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STRETCHING OF TEXTILE MATERIALS

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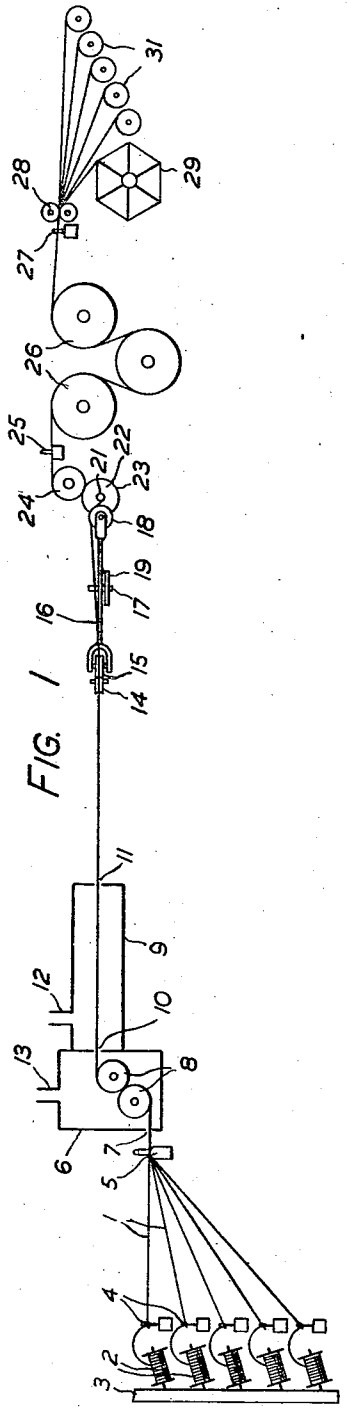

FIG. 1

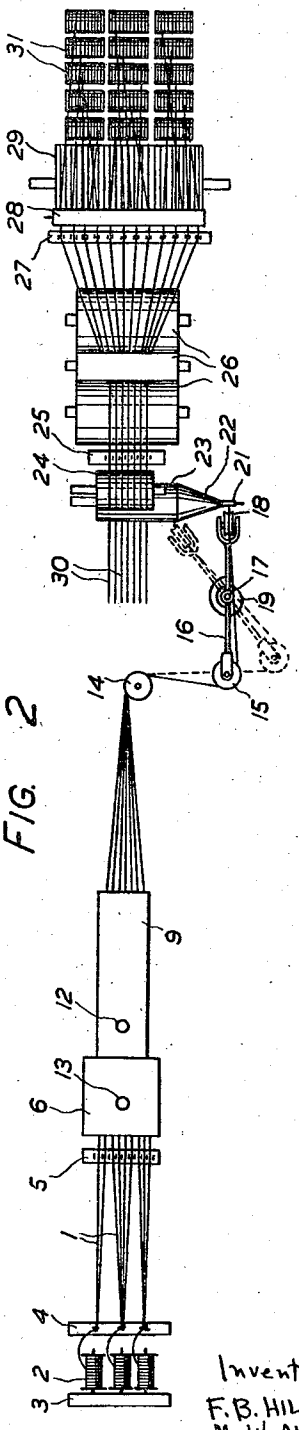

FIG. 2

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STRETCHING OF TEXTILE MATERIAL

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This invention relates to improvements in or relating to the stretching of textile materials, and in particular to the operation of stretching material in the form of filaments or threads by applying tension to said material while it is travelling, and is under the influence of a softening medium, for such purposes as increasing the strength of the material. Such operations are particularly applicable to the treatment of materials of cellulose acetate or other derivatives of cellulose. British Patents Nos. 438,584, 438,587, and U. S. Patents Nos. 2,142,909, 2,142,910 and 2,118,856 describe operations in which steam or hot water, or a liquid containing a solvent or softening agent is used as the softening medium for enabling the stretch to be imparted.

As applied to the stretching of material in the form of filaments or threads, an operation of the character in question is usually performed on a considerable number of ends, e. g. of cellulose acetate or similar threads or filaments, and at the beginning of the operation the ends are drawn through the stretching apparatus and arranged in warp formation with suitable spacing between the threads. On the application of the softening medium, softening of the material of the threads takes place gradually and the threads can be drawn from the apparatus at a continuously increasing speed. It is necessary that the material be kept moving, since otherwise it would be unable to withstand the maintained action of the softening medium and breakages would result. Considerable skill and practice is necessary to avoid frequent breakdowns and consequent wastage of materials. It is a primary object of the present invention to provide a method and means for facilitating the beginning of the stretching operation, the method and means provided being capable, as a secondary function, of facilitating the termination of the operation without the unthreading of the ends from the stretching apparatus.

