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(54) **METHOD AND APPARATUS FOR TWISTING A WIRELESS TWIST TIE**

VERFAHREN UND VORRICHTUNG ZUM VERDRILLEN EINES DRAHTLOSEN BINDESTREIFENS

PROCEDE ET APPAREIL POUR TORDRE UN LIEN ARME SANS FIL

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Description

TECHNICAL FIELD

[0001] The invention relates to a method and apparatus for twisting a wireless ribbon around the gathered neck of a bag for closing and sealing the bag.

BACKGROUND OF INVENTION

[0002] U. S. Patent No. 3,059,670 to Charles E. Burford and Leonard W. Burford entitled "WIRE TWISTING TOOL"; U. S. Patent No. 3,138,904 to Earl E. Burford entitled "METHOD AND APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS;" U. S. Patent No. 3,919,829 to Leonard W. Burford and Charles C. Burford entitled "APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS;" U. S. Patent No. 4,856,258 to Charles E. Burford and Jimmy R Frazier entitled "WIRE TYING DEVICE"; and U.S. Patent No. 5,483,134 to Jimmy R Frazier, John D. Richardson and Greg P. Coxsey entitled "RIBBON SENSING DEVICE FOR BAG TYER" disclose automatic bag closing and tying machines used for closing a flexible bag by attaching and twisting a wire-like ribbon about the neck of the bag.

[0003] Bag tying devices of the type disclosed in the aforementioned patents are commercially available from Burford Corporation of Maysville, Oklahoma. The tying devices are generally constructed to receive packages such as loaves of bread at speeds of for example one hundred (100) packages per minute. A ribbon of wire, encased in a covering of paper or plastic, is pulled from a roll, wrapped around the neck of the bag, cut and twisted to form a reclosable seal.

[0004] U.S. Patent No. 4,797,313 discloses an essentially organic, non-metallic ribbon for use as a twist tie comprising polymeric material exhibiting glass/rubber transitional behaviour. Polymeric ribbons deformed under tensile stress at 25 degree(s) exhibit yield stress between about 3,44 MPa and 62 MPa (500 and 9,000 psi). Discrete lengths of ribbon are capable of being disengagedly formed into fastly held twist ties by rotationally deforming terminal ends of said lengths about each other. The disclosure states that the ribbons can comprise polymers, such as polyalkylene terephthalates, polyvinylchlorides, styrene-acrylonitrile copolymers and polystyrenes. Optional polymeric materials include elastomeric impact modifiers and plasticizers. The patent states that the ribbon was utilised in an automatic bag closing and tying machine (model 50-7, Burford Corporation) at packaging rate of 60 bags per minute. The machine produced tight ties having between 1 and 1½ twists.

[0005] U.S. Patent No. 5,342,687 discloses a non-metallic coreless twist-tie formed by extruding polymeric material and then drawing the material at a rate of more than about 2.5 times. The polymer is described as being formed from polymeric resin having a degree of crystallization of about 10% to 60% at a crystallized temperature range of about 100 degree(s) C. to 250 degree(s) C. and can also include a quantity of fine glass beads.

[0006] U.S. Patent No. 4,907,392 and U.S. Patent No. 4,005,563 both disclose a bag neck tying apparatus comprising a source of ribbon for dispensing a strand of ribbon having a free end and a central portion, a holder-shearer assembly for holding the free end of said ribbon, a twister assembly having a hook adjacent said holder-shearer assembly, a needle assembly for engaging and positioning said central portion of said ribbon adjacent said holder-shearer assembly, and means for rotating said twister assembly for engaging and twisting said ribbon to form a tie.

[0007] Heretofore automatic bag closing and tying machines have been configure for use with wire tie material. Non-metallic coreless twist-tie ribbon has a different cross-sectional profile and physical characteristics that may result is slippage of the ribbon in the twister hook, loose ties and some times disengagement of the end of the ribbon from the holder.

SUMMARY OF INVENTION

[0008] The present invention provides a method for closing and securing a bag comprising the steps of: gathering an open end of the bag to form a gathered neck; encircling the gathered neck with a ribbon strand having first and second ribbon tails; deflecting the ribbon tails relative to the ribbon strand at an angle sufficient to prevent longitudinal movement of the ribbon tails; and rotating the ribbon tails relative to the ribbon strand to twist the ribbon strand to form a tie; characterised by: the steps of deflecting the ribbon tails relative to the ribbon and twisting the tails into a tie comprising the step of: rotating a twister hook on a twister shaft adjacent a laterally extending ribbon guide surface, such that the ribbon extends generally parallel to the twister shaft and said ribbon tails are drawn by the twister hook across the ribbon guide surface and extend generally perpendicular to said twister shaft and to said twister hook.

[0009] The present invention also provides a Bag neck tying apparatus comprising: a source of ribbon for dispensing a strand of ribbon having a free end and a central portion; a holder-shear assembly for holding the free end of said ribbon; a twister assembly having a hook adjacent said holder-shear assembly; a needle assembly for engaging and positioning said central portion of said ribbon; and means for rotating said twister assembly for engaging and twisting said ribbon to form a tie; characterised by: said twisted assembly further comprising a ribbon guide providing an upper surface extending transversely relative to said hook; wherein said needle assembly is for engaging and positioning said central portion of said ribbon adjacent said ribbon guide and adjacent said holder-shear assembly; and wherein upon rotating said twister assembly, said ribbon guide

deflects a portion of said ribbon relative to the direction defined by said hook and said shear holder assembly.

