This invention relates to a machine for gripping, tensioning and tying the tensioned band around boxes, bundles or the like, and it is an object of this invention to provide such a machine which will be simple in design, easy to operate, and practically automatic in performing the different steps of the tensioning and tying operations.

This invention will be illustrated and described in its preferred embodiment for applying flat bands to boxes, but it is to be understood that many of the novel features of the invention are applicable to round wire tying machines, and that with slight modification of the gripping and tying means, the machine may be adapted to apply round wire bands.

It is an object of this invention to provide a light, portable machine which may be handily moved from one box to another, but if desired, may be mounted stationary, and the boxes moved to the machine.

A further object is to provide means for tensioning the band to a predetermined tension.

A further object is to provide means which will operate when the band has been tensioned to a predetermined degree for interrupting further tensioning, and which means may be utilized to automatically inaugurate the tying and severing operations.

A further object is to provide an oscillatory operating handle which will be initially free, but which will become operatively connected with the tensioning means when the tying device is moved from an open position to a position setting directly over the band, whereupon by oscillating the handle the tensioning means will be actuated to pull the band tightly around the article being banded, and for providing means which will activate as soon as the band has been tensioned to a predetermined degree for automatically connecting the operative handle for operating the tying and severing means.

A further object is to provide a master cam, which, when oscillated will actuate the tensioning means and when rotated through a complete revolution, will actuate the tying and severing means.

A further object is to provide means for connecting the oscillatory operating handle with the master cam, in such a way that upon oscillating the handle, the master cam will be oscillated to actuate the tensioning means and for providing means operative when the tension in the band reaches a predetermined degree for re-connecting the handle with the cam, whereupon for each oscillation of the operating handle the cam will be rotated in a forward direction until the master cam has completed a full revolution, whereby the master cam during its forward rotation will actuate the tying and severing means.

A further object is to provide a control means for initially retaining the oscillatory operating handle disconnected from the master cam, and which control means may be automatically operated during the movement of the tying means from the open to the set position to connect the handle with the master cam, whereupon by oscillating the operating handle the cam will be oscillated to actuate the tensioning means. And for arranging the control means to automatically operate when the band has been tensioned to a predetermined degree for changing the connection between the handle and cam, whereupon by oscillating the handle the cam will be rotated in a forward direction for a complete revolution whereby the cam, during its revolution, will actuate the tying and severing means and also the means for returning all of the elements to their initial starting positions.

A further object is to provide a reciprocatory tensioning means with a resilient member which will actuate when the tension of the band reaches a predetermined degree for interrupting further tensioning of the band.

A further object is to utilize the movement of the resilient means for actuating the control means for inaugurating the tying cycle of the machine.

A further object is to provide the journaled end of the oscillatory operating handle with two independent pinions, a pawl for each pinion and a control means operable for initially retaining both of the pawls out of engagement with their respective pinions, and means for operating the control means to first actuate the tensioning pawl into locking engagement with its respective pinion, whereupon the pinion will be oscillated with the oscillations of the handle, and means for further actuating the control means to change the tensioning pawl from a locking to a ratchet engagement with its respective pinion, and simultaneously therewith, for releasing the second pawl into ratchet engagement with its respective pinion whereby as the handle is oscillated, each of the pinions will be rotated in the opposite directions.

A further object is to operatively connect the first or tensioning pinion with a master cam through a pair of gears mounted upon a counter-shaft whereby the cam will be rotated in the same direction as that of the tensioning pinion and
for directly meshing the second pinion with the master cam whereby the cam will be rotated in a direction reverse to that of the second pinion. Thus, by so connecting the two pinions with the cam, the cam will be continuously rotated in a forward direction during the oscillation of the operating handle when the control means releases both of the pawls into ratchet engagement with their respective pinions.

A further object is to provide the oscillatory operating handle with means for transposing the motion of the control means into a rotary motion for rotating the pawl control shaft, and thereby controlling the relation of each of the pawls with its respective pinion.

A further object is to provide a tying means with toggle levers of different length and connecting the adjacent ends of the toggle levers with the free ends of jointed toggle links so arranged and proportioned that when the levers are in the open position, the jointed links will fold back upon the shorter of the levers, and when the levers are actuated to the set position, the jointed links will form a toggle between the levers.

A further object is to provide a spring means for yielding, urging the tying means into the open position and for providing what may be termed an "escapement lock" for releasably locking the tying means in the set position. The term "escapement lock" is deemed appropriate because the locking member corresponds in form to the anchor member of the common escapement device used in clocks and acts in somewhat the same manner.

A further object is to provide a positioning means for maintaining the forming or crimping jaws of the tying means in substantial alignment with respect to the band during the tying operation.

A further object is to provide the master cam with means for actuating said positioning means.

A further object is to provide the master cam with means for returning the toggle links after the completion of the tying operation to an out-of-position wherefrom the links may be folded back upon the shorter of the two toggle levers.

A further object is to provide means for severing the band from its supply before or substantially simultaneously with the tying of the band.

A further object is to provide the master cam with means for actuating the severing means in correct timed relation with respect to the actuation of the other functions of the machine.

A further object is to provide a severing means operative for severing the band close to the tie.

A further object is to provide a first or band-end gripper which will resist movement of the band away from the tying means and which first gripper may be retained cocked in its retracted position or automatically released therefrom into the gripping position by a trigger means when the band is positioned in the machine, and for providing means for automatically re-cocking the first gripper upon the completion of the tie for releasing the tied band and for rendering the gripper ready for the next band to be inserted.

A further object is to provide a second or take-up gripper positioned at the side of the tying means opposite to the first gripper, and arranged to permit the band to be pulled toward the tying means but resisting movement of the band away from the tying means, and to provide a gripper actuating means for retaining the take-up gripper to its retracted position while the tying means are in the open position and for automatically releasing the gripper when the tying means are moved to the set position, and also for returning the take-up gripper to its retracted position upon completion of the tie for automatically releasing the tied band.

A further object is to provide the reciprocating tensioning means with a third or tensioning gripper arranged to be normallycocked in its retracted position and automatically released therefrom into gripping position by the actuation of a trigger means actuated by the band as the same is positioned in the tensioning gripper, and said gripper means being so arranged that upon the outward movement or stroke of the tensioning means, the gripper will grip and pull the band outwardly but upon the in-stroke of the tensioning means the gripper will slide over the band, whereby the band will be tensioned in a step-by-step manner.

Other objects and advantages of the invention will become apparent as the nature of the same is more fully understood from the following description and accompanying drawings wherein is set forth what is now considered to be a preferred embodiment. It should be understood, however, that this particular embodiment of the invention is chosen principally for the purpose of exemplification, and that variations therefrom in details of construction or arrangements wherein the parts may accordingly be effected, and yet remain within the spirit and scope of the invention as the same is set forth in the appended claims.

