Nov. 30, 1943. J. E. ACKERMAN 2,335,838

STRIP-TENSIONING DEVICE FOR SEWING MACHINES

Filed Jan. 24, 1942 3 Sheets-Sheet 1

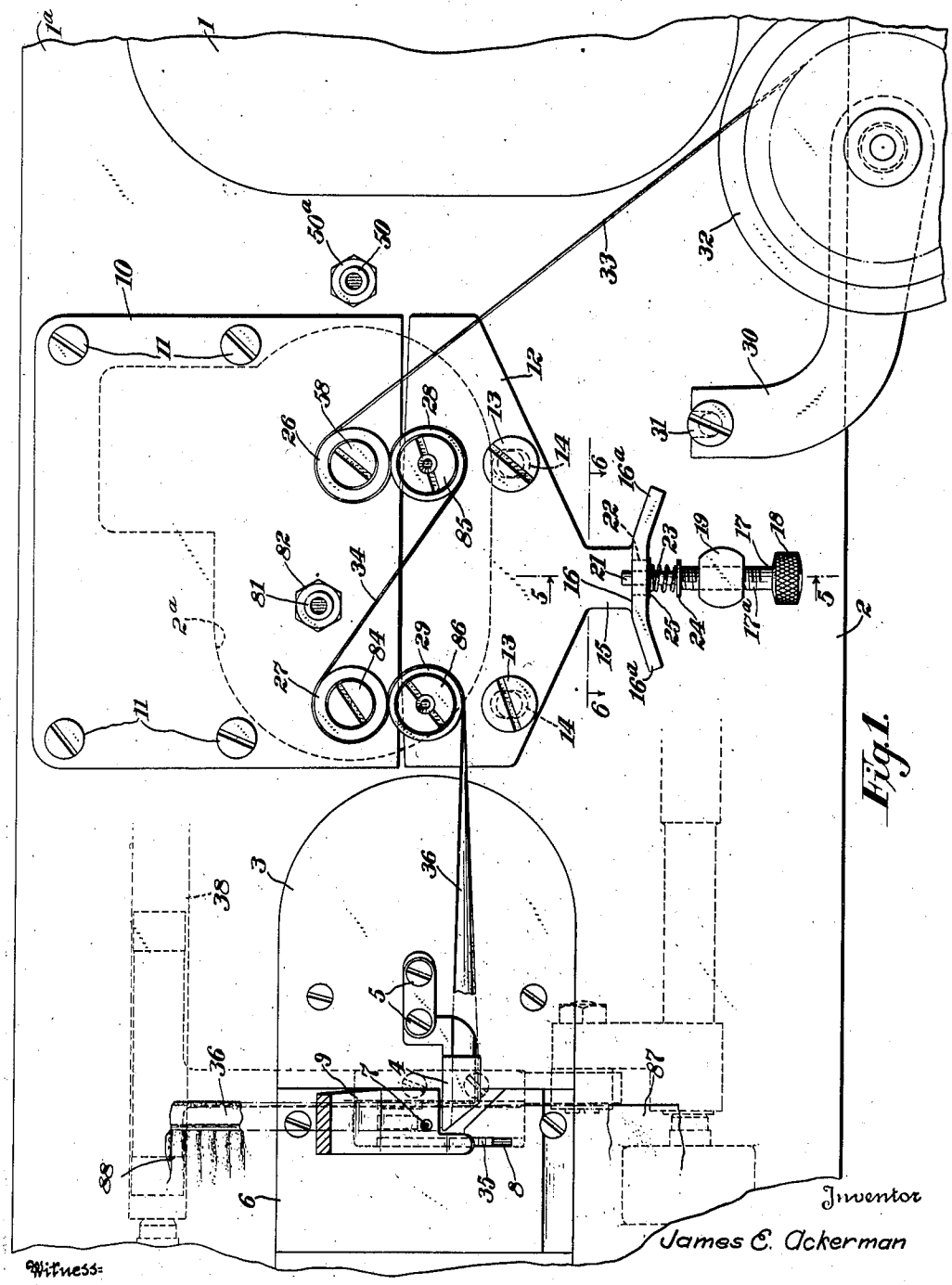


Fig. 1.

