Sept. 5, 1939. S. COHN ET AL 2,171,741

APPARATUS FOR SYNCHRONIZING MACHINES FOR HANDLING TUBULAR FABRIC

Filed June 2, 1936 2 Sheets-Sheet 1

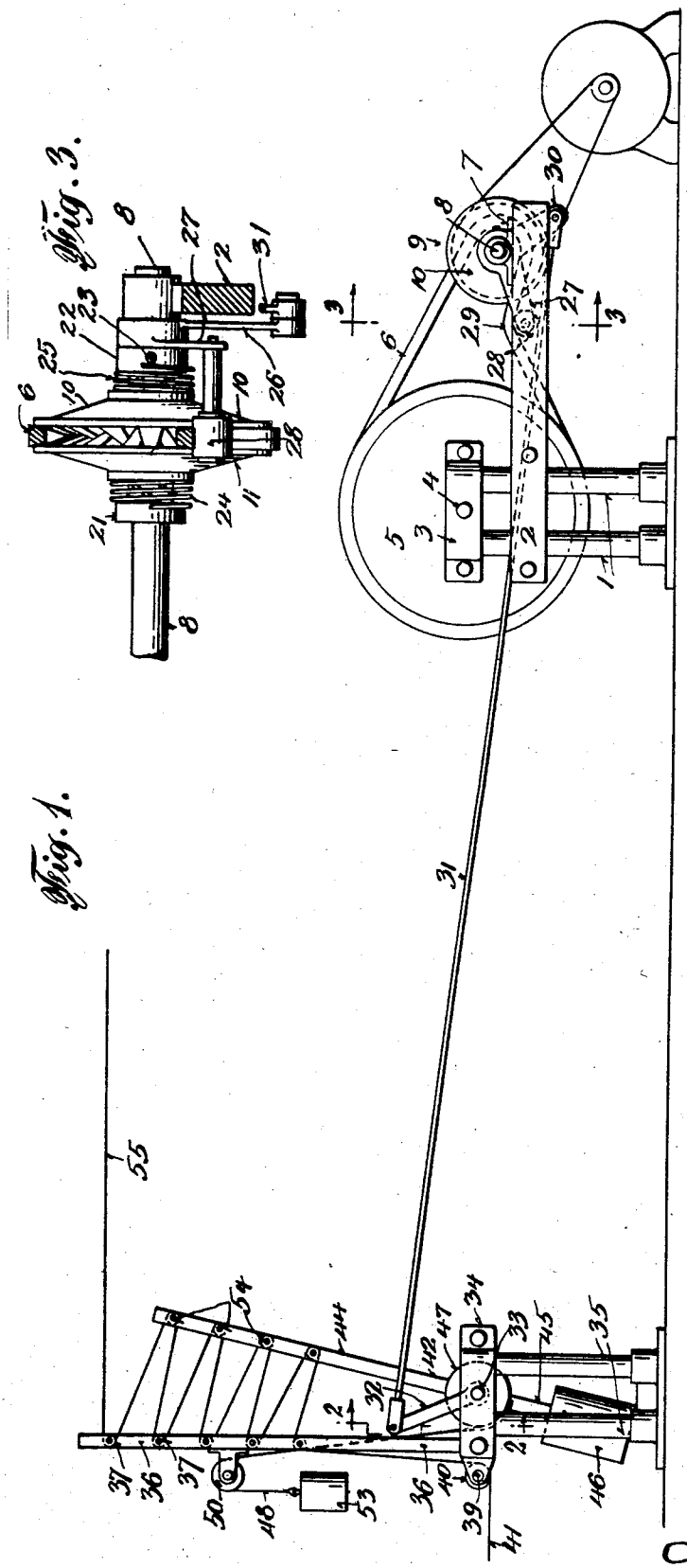

Fig. 1.

Fig. 3.

