

[54] **METHOD AND APPARATUS FOR SLITTING BELT**

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[51] Int. Cl. **B65h 35/02, B65h 19/30**

[58] Field of Search..... **242/56.2, 56.3, 56.4, 56.5, 242/56, 56.6, 56.7, 58.6, 81, 68.4, 68.3, 75.5, 67.3; 83/436, 175**

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[57] **ABSTRACT**

Belt slitting machine and method including two sets of spaced lifting arms each of which supports a spindle which is rotatably secured to the lift arms by a retractable pin nested in an end of each spindle. The lift arms are hydraulically positionable both vertically and laterally. The machine includes a set of drive and pressure rollers for pushing the belt into a knife which is pivotally mounted for piercing the belt from above. A second set of drive and pressure rollers are located downstream of the knife to pull the belt as it is being pushed. To apply tension, the drive roller of the tension set is of a diameter slightly larger than the drive roller of the pusher set. The spindles are rotated by hydraulic motors which are in circuit with the hydraulic motor for the drive rollers and with suitable valves so that the rotation of each spindle is controlled independently of the drive rollers to assure tensioning of the belt regardless of the speed of the drive rollers and regardless of the direction of rotation. Adjustable guides are spring biased in position to guide a cut-out portion of a belt and are automatically disengaged at the end of the cut-out portion. The method involves feeding the belt, piercing, slitting, guiding, and positioning steps.

