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(54) Twist tie ribbon feed, cut and tie apparatus and method of same.

(57) An apparatus for advancing a plurality of different predetermined lengths of twist tie ribbon is disclosed. The apparatus includes a guide for guiding the ribbon along a feed path and a pair of opposed rollers for displacing the twist tie ribbon therebetween. A first of the rollers has first and second circumferential portions and is displacable toward and away from the second roller. The second of the rollers has a first circumferential portion in registration with the first circumferential portion of the first roller and carries a plurality of biasing segments. At least all but one of the biasing segments are slidably mounted on the second roller. The biasing segments are slidable between a first position at which the biasing segments do not contact the second peripheral portion of the first roller, and a second position, wherein the biasing segments contact the first roller and displaces the first roller out of engagement with the tie ribbon, so that the tie ribbon is not displaced by the pair of opposed rollers. The advancing apparatus is readily integratable into a twist tie machine that is capable of wrapping a plurality of different sized objects. The predetermined lengths of ribbon are delivered to an operating position, at which they move a slide which mechanically displaces a hoop to bring the free end of the ribbon to an interior region thereof. In response to the displacement of the slide, the length of ribbon is cut-off and twisted.

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BACKGROUND OF THE INVENTION

This invention relates generally to a twist tie ribbon feeding, cutting and twisting apparatus principally used for closing the open end of flexible packaging and for bundling items and parts of items, and to the feeding and cutting device thereof. The apparatus and the feeding and cutting device thereof cuts a variable length of tying material so that the apparatus is capable of twist tying objects of various sizes.

In the art, machines have been developed which effectively apply a length of twist tie ribbon to products and packaging. The twist tie ribbon can be a malleable wire sandwiched between two strips of paper secured together, for example, with adhesive to form a flat twist tie ribbon, but other forms of twist tie ribbon, formed of other materials and even extruded as a unit can be used. In conventional twist tie machines, the tie ribbon is looped around the bundle or container neck to be tied and is retracted into the machine to form a snug loop of ribbon. After the snug loop of ribbon is formed around the bundle or container neck, the ends of the ribbon are clamped. The ribbon is then cut and rotated about the central axis producing a twist in the length of tie ribbon which remains in place until released. In the known manner, the twist tie ribbon can be untwisted by a user of the product or package and then retwisted when it is desired to reapply the ribbon. The twist tie is familiar to customers in this country, with twist ties being used on many products, such as, for example, tying produce like celery, asparagus, broccoli, and the like, as well as tying the necks of plastic and paper bags that include foodstuff.

Many large, expensive and complicated machines have been provided in the market for the above-mentioned purposes. The primary similarity between all the prior art machines is that the object to be tied is placed within a hoop and the twist tie ribbon is fed around the hoop by a relatively complicated set of gears and rollers. One end of the twist tie ribbon is then pulled back into the machine to securely secure the article to be tied. Then the length of the twist tie ribbon is cut and twisted by the machine. This approach requires a large machine with many parts. In order to circle the tie ribbon around the object to be tied, guides, rollers and further mechanisms are required to retract the twist tie ribbon back into the machine.

It is desirable to provide a twist tie apparatus that is capable of tying a twist tie ribbon around variable sized bundles and that is simple and relatively inexpensive to manufacture and that requires a minimum of moving parts and a minimum amount of movement of the twist tie ribbon. It is desirable to provide a twist tie cutting device which can operate at high speeds.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the instant invention, an apparatus for feeding, cutting and tieing a twist tie ribbon is provided including a device for advancing a plurality of different predetermined lengths of a ribbon-like material from a roll thereof. The ribbon advancing device includes guide members for guiding the ribbon along a feed path. A pair of opposed roller means are provided for displacing the ribbon along the path. The pair of roller means normally engage the tie ribbon. At least one of the roller means is coupled to a motor for rotatably driving the at least one roller means. A plurality of biasing members are each slidably mounted to a first of the roller means so as to be slidable between a first position, wherein the biasing member does not engage the second of the roller means during a portion of each rotation of the first roller means, and a second position at which the biasing member does contact the second of the roller means during a portion of each rotation of the first roller means. One of the first and second roller means is displaceable out of engagement with the ribbon when a biasing member contacts the other of the first and second roller means, so that the tie ribbon is not displaceable by the pair of opposed roller means. The length of ribbon advanced by each rotation of the roller means is determined by the number and circumferential dimension of the biasing members at said second position.

The device for advancing a plurality of different predetermined lengths of ribbon is incorporated within a housing of the twist tie apparatus. An adjustable packing member is disposed on the housing for firmly packing each different sized object to be tied against the predetermined length of tie ribbon fed out by the displacement apparatus. The tie is completed by a displaceable arm that is displaced to push one end of the tie ribbon around the bundle activating a twist head. The twist head engages the first and second ends of the tie ribbon and a cutting member cuts the second end of the tie ribbon, so that the twist head can twist the first and second ends of the tie ribbon.

In an alternative embodiment, the ribbon advancing device is incorporated in a ribbon cutting apparatus including means for cutting the advanced length of ribbon during the period that a biasing means is in contact with the second roller means. In such an embodiment, one of the biasing means is preferably fixed at the second position.

Accordingly, it is an object of the invention to provide a machine that is adjustable to displace and cut a plurality of predetermined lengths of a ribbon material quickly, efficiently and at a low cost.

Another object of the invention is to provide a machine that can displace a plurality of different predetermined lengths of twist tie ribbon and wrap the predetermined length of ribbon around an object, effi-

ciently and at a low cost.

Yet another object of the present invention is to neatly tie variable sized bundles, such that the bundles are always tightly packed and the twist ends come out at even lengths.

Still another object of the invention is to provide a twist tie machine at reduced cost while providing even ends by displacing a predetermined length of ribbon and not reversing the machine to take in slack of the twist tie ribbon.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of constructions, combinations of elements and arrangements of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a first embodiment of the invention showing a ribbon cutting machine;

FIG. 2 is a partial top plan view taken along lines 2-2 of FIG. 1;

FIG. 3 is a front plan view taken along lines 3-3 of FIG. 1;

FIG. 4 is a side elevation view of the first embodiment of the invention during cutting;

FIG. 5 is a perspective view of a second embodiment of the invention showing a twist tie machine;

FIG. 6 is a top plan view of the twist tie machine of the FIG. 5;

FIG. 7 is a partial front elevational view of the twist tie machine of FIG. 6 taken along lines 7-7;

FIG. 8 is a partial cross-sectional view taken along lines 8-8 of FIG. 6;

FIG. 9 is an enlarged fragmentary top plan view of the twist tie machine in accordance with the second embodiment after the tying operation is completed;

FIG. 10 is an enlarged fragmentary top plan view of an article after tying is complete with the ends of the tie ribbon secured within the twist head;

FIG. 11 is a cross-sectional view taken along lines 11-11 of FIG. 10;

FIG. 12 is a partial top plan view of the slide unit of a third embodiment of the invention; and

FIG. 13 is a cross-sectional view taken along lines 13-13 of FIG. 12.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is now made to the Figures, wherein like reference numerals represent like elements. Reference is first made to FIGS. 1-4, wherein a device, generally indicated at 20, for feeding and cutting predetermined lengths of twist tie ribbon is depicted. Feed and cut apparatus 20 is supported on a base 23 and receives twist tie ribbon 22 from a large roll of twist tie ribbon (not shown) preferably also supported on base 23. The tie ribbon 22 passes through an optional print head 27 to print a desired message of an appropriate length on twist tie ribbon 22. For example, print head 27 can print a company name or product name on the tie ribbon 22. Print head 27 includes a print roller having words, symbols or a design in raised form on the periphery thereof. A platen roller 26 for pressing the twist tie ribbon against print roll 24 and inking device 25 for applying ink to print roll 24 are all mounted on housing 21. Print roll 24 and platen roller 26 are rotationally mounted on housing 21 by shafts 28 and 30, respectively. Twist tie ribbon 22 next passes around ribbon pulley 32 which is rotationally mounted on housing 21 by shaft 34. Pulley 32 includes an outer circular flange 36 and an inner circumferential surface 38. Twist tie ribbon 22 rides against inner circumferential surface 38 and is guided by outer circular flange 36 and housing 21.

Twist tie ribbon 22 is pulled in the direction of arrow A by ribbon feed wheel 40 and idler wheel 42 which bears against ribbon feed wheel 40. Ribbon feed wheel 40 is rotationally mounted to housing 21 by shaft 44. A sprocket wheel 45 is mounted on shaft 44 and supports a chain 52 coupled to sprocket wheel 47 mounted on drive shaft 49 of a motor 50, so that the motor rotates ribbon feed wheel 40.

Ribbon feed wheel 40 includes an outer circumferential surface 54 provided to engage twist tie ribbon 22 against the inner circumferential surface 70 of idler wheel 42. Outer circumferential surface of idler wheel 42 has a radius R and, accordingly, the circumferential distance around ribbon feed wheel 40 equals $2\pi R$. Therefore, each time ribbon feed wheel 40 completes one full 360° rotation about shaft 44, $2\pi R$ ribbon is pulled between ribbon feed wheel 40 and idler wheel 42 in the direction of arrow A. Accordingly, an operator of the present device can be certain to displace a constant amount of twist tie ribbon each time the ribbon feed wheel 40 completes one complete 360° rotation. The diameter of feed wheel 40 is designed to be a size such that the circumference of the wheel provides the minimum size length of ribbon desired.