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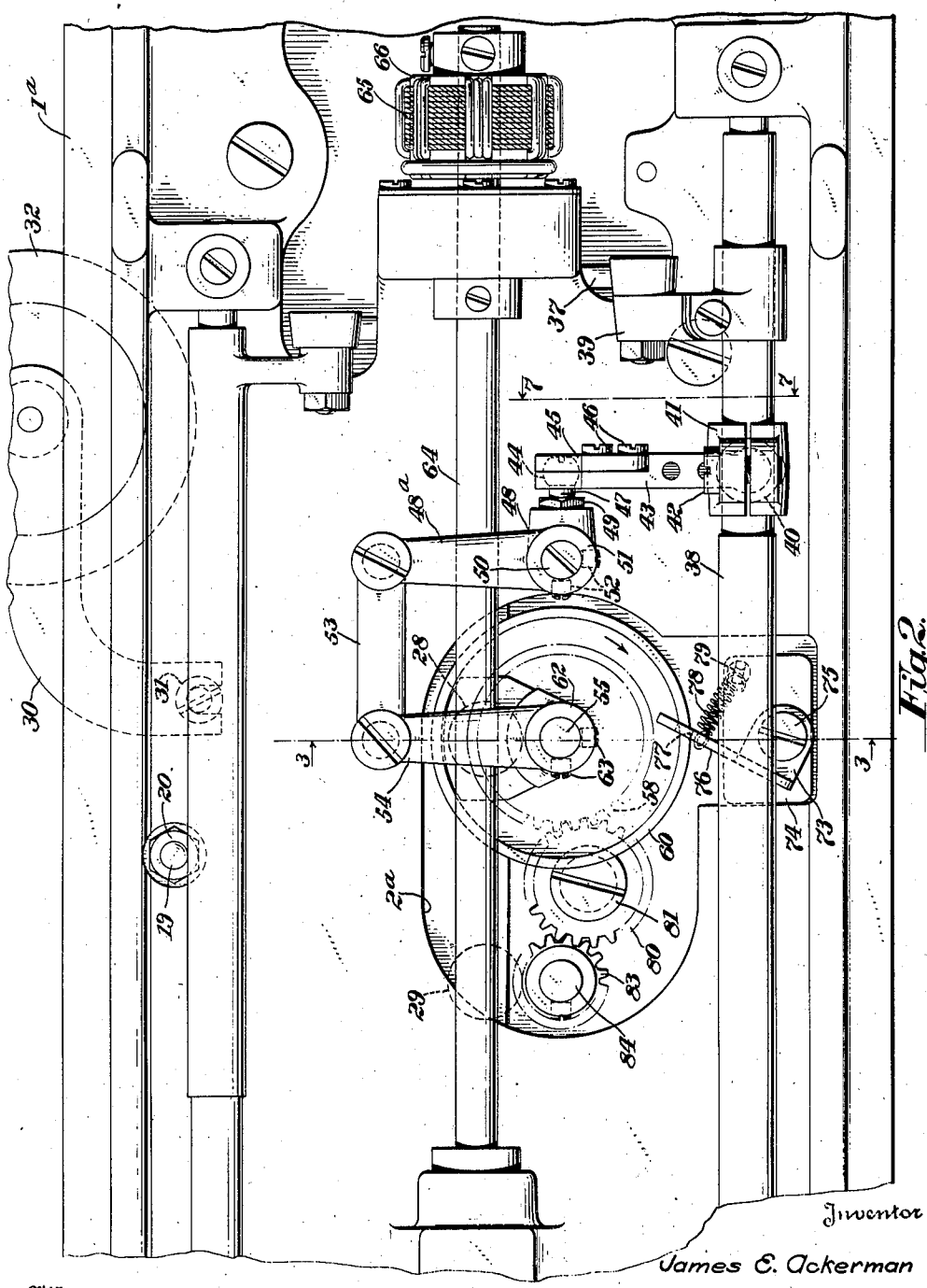


Fig. 2.

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STRIP-TENSIONING DEVICE FOR SEWING MACHINES

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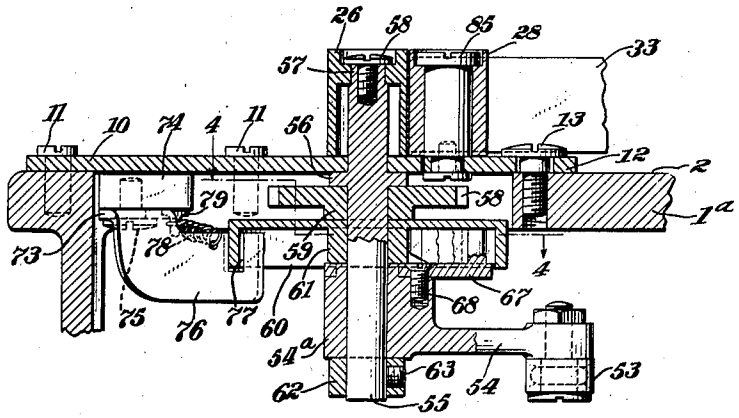


Fig. 3.

