April 11, 1967 J. E. KERRIGAN 3,313,090

MACHINE FOR FORMING AND APPLYING BANDS

Filed Aug. 9, 1963 5 Sheets-Sheet 1

Fig. 1.

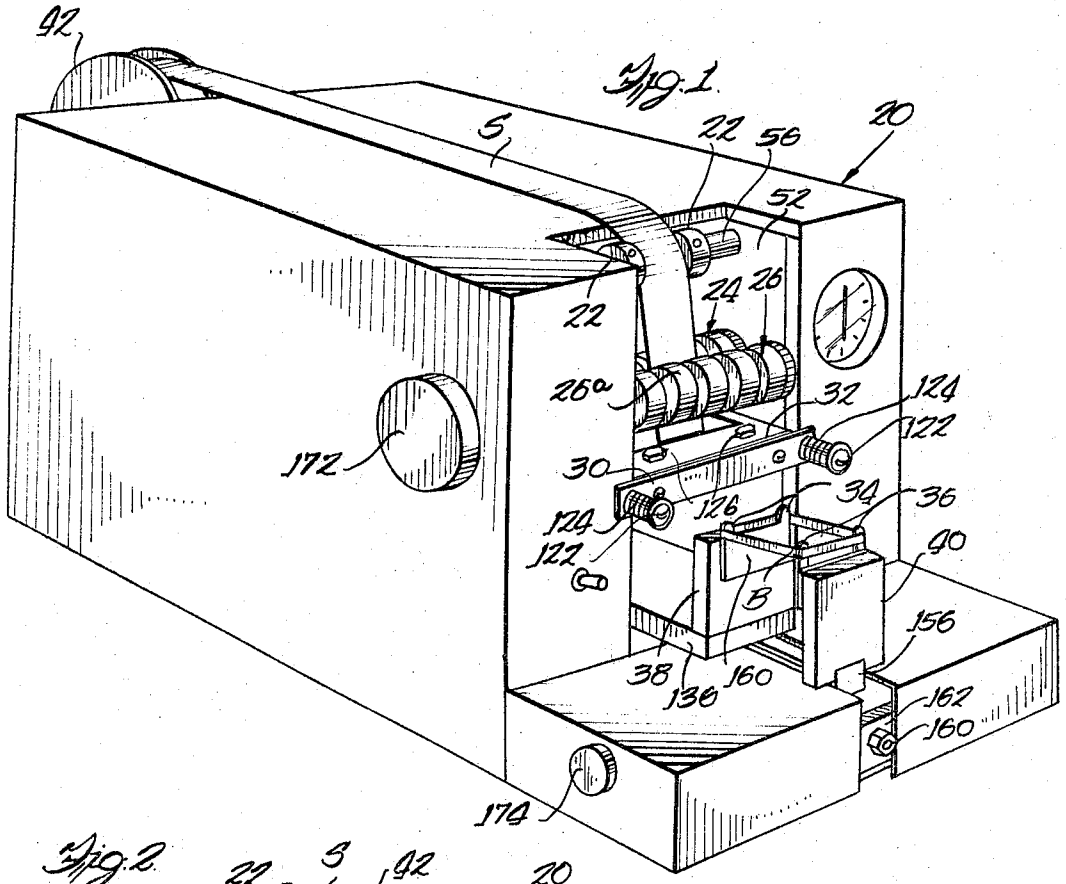


Fig. 2.

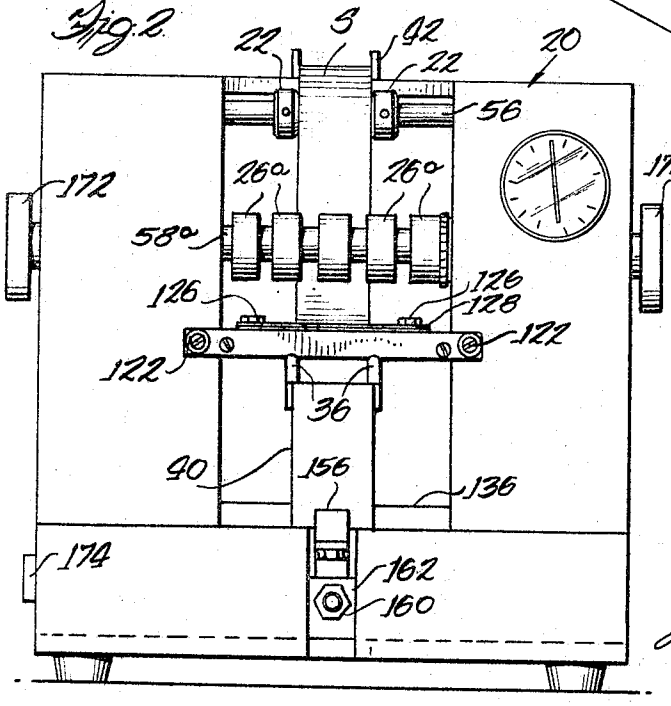
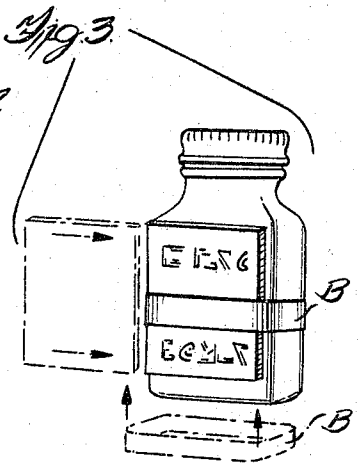


Fig. 3.