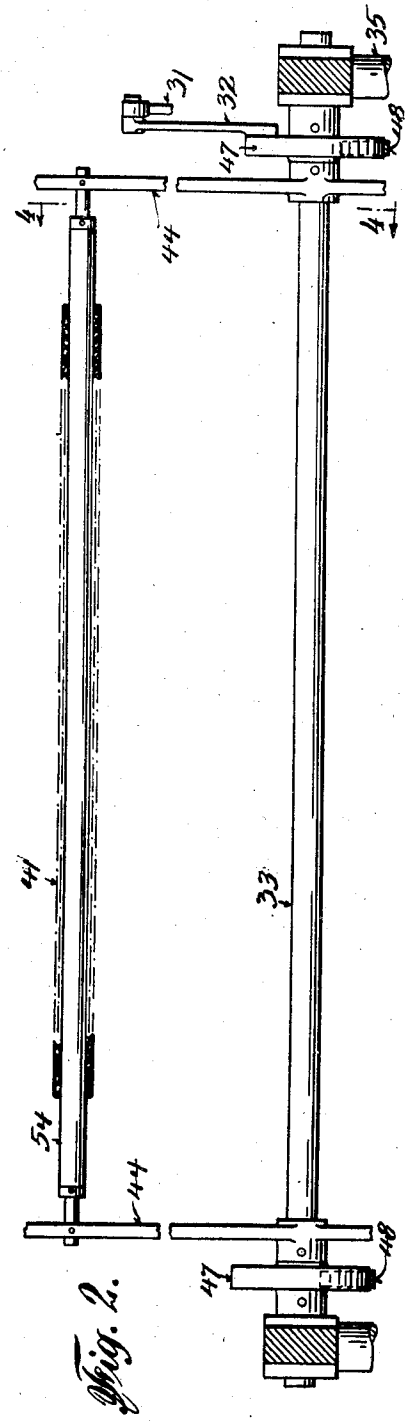

Fig. 2.

INVENTORS
Samuel Cohn
and Jules B. Walter
BY
Charles G. Hensley
ATTORNEY

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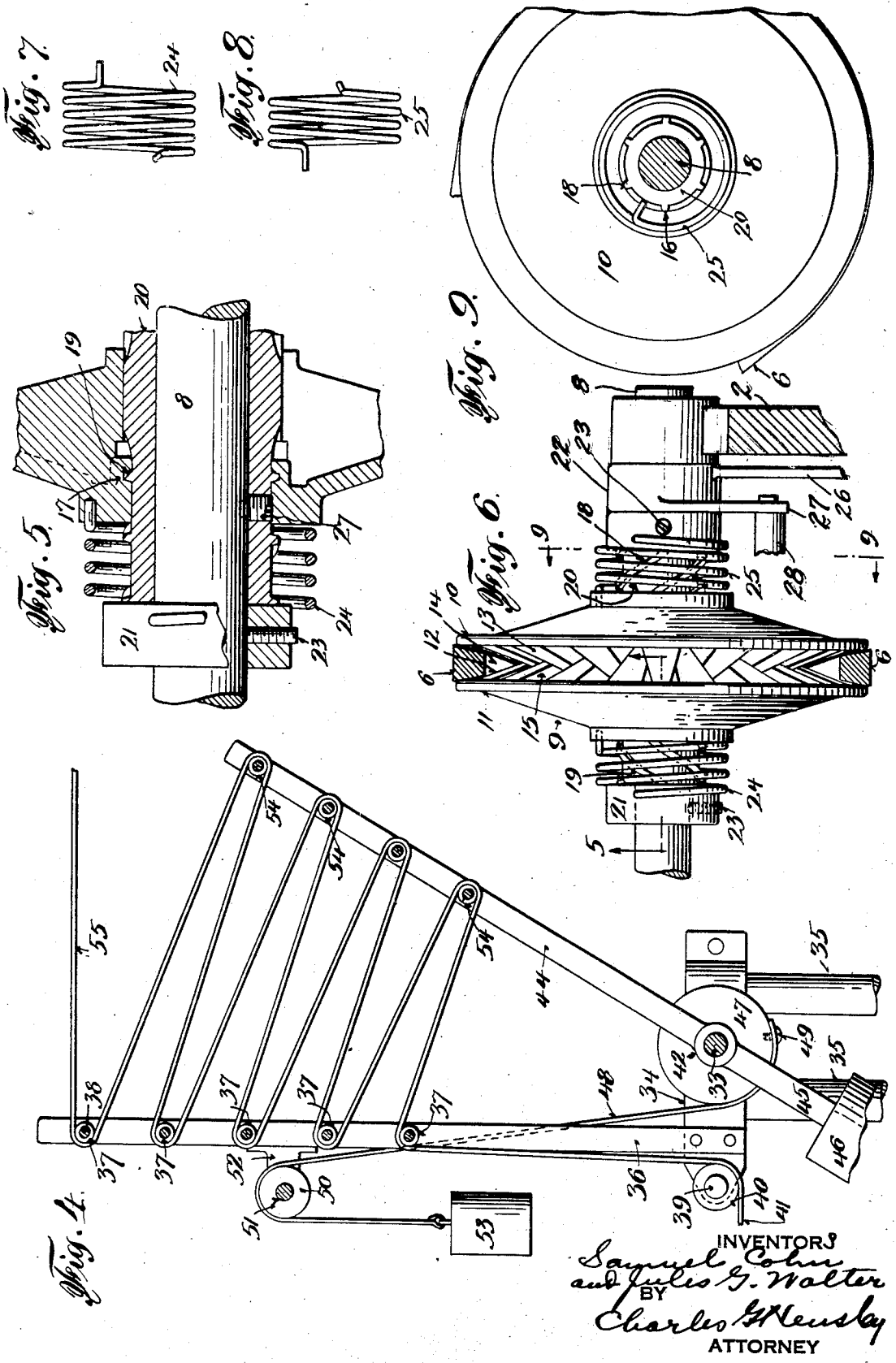

