May 7, 1940. R. McC. JOHNSTONE 2,200,000

ART OF WINDING FLEXIBLE MATERIAL

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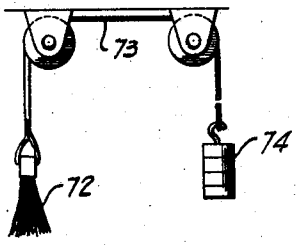



Fig. 2

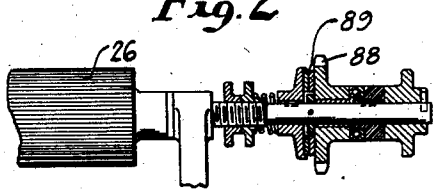
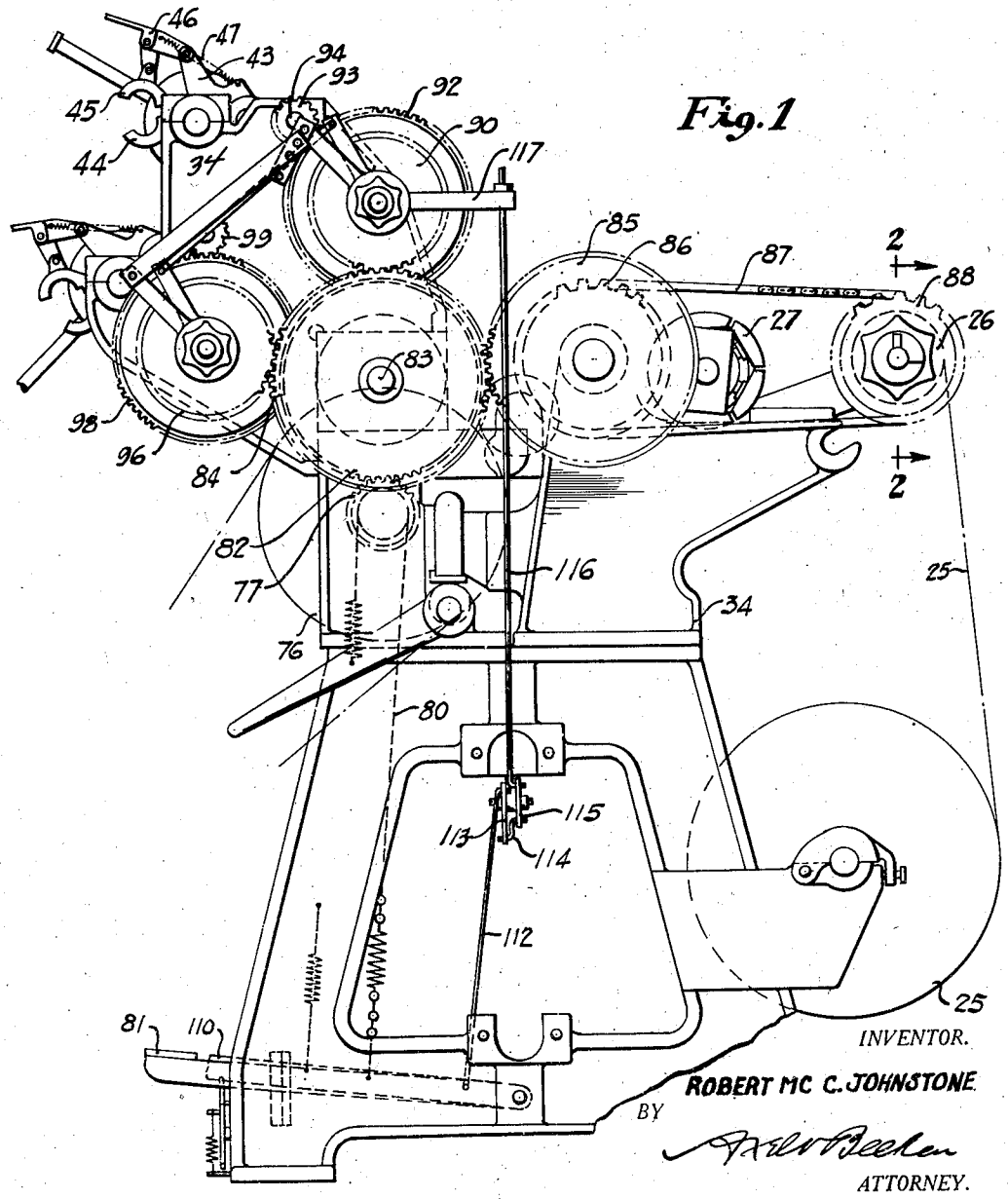



Fig. 1




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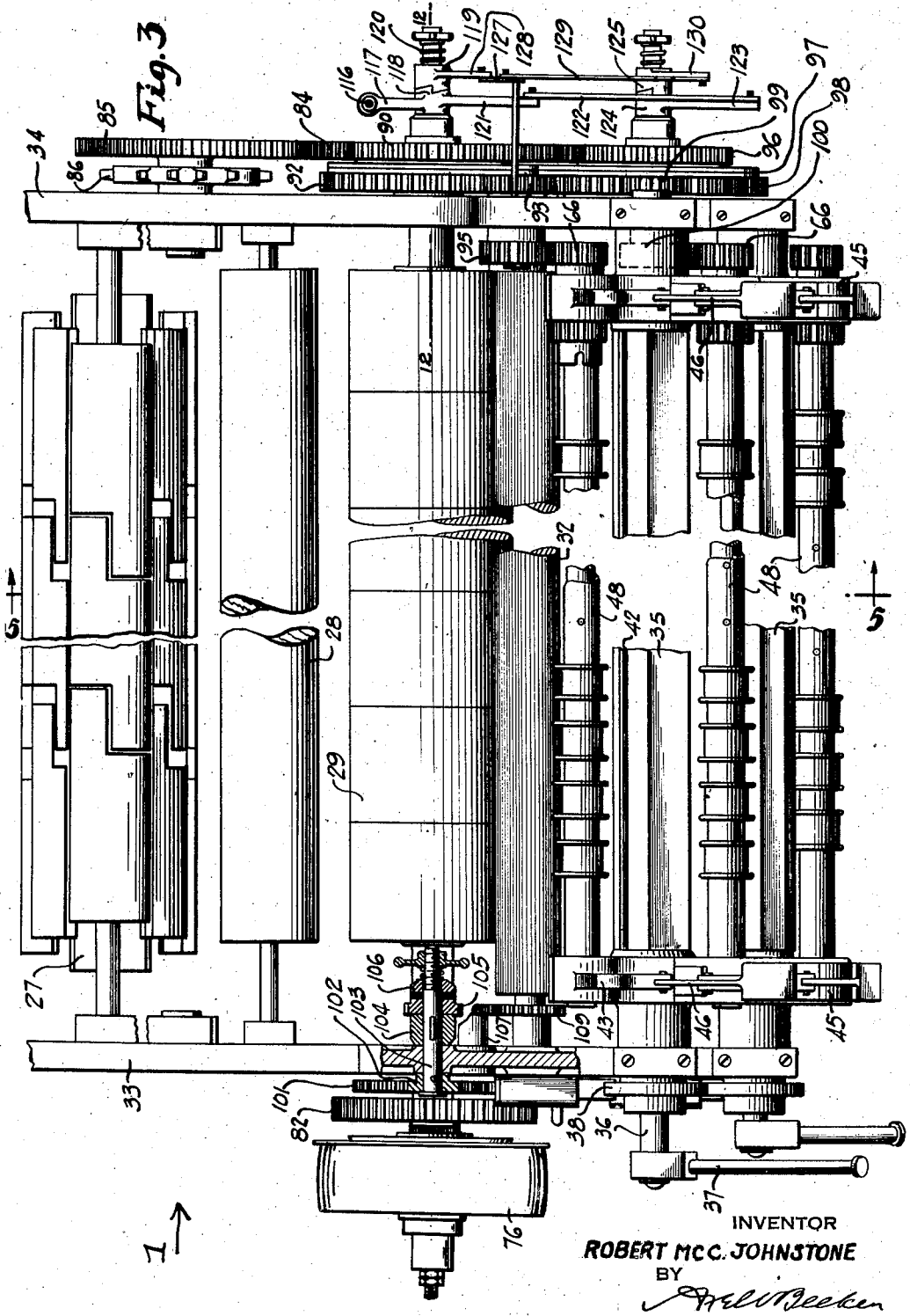
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Fig. 3