17 Claims, 10 Drawing Figures

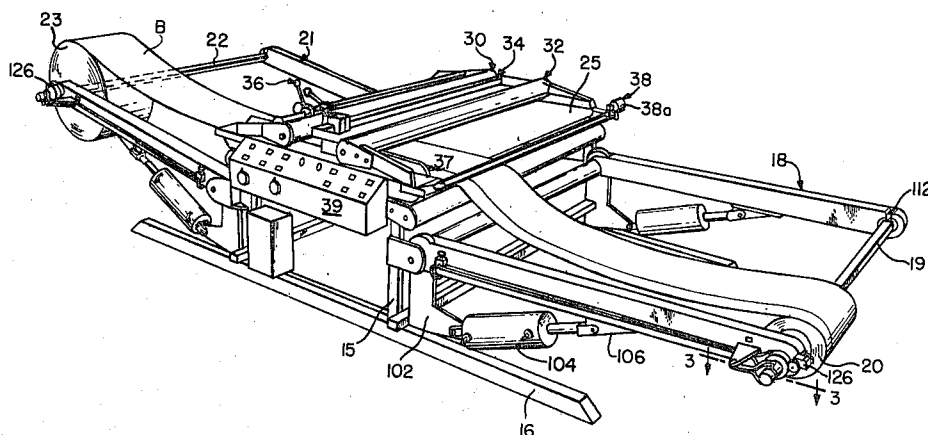


FIG-1

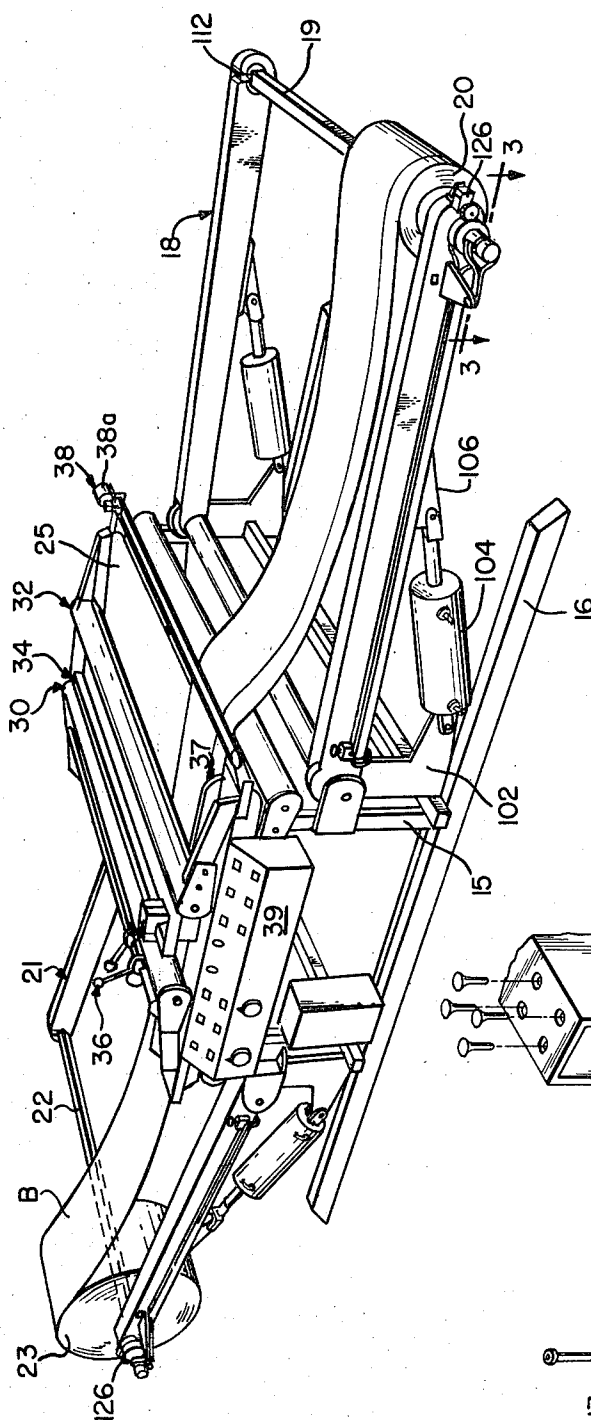


FIG-1A

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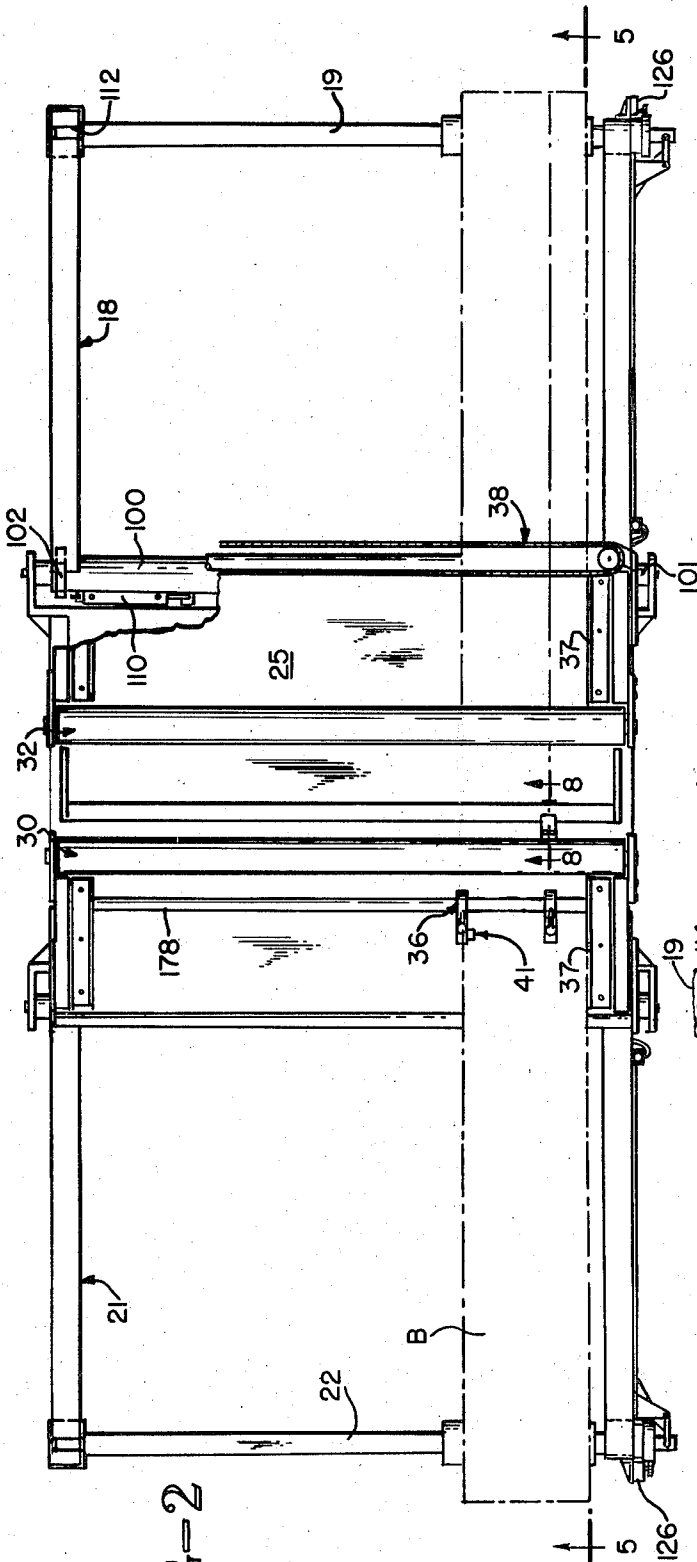


FIG-2

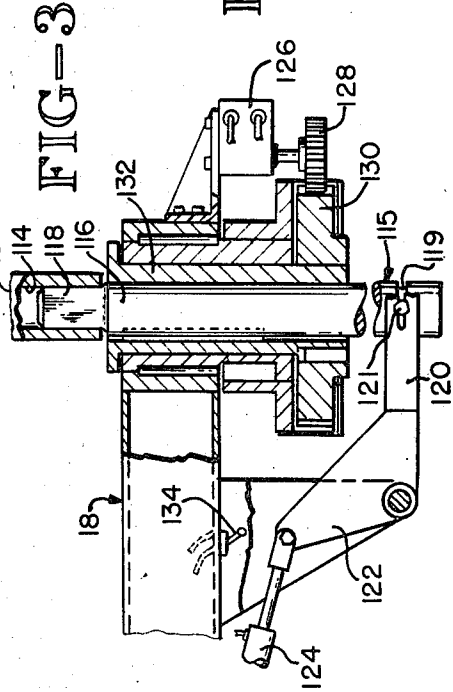


FIG-3

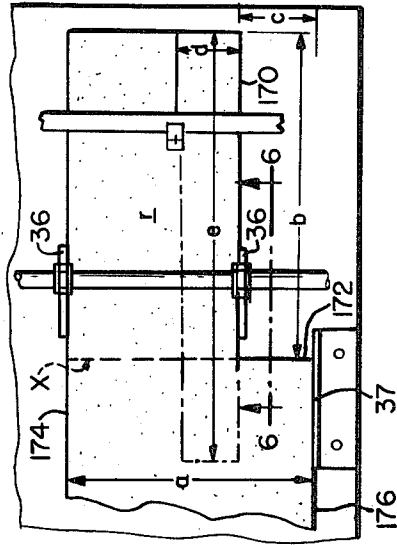


FIG-4

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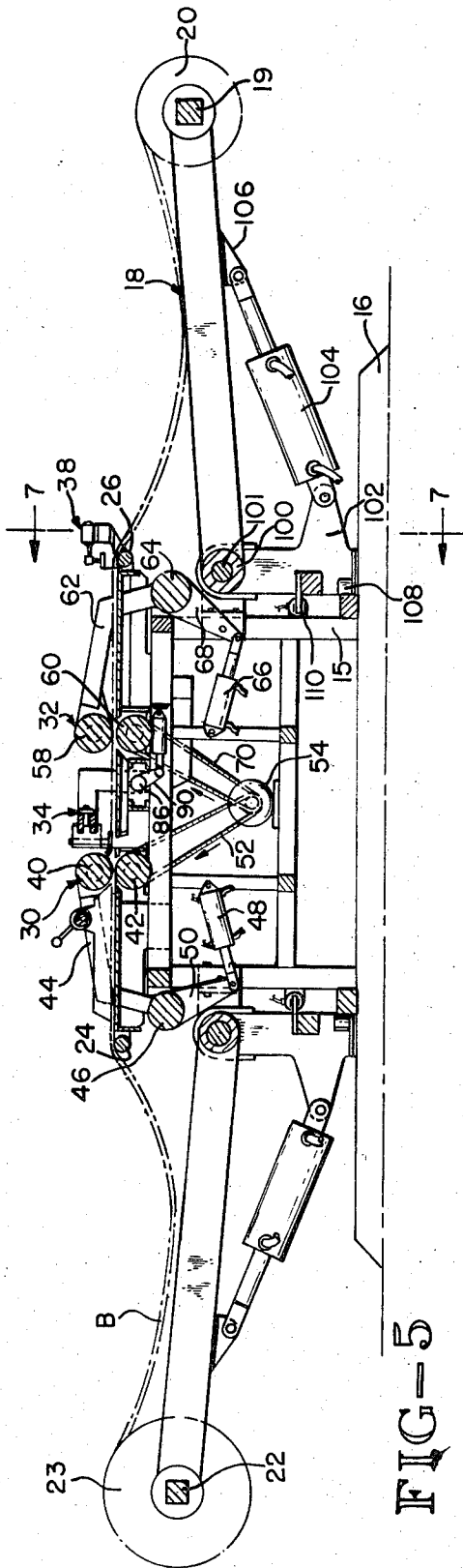