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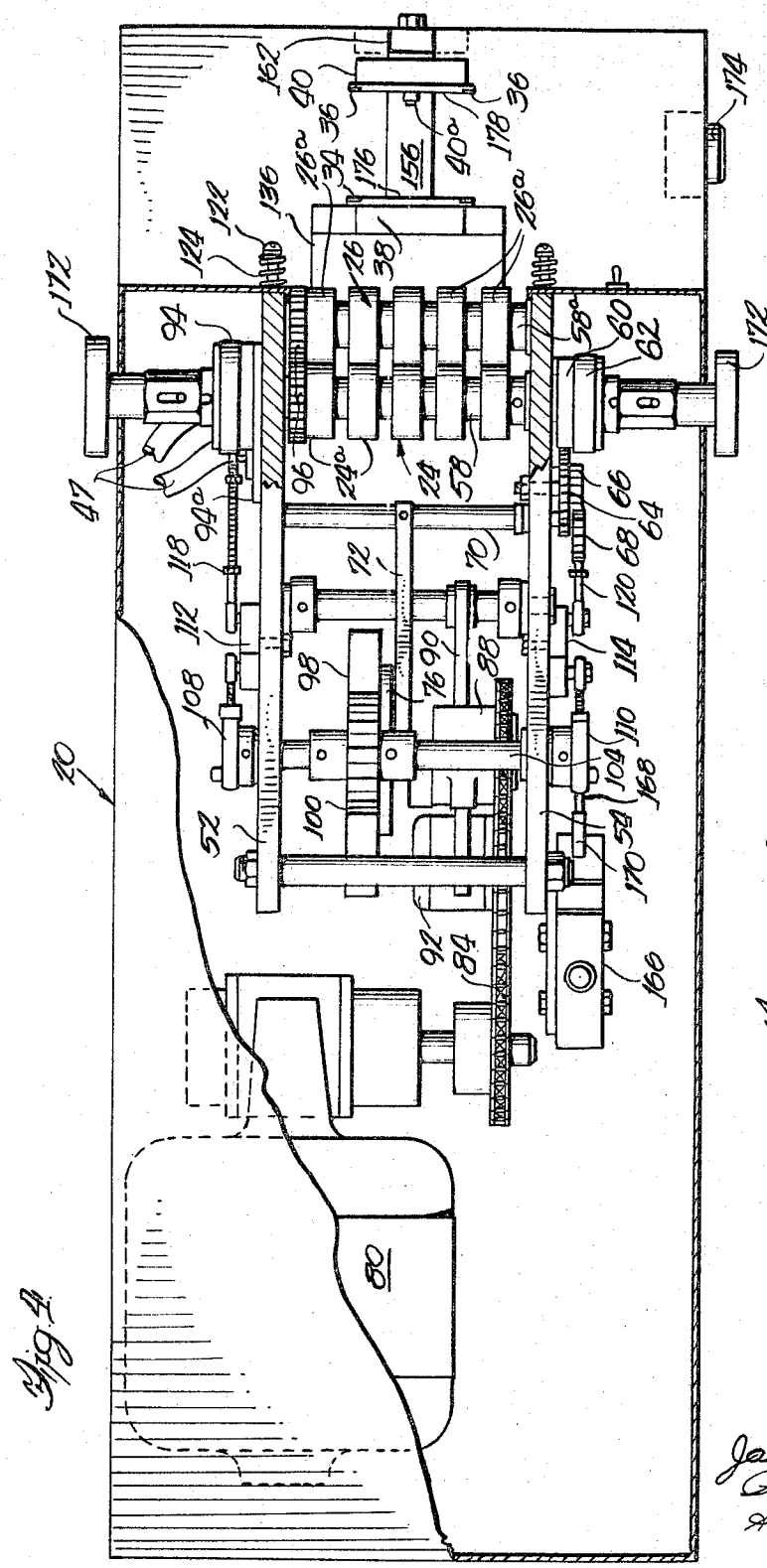


Fig. 4

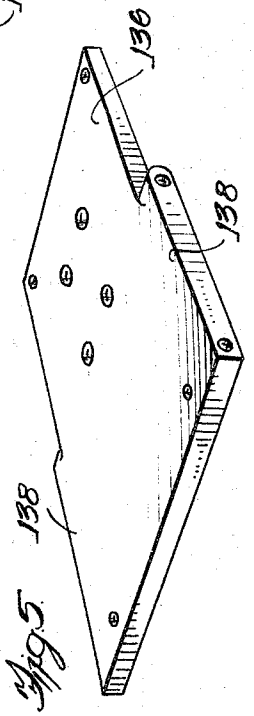


Fig. 5

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MACHINE FOR FORMING AND APPLYING BANDS