In the drawings:

Figure 1 illustrates a plan view of the band tying machine as it normally appears prior to the commencement of the banding operation;

Figure 2 illustrates the left side view of the machine;

Figure 3 illustrates a front view of the machine;

Figure 4 illustrates a sectional view taken substantially in the plane of lines IV—IV of Fig. 1;

Figure 5 illustrates a fragmental sectional view taken substantially in the plane of lines V—V of Fig. 1;

Figure 6 illustrates a fragmental sectional view of the severing mechanism taken substantially in the plane of lines VI—VI of Fig. 1;

Figure 7 illustrates a fragmental plan view showing the action of the resilient member of the tensioning means when the band has been tensioned to a predetermined degree for interrupting further tensioning. This view also illustrates the tying means in the set position;

Figure 8 illustrates on an enlarged scale, a fragmental sectional view taken substantially in the plane of lines VIII—VIII of Fig. 3, and shows the second or take-up gripper and the actuating means therefor;

Figure 9 illustrates on an enlarged scale, a fragmental sectional view taken substantially in the plane of line IX—IX of Fig. 7, and shows the first or band-end gripper, lock, trigger, and automatic cocking means therefor;

Figure 10 illustrates a partial plan view of Fig. 9;

Figure 11 illustrates an enlarged fragmental sectional view taken substantially in the plane of line XI—XI of Fig. 7;

Figure 12 illustrates on an enlarged scale a fragmental sectional view taken substantially in the plane of line XII—XII of Fig. 1;

Figure 13 illustrates on an enlarged scale, a
fragmental view partially in section of the oscillatory operating handle together with the two pawls and two pinions and the controlling means therefor;

Figure 14 illustrates on an enlarged scale a fragmental sectional view taken substantially in the plane of line XIV—XIV of Fig. 13, and illustrating the two pawls held in operative position by the pawl control shaft;

Figure 15 illustrates a view similar to Fig. 14, with the exception that the control shaft has been rotated to lock the tensioning pawl in operative engagement with its pinion;

Figure 16 illustrates a view similar to Fig. 14, with the exception that the control shaft has been further rotated to change the tensioning pawl from locking to a ratchet engagement with its pinion, and illustrating the second pawl in ratchet engagement with its respective pinion;

Figure 17 illustrates an enlarged fragmental sectional view taken substantially in the plane of line XVII—XVII of Fig. 13.

One embodiment of this invention is illustrated in the drawings as disclosing the invention in the form of a portable machine which may be easily moved from one article to be banded to another. In Figure 2 the machine is illustrated as mounted upon a box 1 to which the band 2 is to be applied.

The box 1 is attached to the machine 3, and the machine is placed upon the top surface of the box at the location at which the band is to be placed. Preferably the band is supplied from a reel not shown, and is loosely looped around the box.

To assemble the looped band into the machine, the band-end 4 (note Fig. 3), may be positioned in a notch 5, formed in the inner side of the second gripper anvil 6, for correctly locating the band-end with relation to the tying means. After the band-end has been placed in the locating notch, the band may be threaded between the jaws of the tying means and then over the first gripper anvil 7.

As the band is to be tensioned before the tying operation, it is essential for the end 4 of the band to be securely fastened or gripped in the machine to prevent the band from being pulled out of the machine by the tensioning means. Any suitable gripping means may be provided to grip the band end, which gripping means will be referred to as the band-end or first gripper to distinguish this gripper from the other gripping means. As illustrated most clearly in Figures 3, 9 and 10, the first gripper may include a gripper anvil 7 formed integral or suitably secured to base 3 over which the band is placed, and a gripper member 8 may be operatively mounted above the anvil by means of the pivot pin 9. The engaging face of the first gripper may be serrated as at 10 and may be provided with a curvature eccentric from the pivot pin 9, whereby any tendency of the band to be pulled toward the right as viewed in Fig. 3, or away from the tying means, may act to increase the gripping force of the gripper. A spring means 11 may act between the arm 12 and a suitable pin 13 carried by the base to yieldingly urge the gripper into gripping engagement with the band. However, it is desirable to normally retain the first gripper cocked in an open or retracted position to enable the band to be more expeditiously placed in the machine, and for this purpose a latch member 14 may be pivotally mounted upon the control lever 15 by means of a suitable pivot pin 16 (note Figures 3, 9 and 10), and provided with a latch notch 17 positioned to engage the arm 12 of the gripper to retain the gripper cocked in the open or retracted position. A spring 18, acting between the latch member and a pin 19 on the control lever, may be provided to yieldingly retain the latch in engagement with the gripper arm.

The operator may place the band in the machine more expeditiously, providing it is not necessary to manually open and then close the respective grippers, and therefore, the first or band-end gripper may be provided with means for automatically tripping the cock gripper when the band has been correctly positioned in the machine, which means may include a first gripper trigger 20, pivotedally mounted upon the base as at 21, and may be provided with a suitable torsional spring means 22 for resiliently retaining the trigger in its operative position. The first gripper trigger may be provided with an arm 23 extending above the pivot 21, and adapted to engage a trigger notch 24 of the latch member 14. The lower end of the trigger is positioned to be engaged and swung inwardly as the band is moved into tying position. The movement of the trigger may rock the latch member 14 until the gripper arm 12 is released from the latch notch 17, whereupon spring 11 is free to swing the serrated portion of the gripper into gripping engagement with that portion of the band supported upon the first gripper anvil 7. The gripping anvil 7 of course, is a complementary portion of the gripping means but for the sake of simplicity, when referring to the gripping means broadly, it is to be understood that the anvil is intended to be included.

As soon as the band end is securely gripped by the first gripper, the unnecessary slack of the band loop is taken up and the operator threads the section of the band indicated at 25, through the second or take-up gripper, by placing the band between the second gripper anvil 6 and the second or take-up gripper 26. The second gripper may be referred to as the take-up gripper as this gripper is arranged to permit the band to be moved therethrough in a direction to tension the band, but resists or prevents movement of the band in a reverse direction. Any suitable gripping means may be provided, such as the gripper 26 (note Figure 3) pivotedally mounted upon the base by means of the pivot pin 27, and a spring 28 may be provided to act between the extended end of the gripper and the base, to yieldingly urge the gripper into gripping engagement with the band supported upon anvil 6. Like the first gripper, it is desirable to automatically retain the second gripper in an open or retracted position during the placing of the band in the machine, and therefore, means may be provided for retaining the take-up gripper in an open position until the tensioning operation is ready to be inaugurated, which means may include a control lever 29 (note Fig. 8) pivotally mounted upon the base as at 30, and the gripper may be provided with an arm 31 over-riding the control lever, whereby as the control lever is moved up or down, the second gripper 26 is likewise moved up or down to or from gripping engagement with the band. The control lever in turn may be actuated by a pin 32 carried by the single toggle lever 33 to actuate the tying means, whereby the second gripper is retained in the open or retracted position until the toggle lever 33 is swung to the set position for inaugurating the tensioning and tying operations, whereupon the second or take-up gripper is released into gripping engagement with the band supported upon the adjacent gripper anvil 6. Like the
first gripper, the take-up gripper may be provided with an eccentric gripping surface which may be serrated as indicated at 34, and arranged to permit the band to be pulled toward the tying means, but resists a reverse movement of the band. The band may be next passed through the tying means and over the second or lower tooth 54 and through the third gripping means, which gripping means may include a third gripper member 36, (note Figure 11) pivotally mounted upon the crosshead 37 by means of the pivot pin 38. A trigger means may be provided for the tension gripping means, which may include a trigger 39 pivotally mounted upon the end of crosshead 37 by the pivot pin 40. The trigger 39 may be provided with a shoulder 41 arranged to engage the notch 42 of the gripper 36, and a single spring means 43 may connect the trigger and the gripper for yielding, urging each into its respective operative position. The trigger may be arranged to be engaged and actuated by the band during the placing of the band in the third gripper, whereby the trigger shoulder 41 will be moved out of engagement with the gripper, wherein, due to the action of spring 43, the gripper is swung into gripping engagement with the band supported upon the third gripper arm 44.

The third or tensioning gripper 36 may be provided with an eccentric gripping surface serrated as 36b and arranged to securely grip and pull the band during the out-stroke of crosshead 37, and to slide over the band during the in-stroke of the crosshead, whereby the band will be pulled to take up the slack and to tension the band around the article being bandaged.

The tensioning gripper may be provided with a handle 45 for re-cocking the gripper to the open position for releasing the band upon the completion of the tying operation, and for holding the gripper out of the way during the placing of the band in the machine.