Ribbon feed wheel 40 is provided with a radially extending flange 55 on one side of outer circumferential surface 54. Idler wheel 42 is provided with an inner circumferential surface 70 for engagement

against outer circumferential surface 54 of ribbon feed wheel 40 and a radially extending circumferential flange 73 on the side of idler wheel 42 opposite to flange 55, so that twist tie ribbon 22 is retained between flanges 55 and 73 even if idler wheel 42 is displaced in the direction of arrow B as described below.

In order to adjust the amount of twist tie ribbon advanced during each rotation of ribbon feed wheel 40 so as to advance a smaller length of ribbon, biasing segments 56, 58, 60 and 62 are provided. In this embodiment, wherein the machine is only feeding and cutting tie ribbon 22, segment 56 is mounted in a stationary position on the side surface 57 of ribbon feed by bolts 90a and 90b, so that each time ribbon feed wheel 40 rotates to the position shown in FIG. 4, biasing segment 56 engages the outer peripheral surface of flange 73 of idler wheel 42 and displaces the idler wheel in the direction of arrow B. By this arrangement, inner circumferential surface 70 of idler wheel 42 is displaced away from outer circumferential surface 54 of ribbon feed wheel 40, so that tie ribbon 22 is no longer pulled in the direction of arrow A. Accordingly, tie ribbon 22 stops moving.

A block 72 is mounted to housing 21 by screws 74 and 76. Block 72 includes a bore 78 therethrough to receive a shaft 80 slidably therein. Shaft 80 is coupled on a first side to the base of clevis 82 which extends in the axial direction. A spring 84 is disposed between the base of clevis 82 and block 72. On the second side of shaft 80 is a handle 81 for manually moving shaft 80 in the direction of arrow B during loading and unloading of tie ribbon 22.

Spring 84 biases idler wheel 42 in a direction opposite to arrow B, so that the outer circumferential surface 70 of idler wheel 42 and circumferential surface 54 of ribbon feed wheel 40 normally bear against twist tie ribbon 22.

As stated above, ribbon feed wheel 40 has a radius R and each time ribbon feed wheel 40 makes one complete rotation, the length of tie ribbon 22 displaced in the direction of arrow A equals $2\pi R$. Accordingly, the amount of ribbon displaced by ribbon feed wheel 40 can be adjusted by adjusting the size (radius) of feed wheel 40. However, changing the radius of ribbon feed wheel 40 can be difficult, time consuming and may destroy the alignment of the wheels which is very important due to the delicate nature of twist tie ribbon.

Therefore, the present invention provides a mechanism for changing the length of tie material 22 being displaced in the direction of arrow A each time the ribbon feed wheel 40 makes one complete rotation by movement of biasing segments 58, 60 and 62. Biasing segments 58, 60 and 62 are formed each with a pair of slots 57a and 57b, 59a and 59b and 61a and 61b, respectively. The biasing segments 58, 60 and 62 are each mounted on side surface 57 of ribbon feed wheel 40 by bolts 90c and 90d, 90e and 90f and 90 g and 90h, respectively, each bolt passing through a corresponding slot in the associated biasing segments. The biasing segments are displaceable between a first position and a second position. In the first position, the segments are recessed inwardly from circumferential surface 54 of ribbon feed wheel 40 and they do not contact outer circumferential surface 71 of idler wheel 42. However, through loosening the bolts associated with one or more of the biasing segments, each selected segment can be displaced to a second position wherein the second side 58b, 60b or 62b of the selected segment(s) is aligned with second side 56b of fixed segment 56 and the first surface 58a, 60a or 62a of the selected segment(s) is accurately aligned with the arc defined by first surface 56a of biasing segment 56. The repositioned segment is locked in place by the associated bolts. The first surface 58a, 60a and 62a of each biasing segment positioned in the second position will bear against outer circumferential surface 71 of idler wheel 42 and will cause idler wheel 42 to be displaced in the direction of arrow B. This causes spring 84 to compress, such that the inner circumferential surface 70 of idler wheel 42 will not bear against twist tie ribbon 22 and, accordingly, twist tie ribbon 22 will not move in the direction of arrow A.

Accordingly, apparatus 20 can be adjusted such that the length of twist tie ribbon 22 displaced in the direction of arrow A is decreased each time the ribbon feed wheel 40 rotates one 360° rotation from the maximum of $2\pi R$ minus the length of arc 56a of biasing segment 56 to $2\pi R$ minus the length of the arc of those of first surfaces 58a, 60a and 62a which are displaced to the second position. In this embodiment, segment 56a is always positioned in the second position and, accordingly, always biases outer circumferential surface 71 away from idler wheel 42 when in registration therewith.

While the four biasing segments 56, 58, 60, 62 are formed with essentially equal length first surfaces 56a, 58a, 60a and 62a, respectively, each biasing segment can have a different length first surface if desired. Further, more than four biasing segments can be provided, if desired.

The embodiment of the invention disclosed in FIGS. 1-4 provides an adjustable feed and cut system for twist tie ribbon 22. The feed system has been discussed hereinabove. It is desired to cut to length a maximum amount of twist tie ribbon 22 in a minimum amount of time. However, the problem to be overcome is that twist tie ribbon 22 cannot be moving when the twist tie ribbon 22 is cut. If it is moving, twist tie ribbon 22 will continue to be pushed against the cutting blade, discussed below, which would cause twist tie ribbon 22 to bend, bulk up and jam the machine. Accordingly, it is desirable to produce a machine that is capable of feeding the desired length of ribbon quickly through the machine and, when the de-

sired length has been fed, simultaneously stopping and cutting the ribbon, and therefore immediately starting to feed ribbon again.

As discussed above, because segments 58, 60 and 62 are particularly provided to give adjustability to the length of ribbon desired by defining, as shown in FIGS. 1 and 2, the circumferential distance over which the outer circumferential surface 54 of feed wheel 40 contacts the inner circumferential surface 70 of idler wheel 42 to pull twist tie ribbon 22 in the direction of arrow A. Referring to FIG. 4, when in proper circumferential position, biasing segment 56 engages outer circumferential surface 71 of idler wheel 42 to disengage the inner circumferential surface 70 from twist tie ribbon 22 and, accordingly, therefore preventing twist tie ribbon 22 from being moved in the direction of arrow A.

A cam pin 91 is mounted on the bottom surface of feed wheel 40 in alignment with biasing segment 56.

A lever 92 pivots about shaft 94 in a direction of arrow C such that knife 96 which is mounted to lever 92 is displaceable in the direction of arrow C. During cutting, knife 96 contacts cutting edge 98 of anvil 99 which is mounted to housing 21 by screws 102 and 104. Lever 92 is biased in the direction opposite to arrow C by spring 69 extending between housing 21 and lever 92.

FIG. 1 discloses cam pin 91 with knife 96 biased in a direction opposite to arrow C, such that knife 96 does not engage cutting edge 98 of anvil 99. Only when segment 56 contacts circumferential surface 71 of idler wheel 42 and biases idler wheel 42 in a direction of arrow B does cam pin 91 simultaneously engage lever 92 and displace lever 92 in the direction of arrow C so that knife 96 contacts cutting edge 98 of anvil 99 to cutoff the desired length of twist tie ribbon 22.

Furthermore, as discussed hereinabove, if a shorter length of twist tie ribbon is desired to be cut, any one or more of segments 58, 60 and 62 can be displaced to their second position, so that these segments also bias idler wheel 42 in the direction of arrow B such that the inner circumferential surface 70 is biased away from the outer circumferential surface 54 of ribbon feed roller 40 to prevent tie ribbon 22 from being displaced in the direction of arrow A.

A counter 105 is provided to count the number of rotations of ribbon feed wheel 40, and therefore the number of lengths of twist tie ribbon 22 which are cut off. The counter includes a switch 106 shown in phantom which is activated by a cam 107 that is mounted on shaft 44. Cam 107 depresses switch 106 once each time shaft 44 is rotated one complete revolution. In a preferred embodiment, counter 105 can be operatively coupled to motor 50 to shut motor 50 off when a predetermined count is recorded. Thus, coupling can be by control 94 shown schematically in FIG. 2 coupled to counter 105 and motor 50. Counter 105 can be set to a desired number, such as 50. Accordingly, 50 precut pieces of twist tie ribbon of the same length can be cut to the desired length to be used or resold.

While the apparatus 20 is preferably used to cut lengths of twist tie ribbon, it can also be used for cutting lengths of other ribbon material.

Reference is next made to FIGS. 5-11, wherein a second embodiment of the invention is depicted. This embodiment includes a first section that feeds a predetermined amount of twist tie ribbon 22 in the direction of arrow E, and a second section which bends the twist tie ribbon around an object, and cuts and twists the twist tie ribbon.

First, the feed section of the invention is discussed. Twist tie ribbon 22 is provided on a spool 110 which is rotationally mounted on a shaft 120 supported on L bracket 112. L bracket 112 is mounted on housing 114 by screws 116 and 118. Shaft 120 has a removable head portion 122 thereon for locking spool 110 on shaft 120. A brake 124 is provided for restricting rotation of spool 110 which is otherwise freely rotatable on shaft 120. Twist tie ribbon 22 is inserted through a guide member, generally indicated at 130. Guide member 130 is fixedly secured to housing 114 by screws 132 and 134, so that the twist tie ribbon is maintained in a straight line in the direction of arrow E. Guide member 130 includes two substantially straight guide plates 136 and 138 that are displaced apart a distance slightly greater than the width of twist tie ribbon 22, so that twist tie ribbon 22 can easily pass therethrough, and will not be bent or otherwise twisted.