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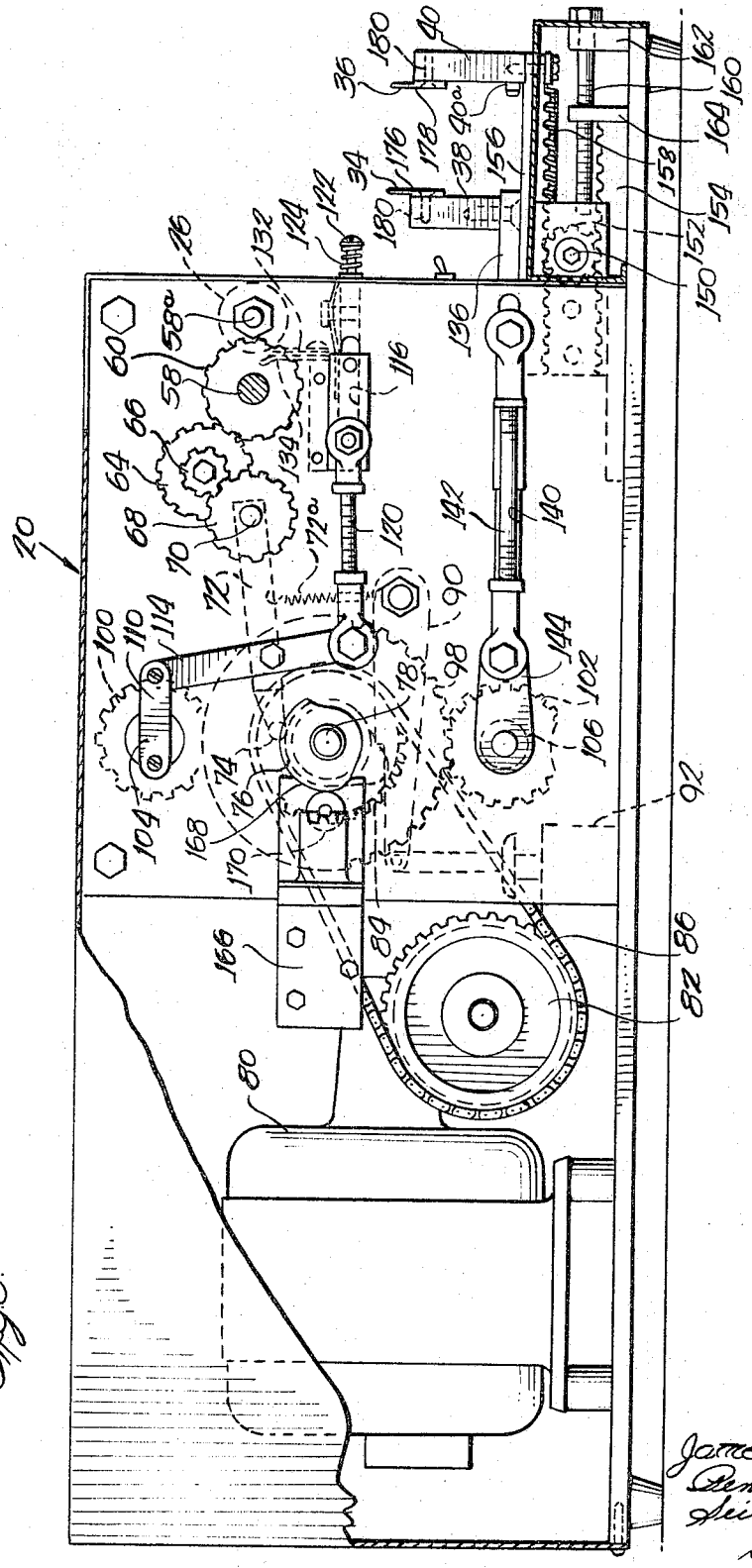


Fig. 6.

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Fig. 7

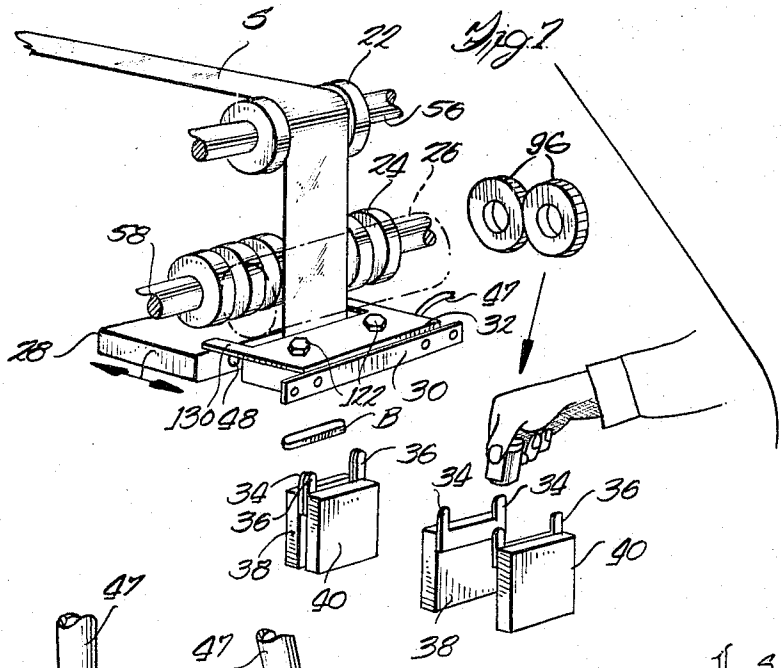


Fig. 8.