The band has now been placed and gripped in the machine and is ready for the commencement of the tensioning, tying and severing operations.

Normally, the tying means are retained in an open or retracted position, as is illustrated in Figure 5, that is, swung away from the placing or gripping of the band in the machine, and therefore, must be swung to the position as illustrated in Figure 4, which position for convenience, may be termed the "set" position, before the tying operation can be started. The tying means, when moved to the set position, sets directly over and partially encloses the band, and is then ready for the tying operation.

The arrangement for moving the tying means from the open to the set position, may include journaling single toggle lever 33 on a toggle shaft 46 suitably supported upon the base, and providing the single toggle lever 33 with an operating handle 47. A spring 48 may act between the pin 49 positioned on handle 47, and the base for yieldingly retaining the single toggle lever in the open position. By means of handle 47, the single toggle lever may be swung against the action of spring 48, to move the tying means from the open to the set position, until the tying or crimping jaw 50 carried by lever 33, engages the edge of the band to arrest further movement of lever 33. It is desirable to releasably lock the tying means in the set position, and for this purpose an escapement lock 51 may be provided. The advantage of utilizing an escapement lock resides in providing a locking means which will only lock the tying means in the set position when a band is placed in the machine. The escapement lock 51 is illustrated clearly in Figures 1 and 4, and may include an anchor member 52 suitably journaled in the base as by the pivot pin 53. The anchor member may be provided with two spaced teeth. The upper of the two spaced teeth 55 is in locking engagement with the locking tooth 54, while the second or lower tooth may be termed the re-setting tooth 55, and are positioned in the path described by the rear end of the single toggle lever 33. From Figure 4 it will be observed that the locking and tripping tooth 54 is in locking engagement with the locking notch 56 positioned in the end of the toggle lever 33. In this arrangement of the parts the locking tooth 54 acts to lock the lever 33 and thereby the tying means in the set position.

The rear edge of the anchor member 52 may be provided with two notches 57 and 58, into either one of which the round nosed pawl 59 is urged by means of spring 60. As will be observed from Figure 4, the round nosed pawl 59 is in engagement with notch 57 when the locking tooth 54 engages the lever notch 56 and should the lever 33 be swung slightly higher, the anchor member 54 will be rotated until the round nosed pawl snaps out of notch 57 into notch 58, thus rotating and locking the anchor member in the position indicated in broken lines, wherein, said lever 33 may return to its open position. The lever notch 56 will not engage the locking tooth 54, and therefore, due to the action of spring 48, will return the tying means to the open position. During the return movement of the lever 33, the reseting tooth 55 which had been swung into the broken line position of Figure 4, in which position the end of the tooth projects into the circular notch 61 formed in the end of lever 33, will be engaged by the tooth 62 formed between the upper end of the circular notch 61 and the rear end of notch 56 to rotate the anchor member until the round nosed pawl 59 rides out of notch 58 and back into the first notch 57. Thus the anchor member will be reset in its locking position. However, as the lever notch 56 will have previously passed beyond reach of the locking tooth 54, the lever notch 56 may return to its open position. It may now be appreciated that when the lever 33 is swung to move the tying means from the open to the set position, when a band is in the machine, that the lever 33 will be stopped by the engagement of the tying die 50 with the edge of the band, and that when so stopped, that the lever notch 56 will have traveled only sufficiently beyond the end of the locking tooth 54 to insure a reliable locking action. But should the lever 33 be swung when no band is in the machine to limit the swinging action of the lever, then the lever notch 56 will engage the locking tooth and thereby rotate the anchor member until the round nosed pawl will ride out of notch 57 and snap into notch 58 to retain the anchor member in the releasing position, thus preventing the locking of the lever 33, and thereby the tying means in the set position.

After the band has been positioned and gripped in the machine, the act of operating the escapement lock 52 and the tying means from the open to the set position, and to there lock the tying means by the escapement lock 52. The movement of the tying means in swinging from the open to the set position may be made use of by a suitable control mechanism for connecting the operating means of the machine so as to actuate the tensioning device. The
control mechanism may include a control lever 15 pivotally supported on the base by means of the pivot pin 63 and acted upon by the spring 64 acting between the control lever as at 65 and the base at 66. The forward end of the control lever 15 may be cam-shaped as at 67, and positioned to be engaged and actuated by the forward end of the single toggle lever 33 during the movement of the tensioning means when returning from the set position to the open position. In other words, when the tensioning means return to the open position, the forward end of lever 33 engages and actuates control lever 15 to shift the operating or driving mechanism of the machine into a neutral position. Intermediate the control lever pivot 62 and the rear end thereof, the control lever is operatively connected to a sleeve 68 by means of the pivot pin 69. The sleeve 68 may be slidably mounted upon a shaft 70 suitably mounted upon the base. When the tensioning means is swung from the open to the set position, the cam surface 67 of the control lever is released, whereupon, the spring 64 acts to rock the control lever 15 and thereby slide the sleeve 68 from the position illustrated in Figures 3, 13, to the position indicated in broken lines in Figure 13. The sliding of the sleeve 68 from the position illustrated in Figure 13 to the position indicated in broken lines in Figure 14, shifts the driving means from a neutral to a driving connection with the tensioning means. The driving means may include an oscillatory operating handle 71 having grip handle 72 at the free end thereof, and double bifurcation at its operative end, including the legs 73, 74 and 75, each leg of which is suitably journaled upon shaft 70. Intermediate legs 73 and 74 are pivotally mounted the two pawls 76 and 77 upon a pawl shaft 80 which may be termed the tensioning pawl and may be brought into operative engagement with a tensioning pinion 79, while the pawl 77 may be termed the tying pawl and may be brought into engagement with a tying pinion 90. The pinions 79 and 80 may be journaled upon a shaft 70 intermediate the legs 73 and 74 of the oscillatory handle. The two pawls are actuated by the control means whereby prior to swinging the tensioning means into the set position, the pawls are retained out of engagement with their respective pinions. While so retained, the handle 71 is in an extended position, and forth without rotating either of the pinions.

By the actuation of the control means during the swinging of the tensioning means from the open to the set position, the tensioning pawl 76 is shifted into locking engagement with the tensioning pinion 79. The mechanism for controlling the pawls may include a bracket 81 formed upon the leg 75 of the oscillatory handle to which bracket a bell crank lever 82 may be pivoted by means of the pivot pin 83, and the bell crank lever may be provided with a depending arm 84 adapted to travel in the semicircular groove 85 of sleeve 68. The bell crank lever 82 may also be provided with an upwardly extending arm 86 having a circular knob 87 adapted to operate in the bore 88 of the link 89. A pawl control shaft 90 may be journaled in the legs of the operating handle. A bifurcated arm 109 is provided upon the pawl control shaft 90 intermediate legs 74 and 75 of the operating handle. The end of link 89 opposite to that having the bore 88, may be operatively mounted between the free ends of the bifurcated crank 91 by means of the pin 92 (note Figure 17). By this arrangement the sliding motion of sleeve 68 is operative for rotating the pawl control shaft 90. The control shaft 90 controls the action of the tensioning pawl 76 by means of a transverse V shaped cam groove 93 and a substantially diametrically opposed transverse, semicircular cam groove 94. The upper end of the tensioning pawl may be provided with an arcuate finger 95 adapted to ride in or out of the V shaped cam groove 93, and a second arcuate finger 96 adapted to ride in or out of the semicircular cam groove 94. With the control shaft 90 rotated to the position illustrated in Figure 14, which position is the normal inoperative position of the shaft, it will be noted that finger 95 has ridden into the V groove while the finger 96 is riding upon the periphery of the control shaft 90 just adjacent the entrance to the circular cam 94. In this position of the control shaft, by means of the fingers 95 and 96, the tensioning pawl 76 is maintained out of engagement with the tensioning pinion 79, and therefore, the handle 71 may be oscillated back and forth without rotating the pinion 79 illustrated in this figure in broken lines. This is the position the parts will assume when the tensioning means is in the open position. When the tensioning means is swung from the open to the set position, the control mechanism is actuated to rotate the control shaft 90 from the position illustrated in Figure 14 to that of Figure 15. In Figure 15, it may be observed that the control shaft 90 has rotated until the arcuate finger 95 has ridden out of the V groove on to the periphery of shaft 90 while the finger 96 has ridden into the semicircular groove 94, and by this arrangement it may be observed that the tensioning pawl 76 is locked in mesh with the tensioning pinion 79, indicated in broken lines, whereby upon oscillating the handle 71 the tensioning pinion 79 will also be oscillated. In this way the control means acts to operatively connect the oscillatory handle to inaugurate the tensioning cycle for tensioning the band around the article to be tied.