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*Fig. 4*

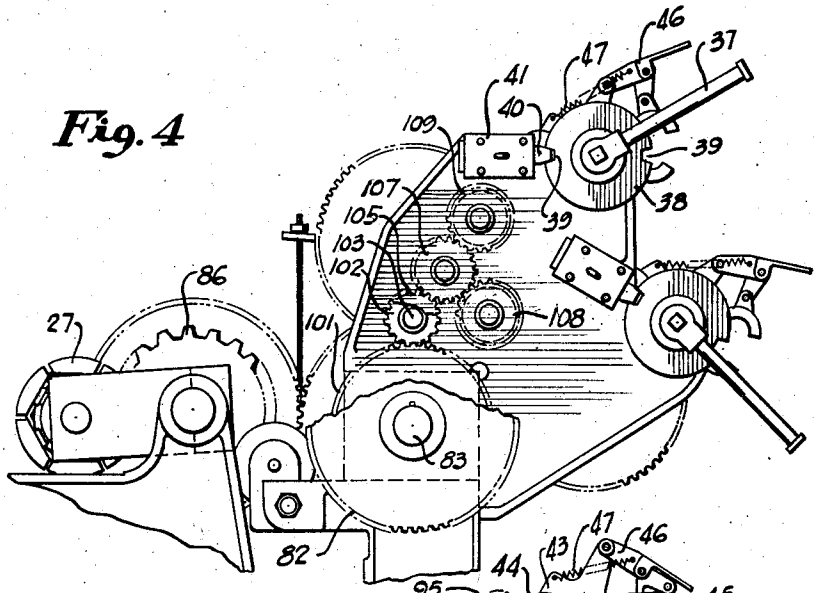
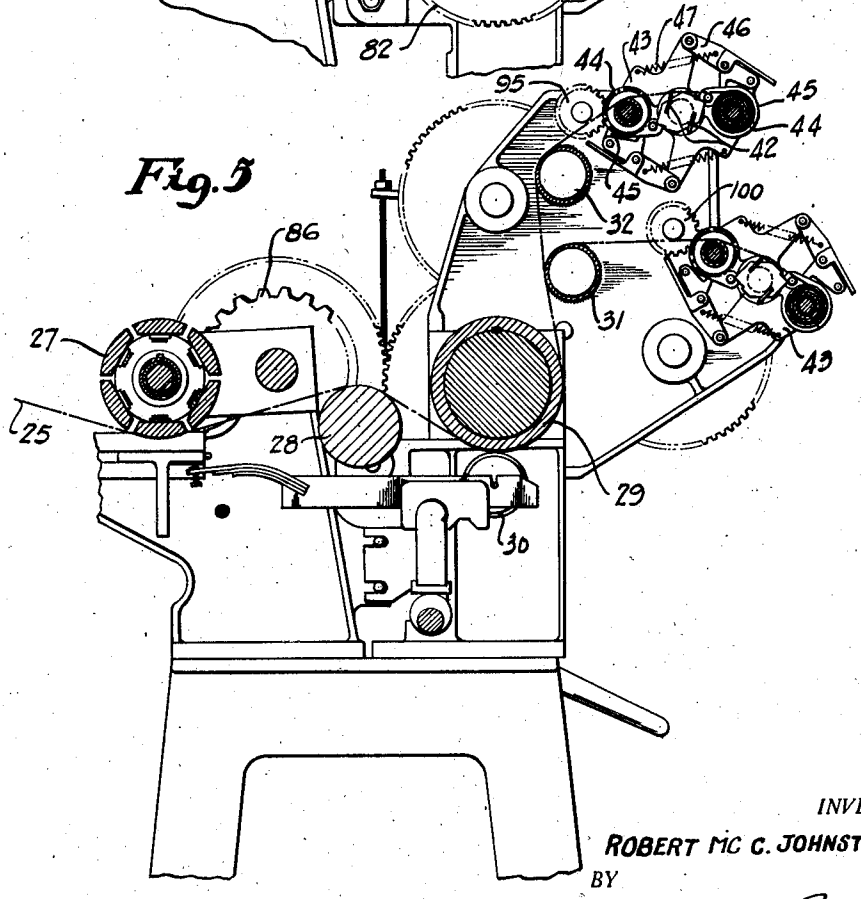



*Fig. 5*




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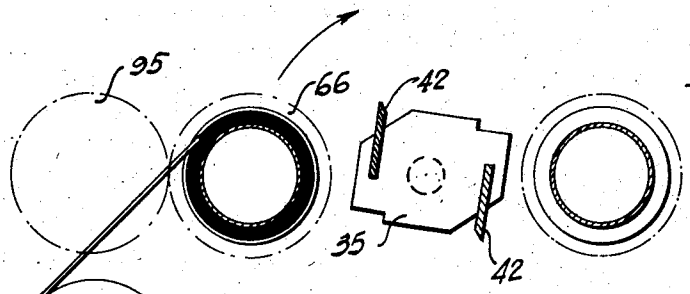
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Fig. 6



