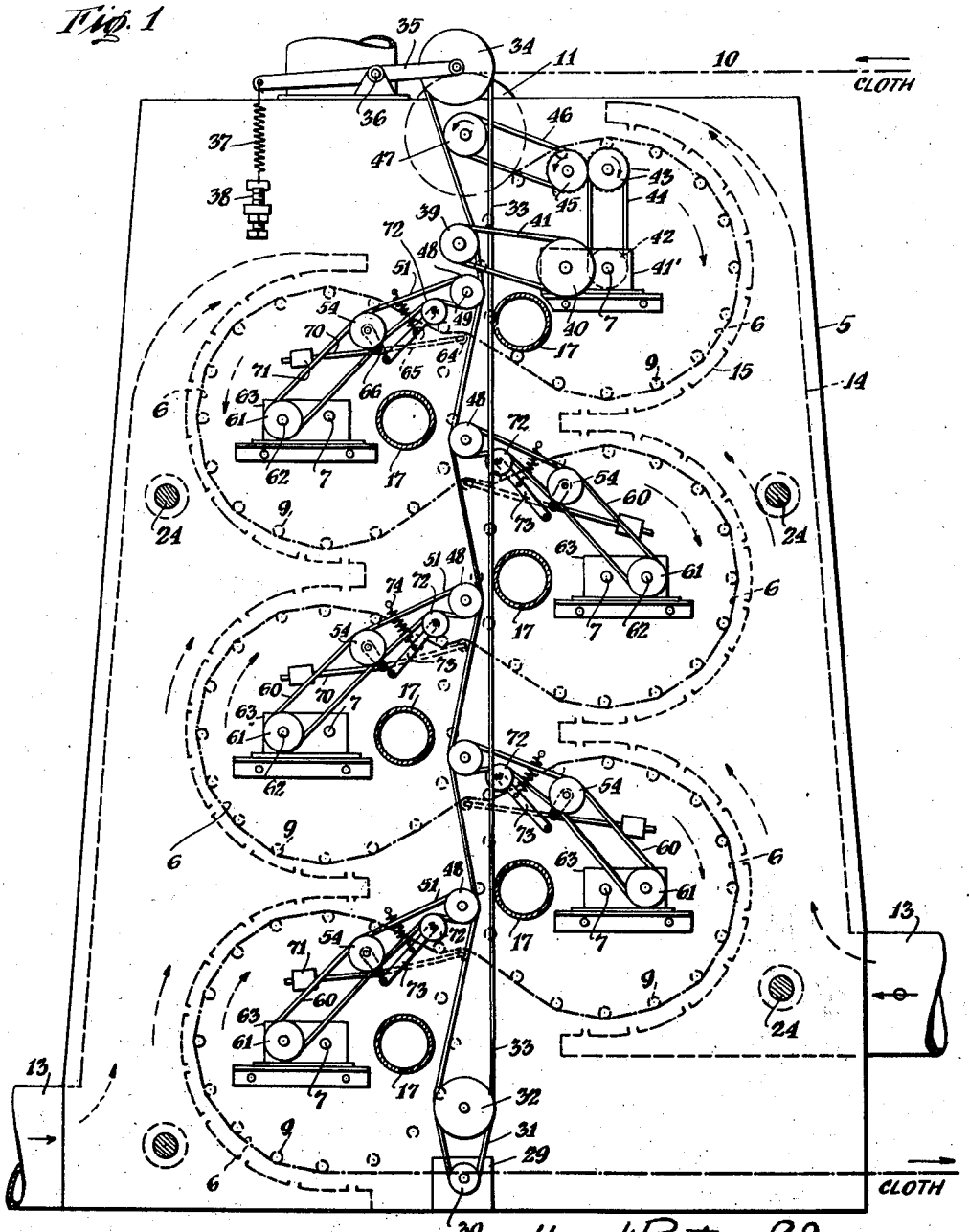
Sept. 23, 1947. H. W. BUTTERWORTH, JR., ET AL 2,427,943