According to the present invention, in an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling and is under influence of a softening medium, the degree of stretch effect is changed, for starting the operation or for terminating it, by placing the output-input ratio of the material under the control of the tension in the material as it leaves the softening medium, and changing the intensity of application of said softening medium, whereby said speed ratio is varied inversely with the variation in tension consequent on the varying softening influence of said softening medium. In this way, the degree of stretching of the material is made a function of the increasing softness of the material as the supply of softening medium is turned on during the starting up of the operation, so that the necessary raising of the degree of stretch until the required degree has been reached may be made to follow automatically upon the softening in a smooth and rapid manner. In a similar manner, as the supply of softening medium is cut off at the end of the operation, the degree of stretch may be automatically reduced. For the purpose of controlling the output-input ratio in the desired manner, tension-sensitive means may be provided with which the material may be caused to pass in engagement, the movement of the tension-sensitive means being used to govern a speed regulator for a pulley or roller by which the material is drawn through the stretching apparatus. Thus the material may be caused to pass over a spring-loaded pulley the movement of which, produced by the tension in the material acting against the spring, is used for this purpose.

When a number of threads have passed through the softening medium in warp form, they may be gathered into a "rope" and passed in engagement with the pressure-sensitive means, e. g., over a pulley on a member movable against the action of a spring, so that at the starting of the operation when the threads are capable of exerting a higher tension, the member is swung in one direction and thereafter begins to move in the other direction as the softening weakens the threads and permits them to exert a lesser tension. Advantageously, the movable member may be used to guide the threads to a take-up or feed roller of conical or other form and to vary the point along the axis of the roller to which the threads are guided, so that the movement of the member carries the threads from a smaller diameter to a larger diameter as softening proceeds. Consequently, the increased softening of the threads is automatically accompanied by an increased rate of take-up, the movable member serving as a compensator throughout the initial stages of the operation.

For fully automatic working, the small diameter of the roller may be such that the peripheral speed of that part of the roller equals the input speed of the threads to the stretching apparatus and the large diameter of the roller may be such that its peripheral speed equals the desired output rate of the stretched threads. In other words, the ratio between the large and

the small diameters of the roller equals the degree of stretch to be imparted, and the conical or other surface connecting the large and small diameters provides for a progressive increase of the rate of stretching until the final desired degree of stretch, e. g., 5, 10, 20 or more times is reached.

The threads may be delivered from the take-up or feed roller to any desired point, or the threads may be transferred from the roller to some other take-up device, the large part of the roller thus serving as a waste roller in the interval lapsing between the time full stretch has been reached and the time at which all the threads have been connected to their ultimate take-up devices. When the threads have reached full strength, they may be disconnected from the compensator member.

By way of example one arrangement of apparatus suitable for carrying out the invention will now be described in greater detail with reference to the accompanying drawing in which:

Fig. 1 is a part sectional diagrammatic side elevation of the apparatus and

Fig. 2 is a plan view of the apparatus.

In the apparatus shown a number of threads 1 are taken from bobbins 2 mounted in a creel 3, are led through guide-eyes 4 in connection with the creel 3 and proceed from the guide-eyes 4 to a spacing comb 5. From the comb 5 the threads 1 enter a stretching apparatus of the general form described in U. S. Patent No. 2,142,909. This comprises an outer chamber 6 having apertures 7 through which the threads enter and containing nip-rollers 8 by means of which the rate at which the threads are drawn into the stretching apparatus is accurately controlled. From the chamber 6 the threads 1 pass to a stretching chamber 9, entering through apertures 10 and leaving through apertures 11. During the stretching operation the stretching chamber 9 is supplied through a pipe 12 with moist steam under pressure and the chamber 6 is supplied with compressed air through a pipe 13. The compressed air in the chamber 6 is supplied at a pressure slightly lower than that of the steam in the chamber 9, and minimizes the flow of steam from the chamber 9 through the apertures 10, so that the threads, softened in the chamber 9 are not broken by being blown back into the chamber 6.

During the initiation of the stretching operation, with which the present invention is specially concerned, the supply of both steam and air through the pipes 12 and 13 respectively is at first shut off, so that the threads 1 may be led through the chambers 6 and 9. The threads emerging from the apertures 11 are gathered as a rope, which passes round a fixed guide pulley 14, round which it turns at an angle of approximately 90°, and proceeds to a guide pulley 15 mounted on a vertical axis on a compensator bar 16 pivoted at 17 and carrying a further pulley 18 on a horizontal axis at its other end. A spiral spring 19 urges the compensator bar 16 in a counter-clockwise direction from above, and the pull of the threads 1 between the pulleys 14 and 15 initially counteracts the pressure of the spring 19. The compensator bar 16, with its pulleys 15 and 18 and spring 19 together constitute the tension-sensitive means of the apparatus. The pulley 18 guides the rope of threads 1 to a conical roller made up of three parts 21, 22 and 23, the parts 21 and 23 being cylindrical and having diameters proportional respectively to the unstretched length of the threads and the stretched length desired. The part 22 is the conical part, and connects the parts 21 and 23. The length of the part 22 and the position of the point 17 are arranged so that the pulley 18 is always close to one or other of the parts, 21, 22, 23, and guides the threads 1 passing over it accurately to the conical roller, to the under side of which the threads pass.