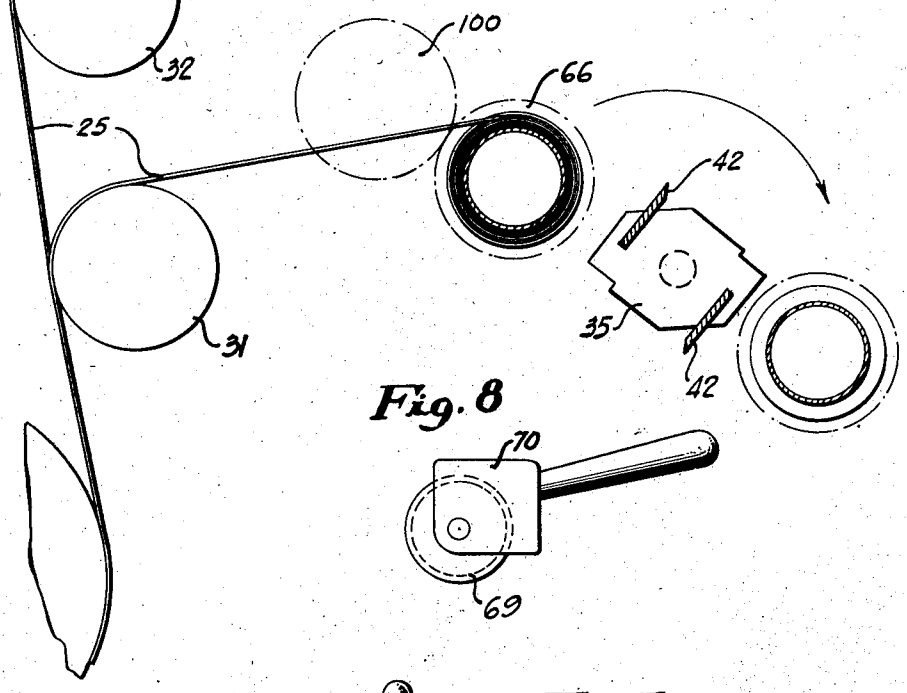
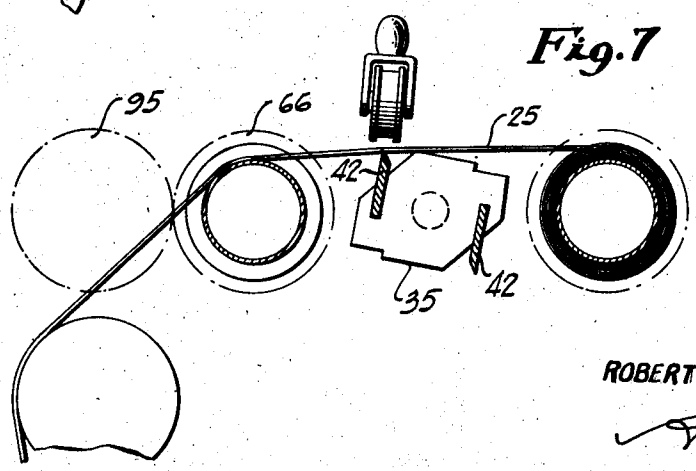




Fig. 8




Fig. 7




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Fig. 9

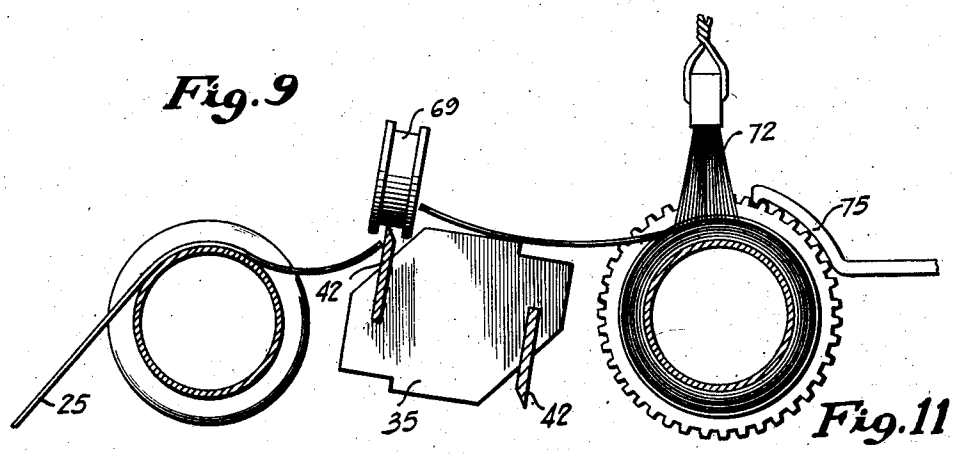
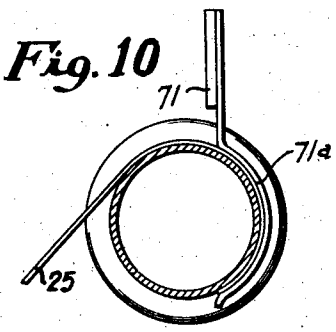



Fig. 11

Fig. 10



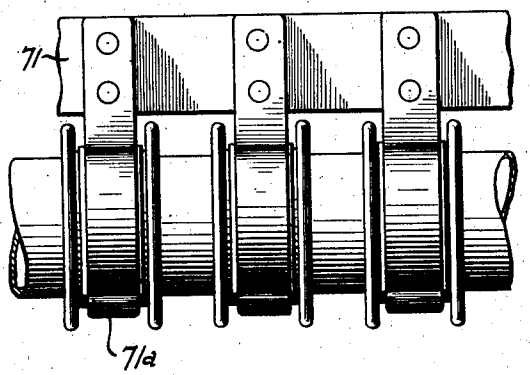
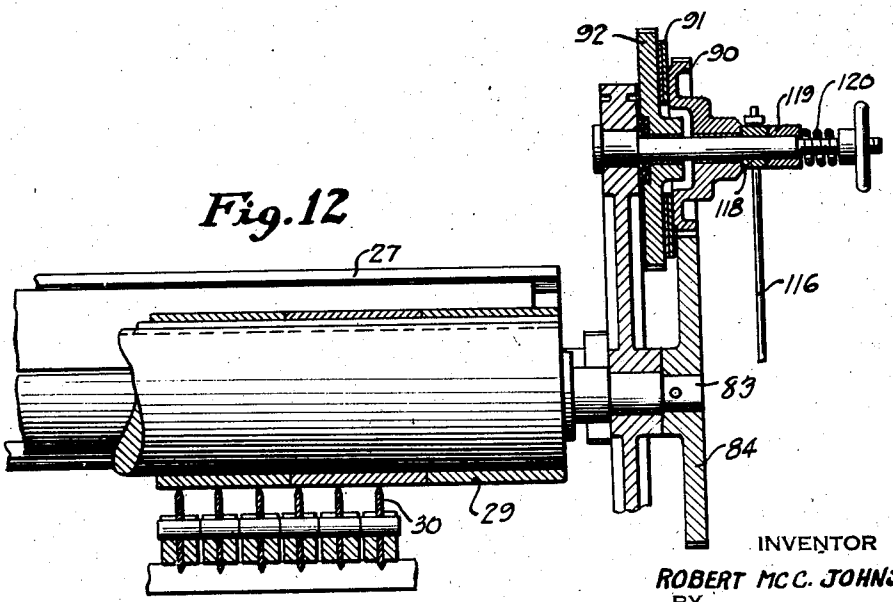