After passing through guide member 130, the tie twist ribbon 22 is displaced by ribbon feed wheel 40' and idler wheel 42'. Idler wheel 42' is rotationally mounted on first end 142 of lever 140 by shaft 146. The second end 144 of lever 140 includes a hole 148 therein for receiving and retaining first end 152 of biasing spring 150 therein. A second end 154 of biasing spring 50 is fixedly secured to housing 114 by pin 156. Spring 150 biases second end 144 of lever 140 in the direction of arrow F. Pivot member 158 is fixedly secured to housing 114 by shaft 160. Accordingly, lever 140 pivots about pivot member 158. Thus, biasing spring 150 also biases first end 142 of lever 140 in a direction of arrow G. Therefore, idler wheel 42' is also biased in the direction of arrow G.

Ribbon feed wheel 40' works in substantially the same manner as that of ribbon feed wheel 40. Ribbon feed wheel 40' is connected through a sprocket and chain to a motor (not shown) in a manner similar to the first embodiment. However, in order to advance tie ribbon 22 only after completion of the twisting and cutting cycle on a previous tie, ribbon feed wheel 40' is connected to the gear train through a conventional single revolution clutch, so that ribbon feed

wheel 40' rotates only one revolution until the clutch is reengaged. The structure of the motor, gear train and clutch is not shown.

Ribbon feed wheel 40' includes an outer circumferential surface 170 and a top surface 172. Segments 56', 58', 60' and 62' are slidably mounted on top surface 172 of ribbon feed wheel 40'. Each of segments 56', 58', 60' and 62' includes a pair of slots 180 and 181, 182 and 183, 184 and 185, and 186 and' 187, respectively, therethrough. The slots are for receiving bolts 90a'and 90b', 90c' and 90d', 90e' and 90f', and 90g' and 90h', respectively.

Segments 56', 58', 60' and 62' are each displaceable between a first position, wherein their first surfaces 56a', 58a', 60a' and 62a' extend past circumferential surface 160 and a second position, wherein surfaces 56a', 58a', 60a' and 62a' do not extend past circumferential surface 170. In FIGS. 5 and 6, segments 56' and 58' are shown in the first position and segments 60' and 62' are in the second position.

The segments 56', 58', 60' and 62' operate similarly to biasing segments 58, 60 and 62 of the first embodiment, because they are displaceable between the first and second positions. However, in the first embodiment, the idler wheel included a first inner circumferential surface 70 and a second outer circumferential surface 71 located on separate planes such that the inner circumferential surface 70 contacted the circumferential surface 54 of ribbon feed wheel 40. Segments 56, 58, 60 and 62 were located in the second plane, co-planar with the outer circumferential surface 71, such that when the segments are in the first position, they contact the outer circumferential surface 71 of the idler.

In the second embodiment, idler wheel 42' has a thickness that is greater than the thickness of ribbon feed wheel 40'. The side surfaces of idler wheel 42' and ribbon feed wheel 40' that are closest to housing 114 are disposed essentially along a common plane and the upper surface, most distant from the housing of both idler wheel 42' and segments 56', 58', 60' and 62' are also substantially disposed in a common plane. Accordingly, when the segments 56', 58', 60' and 62' are disposed in their second position, circumferential surface 143 of idler wheel 42' is biased against outer circumferential surface 160 of ribbon feed wheel 40'. Therefore, when ribbon feed wheel 40' is rotated by the motor, ribbon 22 is displaced in the direction of arrow E.

However, if any of segments 56', 58', 60' and 62' are moved to their first position, wherein the front surfaces 56a', 58a', 60a', 62a' are displaced radially past the circumferential surface 160 of ribbon feed roller 40', then the front surface of the segment would bias against circumferential surface 143 of idler wheel 42' and cause idler wheel 42' to be pushed in the direction opposite to arrow G, such that circumferential surface 143 of idler wheel 42' would no longer contact tie ribbon 22 and, accordingly, tie ribbon 22 would not be moved in the direction of arrow E.

As stated above, the distance along the circumference of a circular object is 2π x the radius of the circular object. Accordingly, when ribbon feed roller 40' makes one complete 360° rotation, it advances $2\pi R$ amount of tie ribbon 22 in the direction of arrow E. Therefore, the amount of ribbon displaced in each 360° rotation can be varied. In an exemplary embodiment, if each segment has a front surface with an arcuate length of one quarter of an inch, the length of ribbon displaced can be decreased by a maximum of one inch. Therefore, assuming $2\pi R$ equals three inches, and each of the segments have an arcuate length of a quarter of an inch, then the amount of twist tie ribbon 22 that is fed at each rotation would be adjustable between two inches and three inches in quarter of an inch increments.

After passing through feed roller 40' and idler wheel 42', the twist tie ribbon is fed through a second guide member, generally indicated at 200. The second guide member 200 is secured to housing 114 by screws 202 and 204. Second guide member 200 also includes two guide plates 206 and 208 for guiding the ribbon along the straight line of the ribbon path in the direction of arrow E. A further guide member 212 finishes guiding tie ribbon 22 to the feed position.

The embodiment just described gives an alternative method for feeding a predetermined length of tie ribbon 22 along a feed path. This embodiment could be used in the feed and cut device of the first embodiment, and the feed mechanism of the first embodiment could be interchangeable herewith.

Attention is next directed to the twisting and cutting section of the twist tie machine of which this machine provides a novel approach. A predetermined amount of tie ribbon is automatically fed to the appropriate position prior to insertion of an object to be tied. For example, FIG. 5 discloses a length of twist tie ribbon 22 that is disposed in a position to be twisted. The ribbon is shown in opening 115 of housing 114.

The user inserts the article to be tied in opening 115 and pushes same against twist tie ribbon 22. The object to be tied and the twist tie ribbon 22 are then further pressed against side wall 222 of slide plate 224 so that slide plate 224 is displaced in the direction of arrow H. Slide plate 224 is coupled to hoop 230 by a rack and pinion. Rod 231 is coupled to slide plate 224. Pinion 232 rotates hoop 230 in the direction of arrow I when slide plate 224 moves in the direction of arrow H. Hoop 230 includes a head 234 having a curved surface 236. Curved surface 236 of head 234 swings in the direction of arrow I, and engages and rotates the end of twist tie ribbon 22 in the direction of arrow I around the object to be tied.

FIG. 9 depicts hoop 230 in the closed position. When hoop 230 is closed, rack 231 completes its motion in the direction of arrow H and camming member

240 contacts switch member 242 of microswitch 244. Microswitch 244 activates a twist head 250 to twist, microswitch 244 having been placed in an operative state by the engagement of camming member 240 with switch member 310 of microswitch 312.

A twist head 250 is connected to a gear train, generally indicated at 252, which includes a single rotation clutch (not shown) similar to that provided for ribbon feed wheel 40'. Accordingly, each time microswitch 244 is activated, gear 254 rotates in one 360° rotation. This causes gear 256 to rotate in one 360° rotation and causes shaft 258 to rotate likewise. Four-to-one step up gear 260 converts a single 360° rotation of shaft 258 to four 360° rotations of shaft 262. Camming member 264 is connected to shaft 262 as is twist head 250. Accordingly, each time microswitch 244 is activated, cam 264 and twist head 250 rotate four full revolutions.

Cam member 264 bears against knife 266 and causes same to cut twist tie ribbon 22. Twist tie ribbon 22 is held between guide plates 206 and 208 of guide member 200 and, accordingly, when knife blade 268 is moved in the direction of arrow H by cam member 264, twist tie ribbon 22 is cut.

Cam member 264 and twist head 250 rotate in the direction of arrow J, such that cam member 264 bears against back surface 265 of knife member 266 so that knife blade 268 can cut twist tie ribbon 22. Knife 266 is pivotably mounted to second guide 200 by bolt 270. Furthermore, knife 266 pivots about bolt 270 and is biased in the clockwise direction as viewed in FIG. 8 about bolt 270 by a spring 272 extending between knife 266 and frame 114. Accordingly, cam member 264 moves knife 266 such that it pivots about bolt 270 and compresses spring 272. After cutting is complete and camming member 264 no longer cams knife blade 266, spring 272 returns knife blade 266 to the position shown in FIG. 8, wherein twist tie ribbon 22 can be displaced to fill opening 115.

Simultaneously with the cutting process, twist head 250 twists ends 22a and 22b of twist tie ribbon 22. Twist head 250 rotates about shaft 263. Twist head 250 includes a central member 280 and two curved fingers 282 and 284 for engaging the ends of twist tie ribbon 22. The fingers are integrally formed with center member 280 to define grooves 286 and 288 for receiving twist tie ribbon 22 therein. Fingers 282 and 284 are formed with tips 283 and 285 so that the tips extend past the body portions 290 and 292. Accordingly, when the tie head 250 is rotated in the direction of arrow J, the inner surfaces 294 and 296 of fingers 282 and 284, respectively, engage the ends of the twist tie ribbon 22 and cause twist tie ribbon 22 to travel along the entire inner surface 294 and 296 until the twist tie ribbon 22 is secured within grooves 286 and 288. The tie head 250 completes four full rotations and causes twist tie ribbon 22 to become twisted as shown in FIG. 10.

FIG. 11 depicts the tied item 298 in a bundle with movable wall 300 bearing against the item to be tied and the tie ribbon 22 therearound. Twist head 250 has end 22b in groove 288 and twisted portion 22c is depicted.