[0010] In a preferred embodiment, an improved holder shear assembly incorporates a V-shaped groove formed in the holder and a V-shaped rib formed on a gripper finger such that the ribbon is contacted at several different areas before the ribbon is cut. As the gripper finger is rotated it pushes the ribbon into the comer of a holder cutting area. Tension on the ribbon extrudes the ribbon and grabs to pre-hold the ribbon. As the gripper finger rotates further, the ribbon is moulded and bent over a cutting edge on the holder. This causes the ribbon to be securely held between surfaces on the gripper finger and the holder before the ribbon is cut. The V-shaped groove in the holder and the V-shaped rib on the gripper finger are not parallel to each other. Consequently, increasing the tension on the ribbon increases the gripping action. A shuttle bar connected for moving the gripper finger is mounted in a resilient bushing such that different gauges of wire or wireless ribbon can be used with the holder shear assembly without requiring adjustment of cams and other actuating mechanisms.

[0011] The following disclosure is provided to illustrate specific embodiments and aspects of this invention but does not imply any limitation of the scope of the invention, as laid down in the appended claims.

DESCRIPTION OF THE DRAWINGS

[0012] Drawings of a preferred embodiment of the invention are annexed hereto so that the invention may be better and more fully understood, in which:

Figure 1 is a perspective view illustrating the front of the bag neck tying device;
Figure 2 is a diagrammatic front elevational view;
Figure 3 is a diagrammatic rear elevational view;
Figure 4 is an end view looking generally in the direction of the arrows along line 4-4 in Figure 2;
Figure 5 is a diagrammatic end view illustrating the discharge end of the bag neck tying device, looking in the direction of the arrows along line 5-5 in Figure 2;
Figure 6 is a top plan view, looking in the direction of the arrows along line 6-6 in Figure 2, parts being broken away to more clearly illustrate the details of construction;
Figure 7 is a wiring diagram of the closed loop microcomputer controlled control system;
Figure 8 is a graphic representation of the sequence of operation of the needle, hook and shear assemblies during a complete cycle of operation;
Figure 9 is a fragmentary perspective view of a twister hook and ribbon guide plate;
Figure 10 is a fragmentary perspective view of the twister hook assembly and the holder shear assembly;
Figure 11 is a diagrammatic perspective view of the holder shear assembly in an inverted position;
Figure 12 is a diagrammatic view indicating the angular relationship of surfaces on the holder; and
Figure 13 is a diagrammatic view illustrating a pinch angle between a gripper finger and holder.

[0013] Numeral references are employed to designate like parts throughout the various Figures of the drawing.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0014] The wire tying device, generally designated by the numeral 10, in FIGS. 1 and 2 of the drawing is preferably of the type disclosed in U.S. Patent No. 5,483,134, that issued January 9, 1996, to Frazier, et al. As will be hereinafter more fully explained, improvements in the twister hook assembly 50 and a holder-shear assembly 60 are incorporated into the device to provide improved performance when different types of ribbon or ribbon constructed of different materials are used to tie bags.

[0015] The wire tying device is mounted adjacent the side of a conveyor 300 of the type disclosed in Burford U.S. Pat. No. 3,138,904 and Burford U.S. Pat. No. 3,919,829.

[0016] Conveyor 300 carries for example, loaves 125 of bread to, through and out of wire tying device 10 in rapid succession. Conveyor 300 is well known to persons skilled in the art and further description thereof is not deemed necessary except in connection with the drive mechanism as will be hereinafter more fully explained. It should be appreciated that other and further structures may form the conveyor.

[0017] Referring to Figure 1 of the drawing, the numeral 20 generally designates a bag gathering apparatus for moving a bag 125 along a path 12 to a position adjacent a needle assembly 40, a twister hook assembly 50 and a holder-shear assembly 60. As will be hereinafter more fully explained, the free end of a ribbon 15 is gripped in a holder-shear assembly 60. The neck of the bag moves through a slot 122 between upper face plate 16 and lower face plate 17 for drawing the bag 125 to a controlled tension about the contents. Needle assembly 40 wraps the ribbon 15 about the gathered neck of the bag and twister hook 50 is actuated for twisting a portion of the ribbon 15 about the neck of the bag 125. It should be noted that the ribbon 15 may be constructed of wire enclosed in paper or plastic or it may comprise a ribbon of plastic or any other material. The strand of ribbon 15 extends around one or more pulleys 41, 41a and 41b, mounted on shafts 41a', from a spool 41c of tie material.

[0018] The mounting for spool 41c is similar to that disclosed in U. S. Patent No. 3,919,829 entitled "APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS".