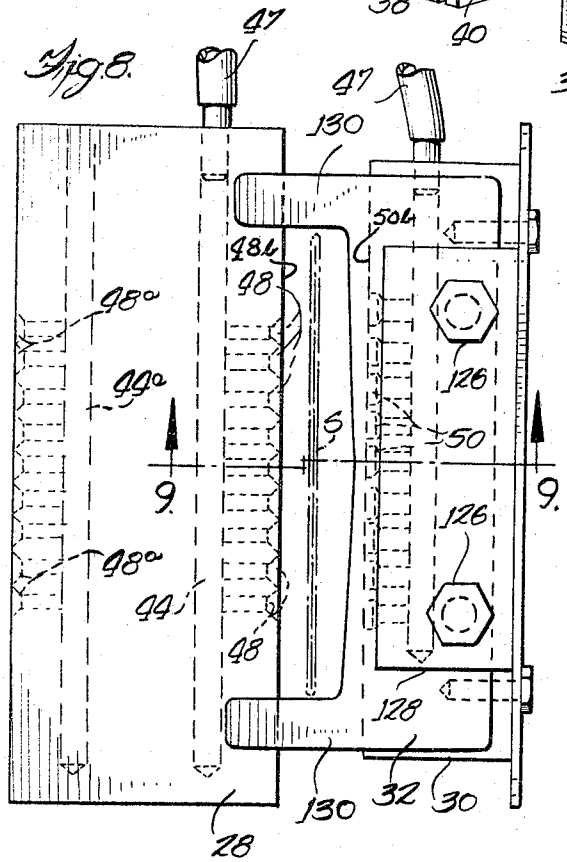


Fig. 9

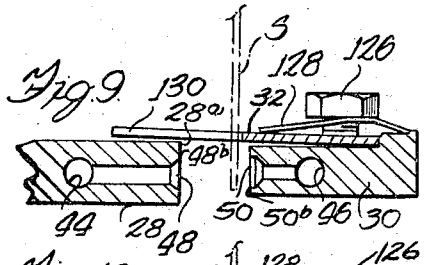


Fig. 10.

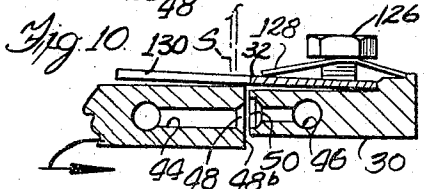
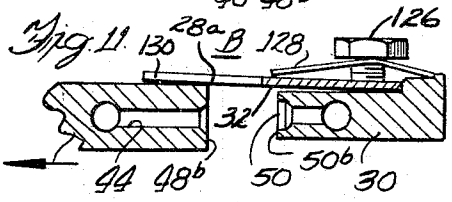


Fig. 11.