Fig. 12




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Fig. 13

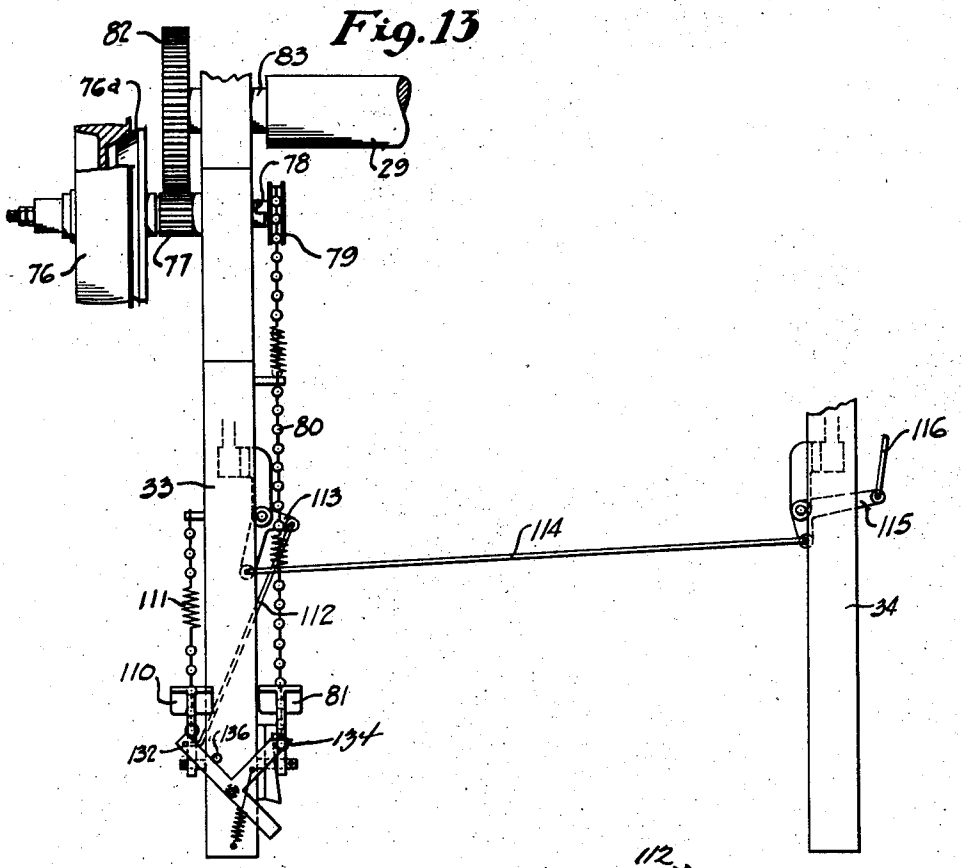



Fig. 14

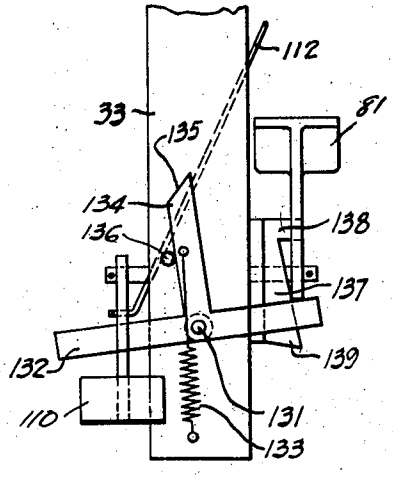
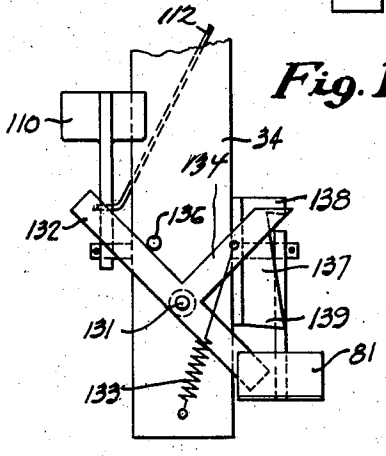



Fig. 15




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Fig. 16

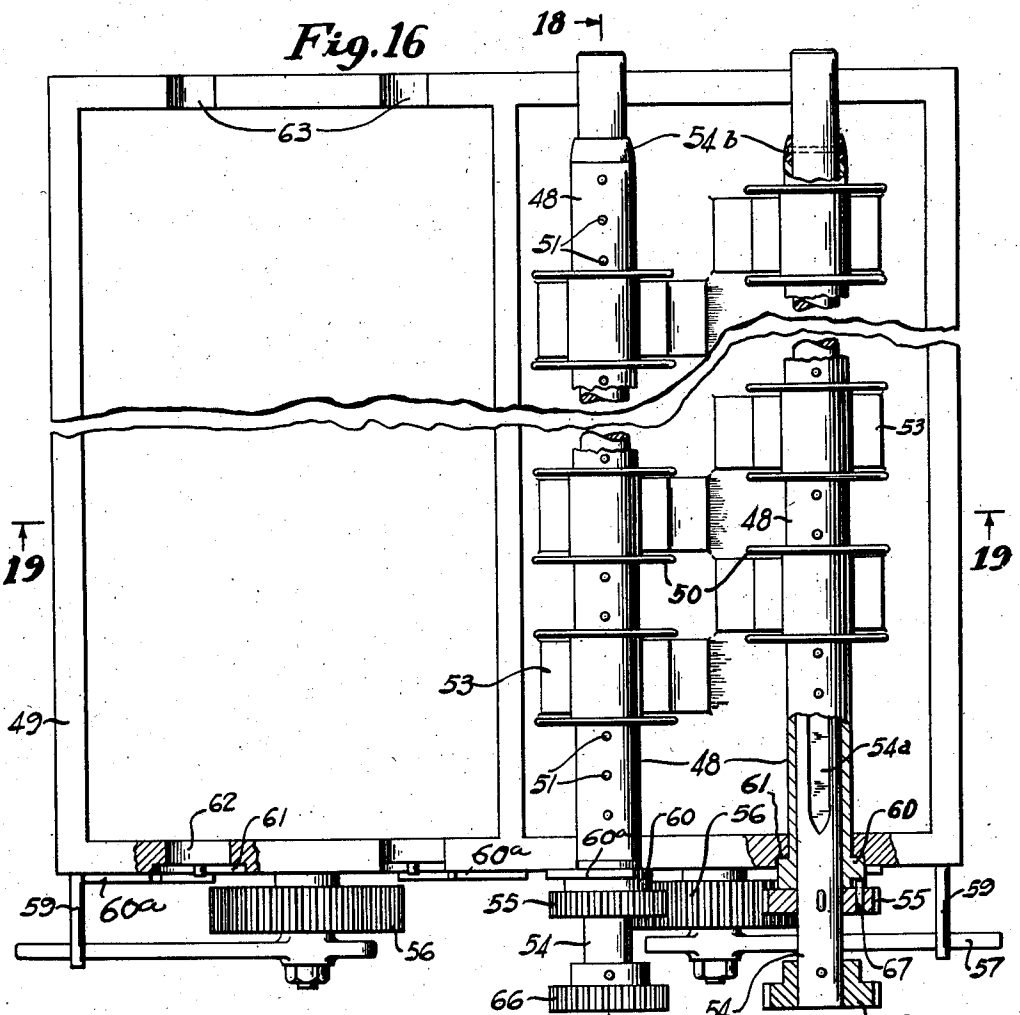
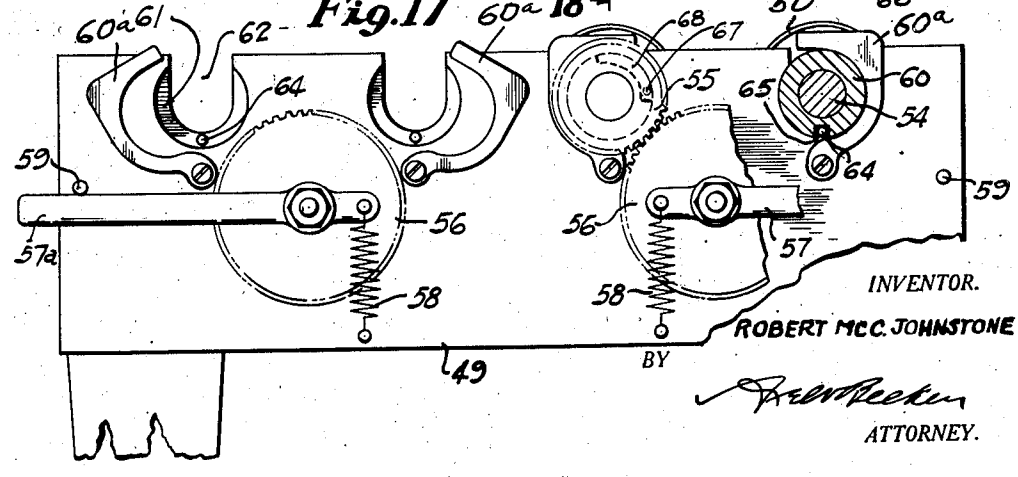