INVENTORS
Samuel Cohn
and Jules G. Walter
BY
Charles G. Hensley
ATTORNEY

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APPARATUS FOR SYNCHRONIZING MACHINES FOR HANDLING TUBULAR FABRIC

Samuel Cohn, New York, and Jules G. Walter, Ridgewood, N. Y., assignors to Samcoe Holding Corporation, New York, N. Y., a corporation of New York

Application June 2, 1936, Serial No. 83,046

11 Claims. (Cl. 26—1)

The present case is a continuation in part of our application Ser. No. 691,522, filed September 29, 1933, which became Patent 2,109,469.

The object of our invention is to provide a simple and efficient device for automatically synchronizing the speed of two or more machines, or parts of machines, which handle fabric, and especially knitted, tubular fabric. Where knitted tubular fabric is handled in one machine, or part of a machine, and then passes into or onto another machine which carries on other functions in connection with the knitted tubular fabric, under a continuous operation, it is necessary to synchronize the operation of the two machines or parts of machines, and to so synchronize the two machines which operate on the fabric as to allow for shrinkage of the fabric, or to allow for stretch of the fabric between the two machines or parts of machines, or to allow for a change in the width of the tubular fabric in passing from one machine to another, so that the speed of the machine or part of the machine which receives the fabric from a prior machine or part of a machine will operate at such a speed as to take the fabric in such a manner as to allow for shrinkage, for stretch, or for change of width of the fabric.

The control of the synchronizing operation is automatic, that is, the control is operated by the fabric itself so that if variations in speed are necessary in one machine to accord with variations brought about by any of the causes mentioned above, the fabric may be received on the receiving machine in uniform condition as to width, stretch, shrinkage or other factor.

The device forming our invention is more simple and less expensive and more efficient than the complicated electrical devices heretofore proposed for the same purpose. One part of the device consists of a V type pulley of solid or unchanging type and a V type pulley of the split variety, wherein the flanges of the pulley are movable toward and from each other to increase and decrease the size of the loop of the belt around the pulley in order to vary the speed ratio between the machine or apparatus which delivers the fabric and the one which receives the fabric. This variable pulley is provided with means for adjusting the pulley to regulate the speed ratio, which is of a much simpler and more delicate character than any adjusting device heretofore proposed because the speed ratio must be under the control of the fabric which is itself of a delicate nature and subject to being easily distorted.

In addition, we provide simple and effective means, such as a series of bars or rollers mounted on a stationary member, and a series of bars or rollers mounted on pivotal levers, the fabric being run back and forth partly around the first mentioned bars or rollers and partly around the second mentioned bars or rollers in a zigzag manner and the movable levers are arranged to actuate the means for controlling the change of speed in the variable drive portion of the device. In this manner the friction on the fabric or tension where the fabric engages around the several bars or rollers is cumulative so that the pull or draft on the fabric necessary to regulate the variable speed drive is created gradually or is spread over a considerable length of fabric in order not to produce unintended variations in the length and width of the knitted tubular fabric.