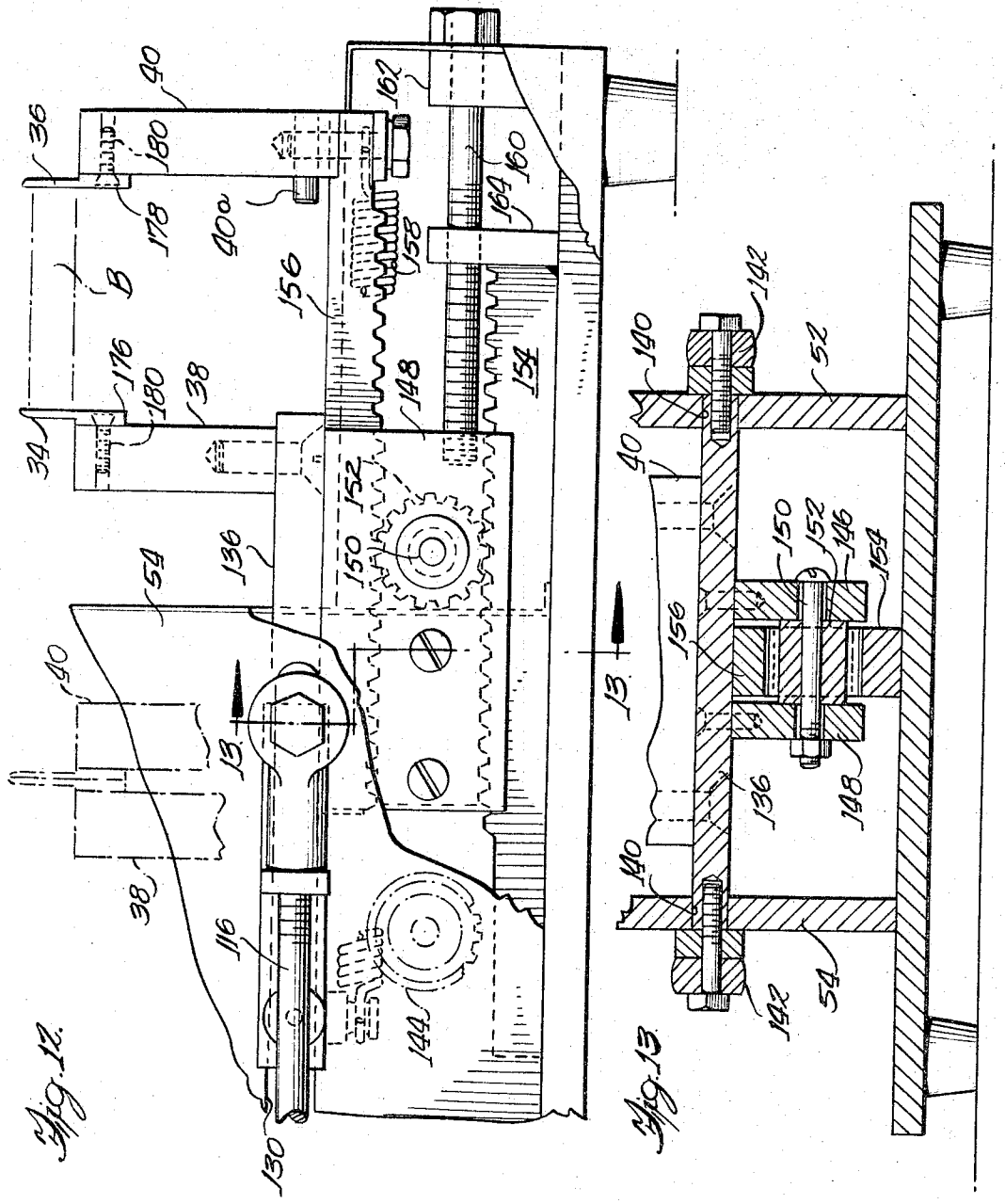


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MACHINE FOR FORMING AND APPLYING BANDS

Filed Aug. 9, 1963 5 Sheets-Sheet 5



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3,313,090
MACHINE FOR FORMING AND APPLYING BANDS

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Filed Aug. 9, 1963, Ser. No. 301,088
2 Claims. (Cl. 53—390)

This invention relates to the formation of elastic bands and the applications of such bands to various articles, and more particularly to machines for use in forming elastic bands from lengths of suitable tubular stock material and applying such bands to articles.

Elastic bands have wide utility in securing various types and/or sizes of articles together, particularly in instances where only temporary securement is required. However, several problems arise in the application of the elastic bands in mass quantities or on a production line basis. If the bands are preformed, application requires that the individual bands be sorted from a supply, oriented with respect to the work, stretched and applied.

One desirable step towards facilitating the application of elastic bands appears to reside in supplying the stock material in elongated tubular form, and cutting bands from an end of the stock as the bands are to be used. This presents each band in a predetermined position and orientation. A satisfactory system for forming and applying elastic bands thus should be capable of cutting or forming bands from such stock material, and should provide for forming the bands of controlled predetermined widths. In addition the system should provide for control of the positioning of the bands and for automatic opening and stretching the bands for application to appropriate articles. These functions should be carried out rapidly and with a high degree of reliability to result in an economical operation competitive with other forms of banding or securing of articles.

Accordingly, it is an object of this invention to provide an improved band forming and applying system which meets the above stated requirements.

It is a further object of this invention to provide a new and improved machine for use in applying elastic bands to various articles.

It is a further object of this invention to provide a new and improved machine capable of automatically performing the functions of cutting, opening and stretching of elastic bands.

It is a further object of this invention to provide an improved machine meeting the aforementioned objects and which is capable of rapid and reliable operation for economical banding of articles with elastic bands.

Further and additional objects will become apparent from the following description and claims, and the accompanying drawings.

In carrying out this invention in one illustrative form a banding machine is provided which includes a pair of opposed members relatively reciprocable toward and away from one another and provided with vacuum ports in their opposed surfaces. Feed means are provided for feeding successive lengths of flexible elongated tubular stock between said members, and cutter means are provided for severing such successive bands from the stock. An appropriate vacuum source is connected to said members and operated to retain opposite side portions of each band against the opposed surfaces of said members as the members are reciprocated to open the band. Two sets of band receiving fingers are positioned together beneath said members to receive therearound a band which is dropped from the separated members upon release of the vacuum. One set of the band receiving fingers is movable relative to the other set for further spreading opposite sides of said band from one another.

For a more complete understanding of this invention, reference should now be had to the example illustrated in the drawings, wherein:

FIG. 1 is a perspective view of a machine employing the teachings of this invention;

FIG. 2 is a front elevation view of the machine in FIG. 1;

FIG. 3 illustrates the assembly and banding of a bottle and article, which may be a piece of literature;

FIG. 4 is a plan view, partially in section, of the machine of FIG. 1;

FIG. 5 is a perspective view of a slide plate of the machine of FIG. 1;

FIG. 6 is a side elevation view of the machine in FIG. 1 with part of the cover removed;

FIG. 7 is a schematic illustration of the operations performed with the machine of FIG. 1;

FIG. 8 is an enlarged top plan view of the cutter mechanism and vacuum heads of the machine of FIG. 1;

FIG. 9 is a partial cross section view taken generally along line 9—9 of FIG. 8 and looking in the direction of the arrows;

FIGS. 10 and 11 are similar to FIG. 9 and, together with FIG. 9, illustrate the steps of operation of the cutter mechanism and vacuum heads;

FIG. 12 is an enlarged partial side elevation view of the spreader mechanism and related drive apparatus of the machine in FIG. 1, and

FIG. 13 is a cross-sectional view on line 13—13 of FIG. 12 and looking in the direction of the arrows.