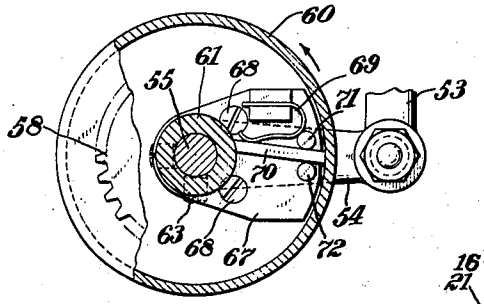


Fig. 4.

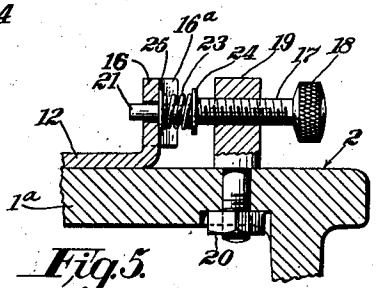


Fig. 5.

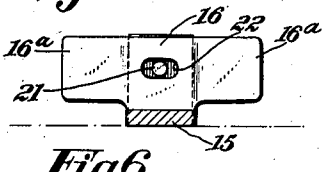


Fig. 6.

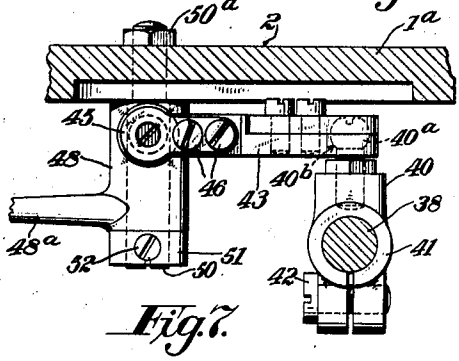


Fig. 7.

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Patented Nov. 30, 1943 2,335,838

UNITED STATES PATENT OFFICE

2,335,838

STRIP-TENSIONING DEVICE FOR SEWING MACHINES

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Application January 24, 1942, Serial No. 428,032

13 Claims. (Cl. 112—2)

The present invention relates to devices for presenting a strip of material under tension to the stitch-forming mechanism of a sewing machine.

In prior art devices, wherein tension is produced by the drag exerted by friction surfaces upon strip material directed to the stitch-forming mechanism of a sewing machine, it is difficult to control the tension of the strip because of the tendency of the material to skid erratically over the friction surfaces. This condition is aggravated when an elastic strip material, such as rubber, Vinylite, etc., has an adherent surface.

A primary object of this invention is to provide an improved means for feeding and guiding elastic strips under substantially constant tension to the main work-feeding mechanism of a sewing machine.

Another object of this invention is to provide an improved means for feeding and guiding an elastic strip in a stretched condition to the main work-feeding mechanism of a sewing machine; said means including a strip-folding binder.

A further object of the invention is to provide improved means for varying and adjusting an auxiliary feeding means to accommodate elastic strips of different thicknesses.

A still further object of the invention is to provide a stretching mechanism for producing a substantially constant and uniform tension in an elastic strip as it is presented with body material to the stitch-forming mechanism so as to effect a substantially uniform shirring of the body material when the strip has been attached thereto.

With the above and other objects in view, as will hereinafter appear, the invention comprises the devices, combinations and arrangements of parts hereinafter set forth and illustrated in the accompanying drawings of a preferred embodiment of the invention, from which the several features of the invention and the advantages attained thereby will be readily understood by those skilled in the art.

In the drawings,

Fig. 1 is a top plan view of part of a sewing machine having the improvements applied thereto.

Fig. 2 is a bottom plan view of the same.

Fig. 3 is a transverse vertical section, partly in elevation, taken on the line 3—3 of Fig. 2.

Fig. 4 is a horizontal section partly in plan taken on the line 4—4 of Fig. 3.

Fig. 5 is a vertical section partly in elevation taken on the line 5—5 of Fig. 1.