Attention is next directed to FIGS. 5, 6 and 9, and, in particular, to the rack and pinion construction, wherein plate 224 is moved by the article to be tied 298 in a direction of arrow H, and hoop 230 is rotated in the direction of arrow I as disclosed above. Furthermore, rack 241, having camming member 240 thereon, is moved to contact switch 310 of microswitch 312 and bear against same. Then, camming member 240 contacts switch 242 of microswitch 244 which causes the motor to be turned on and the twist and cut operations to be performed as described above.

When the tied bundle is removed and pressure is no longer exerted upon plate 224 in the direction of arrow H, spring 315 within spring casing 320 biases rack 231 in a direction opposite to arrow H. When camming member 240 contacts switch 310 of microswitch 312 on the return motion, microswitch 312 having been actuated by the prior actuations of microswitch 244, the ribbon displacement operation is performed. As discussed above, ribbon displacement is performed by the motor and gear train (not shown) which are coupled to a single rotation clutch which rotates the ribbon feed wheel 40' by one 360° rotation.

Accordingly, at that point, another predetermined length of ribbon 22 is provided in opening 115, such that it is ready to be twisted and cut in the manner described above.

Support member 220 includes a first bore therethrough for receiving post 322 and a second bore therethrough for receiving locking member 324. Post 322 is releasably secured by locking member 324, which lockingly engages post 322 in a direction substantially orthogonal to the direction of displacement of post 322. Post 322 is used to displace movable wall 300 which is used to position the object to be tied so that a tight twist tie may be produced. If movable wall 300 is not positioned to place the article to be tied, the proper distance from the end 234 of hoop 230, twist tie ribbon 22 will not form a tight wrap around the object to be tied 298, when the object to be tied 298 is inserted into the opening 115 and, therefore, when hoop 230 is brought around in the direction of arrow I, the tie made will not be tight. Accordingly, when a series of articles are to be tied, plate 300 is first positioned correctly by use of locking member 324.

Accordingly, it can be seen that the present invention provides a new manner of performing a twist tie operation to receive a tight twist around a bundle to be tied. This method includes first displacing a predetermined amount of twist tie material, then entering the object to be tied thereon and bending the twist tie material around using hoop 230 and then causing the

ends of the tie material to be inserted within a twist head 250 which rotates to close the twist tie. Since a predetermined amount of tie material 22 is dispensed, the twist tie ends can be evened after the twist is performed. This provides an aesthetically pleasing finished product.

The operation of the device can be controlled by a control 245 shown schematically in FIG. 5 and operatively coupled to the motor (not shown), microswitches 244 and 312 and the feed wheel single rotation clutch and the twist/cut single rotation clutch. The motor rotates continuously, once turned on. By inserting an object to be tied into opening 115 and displacing plate 224 in the direction of arrow H, hoop 230 is closed by a rack and pinion 231, 232 and microswitch 244 actuates the twist/cut single rotation clutch to effect twisting and cutting. When the object is removed, permitting plate 224 to return to its original position by the force of spring 315, microswitch 312 actuates the feed wheel single rotation clutch to feed the desired length of twist tie ribbon into the entrance of opening 115, so that the machine is ready for the next cycle.

Attention is next directed to FIGS. 12 and 13, wherein an alternative embodiment for the mechanical portion of the object insertion structure of the second embodiment is disclosed.

The third embodiment includes a small rack and pinion section, including rack 400 and pinion 402. Hoop 404 is connected to pinion 402 such that as plate 410 is moved in the direction of arrow H', and rack 400 therefor is moved, pinion 402 automatically causes hoop 404 to swing in a direction of arrow I'. Rack 400 and table 410 are integrally connected to slide 412, which includes camming member 414 thereon for contacting switch 420 of microswitch 422 and switch 424 of microswitch 426. Slide 412 is mounted in a female slide member 416 which includes a flat bottom portion 417 which is mounted upon housing 114 and substantially U-shaped ends 418 and 419. Ball bearings 415 are disposed within U-shaped members 418 and 419 to allow slide 412 to slide along female slide member 416. As slide 412 moves in the direction of arrow H, spring 315' compresses. Upon completion of the twisting process, when the object that is tied is removed from the opening 115, pressure is released from plate 410 and spring 315' exerts pressure in the opposite direction to arrow H' and slide 412 slides in the direction opposite to arrow H'. When cam 414 contacts switch 420 of microswitch 422, a next length of tie ribbon 22 is displaced into a position to be tied.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a 'matter of language, might be said to fall therebetween.

Claims

1. An apparatus for a selected one of a plurality of different predetermined lengths of ribbon, comprising:

   guide means for guiding said ribbon along a feed path;

   a pair of opposed first and second roller means for displacing said ribbon along said guide path, guide means and normally engaging said tie ribbon, each said roller means having a first circumferential portions aligned with each other, said first roller means having a second circumferential portion,

   a motor means operatively coupled to said second roller means for rotatably driving said second roller means;

   means for supporting said first roller means for displacement between a driving position where said first circumferentive portions of said first and second roller means are in operative engagement for displacing a roller therebetween, and disengaged position where said first circumferentive portions are out of operative engagement;

   means for biasing said first roller means in said operative position; and

   a plurality of biasing segment means slidably mounted on said second roller means, at least all except one of said biasing means being aligned with said second circumferential portion of said first roller means and slidable in an essentially circumferential direction, between a first position, wherein said biasing segment means do not contact the second circumferential portion of said first of said first roller means and a second position, wherein said biasing segment means contacts said second circumferential portion of said first roller means and displaces said first roller means to said disengaged position out of engagement with said ribbon during a portion of the rotation of the second roller means, so that said ribbon is not displaced.

2. The apparatus of claim 1, including cutting means for cutting said ribbon to said predetermined length.

3. The apparatus of claim 2, wherein said cutting means is operatively coupled to said second roller means for cutting said ribbon only when one of said biasing segment means is in said disengaged position, so that said cutting is completed when said ribbon is not being displaced.

4. The apparatus of claim 1, and including means for releasably holding at least all except one of said biasing segment means in each of said engaged and disengaged positions.

5. The apparatus of claim 13, wherein the number of lengths of ribbon are determined by the number of slidable biasing segment means.

6. A twist tying machine for tying a plurality of different sized objects using a predetermined length of twist tie ribbon, comprising:

a housing having a tying position;

displacement means disposed on said housing for displacing a predetermined length of twist tie ribbon to said tying position;

slide means mounted on said housing at said tying position and displaceable by an object to be tied together with the length of twist tie ribbon in said tying position;

hoop means adjacent said tying position and mechanically coupled to said slide means for pivoting thereby, said hoop means being adapted to displace the free end of said twist tie ribbon around the object to be tied to a position adjacent another portion of said twist tie ribbon;

twist and cutting means for severing the length of twist tie ribbon in the region of said portion thereof and twisting the free end and cut end of said length of twist tie ribbon to tighten same around the object; and

actuation means operatively coupled to said slide means and said twist and cut means for actuating said twist and cut means in response to said slide means reaching a cut position.

7. The twist tying machine of claim 20, and including adjustment means disposed on said displacement means for adjusting between said plurality of predetermined lengths of said twist tie ribbon.

8. The twist tying machine of claim 21, and including

guide means for guiding said ribbon along a feed path;

a pair of opposed first and second roller means for displacing said ribbon along said guide path and normally engaging said ribbon, each said roller means having a first circumferential portions aligned with each other, said first roller means having a second circumferential portion,

a motor means operatively coupled to said second roller means for rotatably driving said second roller means;

means for supporting said first roller means for displacement between a driving position where said first circumferentive portions of said first and second roller means are in operative engagement for displacing a ribbon therebetween, and a disengaged position where said first circumferentive portions are out of operative engagement;

means for biasing said first roller means in said operative position;

a plurality of biasing segment means mounted on said second roller means, said biasing means being aligned with said second circumferential portion of said first roller means and slidable in an essentially circumferential direction, between a first position, wherein said biasing segment means do not contact the second circumferential portion of said first of said roller means and a second position, wherein said biasing segment means contacts said second circumferential portion of said first roller means and displaces said first roller means to said disengaged position out of engagement with said ribbon during a portion of the rotation of the second roller means, so that said ribbon is not displaced.

9. A twist head comprising:

a retainer having at least one inner wall and at least a first and a second outer wall, said at least one inner wall and said first outer wall defining a first groove; said at least one inner wall and said second outer wall defining a second groove; said first groove essentially facing opposite said second groove;

a first finger coupled to said first outer wall and;

a second finger coupled to said second outer wall, said first finger extending beyond said second wall and said second finger extending beyond said first wall.

10. Method of tying a bundle of a material to be tied with tie material using a twist head, comprising the steps of:

setting the predetermined length of the material;

feeding a predetermined length of tie material to a first position;

tightly packing said material to be tied against said predetermined length of tie material;

beginning to twist said twist head;

cutting said predetermined length of twist tie material; and

finishing the twisting process.