FIG-5

FIG-7

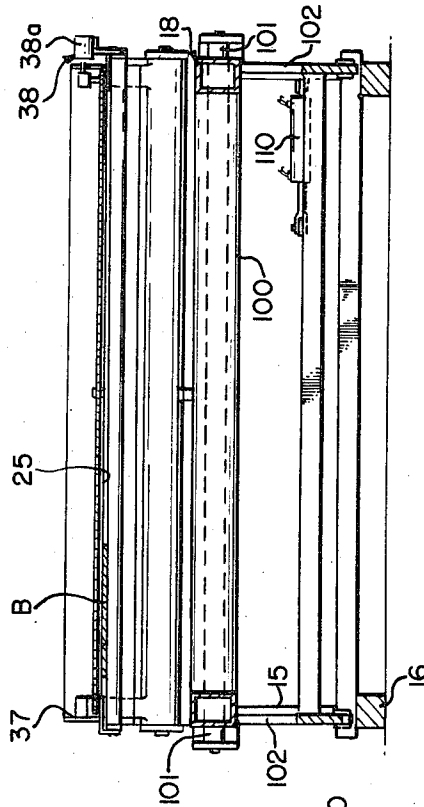
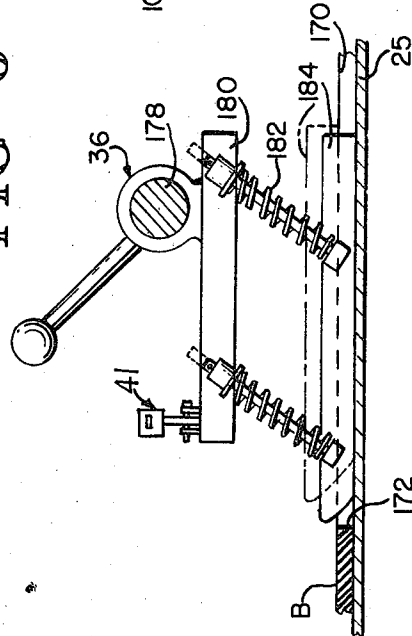


FIG-6



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FIG-9

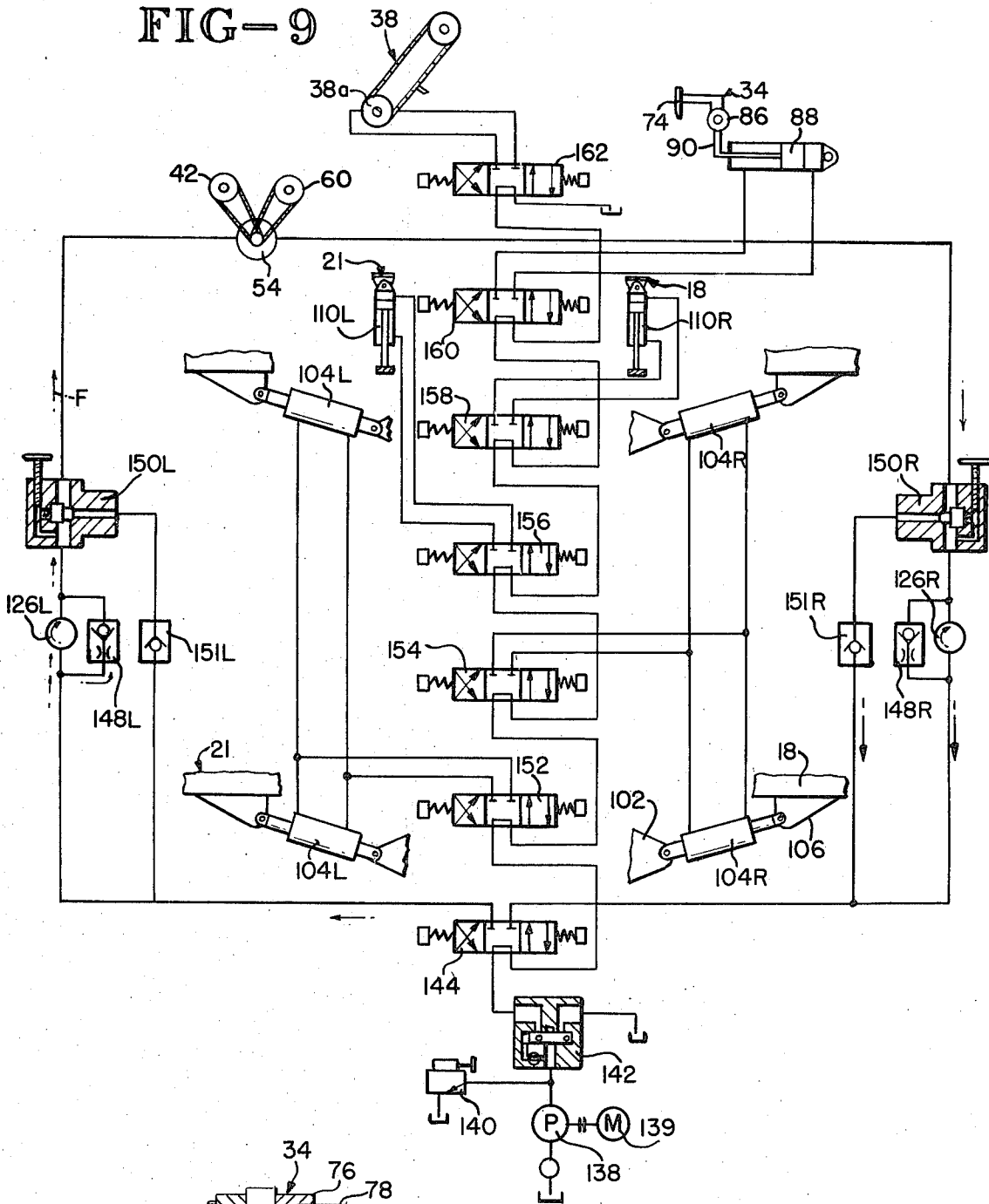
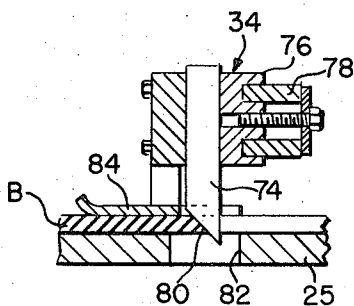


FIG-8



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METHOD AND APPARATUS FOR SLITTING BELT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to methods and apparatus for handling belts and more particularly, to methods and apparatus for slitting belts and like materials.

2. Description of the Prior Art

Heretofore machines for slitting belts or like materials have been difficult to load and operate and have not been suitable for slitting a large variety of belt types. In addition, it has been difficult in these machines to cut more than one piece from the same length of belt which has resulted in remnants that are often wasted.