The tensioning means and drive therefore may include a master cam 97 suitably journaled on the base and provided with spur gear 98 which spur gear may be in operative engagement with the tensioning pinion 79 by means of a pair of back gears 99. (Note Figure 4.) The back gears 99 may include a large driven pinion 100 in constant mesh with the tensioning pinion 79, and suitably journaled upon a back gear shaft 101. A small driver pinion 102 may be likewise journaled upon the back gear shaft 101 and suitably connected to the large pinion 100 to be rotated thereby. The small driver pinion 102 may be in constant mesh with the master cam spur gear 98, whereby when the tensioning pawl is locked in mesh with the tensioning pinion 79, as illustrated in Figure 15, and the handle 71 oscillated, the master cam will be oscillated through the driving connection formed by the tensioning pinion, back gears and master cam spur gear. As may be observed from Figure 7, the right hand face of the master cam 97 may be provided with a tensioning cam 103 having a depression or valley as indicated at 104 from which the cam surface rises to a maximum height at 105 and may gradually recede therewith until just before the cam surface drops off into the valley 104. A tensioning arm 106 may pivot about a pivot arm 107 and adjacent the tensioning cam 103, may be provided with a bifurcated bracket 108, between the bifurcations of which may be suitably journaled the cam roller 109 as by means of pin 110. The cam roller 109 may be positioned to engage the cam surface of the tensioning cam 103 and
when the machine is in its initial inoperative position the cam roller 109 may rest in the valley 104. When the tensioning pawl 76 is actuated into locking mesh with the tensioning pinion and the handle 71 oscillated, the master cam 97 will be correspondingly oscillated, causing in turn the tensioning cam 103 to oscillate and as the cam roller 109 normally rests in the trough of the valley 104, the rotation of cam 103 in either direction will cause the cam roller to ascend the sides of the valley 104, thus as the tensioning cam is oscillated back and forth, the cam roller 109 will move in and out, causing the tensioning arm to reciprocate. A spring 111 may act between the pin 112 carried by the tensioning arm 106 and the pin 113 mounted in the base to yieldingly urge the cam roller 109 into operative engagement with the cam 103.

The forward end of the tensioning arm 106 may be slotted as at 114 and thereby operatively connected to the crosshead 37 by means of the crosshead pin 115. The crosshead 37 may be slidably mounted upon the crosshead guide 116 suitably mounted on the base. As the tensioning arm 106 is swung back and forth, the crosshead is caused to reciprocate along the guide 116. As the crosshead carries the third or tensioning gripper, upon each out stroke of the third crosshead 37, the third gripper will grip and pull in a portion of the slack band while upon the in stroke the third gripper will release and slide over the band. As soon as the third gripper releases the band, the second or take-up gripper grips and holds the band, again slipping back to release the tension in the band. Thus, by oscillating the operating handle 71, the crosshead 37 is caused to reciprocate, and upon each reciprocation taking up a portion of the slack in the band until the band has been tensioned to a predetermined degree, whereupon the tensioning means may be arranged to automatically act to interrupt or stop further tensioning of the band.

The means for interrupting the tensioning operation when the band has been tensioned to a predetermined degree, may follow the teaching in my Patent No. 1,789,900, issued to me on January 20, 1931.

The pivot 107 of the tensioning arm 106, whereby when the resistance of the pull of the band reaches a predetermined value, then the pivot 107 may yield rather than to further reciprocate the tensioning crosshead 37. And means may be provided for retaining pivot 107 in a fixed position until the resistance of the pull on the band becomes a predetermined value, whereupon the yielding means may act to snap to the open position, to definitely interrupt the tensioning operation.

As illustrated in Figures 1, 2 and 7, the means for interrupting the tensioning operation when the band has been tensioned to a predetermined degree, may include a trip segment 117 which, together with the spring 118 may form the resilient member for the tensioning arm pivot 107 to which the trip segment 117 may be operatively connected by means of the link 119. The trip segment may be pivotally mounted upon the base by means of pin 120, and the link 119 may be pivotally connected thereto by means of the pin 121. It may be well to observe that the center line indicated at 122 in Figure 1, passing through the centers of the pivot pins 121 and 107, passes to the rear of the center of rotation of the trip segment, whereby the thrust during the tensioning operation will endeavor to rotate the trip segment 117 in a clockwise direction as viewed in Figure 1. To resist the rotation of the trip segment until the tension of the band reaches a predetermined value, the segment may be provided with a concentric cam surface 123, (note Figure 7) having adjacent the pivot 121 a deep notch 124 into which a roller 125 normally seats. The roller 125 may be rotatably mounted between a pair of trigger links 126, by means of the pin 120, while in turn the trigger links may straddle and be pivoted to trigger carrier 127, which in turn may be pivotally mounted upon the trip segment bearing pin 121. A torsional spring 128 may be provided to yieldingly urge the roller 125 into the deep notch 124. When the roller 125 is seated in notch 124, it will require a force of considerable magnitude to rotate the trip segment 120 to rotate to roll the roller 125 out of the notch, but when such a force is developed by the tensioning means, the trip segment will act with a snap action, lifting the roller onto the concentric cam surface 123 from then on, but a relatively small force is required to rotate the trip segment the amount necessary to permit the tensioning arm pivot to move while the crosshead 37 remains stationary. In other words, after the resilient means snap open, the tensioning arm 106 will pivot about pin 115 as a center, instead of around the pivot pin 107. It is desirable to provide means for adjusting the point of release of the tensioning means whereby the degree of tension may be adjusted, for which purpose the trigger carrier 127 may be connected to an anchor screw 129 having a thumb piece 130 for ease of adjusting the point of release. The anchor screw 129 may be screw-threaded through lug 131 formed on the base. The force required to snap the roller 125 out of the notch 124 will be constant for all positions of the trip segment. However, by actuating the anchor screw 129, the center line 122 will approach or recede from the center of rotation of the trip segment. Of course, should the center line 122 be shifted until it coincides with the pivotal center of the trip segment, then the force acting to rotate the trip segment would be ineffective, and the resilient means would fail to function. But as the center line 122 is moved further and further from the center of rotation of the trip segment, less and less force will be required to snap the resilient means into the open position. The position of the center line 122 with relation to the center of rotation of the trip segment is changed by actuating the anchor screw 129 which, in turn, swings the trigger carrier 127, and thereby the trigger links 126, and through the engagement of the roller 125 with the notch, will act to swing or rotate the trip segment 117.

As the trip segment rotates, the pivot pin 121 shifts with relation to the pivot 120, and the roller shifts the centerline 122 toward or away from the center of rotation of the trip segment, whereby the degree of tension to which the band is to be pulled, may be nicely adjusted.