Co-operating with the large part 23 of the conical roller is a further roller 24 constituting, with the roller 23 a pair of nip-rollers similar to the rollers 8 in the chamber 6. Beyond the rollers 23 and 24 there are a further comb 25, a set of three drying drums 26, a further comb 27, a pair of mangle rollers 28 and the take-up creel for the collection of the stretched threads. The comb 27 and the mangle rollers 28 are wider than the nip rollers 8 and 24, being of a size appropriate to the width of the take-up creel.

In the operation of the device the threads 1 are drawn from the bobbins 2 and threaded through the comb 5 and through the chambers 6 and 9, being collected in the form of a rope at the pulley 14 and proceeding as a rope round the pulleys 15 and 18 and on to the small end 21 of the conical roller. The nip-rollers 8 and the conical roller are then driven at such a speed that the peripheral speed of the nip-rollers 8 is equal to that of the small part 21 of the conical roller. At this stage the compensator bar 16 occupies the position shown in full in Figure 2 and is maintained in that position by the tension in the threads 1 between the pulleys 14 and 15. When the threads 1 are running through the apparatus, the steam is turned on through the pipe 12 and the compressed air through the pipe 13, so that the threads are softened in the chamber 9. As the threads 1 are softened in the chamber 9 they become unable to maintain their former tension between the pulleys 14 and 15, and in consequence the compensator bar pivots, under the action of the spiral spring 19, in an anti-clockwise direction, this movement continuing as the softness of the threads increases. As a result of this the pulley 18 guides the threads 1 up the conical part 22 of the conical roller and this causes the softened threads to be stretched. Excessive stretching of the threads is avoided since any excessive tension placed upon them would act between the pulleys 14 and 15 and prevent further pivoting of the compensator bar 16. In this way the threads automatically receive as much stretch as the softening effected in the chamber 9 enables them to undergo without breaking. As the steam pressure builds up in the chamber 9 the threads become sufficiently softened for the pulley 18 to guide them on the large part 23 of the conical roller. When this occurs the desired degree of stretch has been reached, and the threads may be slipped off the pulleys 14, 15 and 18 and proceed direct from the apertures 11 to the roller 23.

During the operations described above, the threads 1 have been collecting as waste on the free parts 21, 22 and 23 of the conical roller. As soon as the threads are disengaged from the pulleys 14, 15 and 18, however, the rope of threads is cut on the upper part of the roller 23, at the point where they have passed about half way round the roller. The cut end of the rope is then led quickly over the roller 24, over the comb 25, round the drying drums 26, over the comb 27, through the mangle rollers 28 and

on to a waste swift 29 forming part of the take-up creel. The threads in the rope are then separated into the dents of the comb 25 so that they run as a sheet, indicated at 30, under and over the nip-rolls 23, 24 and round the drying drums 26. The threads may then be taken one by one, dropped into the appropriate dents of the reed 27, detached from the swift 29 and led to the separate take-up bobbins, indicated diagrammatically at 31, of the take-up creel.

The stretching operation, having been started in the manner described above then proceeds normally, the strength of the threads being controlled between the nip-rolls 8 and the nip-rolls 23, 24, while the mangle rollers 28 further control the speed of the threads after they have passed round the drying drums 26. The take-up packages 31 are arranged to rotate at an appropriate speed to collect the stretched threads as fast as they are delivered.

When it is desired to terminate the operation, e. g. on approaching exhaustion of the supply packages 2, the threads 1 are connected again as a rope which is slipped on the pulleys 14, 15 and 18, and are severed beyond the nip rollers 23, 24, so that they collect as waste on the lower roller 23. The steam supply is then turned off, and as the softness of the threads 1 decreases in consequence, the increasing tension in the threads rotates the compensator bar 16 till the threads are guided to the small end 21 of the conical roller. The rollers 21 and 8 may then be stopped, leaving the threads 1 threaded through the chambers 8 and 9 ready for restarting. If the supply is to be replenished by replacing the bobbins 2, the new ends have merely to be tied in to the old ends, and do not need to be threaded through the chamber 8 and 9.