The movable levers which carry one set of the bars around which the fabric is threaded are pivoted in order that these movable lever arms may move away from and toward the stationary arms which carry the other set of bars and the movable lever arms are so balanced or counterbalanced that the tension on the fabric necessary to control the variable speed drive may be finely regulated and so that undue tension on the fabric will be avoided.

Other features and advantages of our invention will be set forth in the following detailed description of our invention. In the drawings forming part of this application,

Figure 1 is a side elevation of the variable speed drive and the controlling apparatus,

Figure 2 is a sectional view taken on the line 2—2 of Figure 1,

Figure 3 is a detailed sectional view taken on the line 3—3 of Figure 1 and showing the expansible pulley and associated parts,

Figure 4 is a sectional view taken on the line 4—4 of Figure 2 but on a larger scale,

Figure 5 is a sectional view taken on the line 5—5 of Figure 6,

Figure 6 is a sectional view showing the expansible pulley and parts adjacent thereto,

Figure 7 is an elevation of one of the springs for moving one flange of the expansible pulley,

Figure 8 is a similar view of the other spring, and

Figure 9 is a sectional view taken on the line 9—9 of Figure 6.

In the drawings we have shown part of a machine or device for handling fabric and this includes the standards 1 supporting horizontal bars

2 and in the bracket 3 at the upper end of the standards 1 there is journaled a shaft 4 which carries a pulley 5 of the V type, that is to say, a pulley having a V shaped groove to engage the slanting side edges of a V type belt 6.

This pulley may be of fixed size. On the horizontal bars 2 we mount bearing members 7 in which there is journaled a shaft 8 and on this shaft is mounted an expansible pulley 9 having special features forming part of our invention. The shafts 4, 8 on which the pulley 5 and the expansible pulley 9 are mounted may be permanently fixed at any distance from each other or, in other words, they have fixed centers.

The expansible pulley is constructed as follows: There are two pulley flanges 10, 11 mounted on the shaft 8 and facing each other, that is to say, the left hand flange 11 has a frusto conical face 12 and the flange 10 has a frusto conical face 13, these two frusto conical surfaces facing each other to provide a V shape groove 14 between the flange members, as shown in Figure 6. In order to allow the flange members to approach each other closely in order to operate in conjunction with a comparatively narrow belt, the conical faces of the two flange members are provided with radially extending slots 15 forming a comb-like structure on each flange member and the solid portions of one flange member enter the slots 15 of the opposing flange member so that the two flange members may be moved close together as shown in Figure 6 and engage the V type belt 6 of narrow width, this belt having side edges cut on opposite slanting angles so that the sides of the belt converge or are of V shape.

The hubs of the flange members are provided one with a right hand and one with a left hand internal screw thread 16, 17 and these screw threaded portions co-operate with the male threads 18, 19 formed on the outside of a sleeve 20 which is mounted over the shaft 8 and is compelled to revolve therewith, such as by the set screw 27 shown in Figure 5. The screw thread on one end of the sleeve 20 is a left hand thread, as shown in Figures 5 and 6, whereas the right hand thread 18 in Figure 6 is a right hand thread.

It will be apparent that if the flange members are revolved in relation to the sleeve member 20 in one direction, the flange members will, by reason of their threaded connections, be moved toward each other, whereas, if they are revolved in the other direction in relation to the sleeve they will be moved further apart from each other. Because the threads 18 and 19 are opposite or left and right hand, the two flange members will move opposite each other, i. e., toward each other, at one time, and away from each other another time, according to the relative revolution of the flange members in relation to the sleeve 20.