Upon the completion of the tensioning operation, it is desirable to actuate the trip segment further action of the tensioning means, and to inaugurate the tying operation. For this purpose the control means may again be brought into action. The motion of the roller 125 during snap action of the resilient means, may be utilized to actuate the control mechanism to inaugurate the tensioning action and to inaugurate the tying operation.
For this purpose the link 132 may be pivotally mounted at one end upon the roller pin 126. The link 132 may be provided adjacent its other end with a slot 133 for operative connection with the extended end 134 of the control lever 15, by means of the screw 135. (Note Figure 12.) The slot 133 is provided in link 132 so as not to interfere with the movement of the control lever when the tying means is swung from the open to the set position. By so connecting the roller to the control lever 15, the control lever will be actuated when the roller 125 snaps out of notch 124, to return the control lever substantially one-half the distance it was moved during the swinging of the tying means from the open to the set position.

By the partial return movement, the control lever 15 acts to slide sleeve 68, which, by the means previously described, acts to rotate the pawl control shaft 90, to the position illustrated in Figure 18, wherein it may be observed that the finger 93 of the tensioning pawl 76, has been returned into the V-shaped cam groove 92, while the finger 96 has not entirely ridden out of the semicircular cam groove 94. With the parts so arranged, the tensioning pawl 76 may rock a limited amount upon its supporting shaft 78. A flat spring 138, carried under the handle 71, may act to yielding urge the pawl into engagement with the tensioning pinion 79 illustrated in this figure in broken lines. The tensioning pawl is arranged whereby when the handle 71 is swung in a counter-clockwise direction, as illustrated in Figure 18, the pawl will engage one of the teeth of the tensioning pinion and thus rotate the pinion in a counter-clockwise direction, but when the handle 71 is swung in a clockwise direction as viewed in this figure, the pawl will ride over the pinion teeth and will not effect rotation thereof. In other words, when the pawl control shaft 90 is rotated to the position illustrated in Figure 16, the tensioning pawl is released from its locking engagement with the tensioning pinion, and is shifted into a ratchet engagement therewith. Turning to Figure 4, it will be observed that Figure 4 is taken looking at the parts in a direction opposite to that of Figure 16, so that the direction of rotation will be reversed) when the handle 71 is swung in a clockwise direction that the pawl 76 will act to rotate the pinion 79 in a clockwise direction. The tensioning pinion 79 is transmitted through the back gears 99 to the spur gear 98, it will be observed that the spur gear, and thus the master cam, will also be rotated in a clockwise direction as indicated by the arrow 137. By swinging the handle 71 in a counter-clockwise direction, the pawl 76 will merely ratchet over the teeth of the pinion 79.

The tying operation is accomplished by rotating the master cam through a complete revolution. The tensioning pawl and pinion may be utilized for this purpose, but lost motion would result as during the swing of the handle in the counter-clockwise direction as viewed in Figure 4, the master cam would remain idle. Therefore, a second pinion 80 which has been previously referred to as the tying pinion, may be provided. And a tying pawl 77 may be provided to engage and drive the tying pinion 80 during the back swing, or swing of the handle 71 in a counter-clockwise direction as viewed in Figure 4, but which pawl will ratchet or ride over the teeth of the tying pinion during the forward movement, or swing of the handle in a clockwise direction. The tying pawl 77 may be provided with a finger 137 which is positioned so as to engage upon the periphery of the pawl control shaft 90 at all times, to hold the tying pawl inactive excepting when the pawl control shaft is rotated to the position illustrated in Figure 16, wherein the finger 137 will ride into the V-shaped cam notch 93 to release the tying pawl 77 in operative ratchet engagement with the pinion 80.

A flat spring 138 may be provided to yielding urge the tying pawl 77 into ratchet engagement with the tying pinion 80. The tying pinion 80 directly meshes with the spur gear 98 (note Figure 4). And the tying pinion is rotated in a counter-clockwise direction as viewed in Figure 5, during the back swing of the operating handle 71, and thus acts to rotate the spur pinion 98 of the master cam in a clockwise direction, during which time the tensioning pinion 79 is not being driven by the tensioning pawl 76.

Due to the above arrangement of the parts, by oscillating of the operating handle 71, the master cam 97 will be rotated in a clockwise direction, as viewed in Figure 4, for each swing of the handle, thus increasing the operating efficiency of the machine.

The tying cycle has now been inaugurated and may be carried through to completion by continuing the oscillating of the operating handle 71.

The tying means may be generally of the type disclosed in my pending application, Serial No. 241,097, filed December 19, 1927, and Patent No. 1,607,660, issued February 14, 1928, while the form of the tie may be the same as that disclosed in my Patent No. 1,677,522, issued to me July 17, 1929.

The tying may include a bifurcated toggle lever 139 journaled upon the toggle shaft 40 and a single toggle lever 33 journaled upon the toggle shaft 46 between the bifurcated portion of the toggle lever 139. A pair of first toggle links 140 may be suitably journaled between the bifurcated portion of toggle lever 139 by means of shaft 141, while a second pair of toggle links 142 may be journaled upon opposite sides of the single toggle lever by means of shaft 143. A toggle pin 144 may be provided for operatively connecting the free ends of the first and second pairs of toggle links, and a toggle cam roller 145 may be journaled upon the toggle pin 144 and the master cam. It may be well to observe in Figures 2 and 4, that the single toggle lever 33 is shorter than the bifurcated toggle lever 139. This arrangement of one toggle lever being longer than the other, is one of the features of this invention, as it is this arrangement which permits the free ends of the toggle links carrying the cam roller to fold back upon the single toggle lever 30, thus permitting the tying or crimping jaw 50, suitably carried by the single toggle lever 33, to be swung a material distance from the tying or crimping jaw 146 carried by the bifurcated toggle lever 139, in order that the band may be easily threaded into the machine, this being the open position of the tying means. (Note especially Figure 2.) The toggle links perform no special function during the swinging of the tying means to or from the open position, but after the tying means have been swung into the set position illustrated in Figure 4, the toggle links are then set to form a toggle between the rear ends of the toggle levers 33 and 139. Also note Figure 4 that the tying jaws have been moved into engagement with the overlapping band ends.
and are set or ready for the tying or crimping operation to start. The tying means may be actuated by the tying cam 147 which may be formed integrally with the master cam 97; which, as the master cam is rotated, responsive to the oscillation of the operating handle 71, engages the cam roller 145, and due to its eccentricity, gradually forces the toggle roller 145 to the right as viewed in Figure 4, to actuate the toggle formed by the toggle levers 33, 139 and the toggle links 140 and 142, thus forcing the tying jaws to close upon the enmeshed band with great force, to securely crimp same substantially to the ends of the band. To insure that the band ends will be securely tied, each of the tying jaws 50 and 146 may be provided with a plurality of teeth 148 which may be received in corresponding slots 149 formed in the opposite die. (Note Figure 3.) The action of the jaws is to form the band in a roll having a plurality of shoulders formed throughout the length of the roll. As this form of tie and tying means are fully illustrated and described in my co-pending applications above referred to, it is not deemed necessary to describe the details of the tie or tying jaws further. When the band has been securely rolled and crimped, the toggle roller 145 rolls off the high point of the tying cam into the low point or valley 150 thereof, thus terminating further tying action.