While a conical surface is a convenient form for the portion 22 of the roller connecting the small and large parts 21 and 23, other forms of surface may be employed, for example concave or convex or concavo-convex. In general, the precise form of the surface 22 is immaterial, since the surface has merely to provide the possibility of an increasing rate of stretch without, however, controlling the precise amount of stretch that will be imparted at any given interval after the threads begin to soften. The degree of stretching during the starting operation is governed by the ability of the threads themselves to receive stretch, since the weakening of the threads accompanying the softening governs the position of the compensator bar. Consequently the invention enables starting up to be readily accomplished with yarns of different characteristics and provides automatic compensation whatever the degree of stretch that is to be imparted.

Having described our invention, what we desire to secure by Letters Patent is:

1. In an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling and is under the influence of a softening medium, the steps of changing the degree of stretch effected by placing the output-input speed ratio of the material under the control of the tension in the material as it leaves the softening medium, said speed ratio being varied in accordance with the extent of the softening of the material due to the softening influence of said softening medium.

2. Method of starting up an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling and is under the influence of a softening medium, said method comprising drawing the material under tension out of the softening medium during the initial application thereof to the material, and employing the tension in the material as it leaves said softening medium to control the rate of said drawing and to increase said rate up to a desired limit as the extent of the softening of the material is enhanced due to the increasing softening influence of said medium during its initial application.

3. Method of terminating an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling and is under the influence of a softening medium, said method comprising placing the speed at which the material leaves the softening medium under the control of the tension in the material as it leaves said softening medium and cutting off the supply of softening medium to the material, whereby said speed is diminished as the extent of the softening of the material is lessened due to the decrease softening influence of said medium as its supply is cut off.

4. Method of starting up an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling and is under the influence of a softening medium, said method comprising guiding the material to a conical member for drawing the material under tension out of the softening medium during the initial application thereof to the material and employing the tension in the material as it leaves said softening medium to control the point along the axis of said conical member to which the material is guided and to carry the material towards the larger end of said conical member as the material is softened by said softening medium during its initial application.

5. Method of terminating an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling and is under the influence of a softening medium, said method comprising placing the material under the control of a conical member to which the material is guided as it leaves the softening medium and controlling the point along the axis of said conical member to which said material is guided in accordance with the tension of the material and cutting off the supply of the softening medium to the material whereby the material is carried towards the smaller end of said conical member as the extent of the softening of the material is lessened due to the decreasing softening influence of said medium as its supply is cut off.

6. Method of starting up an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling through and is under the influence of a softening medium, said method comprising drawing the material under tension out of the softening medium during the initial application thereof to the material, and employing the tension in the material as it leaves said softening medium to control the rate of said drawing and to increase said rate from one substantially equal to the speed at which the material is fed into the softening medium up to a desired limit as the extent of the softening of the material is enhanced due to the increasing softening influence of said medium during its initial application.

7. Method of terminating an operation for stretching material in the form of filaments or threads by applying tension to said material while it is travelling through and is under the influence of a softening medium, said method comprising placing the speed at which the material leaves the softening medium under the control of the tension in the material as it leaves said softening medium and cutting off the supply of softening medium to the material, whereby as the extent of the softening of the material is lessened due to the decreasing softening influence of said medium as its supply is cut off, said speed is diminished to one substantially equal to the speed at which the material is fed into the softening medium.

8. In apparatus for stretching material in the form of filaments or threads, the combination with a chamber for the application of softening medium to the material while it is travelling, means for positively feeding the material into said chamber and means for positively drawing the material out of said chamber, of tension-sensitive means adapted to engage the material as it leaves said chamber, said tension-sensitive means being adapted to vary the output-input ratio of said feed and drawing means.

9. In apparatus for stretching material in the form of filaments or threads, the combination with a chamber for the application of softening medium to the material while it is travelling, means for positively feeding the material into said chamber and a conical roller for positively drawing the material out of said chamber, of tension-sensitive means adapted to engage the material as it leaves said chamber and guide means under the control of said tension-sensitive means for varying the point along the axis of said conical roller to which the material is guided so as to vary the output-input ratio of said conical roller and said feeding means in accordance with the extent of the softening of the material as it leaves said chamber.

10. In apparatus for stretching material in the form of filaments or threads, the combination with a chamber for the application of softening medium to the material while it is travelling, means for positively feeding the material into said chamber and a conical roller for positively drawing the material out of said chamber, of a spring-loaded lever between said feeding and drawing means and guide means at one end of said lever adapted to engage the material as it leaves said chamber and to deflect the material through an angle whereby the tension of said material, acting against the loading of said lever, controls the position of said lever so as to vary the point along the axis of said roller to which the material is guided and thus to vary the output-input ratio of said conical roller and said feeding means.

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