Fig. 6 is a vertical section partly in elevation taken on the line 6—6 of Fig. 1.

Fig. 7 is a vertical section partly in elevation taken on the line 7—7 of Fig. 2.

The sewing machine used may be of any desired type. As illustrated in the drawings, it comprises an upright arm 1 positioned on a bed 1a having a work-supporting surface portion 2 and a cover-plate 3 to which a strip-guide in the form of a commonly employed transverse-binder 4 is secured by means of screw 5. A throat-plate 6 containing a needle hole 7 and a feed-dog slot 8 is secured to said work-supporting surface portion 2; the binder 4 having its delivery end disposed in advance of the needle hole 7 and, therefore, in advance of sewing position. Opposed to the throat-plate 6 is a presser-foot 9. A horizontal rectangular stationary plate 10 is secured upon the work-supporting surface portion 2 by screws 11; said plate 10 being positioned between the upright arm 1 and the stitching point defined by the needle hole 7. Disposed edgewise adjacent the stationary plate 10 is a complementary movable plate 12, slidably confined upon the work-supporting surface portion 2 by means of shouldered screws 13 which pass through slotted apertures 14 in the movable plate 12 and are threaded into the bed 1a. The bed 1a has an opening 2a directly beneath the stationary and movable plates 10 and 12 to provide necessary clearance for mechanism depending from said plates. The movable plate 12 is tapered on the side remote from the stationary plate 10 to a neck-portion 15 terminating in an upturned portion 16 which stands at right angles to the work-supporting surface portion 2, as seen best in Fig. 6. The upturned portion 16 is formed with laterally extended end portions 16a which provide finger-grips to facilitate withdrawal of the movable plate 12 from the stationary plate 10. A thumb-screw 17 having a threaded body portion 17a and a knurled head 18 is threaded into an upstanding stud 19. The stud 19 extends through the bed 1a and is secured thereto by a nut 20 threaded onto said stud from beneath the bed, as seen best in Fig. 5. The thumb-screw 17 is formed with a reduced unthreaded end-portion 21 which loosely engages an aperture 22 in the upturned portion 16. A compression spring 23 positioned on the unthreaded end-portion 21 of the thumb-screw 17 reacts at one end against a bearing washer 24 positioned against the shoulder provided by the juncture of the threaded and reduced portions. At its other end, the spring 23 presses against the upturned

portion 16 of the movable plate 12 through the bearing washer 25. It is clear from this description that this construction provides an adjustable spring pressure on the movable plate 12 to urge it generally in the direction of the stationary plate 10.

On the stationary plate 10, adjacent the edge nearest the movable plate 12, are mounted vertical-axis strip-feeding rollers comprising a primary strip-feeding roller 26 and a secondary strip-feeding roller 27. Similarly, on the movable spring-pressed plate 12, adjacent the edge nearest the stationary plate 10, are mounted presser-devices in the form of vertical-axis presser-rollers 28 and 29, so positioned as to be pressed respectively against the feeding rollers 26 and 27 from which they receive their rotary motion by frictional engagement with a binding-strip 33 passing therebetween as clearly seen in Fig. 1. The presser-rollers 28 and 29 are rotatably journaled upon shouldered studs 85 and 86 which themselves are secured to the movable plate 12 by screws as illustrated, for example, in Fig. 3. A strip-reel supporting arm 30 is removably secured to the work-supporting surface portion 2 by means of a screw 31; said arm 30 rotatably supporting a supply spool 32 from which the elastic binding-strip 33 is drawn by the primary feed-roller 26 and its opposed presser-roller 28. In its passage from the supply spool 32 to the binder 4, the binding-strip 33 passes around the primary strip-feeding roller 26 and then between it and its associated presser-roller 28. The binding-strip then passes around the secondary strip-feeding roller 27 and between said roller 27 and its opposed presser-roller 29, from which the strip passes to and through the binder 4 to the main work-feeding mechanism, as shown clearly in Fig. 1.

The primary and secondary strip-feeding devices are therefore arranged successively to engage the strip at different stations spaced from each other lengthwise of the strip in the travel of the strip to the strip-guide or binder 4; the spaced strip-feeding rollers 26 and 27 being disposed to engage and feed the same portions of the strip.