The U.S. Pat. to Trissell No. 2,569,589 shows one such prior machine. In this patent the material is pulled through the cutter by a winding roller. Among other disadvantages this results in a varying feeding speed through the cutter which affects the quality of the cut. In addition, when highly elastic material, such as skirt-board rubber, is pulled through the cutter the material tends to elongate thus producing a slit belt having a width that is less than specified. Another disadvantage is that the original stock roll of belt to be slit must be handled by a vehicle or by several workmen in order that it may be positioned on a spindle of the machine. This is undesirable since the workmen or vehicle are kept from doing other productive work each time it is necessary to load and unload the machine. Another disadvantage in this machine is that it is difficult to cut pieces of various sizes from the same length of belt. The prior practice is thus to cut the belt off evenly across the entire width of the belt after a piece of belt of lesser width is removed. This produces a remnant which is stored in the hopes that a customer will order a piece of belt that closely fits the particular size of the remnant.

Another prior art machine is shown in the U.S. Pat. to Pugh No. 2,827,961. In the machine shown in this patent many of the same disadvantages as are mentioned above are still present with the exception that in the Pugh machine the drive roller is separate from the winding roll and thus a constant feed rate may be maintained during slitting. A disadvantage, however, is that no provision is made for rewinding the belt onto the stock roll and even if such a provision were available in the machine, a slip clutch drive as employed in the patent would cause the belt to unwind from the spools too quickly. Another undesirable feature of this machine is that the belt must be slit by hand prior to engagement with the cutter. Still further, the practice using the Pugh machine is to secure the belt to the rewind cores or spools after the end of the belt has been slit. This practice often leaves the separated ends out of alignment on the spools resulting in uneven winding of the belt strips.

SUMMARY OF THE INVENTION

This invention pertains to a machine and a method for slitting belt or similar materials, to several unique features of a slitting machine, and to methods which improve belt handling procedures. Several of the features provide the machine with outstanding versatility and high quality slit-belt product. The first feature is a technique of slitting belt which includes simultaneously pushing and pulling the belt past the cutting edge so as to prevent elongation of the belt while it is being slit.

The second feature is the technique of piercing a belt while on the machine so that the belt may be machine cut for substantially the entire length of the piece to be cut. Using this technique the belt can be secured to the winding spools before separating the pieces thus assuring accurate alignment of the ends of the pieces on the spools. A third feature is the use of power controlled lift arms for raising and lowering the spindles either to load or unload the machine or to vary the height of the spindles during operation of the machine. In addition, the arms may be moved laterally to "walk" or position a stock roll of belt against a vertical guiding edge of the machine. Still further the arms are uniquely provided with pneumatically operated supporting pins which provide for mounting the spindle between the lift arms and locking it for rotation on the lift arms. A fourth feature is the technique of cutting pieces from a length of belt from which a previous piece has been cut by the use of an adjustable guide which automatically becomes inactive at the end of the cut-out portion. A fifth feature is the use of hydraulic drives for rotating the stock and spool spindles (hereinafter stock spindle will refer to the spindle on which the stock roll is mounted and is facing the cutting edge of the cutter whereas the spool spindle is at the other end of the machine and supports the spools of slit belts) which are isolated from the drive for the feeding or drive rollers so that the speeds of the former may be varied to compensate for changes in roll diameter while the drive rollers maintain a continuous pre-selected speed. The motors for the drive rollers and spindles are reversible so that the belt may be wound or unwound on either spindle. A sixth feature is that the drive rollers and each spindle are driven hydraulically through a common circuit. Suitable flow control valves are accessible to the machine operator to quickly vary the speed of each spindle independently of the operating speed of the drive rollers. Bypass and relief valves also automatically compensate for an increase or decrease in the speed of the drive rollers so that the spindles will be maintained at the desired rotational speed.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective showing a belt-slitting machine embodying the principles of the invention and which is suitable for performing the several methods of the invention.

FIG. 1A is an exploded view in perspective showing additional details of the ends of two of the lift arms.

FIG. 2 is a plan of the machine shown in FIG. 1 with parts removed for clarity.

FIG. 3 is a horizontal fragmentary section taken generally along the line 3—3 in FIG. 1.

FIG. 4 is a schematic plan of a portion of the machine shown in FIG. 1 with parts removed for clarity and illustrating the technique for cutting additional belt strips from a previously slit belt.

FIG. 5 is a vertical section taken generally along the line 5—5 of FIG. 2.

FIG. 6 is a fragmentary section of the machine taken generally along the line 6—6 in FIG. 4 showing an adjustable guide used in the technique illustrated in FIG. 4.

FIG. 7 is a vertical transverse section of the machine taken along the line 7—7 of FIG. 5.

FIG. 8 is a fragmentary vertical section of the machine taken along the line 8—8 of FIG. 2.

FIG. 9 is a diagram of the hydraulic circuit and controls used to operate the machine of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A belt-slitting machine embodying the apparatus features of the invention and suitable for carrying out the method features of the invention is best shown generally in FIG. 1. The machine comprises a frame 15 mounted on a base 16. At the right-hand end of the machine, as viewed in FIG. 1, a pair of lift arms 18 are provided and mount a rotatable spindle 19 which supports spools 20 of slit belt. At the left-hand end of the machine a similar pair of lift arms 21 support a spindle 22 which mounts a stock roll 23 of belt B. For the purpose of this description the term stock roll will mean the roll of belt received from the belt manufacturer and may be as much as 72 inches in width. Stock rolls of lesser width, such as the one shown in FIG. 1, may also be handled on the machine. The term stock roll will thus apply to rolls of any diameter and belt of any width when placed on the machine upstream of the cutter so that the product after being slit will be one or more strips of belt of a width less than the stock roll. Each of the two sets of lift arms are movable vertically and laterally for positioning the rolls and spools in a manner to be later described.

Located centrally of the machine are a first set of drive and pressure rollers 30 and a second set of drive and pressure rollers 32. A cutting mechanism 34 is disposed between the two sets of drive and pressure rollers. As will be described in more detail hereinafter the first set of drive and pressure rollers pushes the belt passed the cutting mechanism whereas the second set of drive and pressure rollers pulls the belt as it is being pushed at a speed slightly greater than the pushing speed. Accordingly, the belt is pushed and simultaneously pulled through the cutting mechanism. Adjustable guides 36 are arranged to be positioned transversely along the left-hand end of the table 25. The adjustable guides co-act with fixed guide 37 that is located at each corner of the table 25. The fixed guides engage both edges of a stock belt that extends the entire width of the machine. When belts of lesser width are being slit one set of fixed guides engages the manufactured outer edge of the belt and an adjustable guide 36 is positioned to engage the opposite edge of the belt. In addition, the adjustable guides are uniquely provided for engaging the edge of a previously cut-out portion of the belt as will be later described.

A conventional chain driven cutter 38 is propelled by a hydraulic motor 38a for cutting the strips of belt transversely. A conventional measuring device 41 is adjustably mounted on an adjustable guide 36 and counts the inches or feet of the belt being slit so that the operator may remove the cutter when the desired length is slit.