APPARATUS FOR FEEDING AND DRYING FABRICS

Original Filed May 18, 1939 2 Sheets-Sheet 1

Fig. 1



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Fig. 2

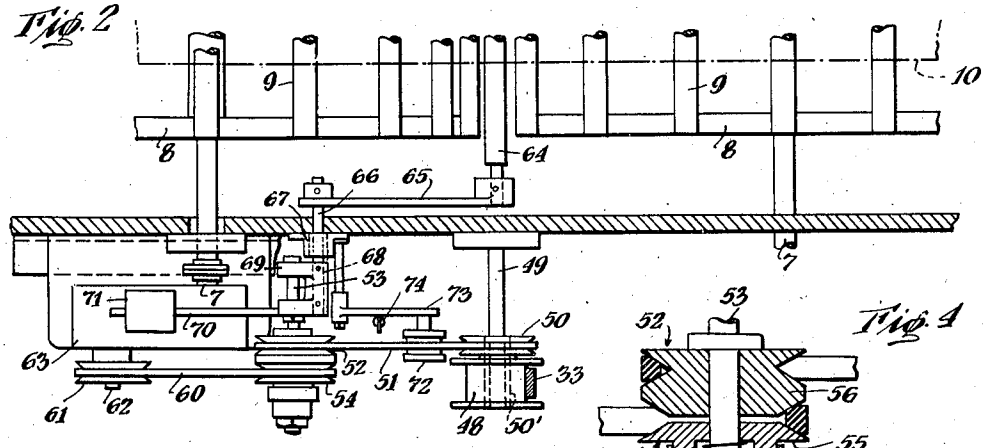


Fig. 4

Fig. 3

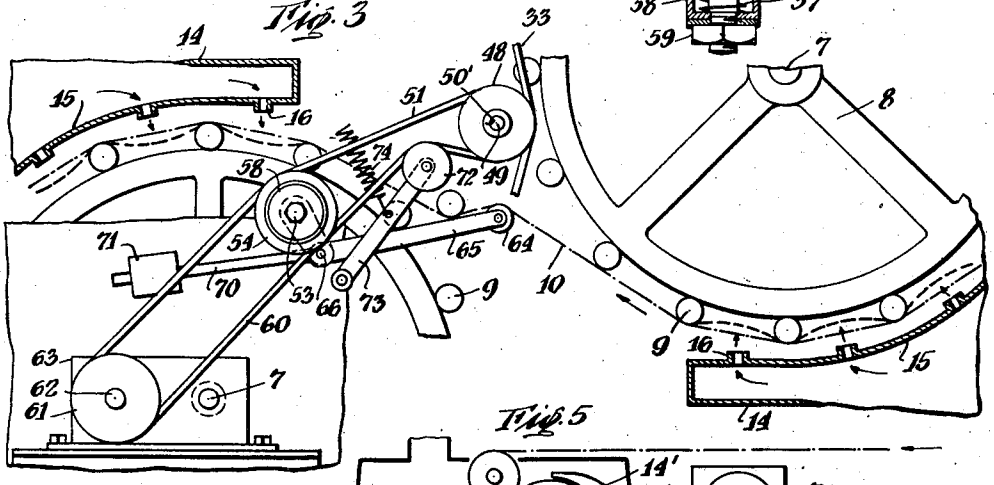
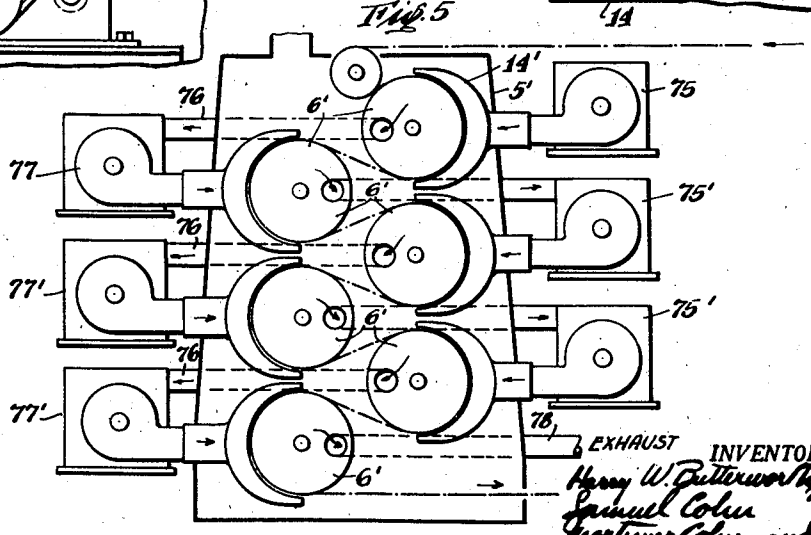