We have shown collars 21, 22 at the ends of the sleeve member 20 which are fixed to the shaft 8 by set screws 23 so that they are adjustable around the shaft for a purpose which will appear hereinafter. There is a light coiled spring 24 mounted between the end of the hub of the left hand flange member in Figure 5 and in Figure 6 and the collar 21. There is a similar spring 25 but coiled in the opposite direction, as shown in Figure 8, and this is mounted between the hub of the right hand flange member in Figure 6 and the collar 22. One end of the spring 24 engages in an aperture in the end of the hub of the left hand flange member and the other, bent end of this spring engages in an aperture in the collar 21. One end of the spring 25 engages in an aperture of the hub of the right hand flange member in Figure 6, and the other, bent end of this same spring enters an aperture in the collar 22.

There is a bell crank lever 26 loosely pivoted on the shaft 8 and one arm 27 of this lever has an idler roller 28 engaging the outer surface of the V belt 6 between the pulleys 5 and 9 for the purpose of forming a loop 29 in the belt, and this loop will be raised in Figure 1 more or less upon the rocking of the lever arm 27 for the purpose hereinafter described.

The other arm 30 of this bell crank lever is pivotally connected with a pitman 31 which extends to the left in Figure 1 and is pivotally connected at its left hand end with a lever arm 32 which is fixed to a cross shaft 33 mounted in the bracket 34 on standards 35 which form part of the machine.

On the bracket 34 there is a fixed arm 36 extending upwardly and it is provided with a number of rollers 37 which revolve on the rods 38 which we have shown extending crosswise in the machine, it being understood that there is an arm 36 at the opposite side of the machine in which the rods 38 carrying the rollers 37 are also fixed. The rods 38 carrying the rollers 37 are shown disposed in a vertical row upon the arm 36 there being five such rods shown and it will be understood that there may be a lesser or greater number of these rods. The bracket 34 also carries a rod 39 extending crosswise of the machine on which is mounted an idler roller 40 around which the fabric 41 coming from the delivering machine or part of the machine engages, and from there the fabric passes upwardly and partly around the lowermost roller 37.

There is a lever 42 pivoted to swing freely on the shaft 33 and the upper arm 44 of this lever extends upwardly and in the same vertical plane as the fixed arm 36 and it will be understood that the construction is duplicated at the opposite side of the machine, as shown in Figure 2. The lower arm 45 of this lever is provided with a counterbalancing weight 46 which is so designed as to normally retain the lever 42 in a vertical position, except when overbalanced in the manner hereinafter described.

There is a pulley 47 which is fixed to the shaft 33 and there is a strap or band 48 having one end fixed to this pulley by the screw 49 in Figure 4, and this band extends upwardly and passes partly around an idler pulley 50 which is mounted on the shaft 51 and the latter is mounted in the bearing members 52 which we have shown secured to the stationary arms 36.

On the other end of this band, which hangs down from the pulley 50 in Figure 4, we have provided a weight 53 which serves to act through the band 48 to apply a light turning force to the pulley 47 for rocking the shaft 33 in one direction, i. e., in the direction necessary to move the lever arms 44 clockwise in Figure 4, or away from the stationary arms 36. Different weights 53 may be provided for the band according to the character of the material which is being handled.

The fabric coming from the first machine or apparatus after passing partly around the guide roller 40 passes around the lowermost guide roller 37 on the stationary arms, thence over the lowermost roller 54 carried by the lever arms 44, thence the fabric passes back and around the second lowermost roller 37 on the stationary arms 36 and again forwardly and around the second roller on the lever arms 44 and the fabric continues to pass back and forth around the rollers on the sta-

tionary arms 36 and the rollers 54 on the lever arms 44 until the fabric finally passes around the topmost roller 37 on the stationary arms and then passes forwardly as shown at 55 to a second machine or part of a machine in which the fabric is to be treated or handled.

The fabric adapted to be handled in the present machine may consist of a plain strip of fabric or a tube of knitted material which by its character is adapted to be stretched laterally or lengthwise. Because of its nature, this fabric, when stretched lengthwise, will decrease in width if not restrained and on the other hand when increased in width it has a tendency to shorten in length.

The operation is as follows: Let it be assumed that a strip of flattened tubular knitted fabric is threaded around the several rollers 37 on the stationary arms 36 and around the rollers 54 on the pivotal arms 44, the operation will be as follows:

The counterweight 53 acting through the band 48 tends to produce a lead or turning action on the shaft 33 and to swing the arms 44 clockwise in Figures 1 and 4, thus swinging these lever arms 44 away from the fixed arms 36.