Most of the components of the machine are hydraulically powered for ease of operation and versatility. For this purpose a control console 39 is provided centrally of the machine to give an operator push button control of all stages of a belt slitting operation. The various pumps, motors, fluid and air supplies required for the

operation of the machine are hidden below the table 25 thus presenting a compact, self-contained apparatus.

PULLING AND PUSHING

As mentioned earlier the customary practice for slitting belt is to pull the belt through the cutter. A feature of this invention is that the belt is pushed through the cutter while being simultaneously pulled from downstream of the cutter. The purpose of pushing the belt is to prevent elongation of highly elastic types of belts, such as chute lining or skirt-board, rubber belts. Simultaneously pulling the belt prevents "puckering", that is, the bunching-up of the belt at the cutting edge, a phenomenon occurring in certain types of relatively thin rubber belt. In addition to overcoming "puckering," the simultaneous pushing and pulling technique is a preferred cutting operation for any type of belt. Preferably the pushing pressure is applied within about three and one-half inches from the cutting edge and the pulling pressure is applied within about sixteen inches of the cutting edge. It has been found that the closer to the cutting edge these pressures can be applied, particularly the pushing pressure, the less likely the belt will be to rise or bulge upstream of the cutting edge or to elongate downstream.

The apparatus for carrying out this unique method of pushing and simultaneously pulling the belt is best shown in FIG. 5. The belt B is engaged between a pressure roller 40 and a drive roller 42 of the set 30. Preferably the drive roller has a knurled surface. The pressure roller 40 is rotatably mounted between a set of spaced arms 44 which are fixed to a pivot shaft 46. The pivot shaft 46 is rotatably mounted in the frame 15 and is pivoted by a conventional pneumatic actuator (cylinder and piston type) 48 that is secured to the frame 15 and to a lever arm 50 fixed to the pivot shaft. As is readily apparent the pressure roller 40 may be pivoted clockwise into engagement with the top surface of the belt to any desired pressure by extending the pneumatic actuator 48. In like manner the pressure roller 40 may be raised from the belt by retracting the pneumatic actuator 48. The drive roller 42 is pivotally mounted in the frame and is rotated by a conventional chain drive 52 secured to the operating shaft of a hydraulic drive motor 54.

The second set of drive and pressure rollers 32 includes a pressure roller 58 and a drive roller 60 preferably having a knurled surface. The pressure roller 58 is rotatably mounted between spaced arms 62 which are secured to a pivot shaft 64. The pivot shaft 64 is rotatably mounted in the frame 15 and is pivoted by a conventional pneumatic actuator 66. The actuator is secured to the frame at one end and to a lever arm 68 that is fixed to the pivot shaft 64. The pneumatic actuator 66 controls the position of the second pressure roller 58 and the amount of pressure applied on the belt. The drive roller 60 is rotatably mounted in the frame 15 and is driven by a chain drive 70 also secured to the operating shaft of the hydraulic drive motor 54.

To provide tension on the belt, in the preferred form of the invention, the diameter of the drive roller 60 is slightly greater than the diameter of the drive roller 42. Since both drive rollers are driven from the same sprocket on the hydraulic drive motor 54 it can be seen that the drive roller 60 will be pulling at a slightly faster

rate than will the drive roller 42 by pushing. In this manner slight tension is provided on the belt as it is being moved past the cutter. It is not always necessary to provide tension for all types of belts and, of course, other types of arrangements for applying the tension will be apparent to one skilled in the art. In the preferred embodiment the diameter of the drive roller 42 is about 5½ inches whereas the diameter of the drive roller 60 is about 0.015–0.025 of an inch greater.

PIERCING

Another advantageous feature of the invention is the concept of piercing the belt so as to provide a machine-cut for substantially the entire length of the belt. For this purpose the belt B is fed along the table 25 and under the cutting mechanism 34 until an inch or two extends beyond the cutter. The cutter is then lowered with the cutting edge passing through the belt to begin a slit. The belt is then slit by moving it past the cutting edge until the forward end of the belt is positioned over the desired spools 20. At this point a workman fastens the belt onto the spools as by tacking. By using the edge of the still unslit end of the belt as a guide the belt may be evenly positioned on both of the spools. It should be understood that for each strip of belt being produced an additional spool is required so that each strip is rolled on a separate spool. After the strips have been tacked to the spools the workman slits the remaining inch or two to separate the strips. By this procedure the belt is thus quickly and accurately cut by the machine and yet provides an integral edge to align the strips on their spools. The belt then is wound on the spools until the desired length is slit after which the cutter is removed and the strip is cut transversely and removed. The stock roll is then rewound and additional strips cut on the roll or it is removed from the machine for storage.

The apparatus for carrying out this piercing technique is best shown in FIGS. 5 and 8. The cutting mechanism 34 includes a blade 74 vertically adjustably secured in a mounting bracket 76. The mounting bracket is transversely adjustably mounted in a tool bar 78. The tool bar extends the entire width of the machine and, as is well known in the art, several blades may be adjustably mounted in the tool bar for simultaneously cutting a plurality of strips from the belt. The cutting blade 74 has a cutting edge 80 that is inclined downwardly and rearwardly at about a 45° angle. It thus can be seen that the edge comes to a point at its lower end so that it will penetrate or pierce the belt. The inclination of the edge also assists in pushing the belt downwardly against the table 25 as it is being cut to produce an accurate and smooth cut. A slot 82 is provided transversely across the table 25 to allow the cutting edge to penetrate the belt. The cutter is also provided with a foot 84 to assist in holding the belt as it is being cut.

For the purpose of piercing the belt, that is lowering the cutting edge 80 through the belt, the tool bar 78 is secured to a pivot shaft 86 that is rotatably mounted in the frame 15. The shaft is pivoted by a hydraulic actuator 88 secured at one end to the frame and at its other end to a lever arm 90 fixed to the pivot shaft 86. Thus by extending the actuator 88 the pull bar is pivoted clockwise lifting the cutting edge 80 from the belt.

When the actuator is retracted the edge is lowered through the belt.

LIFT ARMS AND ASSOCIATED MECHANISMS

The lift arms 18 and 21 and their associated mechanisms are substantially identical to one another. Accordingly, only the right-hand lift arms 18 and associated mechanisms will be described, it being understood that the description is applicable also to the left-hand lift arms and associated mechanisms. The set of lift arms 18 is secured to a hollow pivot member 100 which is pivotally mounted on a pivot shaft 101. The pivot shaft extends about 6 inches beyond the ends of the pivot member to allow for lateral movement. The pivot member is also journaled in a rectangular slide 102. A pair of hydraulic actuators 104 are secured at their inner ends to the rectangular slide 102 and at their outer ends to a pair of brackets 106 secured approximately midway along the length of the lift arms. It is thus seen when the hydraulic actuator is extended the lift arms 18 are raised, thus raising the spindle 19 and any spools of belt thereon, and when retracted the lift arms are lowered. The rectangular slide 102 is slidably mounted for transverse movement on a guideway 108 secured to the frame 15. The details of the guideway and rectangular slide are readily understood by one skilled in the art and will not be further described. A hydraulic actuator 110 is secured to one end to the rectangular slide and at its other end to the frame 15. As is best shown in FIG. 7 when the hydraulic actuator is extended the rectangular slide 102 is shifted laterally to the left and when the hydraulic actuator is retracted the rectangular slide is moved to the right. The preferred length of lateral movement is about one foot.