Fig. 5



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APPARATUS FOR FEEDING AND DRYING FABRICS

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3 Claims. (Cl. 271—2.3)

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This invention relates to a method of an apparatus for drying and conditioning textile fabrics. While the invention will be described more particularly in connection with the treatment of tubular knit rayon fabric, it may be utilized in handling knit, tubularized woven and flat knit and woven fabrics of rayon and fibers other than rayon to afford similar advantages.

Almost all textile fabrics, more particularly knit goods, while in the process of being dried, will either elongate or shrink of their own accord in their various dimensions. Knit fabric, and especially rayon fabric, is by nature very elastic and subject to distortion in handling unless special precautions are taken. This condition is particularly pronounced when the fabric is wet and it is both difficult to keep the fabric in flat condition free from wrinkles as well as to dry same without subjecting it to stretch. The wet fabric may, for example, if subjected to stresses during drying, be stretched beyond its elastic limit, with the result that a permanent set occurs in the individual fibers of the yarn and in the stitches. This results in difficulty because the finished fabric is non-uniform with respect to the natural stitch formation and the distortion of the wales or cross-lines, and it is impossible by further treatment to eliminate the distortion. Consequently, tension should be avoided in drying, to afford the full elasticity of the fabric in length and width when it is completed and to insure the proper appearance of the finished fabric.

Furthermore, it is desirable to avoid over-drying of the fabric which in its finished condition normally contains a given percentage of moisture, depending to some extent upon the nature of the fiber used. The appearance and hand of the fabric depend upon the retention of the normal moisture content. If it is over-dried, the moisture content may be normalized by steaming, but it is preferable to conduct the drying operation so that a proportion of moisture remains in the fabric as it leaves the dryer.

In some types of dryers the forming of wrinkles results in non-uniform drying and over drying. Again, the method of propulsion of the fabrics tends in many cases to create tension. In the loop or festoon type of dryer wherein the fabric hangs in loops from movable slats of a conveyor

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which carries the fabric through the drying chamber, beside the factor of uneven drying due to wrinkles and folds, the moisture present in the loops of fabric is sufficiently heavy plus the weight of the fabric itself, to create tension and the fabric is stretched unevenly.

It is the object of the present invention to provide a method of drying fabric wherein the fabric is supported and is advanced through the dryer, wherein it will either shrink or elongate of its own accord, in its various dimensions, naturally without creating any tension while the moisture is removed progressively and uniformly from the fabric, maintained in flat condition without wrinkles.

Another object of the invention is the provision of a method of drying in which the amount of moisture removed can be controlled easily to insure delivery of the fabric, properly conditioned, that is to say with a residuum of moisture which is adapted to closely approximate the natural moisture content of the fabric.

It is the further object of the invention to support the fabric as much as possible while it is being advanced and to allow the fabric itself to control the speed of the various reels over which it is progressed, to permit the natural shrinking or elongating of the fabric to take place.

A further object of the invention is the provision of a dryer affording means for advancing the fabric uniformly without tension and of delivering thereto large volume of air in such a manner as to progressively remove the moisture content of the fabric to the desired extent.

A further object of the invention is the provision of strip feeding apparatus in which the fabric is advanced at an automatically controlled linear speed with automatic control of the various elements which carry the fabric so as to prevent the application of tension at any portion of the fabric.

A further object of the invention is the provision of a drying apparatus in which the air feed can be adjusted with respect to the width of the fabric so that the apparatus may accommodate fabric of varying widths without loss or waste of air supplied.