The operation of the toggle means may be desirable to retain the tying jaws in alignment with the band. In other words, as the toggle forces the tying jaws closed, one or the other of the jaws may move while the opposite jaw may remain stationary, thus the tie would not be formed central of the band. Means may be provided for retaining the jaws in correct position or alignment with the band, which means may include a positioning cam 151 suitably mounted upon, or formed integral with the master cam, and a positioning bell crank lever 152 journalled upon the base by means of the shaft 153. The arm 154 of the bell crank lever 152 may carry an antifriction cam roller 155 positioned to ride upon the periphery of the positioning cam, while the other arm 156 may extend forwardly and support the rear end of the bifurcated toggle lever 139, by means of the projection 157 thereof. For the start of the operation, the roller 156 may roll upon the high point 158 of the positioning cam 151, and as the positioning cam rotates, during the tying operation, the cam surface thereof presented to the positioning roller may gradually recede from the high point 158. The amount of the recession given to the cam surface of the positioning cam, may be such as to at all times during the tying operation, equal substantially one-half the amount of movement given to the tying means by the tying cam 147 and toggle arrangement. Thereby, during the tying operation, each of the tying jaws will be moved substantially an equal amount, thus retaining the tying means in alignment with the band, and insuring the formation of the tie in accurate alignment with the band. As may be observed from Figure 4, as the cam roller 155 traverses over the receding portion of the positioning cam 151, the bell crank lever 152 will rotate in a clockwise direction, whereby the bell crank arm 156 will be moved downward, thus permitting the rear end of the bifurcated toggle lever 139 to move downwardly a corresponding amount, while substantially simultaneously thereupon, the single toggle lever 33 will be moved upwardly substantially an equal amount due to the action of the toggle means being acted upon by the tying cam.

It is desirable to release the escapement lock 51 during the tying operation, whereby upon completion of the tie, the tying means may be automatically returned to the open position. The releasing of the escapement lock 51 may take place automatically during the raising of the single toggle lever 33, whereby the locking and tripping tooth 54 of the anchor member 55 may be engaged and rotated in a counter-clockwise direction as viewed in Figure 4, by the tooth 62 of the toggle lever 33. As soon as the anchor member 55 has rotated sufficiently to release the round nosed pawl 59 to ride out notch 57, the pawl will snap into the second notch 58, thereby resiliently locking the anchor member in the releasing position as indicated in Figure 4 in broken lines. The escapement lock may be automatically returned to the locking position after the toggle lever 33 has passed out of range of the locking tooth 54, as has already been described.

During the tying operation the toggle links 140 and 142 may be swung by the tying cam 147 into the respective linear positions in such a position so that in the final position they may act as a toggle lock to prevent the tying means from opening upon the completion of the tying operation. It may therefore be desirable to provide means upon the completion of the tying operation, for automatically releasing the toggle links to break any such locking effect, and for this purpose each of the toggle links 140 may be provided with a bracket 159, and to provide the tying cam with a kick back pin 160, which pin will engage the brackets 159 upon the completion of the tying operation. The brackets may be so located that when the toggle links are in substantial alignment, they will project across the path traversed by the kick-back pins 160, whereupon after the completion of the tying operation and during the final rotation of the links, the kicker cam will engage the brackets, thereby swinging the toggle links into the position illustrated in Figure 4. It may be observed in Figure 4 that the kick-back pin is carried slightly beyond the end of the brackets 159 when the master cam is actuated at the end of its operating cycle, thus the toggle links are free to be swung to the folded-back position as illustrated in Figure 2, during the movement of the tying means to the open position under the influence of spring 48.

It is desirable to provide means for severing the tied band from the band supply, which means, (note Figure 6) may include a shearing blade 161 pivotally mounted upon the base by means of a pivot screw 162 and positioned to cooperate with the severing horn 35. In Figure 6, the severed end of the band supply is indicated at 152. Means may be provided for actuating the shearing blade in timed relative with the tying operation. The severing of the band may take place at any time after the tying means have acted to tie the band substantially to prevent the band from slipping, due to the tension thereon. For this purpose a severing cam 164 may be mounted upon or formed integral with the master cam 98. The severing cam 164 may be actuated by two eccentric cam surfaces, as, for example, the inner or inactive cam surface 165, and the outer or active cam surface 166, and these two cam surfaces may be connected with the abrupt cam surfaces 167. During the tensioning opera-
tion and the beginning of the tying operation, the inactive portion of the severing cam 165 may travel past the cam end 168 of the bell crank lever 169. But before the tying jaws start to tie the band, the abrupt surface 167 of the cam may engage and actuate the cam end 168 of the bell crank lever downwardly, which motion may be transmitted through the lever 170 to the master cam 175 carrying at its outer end a driving pin 171, adapted to operatively engage the notch 172 located in the rear end of the shearing blade. Thus, the shearing blade is actuated to sweep across the severing horn and thereby sever the band from the supply. As the master cam approaches the end of its operating cycle, the active cam surface 166 travels beyond the cam end 168 of the bell crank lever, whereupon, due to the action of the compression spring 173, acting between the pin 174 of the base and the pin 175 of the lever 168, the cam lever 168 will ride down the other of the abrupt surfaces 167 and thereby return the shearing blade to its open or retracted position, as illustrated in Figure 6.

Upon completion of the tying operation, it is desirable to actuate the control means to return the tensioning arm 76 and 77 to their inoperative positions, as illustrated in Figure 14 to thereby disengage the oscillating operating handle from driving engagement with either of the pinions 79 or 80. And for this purpose the control lever 15 may be provided with the cam surface 67 positioned to engage the single toggle lever 33 during its return movement to the open position. The shifting of the control lever 15 rotates the pawl control shaft 90 to lift the pawls into their inoperative position as has been previously described. The shifting of the control lever 15, by the single toggle lever during its movement to the open position, may be utilized for cocking the first or band-end gripper 8. For this purpose, the latch member 14 may be pivotally mounted upon the control lever 15 (Fig. 16), whereby the latch 14 of the latch member 14, from which the arm 12 of the gripper was previously released by the trigger 20, may be moved back sufficiently for the latch notch to again drop in back of the gripper arm 13, so that upon the next forward movement of the control lever 15, leaving the band in the open position, the latch member 14 will act to return the gripper to its open or cocked position, and thereby releasing the tied band and retaining the gripper cocked in readiness to be released to grip the end of the next band to be tied.

Also the second or take-up gripper 26 may be automatically actuated to release the tied band and to remain open until the inauguration of the next tensioning operation. For this purpose the pin 32 (note Figures 3 and 9) carried by the single toggle lever 33, will engage the second gripper control lever 29 when the toggle lever is swung to its open position, to lift the second gripper into its open position, and thereby releasing the tied band.

The control lever 29 will act to retain the second gripper in its open position until the toggle lever 33 is again swung to the set position to inaugurate the tensioning operation. For it will therefore be observed that means are provided for automatically releasing the tied band so that the machine may be easily and readily moved clear of the band.

Upon the completion of the tying operation, the tensioning cam roller 160 will again drop into the valley or depression formed by the article and the loop threaded into the machine by first placing the initial or free end 4 of the band into the notch 5 formed in the inner side of the second gripper anvils 6, then threading the band between the tying jaws and then over the first gripper anvils 7. As the band end is placed over the first gripper anvils, the inner edge of the band will automatically trip the first gripper by engaging trigger 20 thereof, as has been previously described, thus securely gripping the initial end of the band in the machine.

As soon as the initial end of the band has been securely gripped by the first gripper, the unnecessary slack of the band loop may be taken up and the second loop 25 of the band threaded into the second gripper and again between the tying means and over the severing horn 35 to the third or tensioning gripper, and securely gripped there-in as soon as the inner edge of the band engages the gripper trigger 39 thereof.