If the material coming from the first machine which acts on the fabric is being delivered too fast and if this condition continues, then the arms 44 will gradually swing from left to right in Figure 4 and in Figure 1 because of the action of the weight 53 acting through the band 48 to rock the pulley 47. This acts on the shaft 33 which carries the lever arm 32. Owing to the relatively loose condition of the fabric around the several rollers 38 and the rollers 54 caused by the too rapid delivery of the material to the present control device, the lever arms 44 swing to the right in Figures 1 and 4. This movement of the lever arms 44 and the shaft 33 causes the lever arm 32 to swing to the right in Figure 1 and this action is transmitted through the pitman 31 to the bell crank lever 27 causing the latter to swing counterclockwise on the shaft 8 in Figure 1, thus moving the roller 28 in a direction to increase the loop 29 of the V belt.

This will have the effect of increasing the size of the loop of the belt 6 around the expansible pulley because as the roller 28 retracts and the loop of the belt around the expansible pulley grows larger, the flanges of the expansible pulley are caused to move toward each other and toward the condition shown in Figure 6 by the turning of the flanges under the action of the light springs 24, 25 in relation to the sleeve 20. As these two flange members are turned in relation to the sleeve by their springs, the oppositely formed threads 18, 19 act on the respective flange members of the pulley to cause them to move toward each other so that they follow against the slanting sides of the V belt as the latter moves into a larger loop.

This has the effect of increasing the speed of operation of the large pulley 5 from which the machine or apparatus which is receiving the fabric is speeded up in order to take the fabric at a faster speed and in accordance with the increased speed at which the fabric is being delivered from the first machine or device to the controlling device described above.

When synchronism has thus been established between the two machines or parts of machines acting on the fabric, the rocking arm 32 will remain stationary in whatever position it was placed by the above-mentioned action. The lever arms 44 will continue to dwell in their new positions until such time as the fabric fed from the first machine to the control device undergoes a change, that is, until the fabric is either fed too fast to the control device or too slowly. The lever arms 44 will swing to the right in Figure 1 from their last position if the receiving machine is to be increased in speed, or to the left if the receiving machine is to be decreased in speed, to synchronize with the machine which is delivering the fabric to the control device.

If the fabric is being fed too slowly to the control device compared with the speed at which the fabric is being taken by the receiving machine, then the action will be opposite to that described above, that is to say, the fabric where it passes around the several rollers 37 and 54 will be shortened, and this will cause the lever arms 44 to move to the left in Figure 1 or counterclockwise. This operation will cause the lever arm 32 also to move counterclockwise in Figure 1, thus pulling on the pitman 31 and rocking the bell crank lever clockwise in Figure 1. This action will move the roller 28 upwardly, thus shortening the effective length of the V belt 6 and decreasing the size of the loop in this belt where it passes around the expansible pulley.

As the loop of the V belt is compelled to decrease in diameter, it forces the two flange members apart, and as the flanges are revolved slightly relatively to the sleeve 20 the threads 18, 19 cause the flange members to move apart. This action is resisted slightly by the torque of the springs 24, 25 since one end of each spring is connected with one of the flange members and the other ends of the springs are connected to the fixed collars 21, 22 on the shaft 8. The resistance of the coiled springs is very light if the springs are made light in their action. However, the resistance is sufficient to keep the flange members engaged with the inclined faces of the V belt with sufficient pressure to provide the necessary traction between the belt and the expansible pulley.

The action described above, by causing the loop of the V belt around the expansible pulley to decrease in diameter while the diameter of the pulley 5 remains constant, will cause the receiving machine or device to operate at a lower speed than before, so that it will take up the fabric from the control device at a lower speed than before, and at a speed which will accord with the speed at which the fabric was delivered from the first machine.

It will be apparent, therefore, that as the arms 44 swing clockwise in Figures 1 and 4, the speed of the receiving machine is increased, whereas when the lever arms move counterclockwise in Figures 1 and 4 the speed of the receiving machine is decreased. As the device is automatic in its action, the two machines or devices will be automatically maintained synchronized in their operations, so that the tension on the fabric will remain uniform. By changing the weight 53 for a heavier or a lighter weight the tension maintained on the fabric between the two machines may be increased or decreased. This change will be made according to the character of the fabric which is being handled and according to the desired degree of tension to be placed on the fabric.