[0019] However, it will be noted that spool 41c of tie material is mounted on a shaft and the ribbon 15 is fed

from spool 14c, routed around rollers 41b, 41a and 41, around needle roller 44 and the cad of the ribbon 15 is gripped in the holder-shear assembly 60, as best illustrated in Figure I of the drawing. Spool 41c is mounted on a shaft engaged by a brake (not shown). As needle 42 forms a loop of tie material around the gathered neck of a bag, the force of inertia and force exerted by the brake cause the spool 41c to remain stationary momentarily as a crank arm, on which roller 41a is mounted, is rotated.

[0020] As will be hereinafter more fully explained, one of the pulleys 41, 41a or 41b is preferably equipped with a sensor device which is capable of calculating the amount of ribbon 15 dispensed from spool 41c. The sensor apparatus determines whether or not a bag neck is present. As needle 41 moves from the full outline position illustrated in Figure 2 to the dashed outline position, if a bag neck is not positioned in the path of the ribbon, the cycle of operation will be interrupted so that the holder-shear assembly 60 will not be actuated and the twister hook assembly 50 will not rotate. This prevents actuation of the holder-shear assembly which would have resulted in the ribbon being dropped or released if a bag neck was not present.

[0021] The frame of the bag tying device may assume many configurations. In the illustrated embodiment upper and lower face plates 16 and 17 are supported on forward edges of vertically extending end plates 18 and 19 having slots formed therein to permit passage of a bag neck. A horizontal mounting plate 19a extends between lower portions of end plates 18 and 19 and a vertical mounting plate 16a extends outwardly from end plate 18.

[0022] A motor M1, having an encoder E1 mounted the rear end of motor M1, is mounted on an upper portion of the vertical mounting plate 16a for driving the gathering assembly 20. A motor M2, having an encoder E2 mounted the rear end and a gear box 46 mounted on the front end of motor M2, is mounted on an upper portion of the rear surface of face plate 16 for driving the needle assembly 40. A motor M3, having an encoder E3 mounted the rear end of motor M3, is mounted vertically on horizontally extending mounting plate 19a for driving the twister hook assembly 50. A motor M4, having an encoder E4 mounted the rear end of motor M4, is mounted on a lower portion of end plate 18, and in the illustrated embodiment extends below motor M2, for driving the holder-shear assembly 60.

[0023] Referring to Figures 1-5 of the drawing, bag neck gathering apparatus 20 comprises, in a preferred embodiment of the invention, an upper gathering belt 22 routed around a driven pulley 24 and idler pulleys 26, 27 and 28. The bag neck gathering mechanism 20 further comprises a lower gathering belt 32 routed around a driven pulley 34 and idler pulleys 36, 37 and 38. As best illustrated in Figure 1 of the drawing, the portion 29 of the upper gathering belt 22, extending between idler pulleys 27 and 28, is substantially parallel and closely spaced relative to the portion 39 of the lower gathering belt 32 which extends between driven pulley 34 and idler pulley 36. In the illustrated embodiment, gathering belts 22 and 32 move a bag neck along path 12 in a plane P as illustrated in Figure 2. A pressure pad 21, resiliently urged upwardly by springs 21a and 21b acting through bell cranks, maintains belts 22 and 32 in frictional engagement with the neck of a bag or other material to be tied.

[0024] As best illustrated in Figures 3 and 5 of the drawing, driven shaft 25, having driven pulley 24 mounted on one end, has a pulley 23 mounted on its opposite end. Driven shaft 35, having driven pulley 34 mounted on one end, has a pulley 33 mounted on its opposite end. A pulley 30 mounted on the drive shaft of motor M1 drives pulleys 23 and 33 through a belt 31 such that driven pulley 24 rotates in a clockwise direction while driven pulley 34 rotates in a counter-clockwise direction, as viewed in Figure 2 of the drawing. Belt guards 16a and 16b and 17a preferably extend between the gathering belts and products on the conveyor. The bag neck is moved into a slot in the belt guard by brushes (not shown) and the product in the bag engages the belt guards when the neck of the bag is drawn by gathering belts 22 and 32 around a bag stop lever 80. It should be appreciated that other and further gathering structures may be used to form a gathered neck on a bag.

[0025] Terms such as "left," "right," "clockwise," "counter-clockwise," "horizontal," "vertical," "up," and "down" when used in reference to the drawings, generally refer to orientation of the parts in the illustrated embodiment and not necessarily during use. These-terms used herein are meant only to refer to relative positions and/or orientations, for convenience, and are not to be understood to be in any manner otherwise limiting.

[0026] As illustrated in Figure 7 of the drawing, motor M1 is driven by a solid state DC motor controller 91 which is capable of varying the speed of motor M1 to substantially synchronize movement of upper gathering belt 22 and lowering gathering belt 33 with the speed of a conveyor 300 moving packages 125 adjacent the bag gathering mechanism 20. For example, if the tier 10 is to gather and tie the necks of 100 bags per minute, the conveyer 3 00 would preferably bring bags to and through the tier at a speed of approximately 91.44 meters per minute (300 feet per minute) and the gathering belts 22 and 32 would preferably be driven at a speed of, for example 92.96 meter per minute (305 feet per minute), so that the neck of the bag would be accelerated for gathering the neck, stopped momentarily while it is being tied with a ribbon and then discharged in a substantially continuous operation.