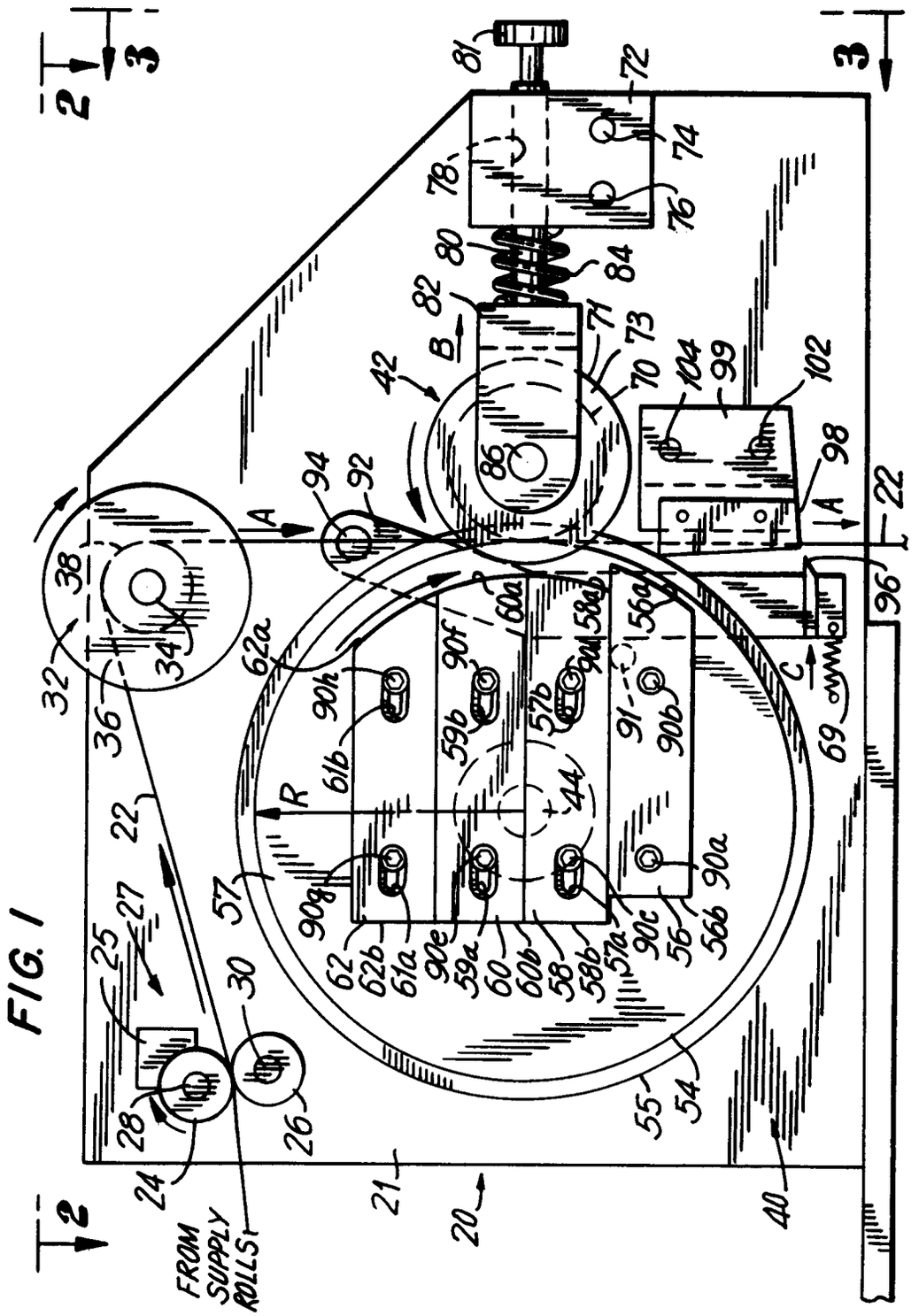
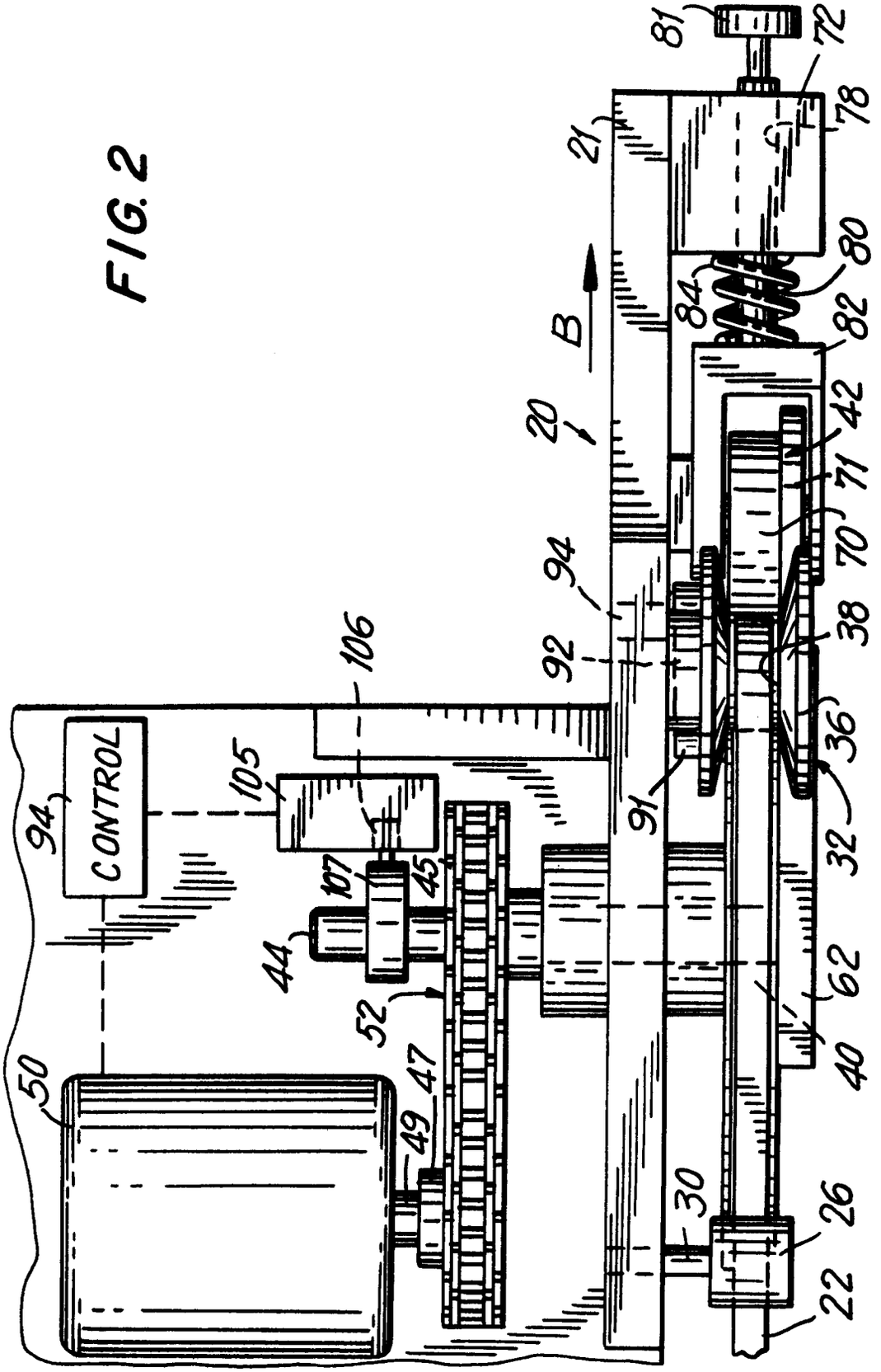


FIG. 1

FIG. 2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72
78
21
80
84
82
B
20
42
71
70
94
38
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52
40
50
47
49
30
26
22