The tension placed on the fabric may, if desired, be slight because the fabric being passed back and forth between the plurality of rollers 37 and 54 causes the tension to be distributed

along a relatively extensive portion of the fabric instead of being applied locally, and this will avoid distortion of the fabric.

The receiving and delivering machines do not necessarily operate at the same speed. For instance, if a knitted tubular fabric is being handled the receiving machine may be operating to spread the fabric laterally and when knitted fabric is spread or stretched laterally it has a tendency to shorten in the direction of its length. In such a case the receiving machine may be taking the fabric at a lesser speed than the first machine is delivering it. Even in this situation the present device will synchronize the two machines or parts of machines and maintain uniform tension on the fabric between the two machines.

As the springs shown in Figures 7 and 8 may be made very light, the force necessary to adjust the variable pulley is very light so that the tension on the fabric necessary to move the lever arm 32 may be very light. As far as we are aware, this is the first instance where springs for controlling the flanges of an expansible pulley have acted by torque action instead of by compression, and therefore the present device is the first one known to us where the expansible pulley can be controlled by a very delicate force.

The collars 21, 22 may be adjusted around the sleeve 20 and fixed in their adjusted positions by the set screws 23. This adjustment will regulate the amount of torque to be exerted through the springs 24, 25 to move the flange members of the expansible pulley apart. By adjusting these collars the ends of the springs which are attached to them will be adjusted in relation to the ends of the springs which are attached to the flange members of the pulley so that the degree of torque exerted by the springs when the flange members are moved laterally in relation to each other may be regulated.

This permits the springs to be adjusted so that they will operate with very slight force exerted on the lever arm 32 so that the tension required in the fabric to control the variable speed device may be reduced to a minimum. This combination makes it possible to control the variable speed device through the action of the fabric, whereas in prior variable speed drives too much force is required to vary the speed to permit them to be used in the character of work described herein.

With the present device it is possible to obtain infinite variations of speed of the receiving machine or apparatus, whereas with electrical controls variations must be limited to a smaller and given number of variations.

Instead of having a spring for moving each flange of the variable pulley, one flange may be fixed and the spring may be applied to the other flange only, although the preferred construction is as shown in the drawings.

The tension in the fabric necessary to operate the member 44 is distributed over a large portion of the fabric because the fabric passes back and forth in a number of runs between the rollers on the member 44 and on the member 36, so that excessive distortion of the local portion of the fabric is avoided, which is desirable where the machine is handling knitted fabric. The large portion of fabric over which the tension is distributed serves to act as a reservoir for the purpose of creating speed changes gradually and there is enough cloth in this reservoir so that the member 44 does not rise or fall too rapidly and thus effect too rapid changes of speed with resulting distortion of the fabric. Furthermore, the fabric, with the present control, does not necessarily have to feed to the receiving machine or apparatus in taut condition, but if desired it may be fed to it under light tension or even in a loose condition. This is made possible by the control device described herein.

Having described our invention, what we claim is:

1. A speed changing device including a shaft, a plurality of frusto conical flange members cooperating to form an expansible pulley, a V type belt travelling between the frusto conical surfaces of said flange members, means for effecting the movement of said flange members toward and from each other and tortion springs acting on said flange members by tortion action and tending to effect the movement of said flange members toward each other by said flange moving means.

2. A speed changing device, including a shaft, a plurality of frusto conical flange members cooperating to form an expansible pulley, a V type belt travelling between the frusto conical surfaces of said flange members, oppositely directed threads for effecting the movement of said flange members toward and from each other, and oppositely arranged tortion springs acting by tortion one on each of said flange members and tending to effect the movement of said flange members toward each other by said threaded means.

3. A speed changing device, including a shaft having a sleeve having reverse threads thereon, a plurality of frusto conical flange members mounted on said sleeve and being threaded to co-operate with said thread, a V type belt travelling around the frusto conical surfaces of said flange members, collars adjustable around said shaft, and tortion springs each having one end connected with one of said collars and the other end with one of said flange members whereby said springs tend to revolve said flange members by tortion in relation to said sleeve.