[0027] As will hereinafter be more fully explained, the gathering assembly 20 also includes a bag stop lever 80, illustrated in Figures 2 and 3, mounted on shaft 85 for rotary movement about a horizontal axis, in the illustrated embodiment. Shaft 85 extends through an electric brake 82, which momentarily locks lever 80 in a lowered

position extending across path 12 such that gathering belts 22 and 32 move the bag neck into engagement with lever 80. After the bag neck has been gathered and tied, the electric brake 82 is released and the gathered neck, carried between belts 22 and 32, urges the lever 80 upwardly such that it does not obstruct movement of the gathered neck. After the gathered neck passes lever 80, the lever 80 moves back to the illustrated position extending across path 12.

[0028] A needle assembly 40, best illustrated in Figures 1-4 and 7, is positioned for wrapping a strand 15 of ribbon material around a gathered neck of a bag. The needle assembly 40 comprises a needle 42 carrying idler rollers 44,44a and 44b. The needle 42 is mounted on the output shaft 45 of a gear box 46 driven by motor M2. Needle 42 is shown in its home position in Figures 1 and 2 of the drawing. Motor M2 moves needle 42 from the full outline position to the dashed outline position, illustrated in Figure 2 of the drawing, and then reverses for moving the needle 42 back to the position illustrated in full outline in Figure 2.

[0029] Referring to Figures 1,3 and 7 of the drawing, a twister hook assembly 50 comprises a twister shaft 52 rotatably mounted in a bearing 53 having a hook 54 on one end thereof and a pulley 55 on the other end. A drive pulley 56 is mounted on the drive shaft of motor M3 and drives pulley 55 through a belt 58.

[0030] A ribbon guide plate 59 is mounted on the upper end of a support plate 57 secured to bearing block 53 and extending generally parallel to shaft 52. The ribbon guide plate 59 has an opening which encircles shaft 52 to provide an upper surface extending generally transversely of twister hook 54. Tails of ribbon 15 extend upwardly from holder shear assembly 66 and are engaged by hook 54 when shaft 52 is rotated.

[0031] The tails of the severed section of ribbon are drawn across guide surface 59 and deflected relative to twister hook 54 at an angle of approximately 90°. This reduces the tendency of the tails of the severed ribbon to slip relative to the twister hook.

[0032] As best illustrated in Figure 9 of the drawing, the loop portion of ribbon 15 extends above hook 54 mounted on shaft 52. Ribbon guide plate 59, mounted immediately below twister hook 54 pulls the tails 15a and 15b across the upper surface of ribbon guide 58 which forms a"kink" where hook 54 engages tails 15a and 15b to at least partially wrap the ribbon around the surface of hook 54 and pull it into a groove between hook portion 54 and shaft 52. Rotation of shaft 52 and hook 54 causes the ribbon material above hook 54 to be twisted.

[0033] As best illustrated in Figure 10 of the drawing, ribbon guide plate 59 is positioned between twister hook 54 and the holder shear assembly 60.

[0034] As best illustrated in Figures 1,2,5 and 7 of the drawing, a ribbon holder-shear assembly, generally designated by the numeral 60, comprises a holder and shear assembly of the type disclosed in U. S. Design Patent No. 307,281 to Charles E. Burford and U. S. Patent No. 4,856,258 entitled WIRE TYING DEVICE, which issued August 15,1989, to Charles E. Burford and Jimmy R Frazier. The holder-shear assembly 60 comprises a gripper arm 62 having a gripper finger 64 on one end thereof rotatably secured to a mounting plate 66 by bolt 65. A pair of anvils 68 and 69 are formed on the end of mounting plate 66, each being associated with shear surfaces 68a and 69a to grip and cut a strand of ribbon as will be hereinafter more fully explained.

[0035] Referring to Figures 11 and 12, as the gripper finger 64 is rotated it pushes the ribbon into the comer 69d between the inclined surfaces 69c and 69e which form a holding area. Because the ribbon is under tension, this "V" point extrudes the ribbon and grabs to prehold the ribbon. As the gripper finger rotates further, the ribbon is molded around point 69b and bent over the cutting edge 69a of anvil 69.

[0036] The gripper finger has ribs 64a and 64b having surfaces that are angularly disposed at the same angle as surfaces 69c and 69d on anvil 69. However, the edge of the rib 64a and the inner section 69d between surfaces 69c and 69e are not parallel. As illustrated in Figure 13, the surface of the rib forms a tapered slot 67 of diverging cross-section to make a pinch angle. As the ribbon 15 is pulled out of the cutting area, this causes the ribbon to be pinched tighter as tension increases.

[0037] It should be readily apparent that as needle 40 moves from the full outline position illustrated in Figure 2 to the dashed outline position the tension in ribbon 15 increases as the ribbon is wrapped around the gathered neck of the bag.

[0038] Gripper finger 62 is oscillated between anvils 68 and 69 by a shuttle rod 75 having a cylindrical end 75a with a resilient bushing 75b through which a bolt 75c extends. The device operates effectively with wire or wireless ribbon 15 and also different gauges of wire or wireless ribbon because resilient bushing 75b is compressed and deforms to accommodate different size ribbon in slot 67.