Referring now to the drawings and particularly to FIG. 1, the machine 20 is designed to form bands B from an elongated or endless supply of flexible, elongated tubular stock S of any suitable material. One example of such stock material which has been utilized successfully in the illustrated machine is a plasticized thermoplastic synthetic polymer product (vinyl acetate-chloride copolymer) formed into tubular form by fusing opposite edges of an elongated sheet of the noted plastic and sold under the trademark "Rapid Ribbon" by Chicago Printed String Co., Chicago, Illinois.

Machine 20 includes guides 22, opposed feed rollers 24 and 26, opposed vacuum heads 28 and 30 (FIG. 8), a cutter blade 32, and spreader fingers 34 and 36 supported on blocks 38 and 40. The rollers 24 and 26 are in pressure contact with one another and one roller is intermittently driven to draw the stock material S from a supply such as a spool 42 supported on the back of the machine, and to project successive lengths of the stock material between heads 28 and 30, note FIG. 7. Head 30 carries the cutter blade 32. The head 28 is reciprocable toward and away from head 30 as indicated in FIGS. 9–11, and includes a sharp corner 28*a* which cooperates with the blade 32 to cut off the extended end of the stock material to form a band B upon each forward movement of head 28. Each head is formed with suitable manifold passages 44 and 46 terminating in openings 48 and 50 in the opposed faces 28*b* and 30*b* of the respective blocks. Passages 44 and 46 are placed in communication with a suitable vacuum pump or the like for creating reduced pressure (less than atmospheric) in the passages 44 and 46, as by flexible conduits 47, whereby the respective sides of a band between the heads are held against the respective opposed faces 28*b* and 30*b* as head 28 is retracted.

Blocks 38 and 40 are mounted for translational and relative reciprocating movement between the positions illustrated in FIG. 7, namely, the closed or aligned positioned beneath the space between heads 28 and 30 and the spread, extended position shown at the right in FIG. 7 and in FIGS. 1 and 6.

In the overall operation of machine 20 the feed rollers 24 and 26 are intermittently operated to feed successive lengths of the stock material between the opposed vacuum heads 28 and 30; see FIGS. 7 and 9. Head 28 is reciprocated toward head 30 as in FIG. 8 to cut off the end portion of the stock and thereby to form a band B of a width corresponding to the length of extension of the stock material between the heads. A vacuum is then drawn in the passages 44 and 46 to engage the respective sides of the band between the heads whereupon the heads move apart to the position of FIG. 11 to open or spread the sides of the band. Meanwhile the blocks 38 and 40 carrying fingers 34 and 36 are positioned beneath the open band as seen in the lower center portion of FIG. 7. The vacuum source is then shut off or disconnected from passages 44 and 46 and air is admitted to these passages whereby the open band is dropped around the fingers 34 and 36. The blocks 38 and 40 are then extended and separated to further spread and/or stretch the band whereupon the articles to be banded are inserted within the band and the band is drawn upward off the fingers 34 and 36 as the articles are removed, thereby permitting the band to contract around the articles.

Turning to further details of the illustrated operative embodiment and particularly to FIGS. 1, 4 and 6, most of the drive mechanism and certain of the operative parts are supported on two vertical support plates 52 and 54. The guides 22 are adjustably secured on a shaft 56 whereby the guides may be laterally adjusted to accommodate and guide stock of various widths. Shaft 56 is mounted on the plates 52 and 54.

Each roller 24 and 26 comprises a plurality of spaced narrow resilient rollers 24*a* and 26*a*, respectively, mounted on a shaft journaled in plates 52 and 54. The rollers 24*a* are mounted on shaft 58 which is driven for intermittent rotary motion by a pinion 60 drive connected to the shaft 58 through a one-way clutch 62.

Pinion 60 is intermittently driven by a train of gears 64, 66 and 68, gear 68 being secured on a shaft 70 which is journaled in plates 52 and 54. An arm 72 is also secured on shaft 70 and carries a follower roller 74 which engages an edge cam 76 mounted on a main drive shaft 78 to oscillate arm 72 in cooperation with a suitable return spring 72*a* Shaft 78 is driven by a motor 80 through a suitable drive train, such as sprockets 82 and 84 and roller chain 86. Sprocket 84 is constantly driven by the motor and is connected to the shaft 78 through a clutch 88 controlled by a stop or trip lever 90 actuated by a solenoid 92.

A second one-way clutch 94 may be connected to the shaft 58 and to a bar 94*a* affixed to the plate 52 to prevent backup of shaft 58 as the pinion 60 is driven. Rollers 26*a* are mounted on shaft 58*a* which is driven from shaft 58 by a pair of spur gears 96.

Also mounted on the main drive shaft 78 is an intermittent drive gear 98 which engages intermittent driven gears 100 and 102 on shafts 104 and 106 respectively. Gear 98 is provided with appropriate teeth over slightly less than one-half its circumference, and the gears 100 and 102 are each provided with the same number of teeth as gear 98. Gear 98 and gears 100 and 102 include cooperative dwell portions as illustrated. Gear 100 drives shaft 104 which in turn drives links 108 and 110 eccentrically connected to opposite ends of shaft 104 and thereby drives rocker bars 112 and 114, pivotally mounted on plates 52 and 54 respectively, to drive the vacuum head 28. The vacuum head 28 is slidably engaged in aligned slots 116 formed in plates 52 and 54 extending longitudinally of the machine 20. Head 28 is reciprocated along these slots, longitudinally of the machine, by connecting rods 118 and 120 which are joined to the lower ends of rocker bars 112 and 114 and secured to the respective ends of the head 28.