4. A device for synchronizing the operation of a plurality of machines or apparatus which operate on a strip of fabric and which deliver the fabric from one to the other, including stationary means, pivoted means movable toward and from the stationary means, a plurality of fabric supporting members on said stationary means and a plurality of fabric supporting members on said pivotal means and around which the fabric is passed in alternate relation in a plurality of runs over the fabric supporting members on both said stationary and said pivotal means while travelling between said machines in flat condition, a speed changing device for controlling the speed of one of said machines, including a plurality of frusto conical flange members mounted adjacent each other on a shaft, means for effecting the movement of said flange members toward and from each other, tortion springs acting by tortion on said flange members, a V type belt engaging around said pulley, and means controlled by said pivotal means and acting on said belt to control the position of said flange members to synchronize the operation of said machines.

5. Apparatus for synchronizing the rate of feed of fabric strip handling machines operating in sequence which comprises a first series of parallel rollers and a second associated series of parallel rollers arranged between contiguous machines to support the strip in a sinuous path passing

around the rollers of the two series in alternation, means supporting the two series of rollers arranged for relative movement between the series, means biasing the two series of rollers away from each other for maintaining uniform tension on the strip within the range of such movement, a speed-changing device controlling the rate of strip travel at the adjacent end of a contiguous machine, and means operated by said relative movement between the two series of rollers for actuating the speed-changing device and thereby maintaining a relatively fixed total length of strip on the two series of rollers.

6. Apparatus as set forth in claim 5 in which one series of parallel rollers is fixed and the other is movable, and the speed-changing device is actuated by movement of the movable series of rollers.

7. Apparatus as set forth in claim 5 in which one series of rollers is mounted for movement about a pivot, and the biasing means includes means for applying a fixed torque at the pivot.

8. Apparatus as set forth in claim 5 in which one series of rollers is mounted for movement about a pivot and the biasing means includes means for imparting a relatively uniform torsion pressure at the pivot and means for imparting a lesser counterbalancing bias increasing in accordance with increase in spacing between the series of rollers.

9. Apparatus for synchronizing the rate of feed of fabric strip feeding machines operating in sequence which comprises a fixed series of parallel rollers, a movable series of parallel rollers mounted for movement about a pivot and located adjacent the fixed series of rollers in position to support the strip traveling in a sinuous path around the rollers of the two series in alternation, means for biasing the movable series of rollers around the pivot and away from the fixed series, a variable diameter pulley, means for driving one of the machines including a belt passing around the pulley, and means for varying the speed of the machine including a rocker arm engaging the belt and mounted for movement transversely to the axis of the pulley and link means connecting the rocker arm to the movable series of rollers for rocking said arm in accordance with variations in the length of material passing over the rollers of the two series, arranged to vary the diameter of the belt loop passing around the pulley and thereby to vary the effective diameter of the pulley.

10. A speed-changing device including a shaft, a plurality of frusto-conical flange members carried by the shaft and cooperating to form an expansible pulley, a belt traveling between the frusto-conical surfaces of the flange members, said flange members being provided with alternating interlocked projections forming part of the frusto-conical faces of the members and axially slidable on each other, means for effecting the movement of the flange members toward and from each other and torsion springs acting on the flange members by torsion action and tending to effect the movement of the flange members toward each other by the flange moving means.

11. Apparatus for synchronizing the rate of feed of two machines operating in tandem to treat a traveling fabric strip, each of said machines having a driving mechanism for propelling the fabric, said apparatus comprising a fixed arm and a movable arm, each of said arms containing a plurality of rollers over which the fabric strip in passing from the first to the second of the two machines, is led back and forth between said arms so that it passes alternately over a roller of the fixed arm and then over a roller of the movable arm, said movable arm being biased to tend to move away from said fixed arm to increase the length of the strip between said arms, (an expansible pulley having V-formed belt driving faces) through which one of said driving mechanisms is driven and to which said movable arm is operably connected to vary its effective belt-driving diameter in response to movement of said pivoted arm, thus regulating the speed of propulsion of the fabric strip in one of the machines to maintain a substantially uniform tension on the fabric strip at said arms.

SAMUEL COHN.
JULES G. WALTER.