Fig. 17




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Fig. 18

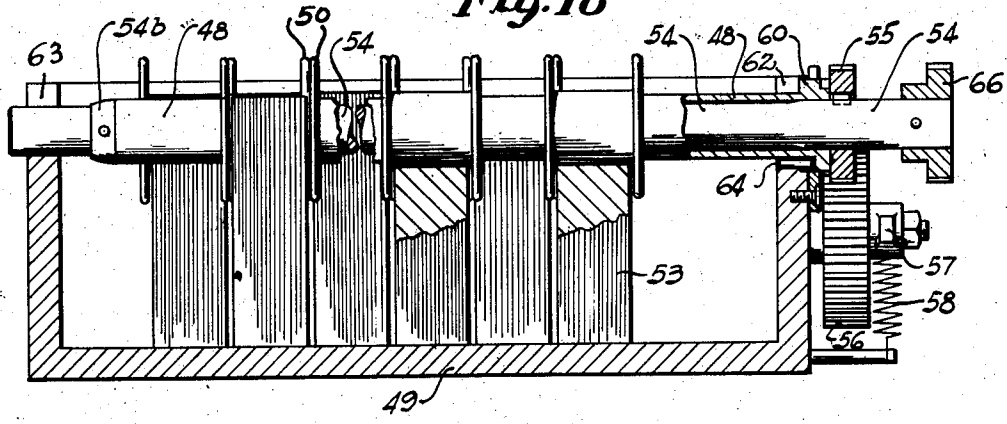



Fig. 19

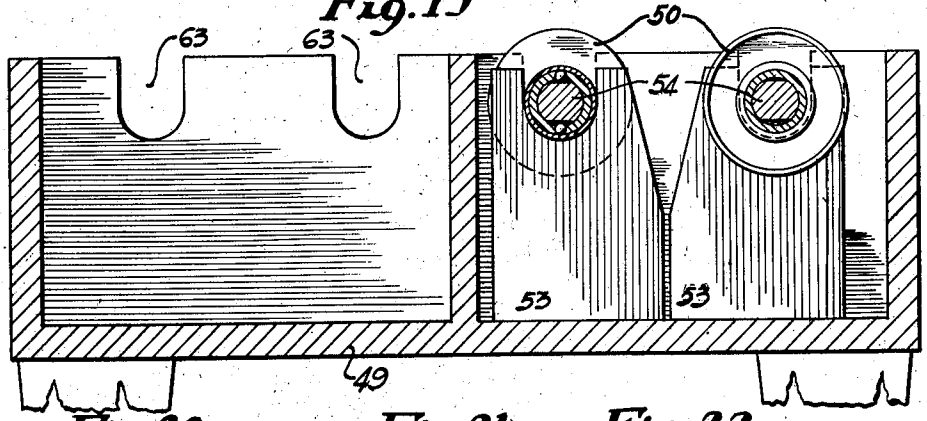



Fig. 20

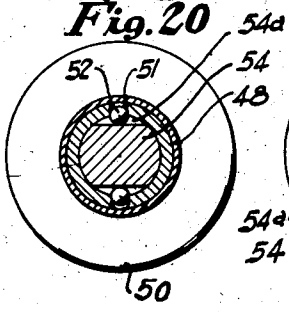



Fig. 21

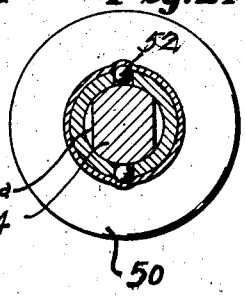



Fig. 22

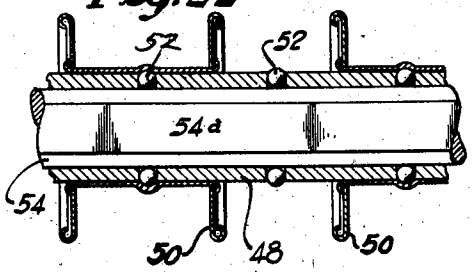
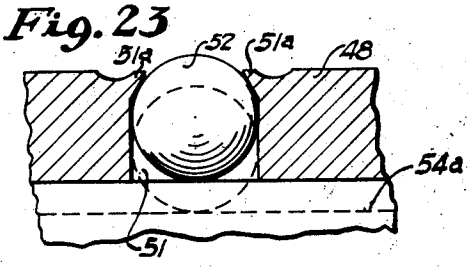



Fig. 23




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Patented May 7, 1940 2,200,000

# UNITED STATES PATENT OFFICE

2,200,000

## ART OF WINDING FLEXIBLE MATERIAL

Robert McC. Johnstone, Short Hills, N. J., assignor to Cameron Machine Company, Brooklyn, N. Y., a corporation of New York

Application September 10, 1937, Serial No. 163,190

4 Claims. (Cl. 242—56)

This invention relates to an improved method of and means for winding one or more sections of flexible material and, more specifically, to a method of and means for producing rolls of adhesive tape. Although, as will be apparent from what follows, there are special problems in connection with the production of rolls of adhesive tape, it follows by no means that the methods and means employed in the solution of such problems are to be limited to the narrow field of adhesive tapes. The main object and feature of the invention is to obtain small rolls of narrow flexible material in great quantities and at a rapid rate. The invention therefore has to do not merely with the winding function as such, but also with the quick assembling and disassembling of core members or spools with respect to a winding arbor because the length of time consumed in winding material on a set of spools is relatively short owing to the small diameter of the wound material, and it is therefore preferable that the operator be able, during the short time consumed in winding material, to discharge the filled spools from the arbor and to arrange a new set of empty spools on a winding arbor. So, likewise, as little time as possible should be lost in substituting a new set of spools for those filled and threading the material on the new spools.