[0039] Profile of cam 75 is shaped to permit rotation of the cam through an angle of a few degrees when the cam and shuttle bar are in home positions without changing the cam follower position. This is done so that the cam may be rotated quickly and if the motor overshoots the home position it can back the cams to the desired home position.

[0040] Because wire and wireless ribbon are not all of the same profile and vary in thickness, compression of the resilient bushing 75b can accommodate different dimensions. As the ribbon 15 is trapped in the holding area in slot 67, the resilient bushing 75b flexes and holds constant pressure on ribbon 15. This allows a change of ribbon types or ribbon thickness without requiring adjustment of cam 70 and cam followers 71 and 73.

[0041] Referring to Figures 5 and 7 of the drawing, a cam 70 is mounted on the shaft of motor M4 and is configured to engage cam-followers 72 and 74 on spaced

arms 71 and 73 secured to a shuttle rod 75 mounted for reciprocating movement in bearings 76. A link 75a secures the end of gripper arm 62 to shuttle rod 75.

[0042] It should be readily apparent when the shaft of motor M4 rotates one-half revolution, cam 70 will exert force through cam-followers 72 and 74 for moving shuttle rod 75 for pivoting the actuating arm 62 about bolt 65. The free end of the ribbon is gripped between the end of gripper finger 64 and anvil 68 or 69, depending on which direction the gripper finger 64 is shifted. As will be hereinafter more fully explained, when needle 42 wraps the intermediate section of the ribbon 15 around the gathered neck of a bag, the ribbon will be positioned between gripper finger 64 and the other anvil 68 or 69. When gripper finger 64 is shifted to its opposite position, the ribbon will be cut and the free end of the strand of ribbon will be gripped between gripper finger 64 and anvil 68 or 69.

[0043] Referring to Figure 2 of the drawing, roller 41 has a plurality of index points 41x. In the illustrated embodiment, the index points are formed by steel dowel pins circumferentially spaced around the axis about which roller 41 rotates.

[0044] A proximity switch, not shown, is positioned near index pointers 41x for making an electrical circuit when the presence of an indexing pin 41x is sensed. The proximity switch is of conventional design and is connected through a suitable power supply and amplifier to the CPU 96.

[0045] Thus, the CPU monitors the proximity output and counts the pulses produced by index pins 41x in roller 41. The CPU 96 calculates the amount of ribbon dispensed to determine whether or not a bag neck is present as needle 42 moves from the full outline position illustrated in Figure 2 of the drawing toward the dashed outline position illustrated in Figure 2 of the drawing. If needle 42 did not wrap ribbon around a bag neck, the CPU will terminate a portion of the remainder of the cycle of operation so that holder-shear 65 will not be actuated to prevent releasing the end of ribbon 15 which is gripped between gripper finger 64 and anvil 68 or 69.

[0046] Referring to Figures 1, 2 and 3 of the drawing, a bag stop lever 80 is mounted on a shaft 85 for rotary movement about a horizontal axis. Shaft 85 extends through an electric brake 82 and has a crank arm 85a secured thereto which is resiliently urged in a clockwise direction, as viewed in Figure 3, by a spring 83.

[0047] A switch 86 is actuated by switch arm 88, which actuates a timer for energizing electric brake 82 which momentarily locks bag stop 80 in a fixed position for a predetermined period of time, for example 0.25 seconds for restraining the leading edge of a bag neck, such that gathering belts 22 and 32 will gather the neck adjacent bag stop 80. At the expiration of the predetermined period of time, electric brake 82 will be de-energized so that linear movement of the bag neck will rotate bag stop 80 upwardly to release the bag so that it will be moved away by the conveyor. Bag stop 80 is biased toward the position illustrated in Figure 3 of the drawing by a spring 83. It should be readily apparent that the spring 83 may be replaced by a counter-weight, air cylinder or other suitable biasing mechanism to resiliently urge bag stop 80 toward its home position.

[0048] Motors M1, M2, M3 and M4 are bi-directional, permanent magnet, DC brush-type servomotors having outputs proportional to the voltage applied across the armatures. Such motors are commercially available from Groschopp, Inc. of Sioux Center, Iowa as a "Power Master 8304" 24 volt DC continuous power motor. At 1500 rpm the motor generates 0.113 Nm (16 oz-in) torque and has an output of 67,1 Watts (090 horsepower) at 4.2 Ampere. At 2450 rpm the torque is 0.332 Nm (47 oz-in) and the output is 84.26 Watts (113 horsepower) at 5 Ampere. At 5400 rpm the torque is 0.261 Nm (37 oz-in) and the output is 146,9 Watts (197 horsepower) at 8.2 Ampere.

[0049] It is noted that other motors and motors of other sizes may be provided to facilitate driving the various assemblies. For example, it is contemplated that smaller motors would be used in a counter top model used for gathering and fastening materials such as coils of electrical cord, water hose, tubing, or yarn, and bundles of cable, rods, or carrots and other produce.

[0050] One side of the armature winding of each motor M1, M2, M3 and M4 is connected to ground such that reversing the polarity of current through the armature winding reverses the direction of rotation of the motor.