Vacuum head 30 is mounted on support plates 52 and 54 by a pair of stud bolts 122 and compression springs 124. The springs permit limited resilent reciprocating movement of the head. Referring to FIGS. 8–11, the cutter plate 32 rests in a recess on head 30, beneath the plane of the upper surface of head 28 and on the adjacent corner 28*a* of head 28, and thereby is slightly canted with respect to the upper surface of head 28. The plate 32 is secured to the top of head 30 as by bolts 126 and a spring plate 128 which biases the cutter plate against the corner 28*a*. Cutter plate 32 includes a pair of side arms 130 which, together with stationary guides 132 and 134 (FIG. 6), serve to guide the stock material being fed from the rollers 24 and 26 between the vacuum heads. The forward edge of plate 32 is tapered with respect to the cooperating edge 28*a*, as by being formed in a wide shallow V as illustrated, to facilitate shearing of the stock material.

Head 28 may be provided with two sets of manifold passages 44 and 44*a*, corresponding ports 48 and 48*a* in opposite side edges, and four sharp corners similar to corner 28*a*, whereby it may be turned over and reversed to present successive sharp cutting corners as the various corners become dull through use.

The support and drive mechanism for blocks 38 and 40 is perhaps best illustrated in FIGS. 12 and 13 as well as in FIGS. 4–6. Block 38 is mounted on the outer end of a slide plate 136 (FIG. 5) which is supported by a pair of shoulders 138 slidably engaged in aligned slots 140 formed in plates 52 and 54 and extending longitudinally of the machine 20. A connecting rod 142 is pivotally joined to each edge of plate 136 and to a link 144 eccentrically connected to the respective end of shaft 106. Shaft 106 is driven by gear 102 to reciprocate slide plate 136 and thereby to carry block 38 and fingers 34 between the two positions illustrated in FIGS. 7 and 12.

A pair of brackets 146 and 148 are secured to the underside of plate 136 and serve as bearing blocks for a shaft 150 carrying a pinion 152. A rack 154 is adjustably fixed to the frame of machine 20 in the path of movement of pinion 152 to be engaged by the pinion as plate 136 is reciprocated. Another rack 156 engages pinion 152 and is relatively slidable longitudinally of the machine, being supported during its reciprocating movement on pinion 152 and in suitable guides (not shown) secured to brackets 146 and 148, and/or plate 136. A tension spring 158 is placed at each side of the rack or slide 156 and connected between block 40 and a fixed portion of the machine frame, see FIG. 12, to urge block 40 and slide 156 to the retracted position wherein a stop 40*a* contacts the end of plate 136 and fingers 34 and 36 are together as in the lower center portion of FIG. 7 and as shown in dot-dash lines in FIG. 12. The toothed portion of rack 154 terminates short of the position assumed by pinion 152 when plate 136 is retracted; see the changed position indicated in dot-dash lines in FIG. 12. As plate 136 is extended from its retracted position, blocks 38 and 40 move outward together until pinion 152 engages rack 154; thereafter, due to the engagement of pinion with racks 154 and 156, further extension of plate 136 moves rack 156 and block 40 outward at a 2:1 ratio to move finger 36 outward relative to finger 34 and therefore to spread and/or stretch a band B which is around the fingers.

Rack 154 is positioned longitudinally of machine 20 by an adjustment screw 160 journaled in a fixed block 162 and threadably engaged in an end block 164 on rack 154. This permits adjustment of the point of engagement of pinion 152 with rack 154 and, thus, variance of the stroke of block 40 relative to block 38 to control the amount by which an engaged band is stretched.

The flexible air lines 47 communicate with suitable conduit (not shown) connected to the outlet side of a control valve 166. The inlet side of valve 166 is connected to a suitable source of reduced pressure such as an external pump. Alternatively a vacuum pump may be provided with the machine and be driven by motor 80. A cam 168 on the main drive shaft 76 engages a follower

170 on the valve 166 and operates the valve in timed relation with the operation of the machine to provide reduced pressures in the manifold passages at the appropriate times.

A pair of knob members 172 are provided on shaft 58 for rotation of feed rollers 24 by the machine operator during threading of the stock material into the machine, or at other times that manual operation may be deemed desirable.

The solenoid 92 is controllled by a suitable, conveniently located switch as at 174 (FIG. 1), or may be connected with two spaced switches in series, thereby providing a safety feature by requiring the operator to make use of both hands to operate the switches when initiating each cycle of operation of the machine.

In operation, beginning from the position illustrated in FIG. 1, but with band B removed, and assuming the stock S has been threaded through the machine and the machine has been cycled at least once, a band will already have been cut from the stock material and clamped between the opposed faces of heads 28 and 30. Gear 100 will be at its dwell point and gear 102 at its midpoint of engagement as illustrated in FIG. 6.