FIG. 3

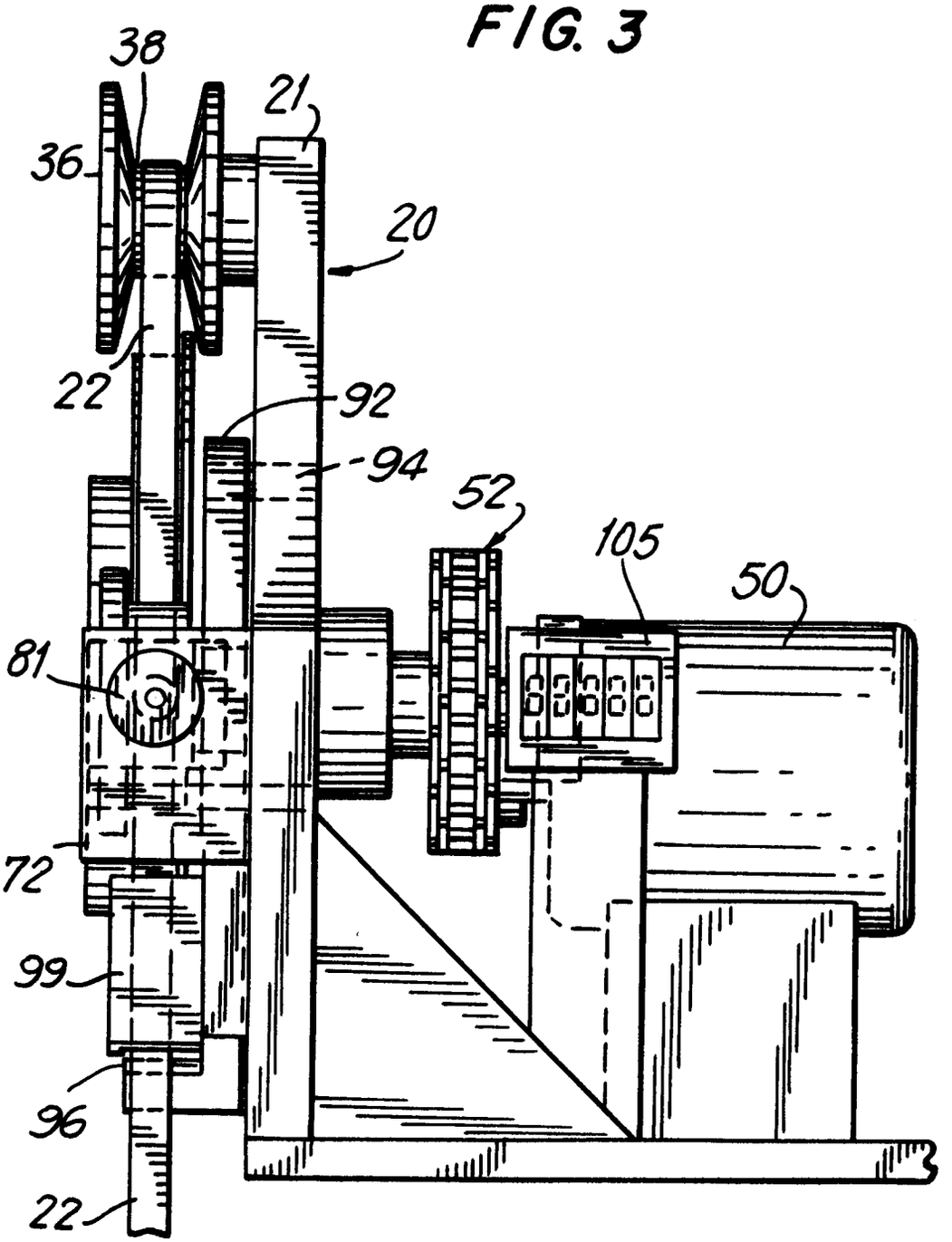


FIG. 4

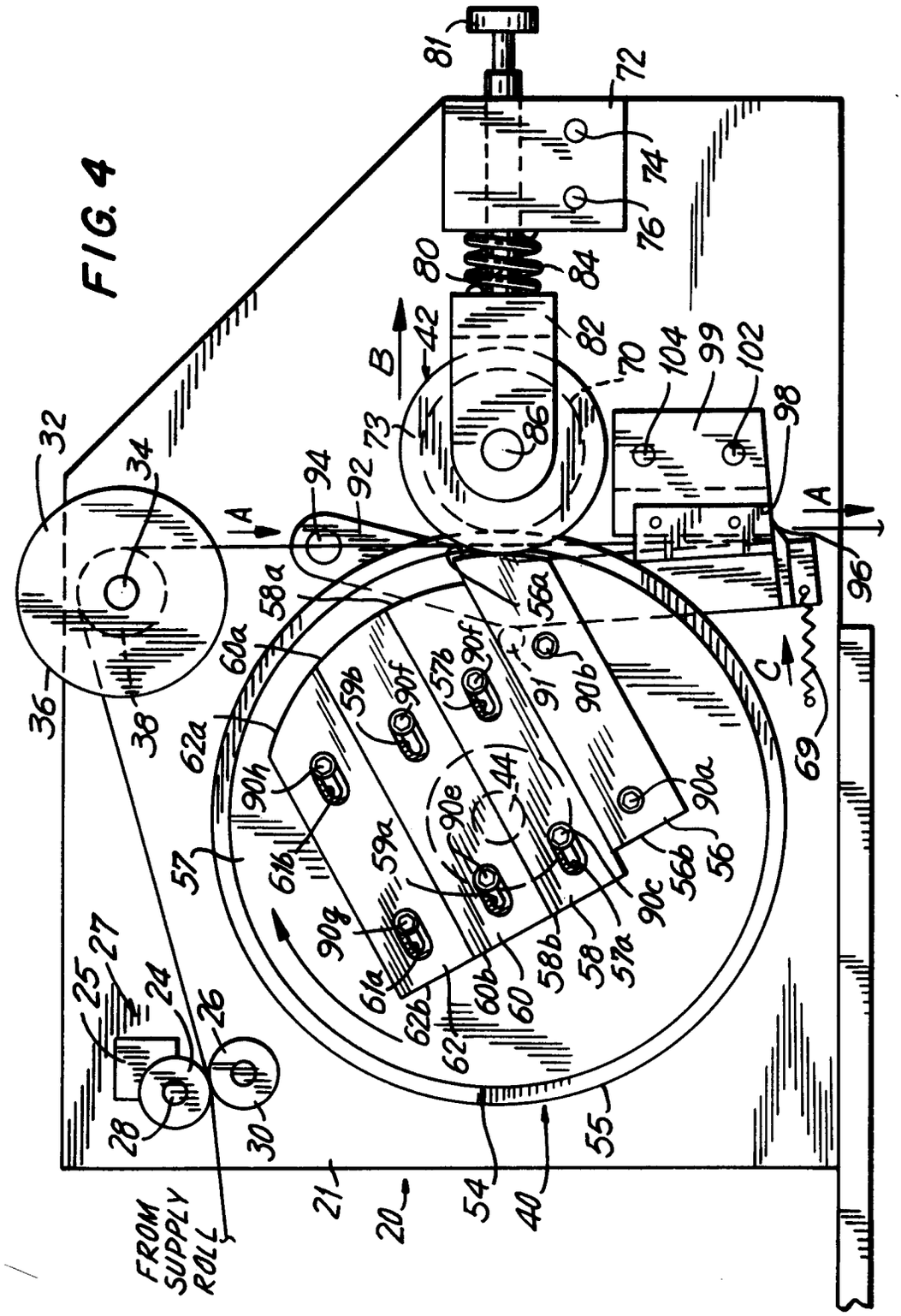
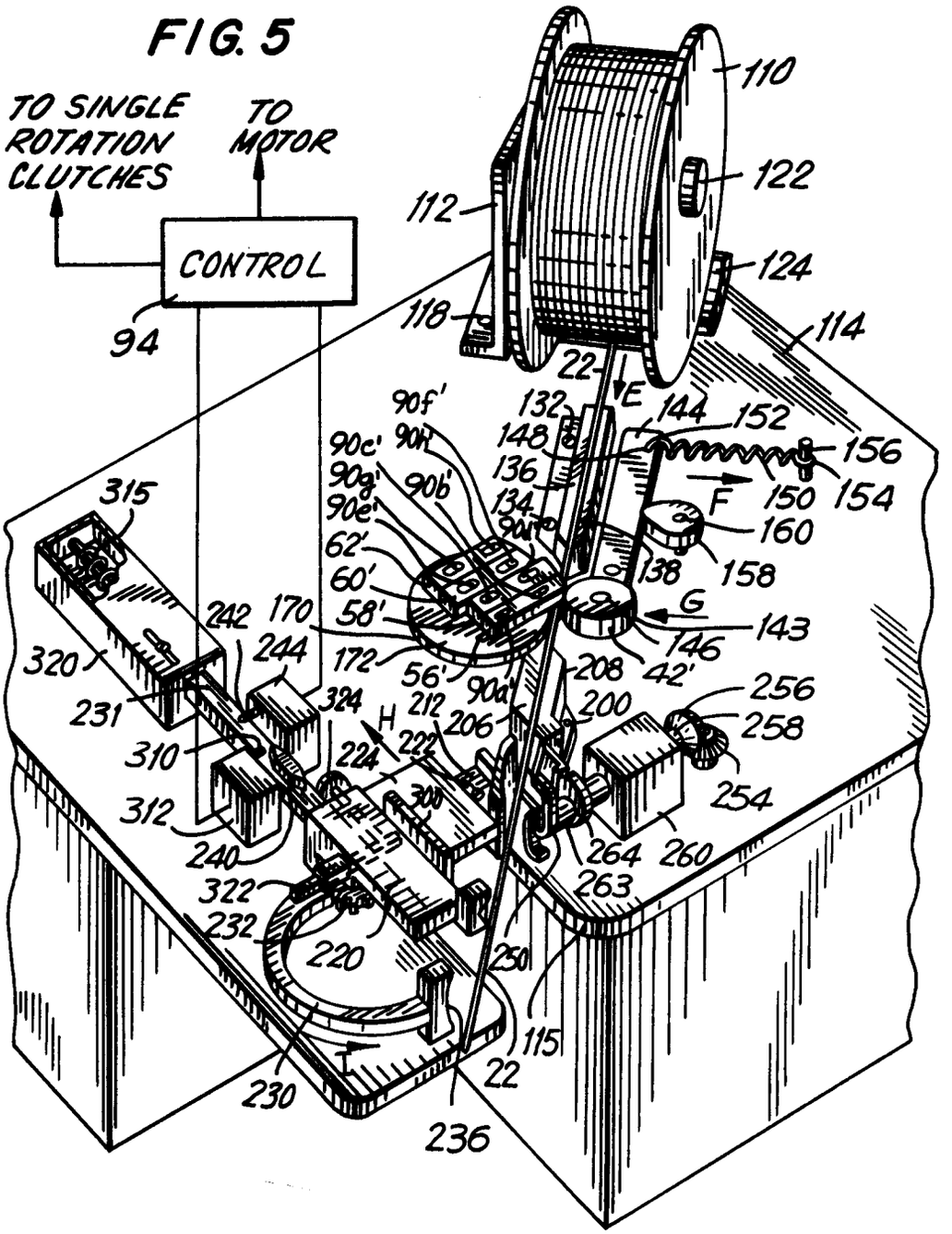