[0051] Each of the motors M1, M2, M3 and M4 has an encoder E1, E2, E3 or E4 mounted on its drive shaft which delivers an electrical signal to a decoder D1, D2, D3 or D4 which is representative of the position of the motor shaft

[0052] Referring to Figure 7 of the drawing, the numeral 90 generally designates a power supply for delivering electric current to motor controller 91 and to motor M1 in the bag neck gathering mechanism 20; motor controller 92 and motor M2 in the needle assembly 40; motor controller 93 and motor M3 in the twister assembly 50; and motor controller 94 and motor M4 in the holder-shear assembly 60.

[0053] The system is controlled by a computer 95, diagrammatically illustrated in Figure 7, which receives and stores a set of instructions and then acts upon the instructions in a predetermined and predictable fashion. A microprocessor 96 is attached to a printed circuit board into which a thin layer of metal has been applied and then etched away to form traces. The electronic components of the central processing unit are attached to the board with solder so that they can change electronic signals through the etched traces on the board.

[0054] A suitable 32-bit integrated microcontroller 96 is the MC68332 which is commercially available from Motorola, Inc. of Schaumburg, Illinois as a product referred to as "MC68332 SIM" System Integrated Module.

[0055] The MC68332 microcontroller 96 contains intelligent peripheral modules such as the time processor

unit (TPU) which provides 16 microcoded channels for performing time-related activities for simple input capture or output capture to complicated motor control or pulse width modulation. High-speed serial communications are provided by the queued serial module (QSM) with synchronous and asynchronous protocols available. Two kilobytes of fully static standby RAM allow fast two-cycle access for system and data stacks and variable storage with provision for battery backup. Twelve chip selects enhance system integration for fast external memory or peripheral access. These modules are connected on-chip via an intermodule bus (IMB).

[0056] The CPU board is connected to an auxiliary board 98 through a connector header which carries data signals and address signals. Driver circuits C1-C4, which generate pulse width modulated (PWM) signals, are mounted on the auxiliary board along with the decoders D1-D4. The pulse width modulated signals from driver circuits C1-C4 are sent to the motor drivers 91-94 selectively delivering positive or negative DC power to control the operation of motors M1-M4.

[0057] The circuits carrying input signals from the encoders E1-E4 to decoders D1-D4; the circuit carrying pulse width modulated signals from driver circuits C1-C4 to motor drivers 91-94; and the circuits carrying power from the motor drivers 91-94 to motors M1-M4 form a closed loop control system. The closed loop control system depends upon the feedback concept for operation and the output PWM signals are forced to a preassigned function of the reference input of the microcontroller of the central processing unit. The microcontroller 96 sends control PWM signals determined by the programmed movements stored in RAM memory in a pre-assigned order as a function of time after switch arm 88 returns to its home position illustrated in Figure 3. The control PWM signals are delivered to the control circuit. Each encoder E1-E4, connected to the shaft of motors M1-M4, send quadrature signals to the decoders D1-D4 that indicate the position of the shaft of each motor. The control PWM signals delivered to each control circuit C1-C4 are delivered to motor drivers 91-94. The quadrature signals from decoders D1-D4 are read to adjust the control PWM signals.

[0058] Drivers 92, 93 and 94, which control the delivery of power to motors M2, M3 and M4, respectively, for controlling the needle assembly 40, twister hook assembly 50 and holder-shear mechanism 60 are substantially identical. One side of the winding of each of the motors M2, M3 and M4 is connected to ground. Drivers 92, 93 and 94 deliver either positive or negative power to the other side of the motor winding for driving motors M2, M3 and M4 in opposite directions. For example, when positive 34 volt direct current is delivered to the winding of motor M2, its shaft is driven in a clock-wise direction. If negative 34 volt direct current is delivered to the winding of motor M2, its shaft will be driven in a counterclockwise direction.

[0059] The driver 91 for motor M1 connected to the bag gathering assembly 20, is similar to drivers 92, 93 and 94 except that driver 91 is not provided with the capability of delivering negative direct current because it is not necessary for motor M1 to be driven in reverse.

[0060] Software is stored in FEEPROM memory on the CPU board for controlling the acceleration, speed and position of the shaft of each motor M1-M4. Figure 11 is a graphic representation of the sequence of operation of the needle, hook and shear assemblies during a complete cycle of operation. The microcontroller 96 is initially programmed by a computer through a serial port RS for storing a program which will initiate movement of needle 42 from its home position illustrated in Figure 3 and the speed of movement toward the dashed outline position illustrated in Figure 3 controlled by signals delivered through control circuit C2 to motor M2. While needle 42 is moving from the position illustrated in full outline toward the position illustrated in dashed outline, the program causes a signal to be sent from control circuit C3 to motor M3 to begin rotating twister hook 54 and continue rotation of twister 54 a predetermined number of revolutions controlled by the motion profile in RAM memory. Similarly, when needle 42 and twister hook 54 are in predetermined positions, a signal will be sent from driver circuit C4 which will energize motor M4 for rotating cam 70 to move the gripper finger 64 to release the free end of the ribbon and shear a segment from the end of the strand of ribbon. At a time controlled by the software, a signal will be delivered to motor M2 for moving needle 42 from the position shown in dashed outline in Figure 3 back to its home position. A signal will be delivered to motor M3 for rotating twister hook 54 two revolutions in the reverse direction for slinging the tie, which has been twisted around the neck of a bag, out of the twister hook 54 for completing a tying cycle.