Other objects and advantages of the invention will be apparent as it is better understood

by reference to the following specification and the accompanying drawing, in which

Fig. 1 is an enlarged vertical section diagrammatically illustrating the progress of the cloth over the drying reels and showing the driving mechanism for the reels;

Fig. 2 is a plan section illustrating details of the driving mechanism;

Fig. 3 is an elevation partially in section of the mechanism shown in Fig. 2;

Fig. 4 is an enlarged sectional view illustrating the variable speed mechanism; and

Fig. 5 is a diagrammatic view illustrating another arrangement of the inlet and outlet ducts for distributing air to the dryer.

As hereinbefore indicated, the invention depends upon the conveyance of the fabric at an automatically controlled linear speed at all sections thereof through the drying compartment wherein it is subjected to a large volume of air at high velocities applied and distributed so as to effect the maximum desired drying effect at an accelerated rate. In accomplishing this purpose, we have provided a drying chamber in which a rotary conveying means comprising a plurality of reels are mounted for rotation and adapted to support the fabric as it advances through the dryer. Preferably each of the reels subsequent to the first is driven through an automatic speed controlling mechanism, and the fabric is advanced over the series of reels without subjecting it to any tension, each subsequent reel thus constituting conveying means cooperating with the preceding reel. As the fabric advances, a large volume of air which may be heated to the desired temperature, is introduced and distributed at high velocities so that it is directed against and passes through the fabric and is withdrawn through a duct at the end of the reel. This air bearing a proportion of moisture removed from the fabric may be re-circulated in various ways, with or without the addition of fresh air, depending upon the amount of drying desired, the nature of the fabric, and the amount of moisture to be withdrawn therefrom.

Instead of withdrawing the air carrying moisture from all of the reels and returning the air to the air inlet, the method may be operated so that the air withdrawn from the first reel is delivered through a supplemental blower to a second reel and so on through the apparatus until the air is finally withdrawn from the last reel, after which it will have done all of the drying of which it is capable. In this procedure, the air undergoes a gradual temperature drop from reel to reel, and its relative humidity is greatly stepped up from reel to reel, so that by the time the air leaves the last reel its temperature, due to evaporation, is very low as compared to its original temperature, and its relative humidity is quite high, due to the moisture which has been absorbed in traveling through the fabric.

The same general result may be accomplished by employing two or more consecutive units for drying and delivering the air withdrawn from the several individual reels of the first unit to the reels of the second unit without intermediate heating or separation of moisture. Thus, in the second unit, through which the fabric passes, it is subjected to conditioning due to the higher moisture content of the air introduced thereto.

Other variations of the method may be employed, the fundamental condition being that the fabric is supported and advanced in a flat smooth condition without being subjected to tension and as it is advanced a large volume of air at high velocity is directed against the fabric, the temperature and moisture content of the air being adjusted in various ways, such as the introduction of fresh air, to insure delivery of the fabric free from surplus moisture. Since the weight of the fabric itself while being advanced and the moisture it contains are factors inducing tension, they are off-set by the considerable support given to the fabric in its position on each reel.

While details of the apparatus may be varied in carrying out the invention, we prefer the apparatus hereinafter described. Referring to the drawing, 5 indicates a chamber of suitable form and construction, affording a compact housing for a series of reels 6, each mounted on a shaft 7 for rotation. The reels may be of any suitable construction, such as slats, fish netting or other porous surfaces or closed surfaces. Preferably, the reels consist of end frames 8 carrying slats 9 forming pervious peripheral support for the fabric. The number of reels in any given dryer may be varied. We prefer to employ an even number, but an odd number may be used.

The fabric 10 before entering the dryer may pass over one or more rectifiers as more fully described in application Serial No. 190,830, now Patent No. 2,198,656, to remove all wrinkles while being spread to smooth, flat condition, or over a spreader unit as more fully described in Patent No. 2,130,118 and then enters the top of the dryer over a cylinder 11 which is driven in a manner hereinafter described, so that its peripheral speed is synchronized with that of the first reel 6. The fabric passes around the first reel 6 and thence around the succeeding reels and is delivered from the bottom of the dryer. As hereinbefore stated, each of the reels 6 is driven, and its speed of rotation is varied continuously so as to avoid any tension in the fabric as it passes from reel to reel.