With the use of this apparatus to provide both vertical and lateral movement the rolls of belt, particularly the stock roll, may be easily positioned at one side of the machine or the other so that the belt when fed through the machine will be positioned against one set of vertical guides. In operation, a roll of belt is placed on a spindle while the roll is being supported by a vehicle or is resting on the floor. The spindle is then raised until the roll is supported by the spindle and then is moved laterally in the desired direction. When the end of the lateral stroke is reached the spindle is then lowered until the roll is again resting on the floor and the spindle is then moved laterally in the opposite direction. The procedure is then repeated until the roll is "walked" into position preferably in alignment with the vertical guiding edges of the machine.

Another feature of the machine is a unique spindle supporting means making it easy for a single workman to load or unload rolls. In the preferred form of the embodiment one of the lift arms 18 is provided with a vertical slot 112 for slidably receiving an end of the spindle 19. The other end of the spindle is provided with a square opening 114 (FIG. 3). When the spindle is installed between the lift arms one end is nested in one of the lift arms and the other end of the spindle terminates just short of the opposite lift arm. A supporting pin mechanism 115 is provided for supporting and turning the free end of the spindle 19. The supporting pin mechanism includes a tubular pin body 116 terminating in a square end 118 which is insertable in the square opening 114 of the spindle 19. The outer end of the

body 116 is provided with a peripheral groove 119. A yoke 120 overlies the groove 119 and is provided with freely rotatable studs 121 which ride in the groove 119. The yoke is secured to a bell crank 122 which is pivoted by a pneumatic actuator 124. As is apparent from FIG. 3 retraction of the hydraulic actuator will move the pin body 116 toward the spindle 119 whereas extension of the pneumatic actuator will pivot the bell crank clockwise to extract the pin from the spindle. The pneumatic system to power the actuator is conventional and the details of which will not be described. A valve for energizing the pneumatic actuator 124 is identified by the reference character 134 (FIG. 3) and is positioned on the lift arm convenient to the supporting mechanism 115. In this manner the workmen loading the roll on the spindle has complete control of the supporting mechanism 115 so as to facilitate placing the pin in the spindle. As can be seen by reference to FIG. 1A, a lift arm such as arm 18 or 21 has in the end thereof a casting 107 in which slot 112 is formed. The casting as can be seen is secured by appropriate screws in the end of the arm. Additionally a detachable bushing member 111 and a stop plug 113 can be provided at the bottom of slot 112 to receive one end of spindle 19.

The pin body 116 is rotated by a hydraulic motor 126 which is mounted to the lift arm by any suitable means. The hydraulic motor is provided with a gear 128 that engages a gear 130 that is keyed to a sleeve 132. The sleeve 132 is rotatably mounted in the end of the lift arm and is slidably keyed to the pin body 116. The hydraulic motor 126 is reversible so that the spindle may be driven in either direction.

HYDRAULIC SYSTEM

One of the unique features of the machine is that the hydraulic motors for rotating the spindles 19 and 22 are isolated from the drive rollers 42 and 60. In addition, by the use of a unique hydraulic control system, the speed and tensioning of the belt on the stock roll or spools may be adjusted independently of the speed of the drive rollers and may be maintained regardless of whether the machine is slitting or rewinding the belt after slitting. In other words, the system operates to control the belt tension between the drive rollers and the spindles whether the machine is running in the forward or reverse direction, at any speed, and regardless of the diameters of the rolls on the spindles. The system includes a combination of separate hydraulic motors for rotating the spindles 19 and 22 and the hydraulic motor 54 for rotating the drive rollers 42 and 60 and is best described with reference to the schematic circuit of FIG. 9. For the purpose of describing the hydraulic circuit and controls an L will be added to the fluid motors and actuators on the left-hand side of the machine and an R will be added to those on the righthand side. Thus, the hydraulic motor for rotating the right-hand spindle 19 is identified by reference numeral 126R and the spindle 22 is rotated by a hydraulic motor 126L. The circuit is supplied with hydraulic fluid by a conventional pump 138 powered by a motor 139. A pressure relief valve 140 is set preferably at a pressure of about 1,600 psi. The 1600 psi pressure in the system is higher than is normally to be expected for operating the various hydraulic motors and actuators of the machine. Fluid is thus pumped through a manually operated,

pressure compensated flow control valve 142 of a type that controls the flow of fluid, as by bypassing it back to the reservoir, while maintaining the pressure in the system at 1,600 psi. A typical valve for this purpose is manufactured by Brand Hydraulics of Omaha, Nebraska, Model No. FC-51. The valve is conventional, however, and other suitable valves may be used. The fluid leaving the flow control valve then passes to a solenoid operated directional valve 144. All of the operator controlled valves hereinafter described are conventional solenoid operated valves except where otherwise specified as manually operated. When the valve 144 is in the centermost position the fluid is diverted solely to the various hydraulic actuators of the machine, in the furthest left position the fluid passes through the system in a clockwise direction, and in the furthest right position the fluid travels in the counterclockwise direction. A flow in the clockwise direction (indicated by the arrows F) causes the hydraulic motors 126L and 126R to rotate clockwise such that the belt is moving through the machine from left to right as viewed in FIG. 1. When the flow is reversed so that the system is running in the counterclockwise direction the hydraulic motors 126L and 126R are also turning counterclockwise as is the condition when the belt is being rolled back on the stock roll 23. The hydraulic motor 126L is provided with a bypass valve 148L which is set to bypass fluid in one direction at a pressure of between 50-150 psi but blocks fluid traveling in the opposite direction. Likewise the hydraulic motor 126R is provided with a bypass 148R which also passes fluid in one direction when the pressure exceeds about 50-150 psi and blocks the fluid traveling in the opposite direction. The 50-150 psi setting is sufficient to turn the spindles as the belt is being unwound. The left-hand side of the system is also provided with a pilot operated pressure relief valve 150L which bypasses fluid only when a set pressure is exceeded and only when the fluid is traveling counterclockwise through the system. This occurs because the valve 150L opens only when a predetermined pressure differential exists between the main line and the bypass line. The pilot relief valve 150L is conventional, a typical form being manufactured by the Bellows-Valvair Corporation of California, Model No. A419. An identical valve 150R is provided in the right-hand side of the hydraulic system along with an identical check valve 151R. The fluid after leaving the valve 150L passes through the hydraulic drive motor 54 which rotates both drive rollers 42 and 60 in the clockwise direction. The fluid then passes into the right-hand pilot relief valve 150R which is preset to the maximum pressure required to rotate the largest normal diameter roll of belt. This pressure is approximately 300-500 psi. It should be understood that the load on each of the hydraulic motors 126L and 126R will vary depending upon the diameter of the roll or rolls of belt on the spindles. In other words when the belt is being wound onto spools the diameters of the rolls will be small and the spools must be rotated at a high rate of speed. As the rolls build-up in diameter the speed must be reduced and the load required to turn the spools will be increased. To accommodate this increase in load and the decrease in the rotational rates of the spools the excess flow over that required to maintain the rotational speed is bypassed through the