As will be described later, it is arranged for the secondary strip-feeding roller 27 to have a somewhat greater surface speed than the primary strip-feeding roller 26 and for this differential feed to be positively maintained. The pressure exerted between paired rollers 26, 28 and 27, 29, respectively, by the spring 23 acting through the movable plate 12 is made sufficient to normally prevent any slippage or skidding of the strip between said paired rollers. Under these conditions, the strip 33 after its passage between the feed rollers 26, 28 is stretched a constant amount equal to the increased length necessary to balance the difference in the linear speeds of the strip at the surface of the feed rollers 26 and 27. That is to say, if "*a*" represents the unstretched strip length per unit time pulled from the supply 32 by the feed-roller 26, and "*b*" represents the strip length per unit time passed between feed rollers 27 and 29, then each "*a*" units in the portion 34 of the strip is stretched by an amount equal to "*b*—*a*" units. It is clear that this uniform stretching per unit length produces a constant tension in the strip in the portion 34. The main work-advancing mechanism includes a feeding element in the form of a conventional four-motion feed-dog 35 operating through the throat-plate 6 and being opposed by the presser-foot 9 substantially at sewing position. The linear rate of feed of the work by the feed-dog 35 is preferably the same as that provided by the face speed of the feed-roller 27. Under these conditions the tension produced in the portion 34 of the strip is maintained in the portion 36 and the strip is advanced forward under constant tension to the stitch-forming mechanism. The body material 87, such, for example, as that used in shower curtains, is presented as shown in Fig. 1, in an unshirred condition to the stitch-forming mechanism which secures the uniformly stretched elastic binding strip 36 embracing the edge of the body material. The elastic strip, after passing beyond the presser-foot 9 contracts to uniformly shirr the edge portion of the body-material at 88. It is clear that the uniformity in the shirring of the body material is dependent directly on the uniformity in the tension maintained in the strip as it is presented to the work-feeding mechanism.

In effect, the differential strip-feeding mechanism described provides a tension producing component and a tension maintaining component whereby the main work-feeding mechanism receives the strip in a uniformly stretched condition but does not itself form part of the tension producing component. By thus separating the tension producing component from the main work-feeding mechanism, the strip approaches said mechanism at a constant linear speed desirable for uniform stitch production, all linear acceleration being taken care of in the separate tension producing component.

The secondary paired rollers 27 and 29 act in a special manner to positively prevent slippage of the strip in either direction from between said rollers. This effect is brought about by the fact that the tension in that portion 34 of the strip on one side of the rollers 27, 29 is automatically maintained substantially equal to the tension in that portion 36 of the strip on the other side of said rollers. Thus, there normally exists at this point no net force tending to cause slippage of the strip.

The primary paired feed-rollers 26 and 28 contact the strip between portion 33, which has substantially no tension, and portion 34, which has substantially maximum tension. That is to say, the total tension is built up in the strip as it passes from between the rollers 26 and 28. It is this difference in tension which provides the force tending to cause slippage of the strip at rollers 26 and 28. When, for any reason, slippage does occur between rollers 26 and 28, a sudden surging forward of the strip results and produces a momentary loss of tension in the strip in the portion 34 thereof. This suddenly-lowered tension condition in portion 34 can be transmitted to portion 36 only as fast as the reduced-tension strip is fed into the portion 36 by the feed rollers 27 and 29. This rate of roller feed is substantially less than the practically instantaneous forward slippage of the strip between rollers 26 and 28. Thus, with momentary slippage, the tension in portion 34 may be partially or fully restored before the tension in portion 36 has been reduced to the low value attained in portion 34. The tension in the strip at the stitching point is therefore maintained more uniform by the provision of the secondary feed rollers 27 and 29 which thus constitute useful means for preventing detrimentally large and sudden changes in tension in the elastic strip material at the stitch-

ing point with a view to improving the uniform appearance of the finished article.

This constant tension maintaining function is especially desirable in those cases in which the elastic strip is threaded through a guide such, for example, as the transverse-binder 4 shown in Fig. 1. In such guides, any widening of the strip due to changes in tension effects either a crowding of the strip within the guide thereby impeding its smooth passage therethrough, or a narrowing of the strip whereby the guide is ineffective in properly directing the strip.