FIG. 5


TO SINGLE ROTATION CLUTCHES
TO MOTOR
CONTROL
94
110
112
122
124
114
118
22
E
90f'
90h'
90c'
90g'
90b'
90e'
62'
60'
58'
56'
90a'
132
148
136
134
144
152
156
154
150
F
160
158
138
G
143
146
42'
208
200
256
258
254
264
260
263
250
115
22
236
230
220
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H
212
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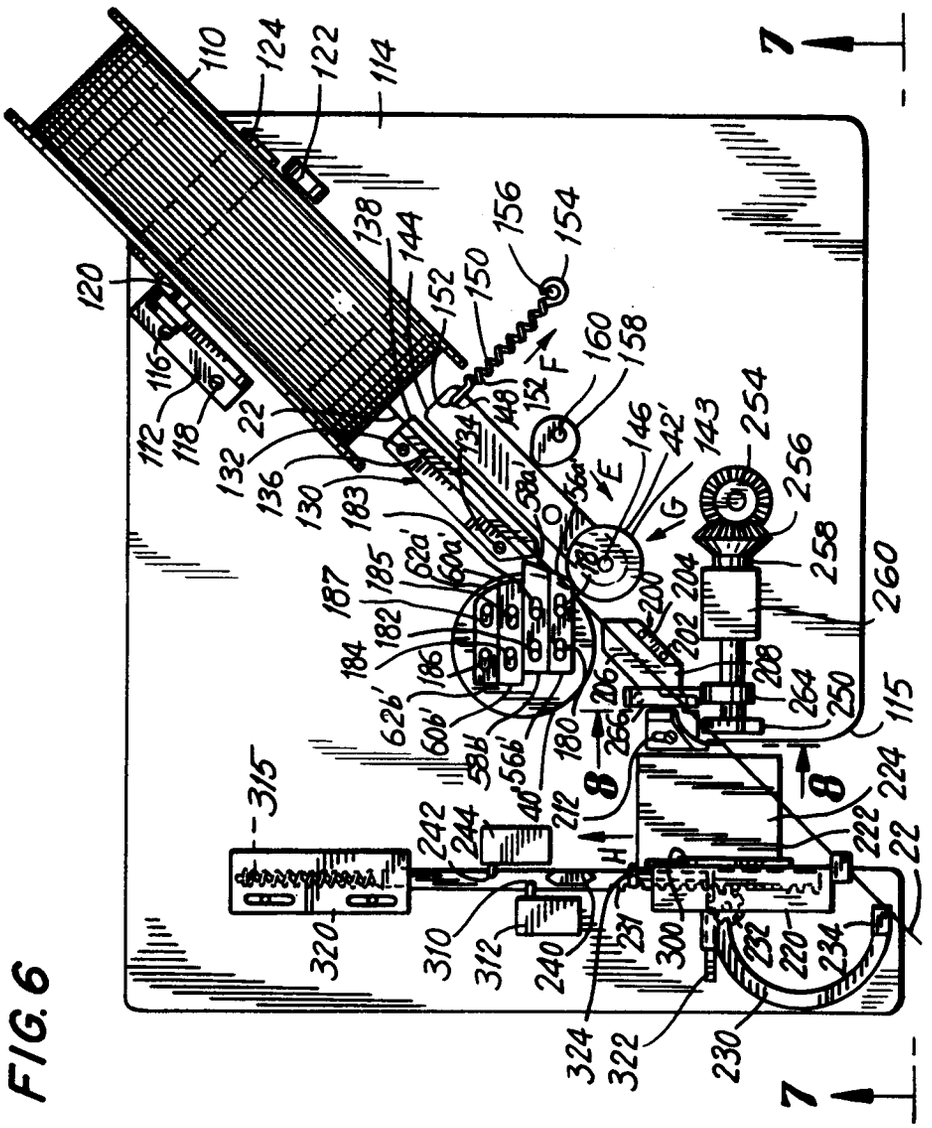
222
224
300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114
7
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152
150
156
154
116
112
118
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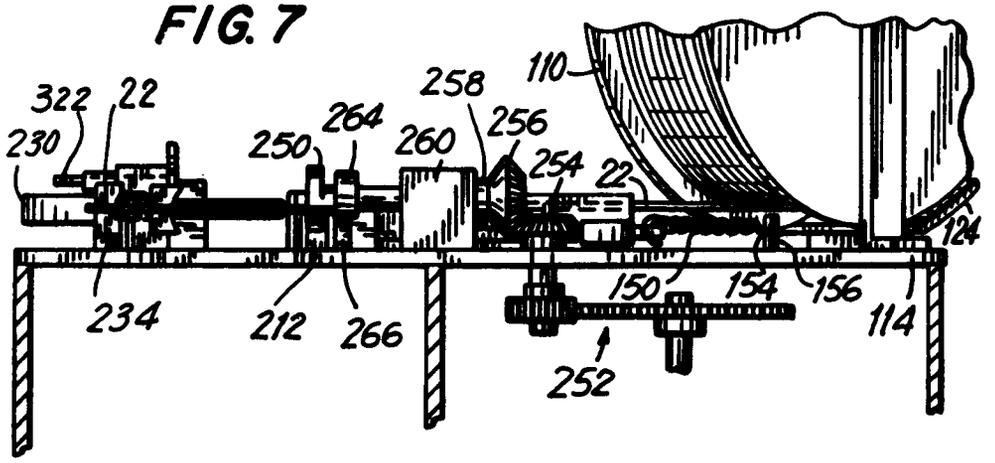
136
130
183
148
152
F
160
158
134
146
42'
143
254
256
258
260
204
200
202
208
264
250
115
224
222
22
220
234
232
231
300
310
312
240
242
244
315
320
324
322
230
212
H
8
266
180
40'
566'
58b'
626'
606'
186
184
182
187
185
62a'
60a'
58a'
183
E
G

FIG. 6

FIG. 7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110
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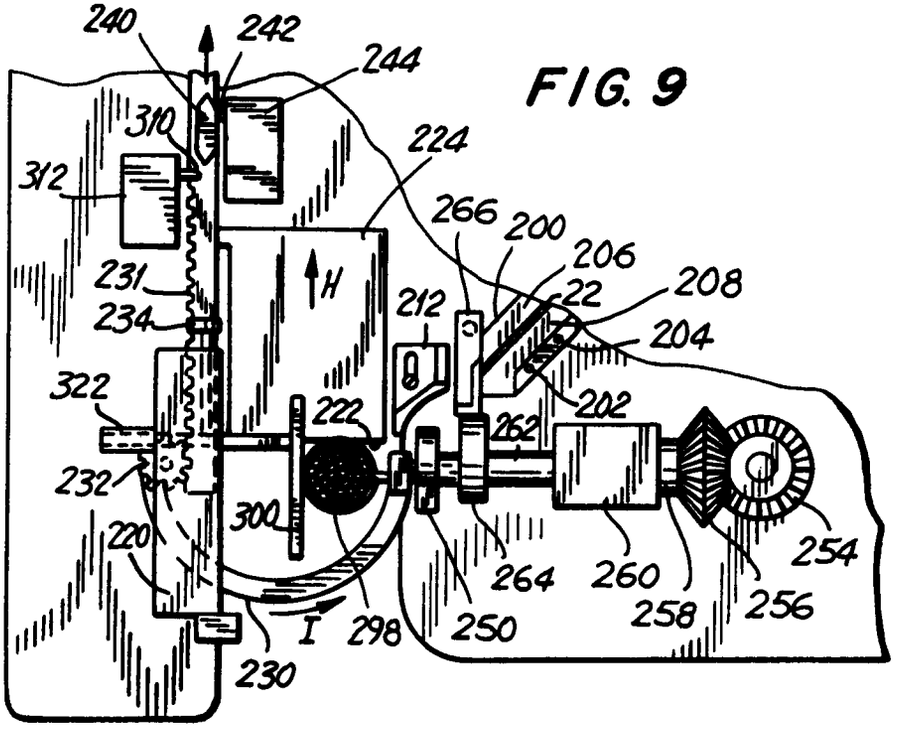
156
114
252

FIG. 9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234
H
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300
220
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260
254
I
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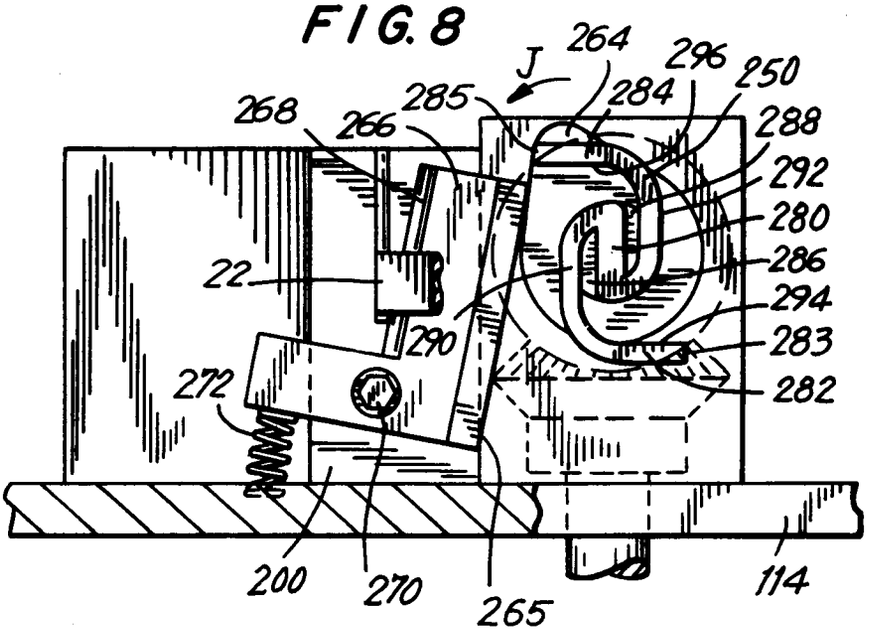
250
258
256
230