[0061] It should be readily apparent that when the neck of a bag moves between gathering belts 22 and 32, switch arm 88 will be moved downwardly from the position illustrated in Figure 3 which will energize electric brake 82 so that belts 22 and 32 will move the neck of the bag into engagement with bag stop 80 causing the neck to be gathered. As the trailing edge of the neck of the bag passes over the end of switch arm 88, switch arm 88 will move back to the position illustrated in Figure 3 causing switch 86 to send a signal to the microcontroller for starting a new tying cycle.

[0062] It is to be understood that while detailed descriptions of a preferred embodiment has been illustrated and described, the invention is not to be limited to the specific arrangement of parts and specific features herein described and illustrated in the drawing. Rather, the descriptions are merely of an exemplary embodiment of the invention, which may be embodied in various forms.

Claims

1. A method for closing and securing a bag comprising the steps of:

   gathering an open end of the bag to form a gathered neck;
   encircling the gathered neck with a ribbon strand (15) having first and second ribbon tails (15a, 15b);
   deflecting the ribbon tails relative to the ribbon strand (15) at an angle sufficient to prevent longitudinal movement of the ribbon tails; and
   rotating the ribbon tails relative to the ribbon strand to twist the ribbon strand to form a tie; **characterised by**:

   the steps of deflecting the ribbon tails relative to the ribbon and twisting the tails into a tie comprising the step of:

   rotating a twister hook (54) on a twister shaft (52) adjacent a laterally extending ribbon guide surface (59), such that the ribbon (15) extends generally parallel to the twister shaft (52) and said ribbon tails are drawn by the twister hook (54) across the ribbon guide surface (59) and extend generally perpendicular to said twister shaft (52) and to said twister hook (54).

2. A method for closing and securing bags according to Claim 1, the step of deflecting the ribbon tails relative to the ribbon comprising the steps of: deflecting the ribbon tails (15a, 15b) relative to the ribbon (15) at an angle in a range between about 70 and 120 degrees.

3. A method for closing and securing bags according to Claim 2, the step of deflecting the ribbon tails (15a, 15b) at an angle in a range between about 70 and 120 degrees relative to the ribbon (15) comprising the steps of :

   moving the ribbon tails across the ribbon guide surface (59) to wrap said ribbon tails around a twister hook (54) to secure the ribbon tails (15a, 15b) relative to said twister hook (54) as the ribbon strand (15) is twisted.

4. A method for closing and securing bags according to Claim 1, the step of encircling the gathered neck with a ribbon (15) having first and second ribbon tails comprising the steps of:

   positioning the ribbon tails in a slot in a twister assembly (50) including said twister shaft (52) extending through a passage in said ribbon guide surface (59), said twister hook (54) extending generally parallel to said ribbon guide surface (59).

5. A method for closing and securing a bag according to Claim 1, the step of encircling the gathered neck with a ribbon (15) having first and second ribbon tails comprising the steps of:

   engaging the free end of a ribbon (15), forming a first ribbon tail, between a shear arm (62) and one of a pair of anvils (68, 69) formed on the end of a mounting plate (66);
   moving the running end of the ribbon (15) between the shear arm (62) and the other of the pair of anvils(68, 69); and
   moving the shear arm (62) toward the other anvil (68, 69) to cut the ribbon (15) to form a second ribbon tail on the ribbon strand and to grip the free end of the ribbon (15), such that the cut ribbon strand forms a loop around the gathered neck and has ribbon tails (15a, 15b) on opposite ends of the ribbon strand.

6. A method for closing and securing a bag according to Claim 5, the step of moving the shear arm comprising the steps of :

   rotating said shear arm (62) having a shaped surface toward holder surfaces (68, 69) to sequentially push the ribbon (15) into a comer (68d, 69d) formed between intersecting portions (68c and 68e, 69c and 69e) of the holder surface, such that tension on the ribbon extrudes and holds the ribbon (15);
   molding the ribbon around a point (68b, 69b) to further hold the ribbon;
   bending the ribbon over a cutting edge (68a, 69a) of the holder (68, 69); and
   cutting the ribbon.

7. A method for closing and securing bags according to Claim 1, the step of encircling the gathered neck with a ribbon having first and second ribbon tails comprising the steps of:

   encircling the gathered neck with a ribbon of wire, encased in a covering of paper.

8. A method for closing and securing bags according to Claim 1, the step of encircling the gathered neck with a ribbon having first and second ribbon tails comprising the steps of:

   encircling the gathered neck with a ribbon of wire, encased in a covering of plastic material.

9. A method for closing and securing bags according to Claim 1, the step of encircling the gathered neck with a ribbon having first and second ribbon tails comprising the steps of:

encircling the gathered neck with a ribbon formed of non-metallic material.