right-hand pressure relief valve 150R. To accomplish this the valve 150R is set to open to bypass when the pressure differential between the main line pressure to the valve and the bypass pressure in the valve exceeds the preset pressure. In this manner the total flow will be going through the right-hand hydraulic motor 126R when the rolls on the spools are small and the pressure required to rotate the spools is small but as the rolls build-up the pressure upstream of the right-hand hydraulic motor 126R will build-up due to the increased load until the preset pressure differential is reached between the main line pressure and the bypass. When this occurs the by-pass is opened and the flow passes through the check valve 151R.

When the flow in the system is reversed, that is, to flow counterclockwise in the system the motors 126L, 126R and 54 and the various valves 148L, 148R, 150L, 150R, 151L, and 151R operate in reverse. In other words, the right-hand hydraulic motor 126R is bypassed through the valve 148R when the pressure exceeds 50-150 psi so that only a sufficient flow passes through the hydraulic motor to assist in rotating or unwinding the rolls on the spools. All the fluid then passes through the right-hand pilot relief valve 150R and passes on to rotate the drive rollers through the hydraulic drive motor 54. When the fluid reaches the left-hand hydraulic motor 126R, which is now turning in the counterclockwise direction to rewind the belt onto the stock roll, all of the flow passes through the hydraulic motor when the diameter of the stock roll is small. As the diameter of the stock roll increases the pressure upstream of the hydraulic motor 126L will also increase until it reaches the pressure setting (300 psi) of the left-hand pilot relief valve 150L. At this time the relief valve 150L will open by passing only so much of the flow as is necessary to keep the pressure from exceeding its setting.

The system also has sufficient versatility and reserve pressure to accommodate simultaneous rotation of the hydraulic motors and operation of the various hydraulic actuators for manipulating other parts of the machine. The various actuators are controlled by a series of pneumatically operated control valves. A control valve 152 is connected to the hydraulic actuators 104L to raise and lower the lift arms 21. A control valve 154 is provided to actuate the hydraulic actuators 104R for raising and lowering the lift arms 18. A control valve 156 operates the hydraulic actuator 110L for moving the lift arms 21 laterally. A control valve 158 is connected to the actuator 110R for moving the right-hand lift arms 18 laterally. A control valve 160 is connected to the hydraulic actuator 88 for raising and lowering the cutting blade 74. A control valve 162 is connected to the hydraulic motor 38a for moving the transverse cutting knife 38. All of the foregoing valves are interconnected in series. The last-mentioned valve 162 is connected to the fluid reservoir. Although these valves have been indicated as being pneumatically operated, suitable manual valves could suffice in a manner well known in the art.

As each of the pilot relief valves 150L and 150R are set to open to bypass upon a predetermined differential pressure between the bypass line and the main line it makes no difference what the pressure is downstream of the hydraulic motor 126L or 126R which ever is

winding. In other words, assuming the flow is in the clockwise direction with the hydraulic motor 126R winding the belt on the spools and assuming that the lift arms 18 are being raised the pressure downstream of the hydraulic motor 126R will immediately go from zero or reservoir pressure to the pressure necessary to raise the lift arms. For this purpose let us assume it takes 500 psi to raise the lift arms. The 500 pound pressure will then be passed upstream through the entire system but the differential (caused by the hydraulic motor 126R) between the main line pressure in the pilot relief valve 150R and the bypass line connected to the bypass valve 151R will remain the same.

ADJUSTABLE GUIDE

As mentioned earlier another advantageous feature of this invention is the technique of cutting multiple strips of belt from the same length of belt. To illustrate the problem assume that a belt of original width a (FIG. 4) has previously been slit and that the strip removed was of a length b and of a width c . The customary practice is to remove the end of the uncut belt as by cutting along the dotted line X. The piece thus cut-off would be called a remnant r and would be stored in inventory until an order was received for a piece of belt exactly the size of the remnant or smaller and the remnant would then be cut by hand to fill the order. Using the technique of this invention the end of the belt is not cut, in other words, the cut X is not made, so that the piece which would have been a remnant is left on the roll and the belt is then rewound onto the stock roll. When a new order requires a width of belt equal to or less than the remaining width of a minus c , for example a width d , the stock roll is placed back on the machine and the new strip of width d , regardless of its desired length, may be machine cut. For the purpose of this example let us assume that the strip of width d to be cut is to have a length e . The original strip of width c and length b that was removed from the stock roll will leave a cut edge 170 running lengthwise of the belt and a transverse cut edge 172. The outer edges of the belt which are normally used for guiding will be trimmed manufactured edges. To machine cut the desired new strip of width d and length e the technique is to guide the length-wise cut edge 170 of the cut-out portion and the original manufactured edge 174 with adjustable guides 36. The belt is then fed through the machine being guided by the two adjustable guides 36 until the other manufactured edge 176 engages the fixed vertical guide 37 which allows it to takeover the guiding function of the adjustable guide 36 that was riding against the previously cut edge 170. In the preferred form of the technique the transfer of the guiding function from the previously cut edge 170 to the manufactured edge 176 is done automatically without stopping the machine by releasing the cut edge 170 once the machined edge 176 is being guided.

Suitable apparatus for carrying out this technique are employed on the instant machine. As best shown in FIGS. 4 and 6 the adjustable guides 36 are mounted on a shaft 178 that is fixed to the frame 15. Each adjustable guide may be locked in a raised position out of engagement with the belt or may be pivoted downwardly into engagement with an edge of the belt. Each adjustable guide is provided with a mounting bar 180 that

rigidly mounts a pair of links 182. The links are telescopic and are spring biased into extended positions. The lower ends of the links are rigidly secured to a guide shoe 184 having smooth, side guide surfaces for engaging the edge of the belt. As is shown in solid lines in FIG. 6 when the shoe is resting on the table 25 it will act as a guide for the edge of the belt against which it is abutting. If the edge happens to be the edge 170 of the cut-out portion it can be seen that the shoe will ride up on the belt into the phantom position when engaged by the edge 172 of the cut-out portion. It should also be noted that adjustably fastening the measuring device to the adjustable guide permits placement of the measuring device on the belt adjacent the cut-out portions so that the length of the cut-out portion may be checked for accuracy.