The invention consists of the methods and means, a preferred form of which is disclosed in the specification and drawings.

In said drawings:

Fig. 1 is a side elevation of the machine looking in the direction of arrow 1 of Fig. 3;

Fig. 2 is a fragmentary section on the line 2—2, Fig. 1;

Fig. 3 is a top plan view of the same, parts being broken away and parts shown in section;

Fig. 4 is a side elevation of an upper fragmentary portion of Fig. 1 taken from the opposite side of the machine;

Fig. 5 is a longitudinal vertical section of the machine on the line 5—5, Fig. 3;

Fig. 6 is a diagrammatic elevation of the spooling mechanism, parts being shown in cross-section;

Fig. 7 is a similar view, of the upper portion of Fig. 6 showing the web-severing operation;

Fig. 8 is a side elevation of the web-severing tool;

Fig. 9 is an enlarged fragmentary portion of Fig. 7 showing the method of severing the tapes at the end of one spooling operation;

Fig. 10 is a transverse section of one of a series of empty spools subsequently to their movement into winding position and after the free ends of the unwound tapes have been tucked into close contact with the core members or spools;

Fig. 11 is a side elevation of Fig. 10;

Fig. 12 is an enlarged vertical section on the line 12—12 of Fig. 3, showing the slip friction clutch whereby increased power is applied to the tapes at the beginning of each winding operation;

Fig. 13 is a fragmentary front elevation of the machine showing the power-controlling devices;

Fig. 14 is an enlarged front elevation of the lower left-hand portion of Fig. 13, with the controls in changed positions;

Fig. 15 is a view similar to Fig. 14, showing the controls in other positions;

Fig. 16 is a top plan view of the spool loading box, parts being broken away and parts shown in section;

Fig. 17 is an end elevation of Fig. 16, parts being broken away and parts shown in section;

Fig. 18 is a vertical section on the line 18—18, of Fig. 16, parts being broken away and parts shown in section;

Fig. 19 is a vertical section on the line 19—19, of Fig. 16;

Fig. 20 is a transverse section of one of the empty spools in position on the arbor prior to its locking engagement therewith;

Fig. 21 is a similar section showing the interlocking connection between spools and supporting arbor;

Fig. 22 is a vertical longitudinal section of Fig. 21; and

Fig. 23 is an enlarged fragmentary section of the arbor sleeve and spool locking device.

It will facilitate an understanding of the invention if, at the outset, I give a brief outline of the sequence of operations or steps and supplement it later by a more detailed description.

First of all, the core members or spools 50 are supported independently of the winding arbor in what I shall call a loading box 49 (Figs. 16 to 23) after which a winding arbor is inserted through the spools, said arbor consisting of a sleeve 48 and an inner shaft 54 which by a relative rotational movement lock the spools in position on the sleeve. This is of great advantage especially as here the core members or spools do not abut but are in spaced relation as it admits of very quick and accurate positioning. The assembly thus produced is then removed from the loading box and placed in the rotatable head of a winding machine while the machine is at

rest (see diagrams Figs. 6, 7, 9, 10 and 11). The rotatable head is turned thereby moving an arbor with spools, that have been filled, out of driving relation with gear 95 and bringing the arbor with the new spools into driving relation with said gear at the same time bringing the surface of the empty spools against a taut portion of the unwound material. The surface of the spools can be provided with prongs to catch and retain the material but in the present instance this is unnecessary as the material is tacky and therefore adheres firmly to the surface of the spool. The material extending between the two sets of spools is now severed transversely and a long brush 72 is employed to sweep the loose ends of material on the wound roll against the periphery of the roll, and the loose ends of material adjacent the new spools are tucked into position by means of a long tucker blade 71. The machine can now be started up to wind material on the new spools. The arbor containing the spools already filled is now removed from the machine and placed in the left-hand empty compartment of the loading box (Fig. 16) where by a quick movement the spools are released and stripped from the arbor, which latter is then reloaded in the other side of the box, and the described sequence of operations is then repeated.

Coming now to a more detailed description it will be seen that Fig. 1 shows a roll or web of material 25 which passes over a power-driven roller 26 to a spreader 27. As shown in Fig. 5, said web passes from spreader 27 to and over a guide roller 28 and from thence under a slitter drum 29 between which and a transverse series of cutters 30, the web is slitted longitudinally to form a multiplicity of strips or tapes. As the strips or tapes pass upwardly with their contiguous lateral edges in juxtaposition, alternate strips or tapes are diverted over a lower guide roller 31 to a lower spooling mechanism to be hereinafter described while the remaining strips or tapes continue their movement upwardly about an upper guide roller 32 to an upper spooling mechanism. In this way the strips or tapes are formed into separate groups of laterally-spaced tapes arranged in a predetermined order in which they are to be separately spooled.

The upper and lower spooling mechanisms are substantially similar in construction so that a description of the upper one will serve for both. Journaled in opposite side frames 33 and 34 is a transverse head 35, said head being provided at one end with a shaft or journal 36 (Fig. 3) which extends through and projects beyond side frame 33. Mounted at the outer end of shaft 36 is a lever 37 whereby the head and spool supports (to be presently described) are shifted through arcs of 180 degrees after each spooling operation. Keyed to shaft 36 at the outer surface of side frame 33 is a locking disk 38 which, as shown in Fig. 4, is provided with diametrically opposite notches 39 for receiving a spring-pressed bolt or detent 40 in a housing 41 mounted on the side frame, the head being thereby locked in a stationary position after each rotational shift. Oppositely presented cutter blades 42 are suitably arranged on the head for severing the tapes or strips between the filled and empty spools in the manner to be hereinafter explained. Rigidly connected to head 35 at opposite ends within side frames 33 and 34 are bearing frames or spiders 43 which carry fixed bearing members 44 and removable bearing caps 45 for journaling the spool-supporting arbors, said bearing caps being pivotally mounted on spider frames 43, under the constraint of toggles 46 which are stabilized in either position of the cap bearings by means of tension springs 47.