Air is introduced, preferably at high velocities, by blowers preferably disposed at both ends of the dryer through ducts 13 to distributors 14 having semi-cylindrical faces 15 disposed about the surfaces of the respective reels. The surfaces 15 are provided with a multiplicity of nozzles 16 which direct the air onto the fabric as it rests upon the slats 9. The air is directed against and passes through the fabric and is withdrawn through ducts 17 located in suitable positions. Air is distributed only through the nozzles 16 which are registered with the fabric passing through the dryer, and the maximum utilization of the air supplied is accomplished.

Referring to Figs. 1 to 5 inclusive, the reels are driven from any suitable source of variable speed power, such as a variable speed motor 29 having a pulley 30 thereon connected by a belt 31 to a pulley 32. A flat belt 33 extends about the pulley 32 and upward to a pulley 34 at the top of the dryer. The latter pulley is mounted on an arm 35 pivoted at 36 and adjustable by means of a tension device or spring 37 and a screw 38, so that the tension on the belt 33 is uniformly maintained. The high speed belt 33 drives combination V and flat belt pulley 39 by short arc contact. The V groove and combination pulley 39 drives pulley 40 through V belt 41. Pulley 40 is fastened to the input shaft of the reducer 41'. The output shaft of the reducer is direct coupled to reel 6. This same output shaft carries pulley 42 which drives to combination pulley and gear 43 through V belt 44. The gears 43, 45 reverse ro-

tation and the drive continues through combination gear and V belt pulley 45 through V belt 46 to pulley 47 on the shaft of the cylinder 11. The connections are such that the peripheral speed of the first reel 6 is identical with that of the cylinder 11, and no tension can be exerted on the fabric as it enters the dryer.

Each of the subsequent reels 6 is driven by a variable speed mechanism which is illustrated in detail in Figs. 2 to 4 inclusive of the drawing. A description of one of these mechanisms will serve for all of the subsequent reels, the peripheral speeds of which are adjusted automatically by the mechanism to control the tension of the fabric.

Pulleys 48 and 50 are fastened together having a suitable common bearing 50' and revolving on a stationary shaft 49. Pulley 50 through belt 51 drives a pulley 52 fastened to revolving shaft 53 which also carries a variable speed pulley 54 of the type illustrated and described, for example in Patent No. 2,050,358. This pulley, as illustrated in Fig. 4, comprises a member 55 which is biased toward a cooperating member 56 by a spring 57, bearing against a cap 58 which rests upon a shoulder on the end of the stub shaft 53 and is held thereon by a nut 59. The member 55 is permitted to move toward and from the member 56, permitting the V-belt 60 to move toward or from the stub shaft 53, thus varying the pitch of the pulley. The V-belt 60 is connected to a pulley 61 on a shaft 62 of a speed-reducing mechanism 63, the details of which form no part of the present invention and are not illustrated. The output of the speed-reducing mechanism 63 is the shaft 7 of the reel 6.

To accomplish the speed variation, a dancer roll 64 is mounted on an arm 65 which is secured to a shaft 66 mounted in a bearing 67 in the side wall of the dryer. The dancer roll 64 is adapted to rest lightly against the fabric 10 as it passes from one reel to the next. Any variation in the tension of the fabric causes the dancer roll 64 to move, thus transmitting motion to the shaft 66. Secured to this shaft is an eccentric arm 68 carrying bearings 69 for the stub shaft 53 and also an arm 70 with a counterweight 71 which is adapted to be adjusted so as to balance the dancer roll 64, thereby making it sufficiently sensitive for the purpose.

As the dancer roll shifts the position of the stub shaft 53, the relative positions of the various pulleys will be changed. Any slack in the belt 51 is immediately taken up by an idler 72 on an arm 73 which is held under tension by a spring 74. Variations in the relative positions of the shafts 62 and 53 will cause, through the variable speed pulley including the element 55, a change of pitch of the latter pulley and a modification of the speed of the shaft 62 in accordance with the temporary condition of the fabric 10. Thus, the second reel 6 and each of the succeeding reels is subject to an increase or reduction of peripheral speed continuously as the condition of the fabric 10 varies. In operation, the dancer roll 64 changes its position to vary the speed of the reel it controls according to the elongation or shrinking of the fabric being handled to accomplish the purpose of advancing the fabric without subjecting it to any substantial tension. Thus, on certain fabrics, the speed of the reels may be progressively increased, on other fabrics, the speed of the reels may be alike or where shrinkage takes place during drying, one or more of the reels subsequent to the first may be run