After the band has been positioned and gripped in the machine, the next operation will be to swing the tying means from the open to the set position and to be there locked by the escapement lock 51. The movement of the tying means to the set position will actuate the control means, as previously described, to operatively connect the operating handle 71 with the spur gear 98, whereby upon the handle 71 may be rocked back and forth which in turn will rock or oscillate the tensioning cam 103 for reciprocating the tensioning means to take up the slack band and tension the band to a predetermined degree. It may take one or a number of oscillations of the lever 71 to tension the band, but as soon as the band has been tensioned to a predetermined degree, the means for interrupting the tensioning operation will automatically function to shift the control means to release the tensioning pawl 76 and simultaneously therewith release the tying pawl 77, whereby the spur gear 98 will be rotated in a continuously forward direction until this spur gear will have completed one revolution from its starting position. During the forward rotation of the master cam by the spur gear 98 the tying cam 147 will engage the cam roller 145 of the tying means and, due to its eccentricity, will gradually force the tying jaws together to form a secure tie in the overlapping ends of the band located between the first and second grippers. When the band has been securely tied, the roller 148 will ride off the high point of the cam, thus terminating further tying action.

During the tying operation, the tying jaws are maintained in alignment with the band by the positioning means previously described, and also the escapement lock 51 will be disengaged therefrom. Upon the completion of the tying operation, the kick-back pins 180 will engage the brackets 159 of the toggle links of the tying means to...
thereby swinging these links to open the tying jaws, and thus release the band from the tying means.

The band cutting or severing means may be actuated as any actuator after the tying means have acted to tie the band sufficiently to prevent the band from slipping, due to the tension thereon. For this purpose, the severing cam 164 may be mounted upon the master cam and so related thereto as to actuate the severing means after the tying means have acted to tie the band. Upon the completion of the tying operation, the control means will act to return the tensioning and tying paws 76 and 77 to disengage the oscillatory operating handle 71 from driving engagement with the machine, and for this purpose the control lever 15 may be actuated by the tying means during the swinging thereof to their open position. Also, this swinging action of the tie means is utilized to cock the first and second grippers so as to release the tied band, whereupon the machine may be moved to its next tying position.

Upon the completion of the tying operation, the tension cam roller 109 will again drop into the valley 104 of the tensioning cam 103, whereupon due to the action of spring 111 and the trip segment 117, the tensioning arm 100 and the trip segment 117 will be automatically returned to their initial starting positions, whereupon the roller 125 will drop into the notch 124 of the trip segment.

As all of the elements have been returned to their initial starting positions, the machine will be ready for the next tying operation. From the foregoing it will be appreciated that the invention is relatively simple, compact and very efficient for performing the many operations necessary for successfully tying a tensioned band having its ends closed, and that the invention contains many novel parts and combinations of parts organized in cooperative relationship for rendering a machine which may be operated with ease and dispatch and requiring the minimum of attention on the part of the operator.

It is to be understood that the embodiment of the invention illustrated and described herein, is only one of the many embodiments this invention may take, and I do not wish to be limited in the practice of the invention, nor in the claims to the particular embodiment set forth.

I claim:

1. In a band tying machine a reciprocatory tensioning means, band gripping means operable for maintaining the band under tension, a band tying means, an operating handle initially operative for actuating the reciprocatory tensioning means, and means operative when the band reaches a predetermined tension for interrupting the tensioning operation and for connecting the operating handle with the tying means so that upon further actuation of the operating handle the tying and severing means will be actuated for tying and severing the band.

2. In a band tying machine a reciprocatory tensioning means, band gripping means operable for maintaining the band under tension, a band tying means, a band severing means, an operating handle initially operative for actuating the reciprocatory tensioning means, and means operative when the band reaches a predetermined tension for interrupting the tensioning operation and for connecting the operating handle with the tying and severing means so that upon further actuation of the operating handle the tying and severing means will be actuated for tying and severing the band.

3. In a band tying machine a reciprocatory tensioning means, band gripping means operable for maintaining the band under tension, a band tying means, an operating handle initially operative for actuating the reciprocatory tensioning means, a control means operative when the band reaches a predetermined tension for interrupting the tensioning means and for connecting the operating handle with the tying means so that upon further actuation of the operating handle the tying means will be actuated for tying the band, and means automatically operable upon the completion of the tying operation for releasing the band from the gripping means.

4. In a band tying machine a tensioning means, band gripping means operable for maintaining the band under tension, a band tying means yieldably retained in the open position, an operating handle freely journaled in the machine, and a control means actuated by the movement of the tensioning means to the set position for operatively connecting the handle with the tensioning and severing means and further operative when the band has been tensioned to a predetermined degree for disrupting the tensioning means and for connecting the handle with the tying means and upon further actuation of the operating handle the tying means will be actuated for tying the band.

5. In a band tying machine a tensioning means, band gripping means operable for maintaining the band under tension, a band tying means yieldably retained in the open position, means for moving the band tying means into the set position, a locking means operative for locking the band tying means in the set position, an operating handle freely journaled in the machine, and a control means actuated by the movement of the tensioning means to the set position for operatively connecting the handle with the tensioning and severing means and further operative when the band has been tensioned to a predetermined degree for disrupting the tensioning means and for connecting the handle with the tying means and upon continued operation of the handle the tying means will be actuated for tying the band.

6. In a band tying machine an operating handle, a tensioning means, band tying means, gripping means including a band-end gripping spring for said band-end gripper for urging said gripper into gripping position, a releasable locking means for retaining said gripper in the retracted position, a trigger operative for releasing the gripper locking means, a control means operative when the band reaches a predetermined tension for interrupting the tensioning means and for connecting the operating handle with the tying means, and said control means being operative upon the completion of the tying operation for returning the band-end gripper to the again locked in the retracted position.

7. In a band tying machine an operating handle, a tensioning means, band tying means, gripping means including a band-end gripper, a spring for urging said band-end gripper into gripping position, a releasable locking means for retaining said gripper in the retracted position, means actuated by the placing of the band in the machine for releasing the gripping locking means, a control means operative when the band reaches a predetermined tension for interrupting the tensioning means and for connecting the operating handle with the tying means, and said control means
being operative when the band is tied for returning the band-end gripper to be again locked in the retracted position.

8. In a band tying machine a reciprocatory tension means, a tensioning gripper carried by said means, a spring means for urging said gripper into gripping position, a releasable locking means for retaining said gripper in the retracted position, a trigger positioned to be actuated by the band for releasing said gripper locking means, and said gripper arranged to grip and pull the band during the outward movement of the reciprocatory tensioning means and to slide over the band during the inward movement thereof, and a lever for cocking said gripper.

9. In a band tying machine a reciprocatory tension means, a tensioning gripper carried by said means, a spring means for urging said gripper into gripping position, a releasable locking means for retaining said gripper in the retracted position, a trigger positioned to be actuated by the band for releasing said gripper locking means, and said gripper arranged to grip and pull the band during the outward movement of the reciprocatory tensioning means and to slide over the band during the inward movement thereof, and a lever for cocking said gripper.

10. In a band tying machine, a reciprocatory tensioning means, a band tying means, a master cam, and a drive means for the master cam operative for oscillating said cam for actuating the tensioning means and thereafter operative for rotating the cam through the remaining cycle of operation for actuating the tying means.

11. In a band tying machine a reciprocatory tensioning means, a band tying means, a master cam, an operating handle, a control means for initially connecting the operating handle with the master cam so as to oscillate the cam for actuating the tensioning means, and said control means being responsive to a predetermined tension of the band for connecting the operating handle with the master cam for being operative for oscillating said cam for actuating the tensioning means and thereafter operative for rotating the cam through the remaining cycle of operation for actuating the tying and severing means.

12. In a band tying machine a reciprocatory tensioning means, a band tying means, a band severing means, a master cam, an operating handle, a control means for initially connecting the operating handle with the master cam so as to oscillate the cam for actuating the tensioning means, and said control means being responsive to a predetermined tension of the band for connecting the operating handle with the master cam for rotating the cam through the remaining cycle of operation for actuating the tying and severing means.