Referring now to Figs. 16 to 23 of the drawings, spool-supporting or winding arbors are provided, each of said arbors, in the form here illustrated, consisting of an inner shaft 54, an outer sleeve 48 within which the shaft is turnable, and a tapered band or thimble 54b which retains the sleeve against axial displacement on the shaft and facilitates the insertion of the arbor into the winding cores which are here shown in the form of spools 50 arranged in predetermined laterally-spaced order. For the purpose of releasably locking the spools to the arbor in any desired arrangement, suitable means are provided such, for example, as that shown in Figs. 20, 21, 22 and 23. As there shown, sleeve 48 is provided with opposite series of holes or sockets 51 having portions of the surrounding metal upset by a peening operation to form flanges 51a (Fig. 23) for limiting the outward displacement of spool-engaging locking members, here shown as balls 52 disposed in said holes or sockets. For limiting the inward movement of balls 52, shaft 54 is provided with oppositely presented flattened surfaces 54a, the construction being such that in the relative positions of the parts shown in Fig. 20, the spools may be readily placed on and removed from the arbor while, in the positions of the parts shown in Figs. 21 and 22, the spools are locked to the arbor by permanently deforming the sheet material of the spools by the protrusion of balls 52. For the purpose of facilitating these operations and more especially for enabling the spools to be mounted on the arbor in a predetermined laterally-spaced order in a rapid and accurate manner, a loading box 49 is provided in which stationary spool supports 53, in the form of open bearings to engage the outer surfaces of the spools, are arranged in the desired predetermined order in which the spools are to be mounted in the rotatable head of the winding mechanism. The spools having been placed on said supports, the arbor is next inserted endwise through said spools until an enlargement or collar 60 near its outer end enters a recess 61 in the side wall of loading box 49 with the arbor resting in coaxially alined bearings 62 and 63 in the opposite side walls of the loading box. If desired, pivoted latches 60a can be used to hold the arbor down in bearings 62 and 63. Keyed to the shaft 54 is a spur gear 55 which meshes with a larger spur gear 56 which turns on a fixed stub shaft mounted on said side wall of the loading box. A lever 57, which is acted upon by a spring 58 that tends to retain it in normal position against a stop pin 59, is rigidly connected to gear 56 for turning gear 55 and shaft 54 from its position shown in Fig. 20 to its position shown in Fig. 21. During this movement, the sleeve is held against turning by means of a fixed pin 64 in recess 61, said pin being then disposed in a peripheral notch 65 (Fig. 17) in enlargement 60 of the sleeve. As shown in Figs. 16 and 17, enlargement 60 is provided with a peripheral groove 68 extending approximately 90 degrees about the axis of the sleeve. A pin 67 presented into this groove from gear 55, is moved in a counterclockwise direction from its position shown in Fig. 17 to the upper end of said groove by the rotation of shaft 54 between its successive positions with respect to sleeve 48

shown in Figs. 20 and 21 respectively. Keyed to the outer end of shaft 54, is a spur gear 66 by means of which the arbor is rotated in the winding mechanism. According to the embodiment of the invention shown in the drawings, two groups of empty spools are shown at the right in Figs. 16 and 17, the coaxially arranged spools on one arbor being disposed in staggered relation to the similarly arranged spools on the other arbor. After lever 57 on the right has been depressed to impart a quarter turn in a clockwise direction (Fig. 17), to lock the core members to the spools, both groups of spools with their arbors are removed from the loading box and are in readiness to be placed in the upper and lower spooling mechanisms respectively of the winding machine. It will be understood that, when cores 50 are locked to sleeve 48 by the turning movement of shaft 54, pin 67 abuts against the end of slot 68, and that the parts remain in this position when the arbor is inserted in the winding machine. Therefore, when power is applied by the winding machine to gear 66 on shaft 54, the rotation of the latter will drive sleeve 48 through 67 and 68 in unison with said shaft. According to Fig. 5, the right-hand spools in the upper and lower spooling mechanisms have been filled and spiders 43 with their interposed heads have been moved, while the winding action is discontinued, through an angle of 180 degrees from position Fig. 6 in readiness for the tapes to be severed between the filled and empty spool groups in the manner indicated in Figs. 7 and 9. In so doing, the clockwise displacement of the filled spools causes a portion of the wound material to be unwound from the filled spools and causes the tapes to be drawn taut over the cutter blades 42 by which they are cut under the pressure of a hand-applied roll 69 as it is moved lengthwise of the cutter blade. As shown in Fig. 8, the roll may be journaled in a hood 70 provided with a handle. After the tapes are thus severed, the loose ends on one side of the cutter blade are pressed into contact with the drums of the empty spools by a multiplex sweep comprising a transverse bar 71 and curved blades 71*a* which conform to the curvature of said drums. For the purpose of wiping the free ends of the severed tapes on the opposite side of cutter 42 into contact with the wound tapes, an elongated brush 72 may be applied thereto while the arbor is being turned by means of a spanner wrench 75. For convenience in using said brush, it may be suspended by ropes 73 from overhead pulleys and counterbalanced by a weight 74. Upon completion of the spooling operations as described, the arbor or arbors which carry the filled spools, are removed from the winding mechanism and placed in bearings 62 and 63 shown at the left in Fig. 16 with notches 65 in enlargements 60 of the sleeves in engagement with the fixed pins 64, the pins 67 on the spur gears 55 being disposed at the upper ends of arcuate recesses 68. A depression of left-hand lever 57*a* produces an unlocking movement of shafts 54 within sleeves 48, said unlocking movement being substantially similar to but in a reverse direction with respect to the locking movement produced by lever 57. The balls 52 are now relieved from an outward displacing pressure due to the clearance afforded to them by flattened surfaces 54*a*. The arbors are then retracted endwise from the spools which are stripped therefrom by a side wall of the loading box. It is clear from the foregoing description that the empty spools are rapidly and easily arranged in predetermined order in one side of the loading box wherein they are simultaneously loaded upon arbors which may be quickly and easily mounted in the winding mechanism and expeditiously wound, after which the wound cores or spools are removed from said winding mechanism and are stripped from the arbors to fall into the other side of the box from which they may be taken and wrapped for the market.

Suitable means for supplying power to the machine, may be provided by a belt-driven pulley 76 (Figs. 3 and 13) constructed and arranged to transmit power intermittently through a clutch 76*a* to a spur pinion 77. An axial thrust cam 78 for actuating said clutch may be operated by a sprocket 79 over which a chain 80 is movable by a treadle 81. A gear 82 is driven by pinion 77, said gear being keyed to a transverse shaft 83 upon which drum 29 of the web-slitting device is mounted. Keyed to shaft 83 on the opposite side of the machine, is a power-distributing gear 84 which meshes with a gear 85 (Figs. 1, 3 and 5). A driving sprocket 86 which is driven by spur gear 85 is connected by a chain 87 to a follower sprocket 88. A friction coupling 89 (Fig. 2) is interposed between sprocket 88 and roller 26 (Fig. 1). A spur gear 90 (Figs. 1 and 12), driven by spur gear 84, transmits power through a slip fraction clutch 91 to a spur gear 92. A small pinion 93 (Fig. 1) which is driven by gear 92, is keyed to a spindle 94 journaled in side frame 34, a spur pinion 95 being also keyed to spindle 94 on the inner side of said frame for driving the upper spooling mechanism. A similar train of gears comprising gear 96, slip friction clutch 97 (Fig. 3), gear 98, and gear 99, connects power distributing gear 84 to a pinion 100 for driving the lower spooling mechanism. Driving pinions 95 and 100 are suitably located to mesh with gears 66 on the outer ends of winding arbors as said arbors are moved successively into winding position in the upper and lower spooling mechanisms by successive rotational movements of spider frames 43. Keyed to drum shaft 83 is a spur gear 101 (Figs. 3 and 4), said gear being connected to pull rollers 31 and 32 for the upper and lower spooling mechanisms, respectively, through a gear 102 on an intermediate shaft 103, friction block 104 keyed to shaft 103, pinion 105 freely rotatable on shaft 103 under the adjustable pressure of a disk 106, an idler 107, and pinions 108 and 109, the latter of which are carried by pull rollers 31 and 32 (Figs. 3 and 4).