It is important that the strip-feeding mechanism be operated in synchronism with the work-feeding mechanism to render the strip tension independent of the work-feeding rate and how this is accomplished will now be described. Referring to Fig. 2, a pitman 37, positioned within the hollow upright arm 1 and deriving its motion from a conventional feed-eccentric on the main shaft (not shown), is connected to a conventional feed-advance rock-shaft 38 through a rock-arm 39 and imparts to the rock-shaft an oscillatory motion. The rock-shaft 38 is connected in any usual or suitable manner to impart work-advancing and return movements to the feed-dog 35. As seen best in Fig. 7, a driving crank 40, formed at one end with a split hub 41 which embraces the rock-shaft 38 and is secured thereto by means of the headed screw 42, has threaded into the other end a ball-screw 40a which is seated within a spherical socket 40b in one end of a link 43. A similar spherical socket 44 formed at the other end of the link and having a retaining cap 45 secured thereto by screws 46 is engaged by the ball-screw 47 threaded into one arm of a bell-crank lever 48 and fixed therein by lock nut 49. The bell-crank lever 48 is pivoted on a fulcrum stud 50 which extends through the bed 1a and is secured thereto by a nut 50a threaded onto said stud from the upper side of the bed as seen in Fig. 1. The bell-crank lever 48 is formed with an off-set arm 48a which operates in a horizontal plane beneath the hook-shaft 64 journaled in the bed 1a and actuated by a clip belt 65 engaging a sprocket-wheel 66 carried by the hook-shaft 64. A collar 51 secured to the stud 50 by set-screws 52 retains the bell-crank lever in axial position on the stud 50, and a link 53 pivotally connects said bell-crank lever 48 with a driving-wheel-lever 54 said lever 54 having a hub 54a freely pivoted on a vertically disposed stud 55.

Referring now to Fig. 3, the stud 55 is rotatably supported by the stationary plate 10 and is formed with a flange 56 bearing against the under side of said plate 10. The stud 55 carries the feed-roller 26 secured to a reduced upper portion 57 by a headed screw 58 threaded axially into the end of said stud. A driving pinion-gear 58 having a hub 59 is pressed onto the stud 55 for rotation therewith and is positioned against the flange 56, while driving-wheel 60 having a hub 61 is also pressed onto said stud 55 for rotation therewith and is positioned against the hub 59. A collar 62 is secured to the stud 55 by set-screws 63 so that the hub 54a of the driving-wheel lever 54 is positioned on the stud 55 to endwise abut the hub 61 of the driving-wheel 60; said hub 54a being free to turn on said stud.

The previously described rocking motion of the driving-wheel lever 54 imparts an intermittent uni-directional rotation to the driving wheel 60 through the agency of a one-way clutch device. This clutch device comprises a pawl and spring holder plate 67 secured to the hub 54a of the lever 54 by means of screws 68 and having mounted thereon a U-shaped spring 69 and a pawl 70 positioned adjacent one end between two driving pins 71 and 72 secured to said plate 67. The spring 69 urges the pawl 70 into a wedged position between the hub 61 and the inner periphery of the edge of the driving-wheel 60 so as to impart to said driving-wheel the motion of the lever 54. As seen best in Fig. 4, a clockwise motion of the lever 54 tends to urge the inner end of the pawl 70 against the spring 69 to decrease the wedging action of said pawl and permit the outer end of the pawl to slip over the inner periphery of the driving-wheel 60 without transmitting driving force thereto. On the other hand, a counterclockwise motion of the lever 54 tends to urge the pawl 70 into a more nearly radial position, thereby increasing the wedging action of said pawl and imparting to the driving-wheel the motion of the lever 54.

To prevent retrograde motion of the driving-wheel 60, a one-way-acting brake is employed which applies a braking force to the driving wheel whenever it tends to turn in a direction counter to that corresponding to normal forward feed. This brake comprises a slotted angle-piece 73 pivotally secured to a block 74 by means of a shouldered screw 75 and formed with an upstanding portion 76 having a slotted portion 77 which grippingly embraces the peripheral rim of the driving-wheel 60; against which rim said slotted portion is urged by a tension spring 78 anchored at one end to a post 79 secured to the block 74, as seen best in Fig. 2. The angle-piece 73 is so positioned that the upstanding slot-containing portion 76 stands in a plane oblique to the peripheral rim surface at the point of engagement of said rim by said slotted portion 77, and, as viewed in Fig. 2, clockwise rotation of the driving-wheel 60 serves to release the slotted portion 77 from its gripping embrace of the rim of the driving-wheel 60 by urging the upstanding portion 76 against the pull of the spring 78 into a less oblique position relative to the rim of the driving wheel 60. On the other hand, counterclockwise rotation of the driving-wheel 60, which corresponds to a retrograde direction of feed, urges the slotted portion 77 of the angle-piece 73 to pivot about the screw 75 to apply to said wheel a gripping force sufficient to prevent motion in this direction. From this description, it is clear that the stud 55 to which is secured the pinion-gear 58 and the feed roller 26, has imparted to it an intermittent uni-directional rotary movement in unison with the work-feed advance movement of the feed-dog 35.