Upon closing of switch 174, solenoid 92 operates trip 90 to permit one revolution of shaft 78 by the motor 80. Gear 98 is first driven through one-half revolution to its dwell point and thereby retracts the blocks 38 and 40 to position the fingers 34 and 36 beneath the gap between heads 28 and 30. The vacuum valve 166 is opened by cam 168 to reduce the pressure in manifolds 44 and 46, and gear 100 is driven to retract head 28 from head 30. The respective sides of the band are retained against the respective faces 28*b* and 30*b* of the vacuum heads whereby the previously flat band is opened; see FIG. 11. The active vacuum ports 48 and 50 do not extend the full width of stock material S, to avoid exposure of the end ports as the band is opened, and the edge portions of the collapsed stock become the ends of the opened band. Head 28 is moved only a short distance, e.g. ½" with 2¾" stock material, to adequately open the band for encircling fingers 34 and 36 while avoiding detachment from either surface 28*b* or 30*b*. Cam 76 then operates the related drive system to rotate the feed rollers 24 and 26 and advance the stock material S a distance equal to the width of the next band to be formed. This feeding action may take place before the vacuum to the manifolds 44 and 46 is cut off, whereby the advancing stock preloads or biases the opened band in a downward direction. The vacuum is then cut off and air is admitted to manifolds 44 and 46, thereby releasing the opened band which is thereby dropped or projected around the subjacent fingers 34 and 36. Completion of the rotation of gear 100 then advances head 28, toward head 30, to cut off the newly extended end of the stock material S and thus to form a new band B and clamp the newly formed band between the opposed faces 28*b* and 30*b* of heads 28 and 30. As gear 100 returns to its dwell point, gear 102 is engaged by gear 98 to advance and separate the fingers 34 and 36 thereby to further spread and/or stretch the band B to the position illustrated in FIG. 1; see also the righthand portion of FIG. 7. Latch 90 re-engages the clutch to prevent further rotation of shaft 78 and thereby completes the cycle of operation.

The limited movement of the head members 28 and 30 avoids stripping of the bands from the head member during the initial band opening step and avoids stretching of the material of the bands. This prevents snapping or sudden rebound of the bands when they are released by the head members for transfer to the fingers 34 and 36, and facilitates the very simple transfer step which is effected by the illustrated machine.

During the cycling of the machine, the operator may arrange elements to be banded, such as the bottle and literature shown in FIG. 3. The combined articles are then inserted within the opened band, and the band is gripped against the articles and pulled upwards, off of the fingers 34 and 36, as the articles are raised, whereby the band, previously stretched by the machine contracts around the articles.

The fingers 34 and 36 are integral with bars 176 and 178 which are suitably secured to the respective blocks 38 and 40 as by screws 180; see FIG. 12.

The bands B will be of constant predetermined width in accordance with the amount of rotation of shaft 58 during each cycle of the machine 20. The width of the bands may be varied by varying the stroke of arm 66, such as by selecting and substituting another cam 76 of appropriate configuration.

It will thus be seen that a novel and improved band forming and applying system has been provided which is capable of rapidly, reliably and automatically forming and spreading elastic loop bands to facilitate rapid and economical application of these bands to various articles.

While particular embodiments of the invention have been shown, it will be understood, of course, that the invention is not limited thereto since modifications may be made by those skilled in the art in light of the foregoing teachings. Therefore, it is contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A machine for cutting elastic bands from flexible, elongated, tubular stock and opening such bands comprising means for severing successive end portion of such tubular stock to form endless bands therefrom, means associated with said severing means for releasably gripping opposite side portions of each such band as it is severed from such stock and for moving such side portions apart, first and second sets of band receiving fingers mounted for movement together adjacent said gripping means to receive a band therearound from said gripping means, said first set of said fingers being supported on a reciprocable member, a pinion movable with said reciprocable member, a rack fixed in position to be engaged by said pinion during reciprocation of said reciprocable member, and a movable rack engaging said pinion and drive connected to said second set of fingers whereby said second set of fingers is reciprocated relative to said first set as said first set is reciprocated for spreading opposite sides of such bands from one another.

2. A machine for cutting elastic bands from flexible, elongated, collapsed tubular stock and opening and stretching such bands comprising a pair of opposed horizontally arranged head members each formed with manifold passages communicating with ports in the face thereof opposed to the other of said pair of members, a shear plate secured to the upper side of one of said members and having a leading edge extending at a shallow angle with respect to the adjacent surface of the other of said members and adapted to cooperate with said other of said members for severing stock material disposed therebetween, conduit and valve means for placing an air pump in communication with said manifold passages for creating a partial vacuum in said manifold passages when said ports are covered, said other of said members being reciprocable toward and away from said one member whereby bands may be severed from such stock and the respective adjacent sides of each band may be secured on said members over said ports and moved apart, a pair of abutting resilient feed rollers disposed over said members, drive means for unidirectionally and intermittently rotating said rollers to extend successive lengths of stock material between said members, first and second sets of band receiving fingers mounted beneath said members and movable together therebeneath to receive a band therearound from said members, said first set of said fingers being supported for reciprocation horizontally, a pinion movable with said first set of fingers, a first rack ad-

justably fixed in position to be engaged by said pinion during a portion of the reciprocatory movement of said pinion, a movable rack generally parallel to said first rack and engaging said pinion, said movable rack supporting said second set of fingers whereby said second set of fingers is reciprocated a greater distance than said first set as said first set is reciprocated for spreading opposite sides of such bands from one another, and means for adjusting the position of said first rack to vary the range of engagement of said pinion therewith to control the relative movement between said sets of fingers.

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