13. In a band tying machine a reciprocatory tensioning means, a band tying means, a band severing means, a master cam, an operating handle, a control means actuated by the movement of the tying means from the open to the set position for operatingly connecting the handle with the cam whereby upon oscillating the handle the cam will be oscillated to operatively reciprocate the tensioning means, and said control means being responsive to a predetermined tension of the band for connecting the handle with the cam whereby upon further oscillation of the handle the cam will be rotated through the remaining cycle of operation for actuating the tying means.

14. In a band tying machine a reciprocatory tensioning means, band gripping means operative for maintaining the band under tension, a band tying means normally retained in an open position, means for moving the tying means from the open to the set position, a releasable locking means for locking the tying means in the set position, a master cam, an oscillatory operating handle, a control means actuated by the tying means while moving from its open to its set position for operatively connecting the handle with the master cam whereby upon oscillating the handle the cam will be oscillated to operatively reciprocate the tensioning means, and said control means being responsive to a predetermined tension of the band for connecting the handle with the cam whereby the handle the cam will be rotated through the remaining cycle of operation for actuating the tying means.

15. In a band tying machine a reciprocatory tensioning means, band gripping means operative for maintaining the band under tension, a band tying means normally retained in an open position, means for moving the tying means from the open to the set position, a releasable locking means for locking the tying means in the set position, a master cam, an oscillatory operating handle, a control means actuated by the tying means while moving from its open to its set position for operatively connecting the handle with the master cam whereby upon oscillating the handle the cam will be oscillated to operatively reciprocate the tensioning means, and said control means being responsive to a predetermined tension of the band for connecting the handle with the cam whereby the handle the cam will be rotated through the remaining cycle of operation for actuating the tying means.

16. In a band tying machine a reciprocatory tensioning means, a band gripping means operative for maintaining the band under tension, a band tying means normally retained in an open position, means for moving the tying means from the open to the set position, a releasable locking means for retaining the tying means in the set position, a master cam, an oscillatory operating handle, a control means for operatively reciprocating the tensioning means and said control means being responsive to a predetermined tension of the band for interrupting further tensioning of the band and for connecting the handle with the cam whereby for each oscillation of the handle the cam will be rotated in a forward direction for the remaining cycle of operation for actuating the tying means, and means for returning all of the parts to their initial starting position.

17. In a band tying machine a reciprocatory tensioning means, a band gripping means operative for maintaining the band under tension, a band tying means normally retained in an open position, means for moving the tying means from the open to the set position, a releasable locking means for retaining the tying means in the set position, a band severing means, an oscillatory operating handle, a control means operative by the tying means while moving from the open to the set position for operatively connecting the handle with the cam whereby by oscillating the handle the cam will be oscillated for operating the reciprocatory tensioning means, said control means being responsive to a predetermined tension of the band for interrupting further tensioning of the band and for connecting the handle with the cam whereby for each oscillation of the handle the cam will be rotated in a forward direction for the remaining cycle of operation for actuating the tying and severing means, and means for returning all of the parts to their initial starting position.

18. In a band tying machine a tying means including a pair of toggle levers, means for yieldingly retaining said toggle levers in an open position.
position, means for swinging the toggle levers to a set position, and an escapement lock means for releasably locking the toggle levers in the set position.

10. In a band tying machine a tying means including a pair of toggle levers, means for yieldingly retaining said toggle levers in an open position, means for swinging the toggle levers to a set position, an escapement lock means operative for releasably retaining the toggle lever in the set position, means for actuating the pair of toggle levers for forming the tie, and said escapement lock means being actuated to a releasing position during the tie forming operation whereby upon completion of the tie the yielding means may act to return the toggle levers to their open position.

15. In a band tying machine a tying means including a movable member, means for yieldingly retaining said movable member in an open position, means for actuating said member into a set position, a lock operative for locking said member in the set position, and means for releasing said locking means when said member is moved beyond the set position.

20. In a band tying machine, a band tying means including a pair of pivotally connected toggle levers provided with tie forming jaws, toggle lever actuating means operative for actuating said jaws to form a tie in a band, and cam actuated means associated with the toggle levers and operable by the toggle lever actuating means for swinging said levers during the tie forming operation in order to maintain the tying jaws in alignment with the band.

25. In a band tying machine, a band tying means including a pair of pivotally connected toggle levers provided with tie forming jaws, toggle lever actuating means operative for closing said jaws to form a tie in a band, and cam actuated means operable by the toggle lever actuating means for swinging said levers during the tie forming operation to insure that each of said jaws will close in an equal amount upon the band.

30. In a band tying machine a band tying means including a pair of toggle levers provided with tie forming jaws, a tying cam, toggle lever actuating means operative by said cam for actuating said jaws for forming a tie in a band, a positioning cam and means actuated by said positioning cam for substantially maintaining the forming jaws in alignment with the band during the tie forming operation.

35. In a band tying machine, the tying means of a band tying machine including, a tying means provided with a pair of pivotally connected toggle levers, one of said levers having a lever arm of greater length than the other of said levers, and jointed toggle links interconnecting the lever arms of said levers adjacent the ends thereof and arranged so that when the lever arms are swung together the jointed portion of the toggle links will fold back upon the shorter of said toggle levers.

40. In a band tying machine a tying means including a pair of pivotally connected levers, a tie forming jaw provided in the forward end of each lever, one of said levers having a rearwardly extending lever arm of greater length than the other of said levers, jointed toggle links interconnecting the rearwardly extending lever arms of said levers adjacent the ends thereof, said jointed toggle links being arranged to fold back upon the shorter of said lever arms to permit the tie forming jaws to be widely separated to an open position, means for swinging the pivoted levers to a set or band engaging position and thereby swinging the jointed links to a toggle position between said lever arms, and means operative for actuating the toggle formed between said jointed links and levers for actuating said tying jaws into a tie forming position.

45. In a band tying machine, a band tying means including a bifurcated lever, a single lever journal between the bifurcations of the first said lever, a tie forming jaw provided in the forward end of each lever, said single lever having a rearwardly extending lever arm shorter than the lever arm of the bifurcated lever, a pair of first toggle links pivotally connected to and between the bifurcated portion of the bifurcated lever adjacent the rear end thereof, a pair of second toggle links pivotally connected to opposite sides of the single toggle lever adjacent the rear end thereof, a toggle pin pivotally connecting the free ends of said first and second toggle links, said first and second toggle links being arranged to fold back upon the single lever to permit the tie forming jaws to be widely separated to an open position, means for swinging the single lever to a set or band engaging position and by a rotary motion for actuating said bifurcated and single levers, and means operative for actuating the toggle formed by the first and second links between the bifurcated and single levers for actuating the tying jaws into the tie forming position.

50. In a band tying machine, a reciprocatory tensioning means, a band tying means, a band severing means, a master cam, and a drive means for said master cam operative for oscillating said cam for actuating the tensioning means and thereafter operative for rotating the cam through the remaining cycle of its operation for actuating first the severing means and then the tying means.

55. In a band tying machine, a reciprocatory tensioning means, a band tying means, a band severing means, a master cam, an operative handle, a control means operative for initially connecting the operating handle with the master cam for oscillating the cam for actuating the tensioning means, and said control means being responsive to a predetermined tension of the band for connecting the operating handle with the master cam for rotating the cam through the remaining cycle of its operation for actuating first the severing and then the tying means.

60. In a band tying machine, a band tensioning means, a band tying means, and a master cam operable by an oscillatory motion for actuating said tensioning means and by a rotary motion for actuating said tying means.