The driving pinion gear 58 meshes with an idler gear 80 secured to the stationary-plate 10 by a shouldered screw 81 which extends through said plate and is secured on the top side by means of a nut 82 as seen best in Fig. 1. A small gear 83 meshed with the idler gear 80 is secured by a press fit to a stud 84 which carries at its upper end the feed roller 27 secured to said stud by means of headed screw 84. It is clear from this description that the feed roller 27 is positively driven in the same direction as and at higher face speed than the roller 26 and that the intermittent feed of roller 27 is in synchronism with that of the feed-roller 26 and of the main work-feeding mechanism. This synchronism of the strip-feed with the work-feed is important par-

ticularly where uniform tension in the strip regardless of machine speed is desired.

It is evident that the elastic strip may be initially inserted in a stretched condition between the feed and presser-rollers 27, 29, threaded through the binder 4 and engaged by the feed-dog 35 and opposed presser-foot 9; the initially stretched condition of the strip being preferably such that the strip is under approximately a desired tension which may be readily regulated and maintained by the auxiliary strip feeding mechanism as hereinbefore explained. Once the desired tension is established, it will be maintained constant in the portion 36 of the strip until the presser-foot 9 is raised. In production sewing, where one work-piece after another is successively presented to the stitch-forming mechanism, said pieces being joined together after stitching by the continuous strip, it will be necessary to raise the presser-foot 9 only when the strip-supply needs to be replenished and the strip-feeding mechanism re-threaded.

It has been shown that the pressure exerted on the strip between the driving and driven feed rollers may be adjusted by manipulation of the thumb-screw 17 and it is clear that this adjustment may be employed to accommodate any desired thickness of the elastic strip, the resilient construction compenating for any irregularity in the thickness of any given strip.

From the foregoing it will be perceived that I have provided an improved mechanism for feeding elastic material under tension to the stitching mechanism of a sewing machine, which feeding mechanism maintains a uniform tension in the material as it is presented to the stitch-forming mechanism.

It will be obvious to those skilled in the art that the invention may, without departure from its essential attributes, be embodied in various specific forms other than that shown and described, which latter is to be considered in all respects as illustrative of the invention and not restrictive; reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having thus set forth the nature of the invention what I claim herein is:

1. In a sewing machine, the combination with a main work-feeding mechanism, of primary and secondary strip-feeding rollers disposed successively to advance a strip of material toward said main work-feeding mechanism, presser-members yieldingly opposed to said strip-feeding rollers, and means for rotating said rollers at different speeds.

2. In a sewing machine, the combination with a main work-feeding mechanism, of primary and secondary strip-feeding rollers disposed successively to advance a strip of material toward said main work-feeding mechanism, presser-members yieldingly opposed to said strip-feeding rollers, and means for intermittently rotating said primary and secondary strip-feeding rollers at different speeds, the speed of rotation of said secondary strip-feeding roller being in excess of that of said primary strip-feeding roller.

3. In a sewing machine, the combination with a main work-feeding element having intermittently effective work-advancing movements of a predetermined amplitude, of primary and secondary strip-feeding rollers disposed successively to engage and advance the same strip of material toward said main work-feeding element, means for intermittently rotating said secondary strip-feeding roller at a speed to impart thereto strip-advancing movements of substantially the same amplitude as the amplitude of work-advancing movement of said main work-feeding element, means for intermittently rotating said primary strip-feeding roller at a less speed than that of said secondary strip-feeding roller, and presser-rollers yieldingly opposed to said strip-feeding rollers.

4. In a sewing machine, the combination with a main work-feeding mechanism, of an auxiliary strip-tensioning and -feeding mechanism comprising a plurality of feed-rollers disposed successively to advance a strip of material toward said main work-feeding mechanism, means for rotating said rollers unidirectionally at different speeds in unison with the work-feeding movements of said main work-feeding mechanism, and presser-members yieldingly opposed to said rollers.