In machines of the character described above, whenever the winding operation is interrupted for any purpose such, for example, as the replacement of filled winding cores or spools by empty ones, there is a tendency during the rest periods for the material to cling to the rollers and drums which guide said material through the machine. This condition is especially noticeable in cases where the material is coated with adhesive and the tacky surfaces are permitted to come to rest in contact with said rollers and drums. In consequence it is readily seen that to break down this bonding tendency between the material and the rotary members over which it passes calls for the application of considerable power for this purpose alone. For the purpose of applying additional power for breaking this bonding or clinging tendency after each stoppage of the machine, there are means of suitable construction which operate automatically to increase the application of power whenever the winding operation is

initiated and to reduce the application of power to a running normal when the material is running freely through the machine. For this purpose, a cam-operating treadle 110 shown at the left in Fig. 13 to be normally held in elevated position by a yieldable hanger 111, is connected by an inclined link 112 to one arm of a bellcrank 113, the other arm of said bellcrank being connected by a link rod 114 to one arm of a second bellcrank 115. Extending upwardly from the other arm of the second bellcrank, is a rod 116 which is connected at its upper end to the outer end of a cam actuating arm 117. As shown in Fig. 3, the arm 117 when depressed imparts an angular displacement to a cam member 118 and a consequent axial displacement to a complementary cam member 119. As shown in Fig. 12, the outward displacement of cam member 119 compresses a spring 120 and thereby increases the pressure between friction disks 91 and thus provides for momentarily increasing the driving power delivered to the gear 92 whenever the treadle 110 is depressed for delivering more power to the driving gear 95 for the upper spooling mechanism. As the machine accelerates, gear 90 moves in a direction counter to the angular displacement of cam 118 and operates thereon by friction to return it to its normal position and thus permits the spooling operation to continue under normal power. A similar increase in the driving power of the pinion 100 for the lower spooling mechanism, may be provided for as follows. A radial arm 121 on cam member 118 is connected by a rod 122 to a radial arm 123 on a cam member 124 of the lower spooling mechanism. Cooperating with cam member 124 is another cam member 125, a relative turning movement between said cam members serving to increase the yieldable pressure applied to friction coupling 97 between spur gears 96 and 98. For the purpose of maintaining oscillatable cam members 119 and 125 in definite rotational relation to each other while at the same time permitting them to be displaced axially to a limited extent, a rod 126 is mounted in side frame 34 (Fig. 3), a perforated connection plate 127 being mounted on the outer end of said rod with a limited amount of lateral play. An arm 128 projects radially from clutch member 119 and is pivotally connected at its outer end to plate 127 through one of the perforations at a distance from one end of a connecting rod 129 which is connected thereto through another perforation. The other end of rod 129 is pivotally connected to the outer end of a radial arm 130 carried by cam member 125.

The starting and acceleration controls are shown in Figs. 1, 13, 14 and 15. Pivotally mounted on a pin 131 at the bottom of the front end of side frame 33 is a rock bar 132 to which is connected a spring 133 which tends to retain the rock bar in one or the other of two extreme positions assumed by said bar at different times. Projecting normally from the rock bar is an arm 134 which is provided with an inclined upper edge 135 for temporarily preventing the downward movement of power treadle 81 until after cam-controlling treadle 110 has been depressed to increase the power transmitted to the spooling mechanisms in the manner described above. A stop pin 136 which projects forwardly from the side frame 33 in the angle between the left-hand arm of rock bar 132 and stop arm 134 is arranged to limit the movement of said rock bar in either a clockwise or counterclockwise direction. Secured to the inner wall of side frame 33 is a bracket 137 with a stop or lug 138 for limiting the upward movement of treadle 81, said bracket being further provided with a downwardly inclined shoulder 139 for retaining treadle 81 in depressed position while the machine is running. While the machine is at rest, the cam and power controls are in their relative positions shown in Fig. 13, the downward movement of power treadle 81 being blocked by stop arm 134 which is then in its extreme position toward the right. To start the machine after installing empty spool assemblies to replace the filled spool assemblies, treadle 110 is depressed to increase the power-transmitting capacity of friction couplings 91 and 97 through which the spooling mechanisms are driven while at the same time removing stop arm 134 from the downward path of treadle 81. As indicated in Figs. 14 and 15, the downward movement of power-controlling treadle 81 moves rock bar 132 in a clockwise direction until the tension of spring 133 becomes active to the right of pivot 131 when said rock bar is actuated thereby to come into engagement with stop pin 136. After treadle 81 has been sufficiently depressed to be anchored below shoulder 139 where it remains until the spooling operation has been completed, treadle 110 is permitted to reassume its upper position to permit the winding operation to continue at normal running speed. The relative positions of the parts while the machine is running is shown in Fig. 15. As soon as the spooling operation has been completed, a slight downward and lateral displacement of treadle 81 serves to release it from the shoulder 139. As the treadle moves upwardly to its initial position shown in Fig. 13 it imparts a slight counterclockwise movement to stop arm 134 which is immediately returned to its initial position (Fig. 13) by the spring 133.

The method and means for assembling core members on an arbor are not claimed herein but form the subject matter of a divisional application Ser. No. 207,258, filed May 11, 1938.

The method and means for temporarily increasing the winding tension and the power applied to the machine are not claimed herein but form the subject matter of a divisional application Ser. No. 207,259, filed May 11, 1938.

I claim:

1. The method of winding flexible material into successive rolls which consists in winding a portion of said material on a member, interrupting the winding operation, moving said member out of winding position and moving a second member into engagement with the unwound material to thereby unwind a portion of the wound material from said first member and to create a taut portion of material that extends between said first and second members, severing the material at a point between the two members, tucking the loose ends of the material thus formed one against the wound material on the first member and the other against the second member, and then continuing the winding operation of the material on the second member.

2. In a winding machine, a rotatable head, means to support two winding arbors in spaced apart relation on said head, and two oppositely facing knives carried by said head intermediate the supporting means.

3. The method of winding a section of flexible material into successive rolls which consists in winding a portion of said material on a member occupying an operative position, stopping the

winding operation, moving said member out of operative position and simultaneously moving a second member into operative position in engagement with the unwound material to thereby unwind a portion of the wound material from the first member and to create a taut portion of material that extends between the first and second members, severing the taut material intermediate the two members, and then resuming the winding operation to wind material on said second member.

4. In a winding machine, a rotatable head; a plurality of winding arbors, carried in spaced relation on said head, and individually rotatable in either direction; a pinion on each arbor; a driving gear located extraneously of the head with which the pinions of the arbors are to successively engage and disengage when said gear is stationary and which when rotated drives that winding arbor the pinion of which is in engagement therewith to thereby wind material on said arbor; mens to turn said head, while the driving gear is standing still to bring the pinion of one arbor out of mesh and the pinion of another arbor into mesh with said gear to thereby unwind material from that arbor the pinion of which is moving out of mesh with said gear and on which arbor material has been previously wound whereby a taut section of material is created between the two arbors.

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