OPERATION

To illustrate a typical operation of the machine assume that a stock roll of belt B is to be slit. The stock roll is either vehicle carried or rolled across the floor and positioned between the lift arms 21. The spindle 22 is then inserted through the roll and one end of the spindle placed in the vertical slot in the lift arms. The operator then aligns the square opening in the spindle with the square end 118 of the extractor pin mechanism and operates the pneumatic valve 134 to drive the pin into the opening. If the roll is not positioned at the extreme left end of the machine, as viewed in FIG. 7, the roll is then "walked" towards the left as described earlier. The end of the belt is threaded over the guide roller 24 thence between an adjustable guide 36 and a fixed vertical guide 37 and finally beneath the pressure roller 40. The pressure roller is then lowered and the belt is fed a few inches beyond the slot 82 in the table 25. Next the tool bar 78 is pivoted downwardly so that the cutting edge 80 pierces the belt. The belt is then fed through the machine until it is beneath the pressure roller 58. The pressure roller 58 is then lowered and the belt is fed further by the pushing and pulling technique earlier described. The belt is then fed over the guide roller 26 and onto the spools 20 fastened for rotation on the spindle 19. At this time the workman tacks the end of the belt on the various spools, depending upon how many strips are being slit, and makes the final cut to separate the strips. The belt is then slit until the desired length is reached as determined by the counter 41. At this time the cutter is raised and the belt is fed further until the length prescribed is beneath the transverse cutter 39 and the strip or strips are severed at their desired lengths. The belt is then rewound onto the stock roll by reversing the flow of hydraulic fluid and by lifting one of the pressure rollers 40 or 58. If another strip is to be removed from the same belt the belt can be rethreaded through the machine and slit using the unique adjustable guide feature as earlier described. The stock roll and spools are then easily removed by lowering the lift arms 18 and 21, releasing the extractor pins from the spindles 19 and 22, and removing the rolls and spools from the spindles.

It should be readily apparent that all of these operations can be performed with a minimum of time and manpower. The belt is always being guided as it is slit and the machine has the versatility of performing many functions not available on prior art devices.

It should also be apparent that each of the various features is separately unique and that the preferred forms illustrated are capable of variation without departing from the principles employed. Accordingly many changes in construction and applications will suggest themselves to those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. The method of slitting a belt or the like and winding the slit ends on spools or the like comprising: feeding the belt along a predetermined path until its forward end is slightly downstream of a cutting station; piercing the belt slightly upstream of its forward end at said cutting station; slitting the belt longitudinally after piercing; stopping the belt when its forward end reaches the winding spools; fastening the forward end of the belt on the winding spools; and feeding, slitting and winding the belt until the desired slit length is obtained.
2. The method defined by claim 1, further including the step of manually slitting the unslit end of the belt after fastening to said winding spools but before feeding and winding the belt to obtain the desired length.
3. The method defined by claim 1, wherein said belt is pierced within three inches of its forward end.
4. The method defined by claim 2, wherein said belt is pierced within three inches of its forward end.
5. The method of positioning a roll of stock belt along the vertical guide edge of a belt-slitting machine, comprising: placing a stock roll of belt on a spindle while the roll is on a support; raising the spindle until the roll is off the support and moving it laterally toward said vertical edge; lowering the spindle until the roll rests on a support; moving the spindle laterally away from the vertical guide while the roll rests on a support; and repeating said raising, lowering and laterally moving steps until the roll abuts against said vertical guide.
6. A belt slitting machine comprising:
 - a A belt table;
 - drive means for moving a belt along a path across said table;
 - cutter means arranged in said path for slitting the belt as it is moved;
 - roll support means at opposite ends of said path, said roll support means each including a pair of movable lift arms for supporting a spindle and hydraulically powered means for moving said lift arms vertically;
 - means for rotating the downstream spindle to wind the belt on a roll and to rotate the upstream spindle to unwind the belt on the other roll; and
 - said lift arms include extendible pin means for selectively supporting and releasing one end of a spindle.
7. The belt-slitting machine defined by claim 6, further including hydraulically powered means for moving said lift arms laterally.
8. The belt-slitting machine defined by claim 6, further including hydraulically powered means for moving said lift arms laterally.
9. The method of cutting and guiding a belt having a cut-out portion removed, comprising:

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moving the belt along a predetermined path;
 slidably engaging the edge of the cut-out portion to
 guide the belt along said path;
 slitting the belt as it is moved along the path;
 slidably engaging the outer edge of the belt at the end
 of said cut-out portion;
 disengaging the edge of the cut-out portion at the
 end of said cut-out portion; and
 continuing the slitting step until the desired length of
 belt is slit.

10. A belt-slitting machine or the like, comprising:
 means for supporting a belt for movement along a
 predetermined path;

means for pushing the belt along said predetermined
 path;

means in said path for cutting the belt; and
 means in said path downstream of said cutting
 means for pulling the belt along said path at a rate
 slightly greater than said pushing means, and
 roll support means at opposite ends of said path in-
 cluding raisable and lowerable, reversible, winding
 and unwinding means.

11. The belt-slitting machine of claim 10 and
 wherein said roll support means are raisable and
 lowerable areas supporting said winding and unwinding
 means.

12. The belt-slitting machine of claim 11 and includ-
 ing control means for automatically varying the speed
 of said winding and unwinding means independently of
 the speed of said belt moving means so that the lineal
 speed of the belt passing through the cutter is main-
 tained constant at said selected speed.

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13. The belt-slitting machine of claim 12 and
 wherein said supporting means includes a table and
 each of said pushing means and said pulling means in-
 cludes a drive roller and a pressure roller, the diameter
 of said drive roller in said pulling means being slightly
 greater in diameter than the drive roller in said pushing
 means.

14. In a belt-slitting machine having a belt-support-
 ing table, feed means for moving the belt across said
 table and a cutter positioned over said table for slitting
 the belt as it is moved thereacross, an adjustable guide
 including:

a vertical guide surface engageable with the side
 edge of a cut-out portion of a belt; and

means for automatically disengaging the guide sur-
 face at the end of said cut-out portion.

15. The belt-slitting machine of claim 14, wherein
 said means for automatically disengaging the guide sur-
 face includes a bottom surface engageable with the top
 surface of the belt and with said vertical guide surface
 and means releasably supporting said bottom surface
 for movement vertically to ride up on said belt at the
 end of a cut-out portion.

16. The machine of claim 15, and further including
 means for moving the guide laterally over the belt.

17. The machine of claim 16, and wherein said guide
 includes a lower shoe defining said vertical and bottom
 surfaces and a mounting bar pivotally mounted to said
 machine, and wherein said lower shoe is spring biased
 downwardly from said mounting bar.

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