5. In a sewing machine, the combination with a main work-feeding mechanism, of an auxiliary strip-tensioning and -feeding mechanism comprising differential strip-feeding rollers supported for rotation about substantially parallel axes, said rollers being disposed successively to engage and advance a strip of material toward said main work-feeding mechanism, means for rotating said rollers uni-directionally at different speeds in unison with the work-feeding movements of said main work-feeding mechanism, and presser-rollers yieldingly opposed to said strip-feeding rollers.

6. In a sewing machine, the combination with a work-advancing feed-dog, and means including a feed-advance rock-shaft for actuating said feed-dog, of primary and secondary strip-feeding rollers disposed successively to engage and advance a strip of material toward said feed-dog, a one-way clutch-device associated with said primary strip-feeding roller, connections with said rock-shaft for actuating said clutch-device to intermittently rotate said primary roller, operative connections for intermittently rotating said secondary strip-feeding roller uni-directionally in unison with and at a speed in excess of that of said primary strip-feeding roller, and presser means yieldingly opposed to said rollers.

7. In a sewing machine having a frame including a work-support, a work-advancing feed-dog operating through said work-support, a primary strip-feeding roller mounted upon said work-support to advance a strip of material toward said feed-dog, a secondary strip-feeding roller mounted upon said work-support for engaging said strip between said primary roller and said feed-dog, said strip-feeding rollers being supported for rotation about spaced axes disposed substantially normal to the upper face of said work-support, a feed-advance rock-shaft disposed below said work-support and operatively connected to actuate said feed-dog, actuating means connected to said rock-shaft for intermittently rotating said primary strip-feeding roller, gear connections between said rollers for intermittently rotating said secondary strip-feeding roller at a speed in excess of the speed of rotation of said primary strip-feeding roller, and presser-devices yieldingly opposed to said strip-feeding rollers.

8. In a sewing machine, the combination with a main work-feeding mechanism, and a strip-reversing binder disposed to direct a folded binding-strip toward said work-feeding mechanism, of a primary binding-strip feeding device dis-

posed to engage and advance said binding-strip toward said binder, a secondary binding-strip feeding device disposed between said primary strip-feeding device and said binder, and means for actuating said binding-strip feeding devices at different speeds.

9. The combination with a sewing machine having a work-feeding mechanism, of primary and secondary strip-feeding devices spaced from each other lengthwise of a strip of material in the path of travel of said strip to said work-feeding mechanism, said strip-feeding devices being disposed successively to engage and feed the same portions of said strip, and actuating mechanism for imparting differential strip-feeding movements to said devices.

10. The combination with a sewing machine having a main work-feeding element, and actuating mechanism for imparting intermittent work-advancing movements of predetermined amplitude to said main work-feeding element, of auxiliary primary and secondary strip-feeding devices spaced from each other lengthwise of a strip of material in the path of travel of said strip to said main work-feeding element, said strip-feeding devices being disposed successively to engage and feed the same portions of said strip, actuating mechanism for imparting to said primary strip-feeding device intermittent work-advancing movements in unison with and of less amplitude than the work-advancing movements imparted to said main work-feeding element, and operative connections for imparting to said secondary strip-feeding device intermittent work-advancing movements in unison with and of substantially the same amplitude as the work-advancing movements of said main work-feeding element.

11. In a sewing machine, the combination with a work-advancing feed-dog, and means including a feed-advance rock-shaft for actuating said feed-dog, of primary and secondary strip-feeding devices spaced from each other lengthwise of a strip of material in the path of travel of said strip to said feed-dog, said strip-feeding devices being disposed successively to engage and feed the same portions of said strip, and operative connections with said rock-shaft for imparting differential strip-feeding movements to said devices.

12. The combination with a sewing machine having a work-feeding mechanism, and a binder constructed and disposed for delivering a longitudinally folded binding strip to said work-feeding mechanism, of means comprising primary and secondary strip-feeding devices disposed successively to engage and advance the binding strip in its travel to said binder, and actuating mechanism for imparting relatively slow and fast strip-advancing movements to the respective strip-feeding devices.

13. The combination with a sewing machine having stitch-length defining work-feeding mechanism disposed substantially at sewing position, and a strip-guide disposed in advance of sewing position for delivery of a strip of material to said work-feeding mechanism, of primary and secondary strip-feeding devices arranged to engage said strip at different stations spaced from each other lengthwise of the strip in the travel of the strip to said strip-guide, and means for imparting differential strip-advancing movements to said strip-feeding devices.

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