at a speed slower than that of the first reel. Where elongation of the fabric takes place during drying, which may be predetermined, the speed of the reels subsequent to the first may be fixed at a progressive increase. In such case, the dancer rolls and the devices controlled by them may be eliminated or may be used to effect such changes in the individual drive of the several reels as may be necessary to meet the varying conditions which cannot be predetermined. It is understood that where tension on the fabric is desired, the dancer roll 64 may be so adjusted as to obtain the tension desired.

In Fig. 5 we have illustrated a modification of the apparatus in which the drying chamber 5' is provided with reels 6' and distributors 14' as in the preceding embodiment of the invention. The fabric is conveyed through the dryer in the manner hereinbefore described. In this case, however, air is introduced by a blower 75 to the first distributor 14' and is withdrawn through a duct 76 receiving the air through the opening shown in the side of the chamber adjacent the end of the corresponding reel so that air from the distributor 14' passing through the fabric is drawn out through this duct 76 and delivered by a blower 77 to the second reel 6'. Thence the air is withdrawn and returned to successive reels by blowers 75' and 77' until it is withdrawn through the exhaust 78. This arrangement, as we have hereinbefore stated, permits the application of air, partially moistened by passage through the fabric, again to the fabric in the several stages. The several reels 6' will be driven so as to avoid stretching the fabric by utilizing the mechanism hereinbefore described.

The uniformity of the method of air application to the fabric is novel. As indicated in the drawings, the air is applied directly to one side of the fabric while it is flexed in its curved position around the reel and as the fabric passes on to the following reel, the air is simultaneously applied but to the opposite side of the fabric, thus insuring uniformity of air permeation through the fabric and drying.

It is to be understood that numerous variations of the procedure and apparatus are possible. For example, the fabric may enter the bottom and leave the top of the dryer, the flow of air being as shown or reversed. Also, instead of conveying the fabric transversely from reel to reel, it may be caused to travel down one side of the dryer and up the other side, and the delivery of air and the moisture content thereof in the two sides of the dryer may be adjusted to effect the drying of the fabric in the desired manner and particularly to leave therein the amount of residual moisture which is required to afford the optimum condition thereof. Another alternative use of the dryer involves, as we have stated, the use of two or more units arranged so that the fabric passes through each unit successively and the air employed in one unit is delivered without further heating or drying to the following unit to effect conditioning of the fabric.

These and other modifications may be introduced without departing from the invention or sacrificing the advantages thereof.

This application is a division of U. S. application Serial No. 274,388, now Letters Patent No. 2,301,249, granted November 10, 1942.

We claim:

1. In a variable speed transmission for controlling a feeder roll of conveying means of a continuous strip feeding apparatus by a variable di-

ameter belt pulley and by a dancer roll in contact with said strip, driving and driven pulleys having a connecting belt with tensioning means tending to draw said pulleys toward each other, said variable diameter belt pulley rotating with said driven pulley and having belt means driving said conveying means and acting to exert a tension on said driven pulley opposite to the tension of said belt means, and connections from said dancer roll acting to counter-balance said tensions in opposite directions and correspondingly shift said belt means in the variable diameter belt pulley to vary the speed of the conveying means.

2. A variable speed transmission for a continuous strip feed comprising a rotary driving member, a rotary driven member, driving means between said driving and driven members including an intermediate pulley having a movable mounting to vary the distances of the pulley from both the driving and driven members and correspondingly varying the pitch diameter of said pulley to control the relative speed of the driven member, a feeler member adapted to engage the strip being fed and acting to shift said mounting, yielding means on said pulley tending to increase the pitch diameter thereof and a second yielding means acting to resiliently tension a portion of said driving means and exert a force on said intermediate pulley tending to decrease its pitch diameter and oppose the action of said first mentioned yielding means so that the control effort of said feeler

member is reduced by the balancing effect of said second yielding means.

3. A variable speed transmission as set forth in claim 2 in which the intermediate pulley is resiliently drawn toward the rotary driving member.

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