FIG. 8


264
J
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200
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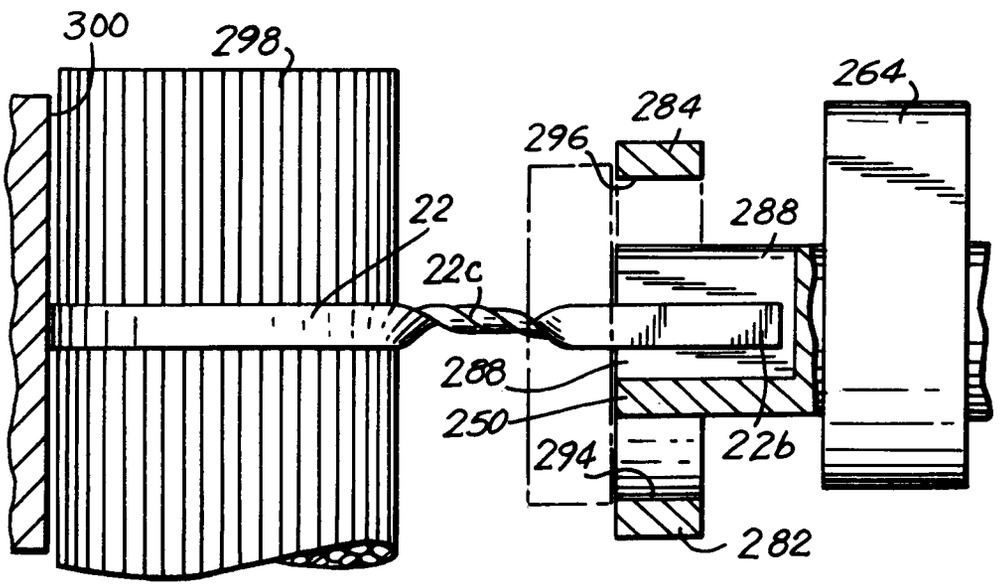
265
114

FIG. 11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284
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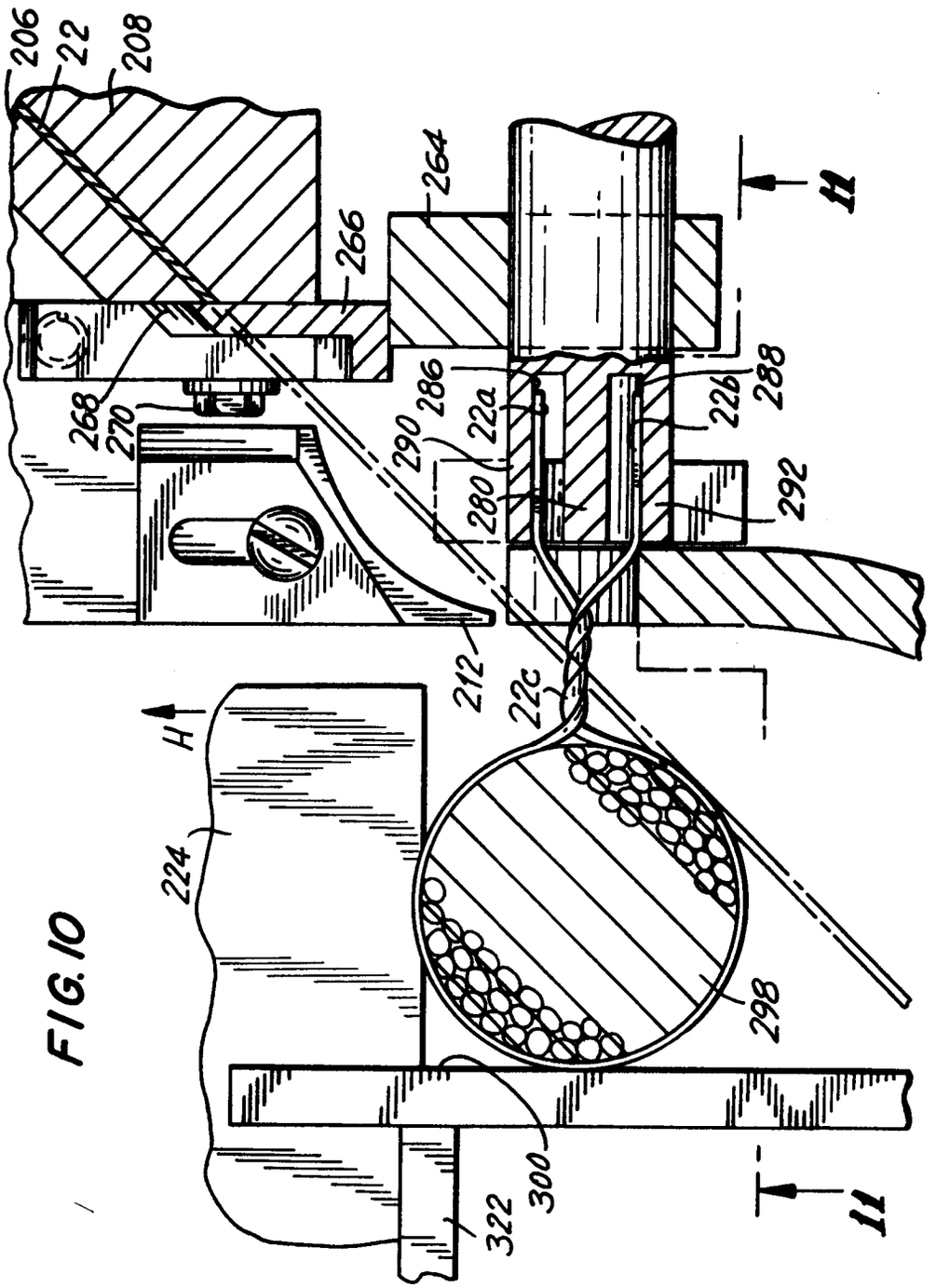
22
288
22c
288
250
294
22b
282


206
22
208
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266
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270
286
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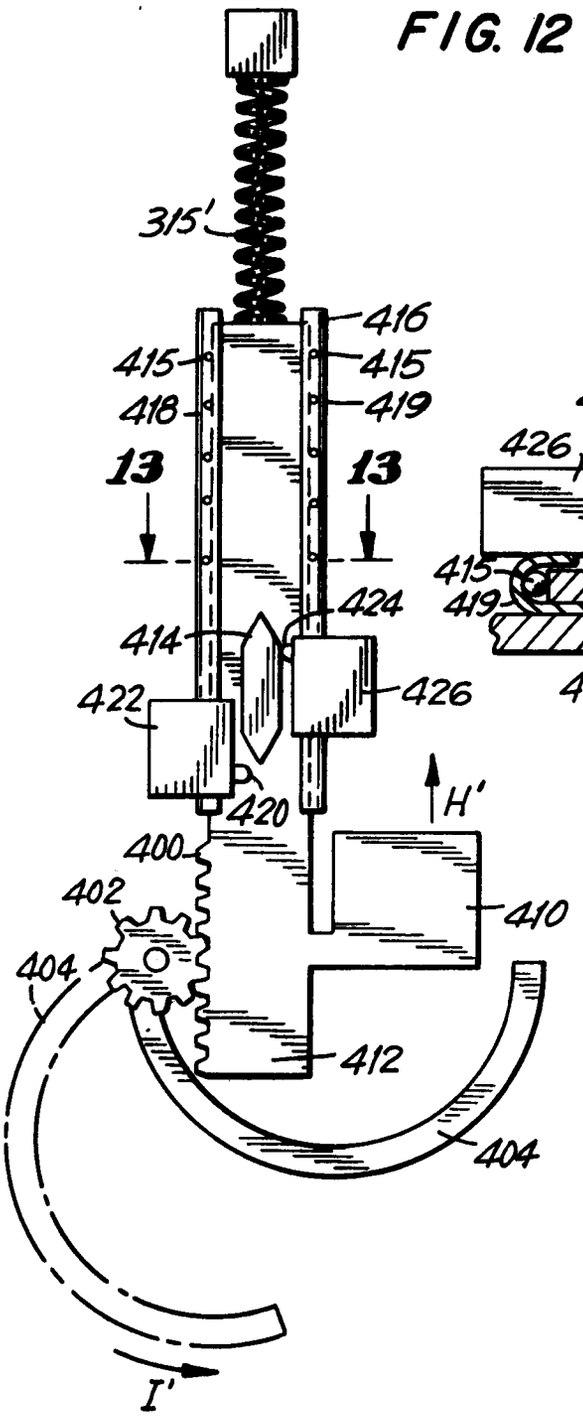
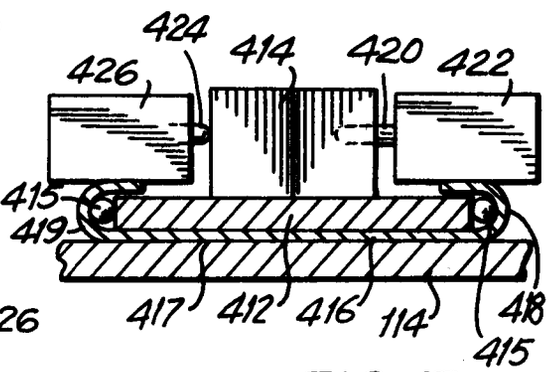
280
226
288
292
212
22c
H
224
298
300
322
11

FIG. 10

FIG. 12


315'
416
415
415
418
419
13
13
424
414
426
422
420
H'
400
402
410
404
412
404
I'


424
414
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422
426
415
419
417
412
416
114
418
415

FIG. 13