10. Bag neck tying apparatus comprising:

a source of ribbon for dispensing a strand of ribbon (15) having a free end and a central portion;
a holder-shear assembly (60) for holding the free end of said ribbon (15);
a twister assembly (50) having a hook (54) adjacent said holder-shear assembly (60);
a needle assembly (40) for engaging and positioning said central portion of said ribbon (15); and
means for rotating said twister assembly (50) for engaging and twisting said ribbon (15) to form a tie; **characterised by**:

said twister assembly (50) further comprising a ribbon guide (59) providing an upper surface extending transversely relative to said hook (54);

wherein said needle assembly is for engaging and positioning said central portion of said ribbon adjacent said ribbon guide and adjacent said holder-shear assembly (60); and

wherein upon rotating said twister assembly (50), said ribbon guide (59) deflects a portion of said ribbon (15) relative to the direction defined by said hook (54) and said shear holder assembly (60).

11. Bag neck tying apparatus according to Claim 10, said means for rotating said twister assembly (50) for engaging and twisting said ribbon (15) to form a tie comprising:

an electric motor having a drive shaft connected to each of said holder-shear assembly (60), needle assembly (40) and twister assembly (50).

12. Bag neck tying apparatus according to Claim 11, said twister assembly comprising:

a twister shaft (52);
a hook (54) on said twister shaft (52); and
means (56) connecting said drive shaft of said motor (M3) to said twister shaft (52).

13. Bag neck tying apparatus according to Claim 11, said needle assembly (40) comprising:

a needle (42);
an idler roller (44) on said needle (42); and
a gearbox (46) drivingly connecting said needle (42) to said motor output shaft.

14. Bag neck tying apparatus according to Claim 11, said holder-shear assembly (60) comprising:

a mounting plate (66);
a shear arm (62);
a gripper finger (64) on one end of said shear arm (62);
means (65) for rotatably securing said shear arm (62) to said mounting plate (66); and
a pair of anvils (68, 69) on said mounting plate (66), each of said anvils being associated with shear surfaces (68a, 69a) to grip and cut a strand of ribbon positioned between one of said anvils and said gripper finger.

15. Bag neck tying apparatus according to Claim 11, with the addition of:

a material gathering assembly (20) for gathering material moving toward said ribbon of tie material, said gathering assembly being positioned adjacent said holder-shear assembly (60).

16. Bag neck tying apparatus according to Claim 15, said material gathering assembly (20) comprising:

a bag stop lever (80) mounted on a shaft (85) for rotary movement about an axis;
a brake (82) for momentarily locking said lever (85) in a position extending across a path such that the bag neck moves into engagement with said lever (80) for gathering material moving toward said ribbon of tie material.

Patentansprüche

1. Verfahren zum Schließen und Sichern eines Beutels, umfassend die Schritte:

Raffen bzw. Zusammenziehen eines offenen Endes des Beutels, um einen zusammengezogenen Hals auszubilden;
Umgeben des zusammengezogenen Halses mit einem Bandstrang (15), der erste und zweite Bandenden bzw. -schwänze (15a, 15b) aufweist;
Ablenken der Bandenden relativ zu dem Bandstrang (15) unter einem Winkel, der ausreichend ist, um eine Längsbewegung der Bandenden zu verhindern; und
Drehen der Bandenden relativ zu dem Band-

strang, um den Bandstrang zu verdrillen, um einen Bindestreifen bzw. eine Verbindung auszubilden; **dadurch gekennzeichnet, daß**:

die Schritte eines Ablenkens der Bandenden relativ zu dem Band und das Vertwisten bzw. Verdrillen der Enden in einen Bindestreifen bzw. eine Verbindung die Schritte umfassen:

Drehen eines Verdrillhakens (54) auf einer Verdrillwelle (52) benachbart zu einer sich seitlich erstreckenden Bandführungsoberfläche (59), so daß sich das Band (15) allgemein parallel zu der Verdrillwelle (52) erstreckt und die Bandenden durch den Verdrillhaken (54) um die Bandführungsoberfläche (59) gezogen werden und sich allgemein senkrecht zu der Verdrillwelle (52) und zu dem Verdrillhaken (54) erstrecken.

2. Verfahren zum Schließen und Sichern von Beuteln nach Anspruch 1, wobei der Schritt des Ablenkens der Bandenden relativ zu dem Band die Schritte umfaßt: Ablenken der Bandenden (15a, 15b) relativ zu dem Band (15) um einen Winkel in einem Bereich zwischen etwa 70 und 120 Grad.

3. Verfahren zum Schließen und Sichern von Beuteln nach Anspruch 2, worin der Schritt des Ablenkens der Bandenden (15a, 15b) um einen Winkel in dem Bereich zwischen etwa 70 und 120 Grad relativ zu dem Band (15) die Schritte umfaßt:

Bewegen der Bandenden um bzw. über die Bandführungsoberfläche (59), um die Bandenden um einen Verdrillhaken (54) zu wickeln, um die Bandenden (15a, 15b) relativ zu dem Verdrillhaken (54) zu sichern, wenn der Bandstrang (15) verdrillt wird.

4. Verfahren zum Schließen und Sichern von Beuteln nach Anspruch 1, worin der Schritt des Umgebens des zusammengezogenen Halses mit einem Band (15), das erste und zweite Bandenden aufweist, die Schritte umfaßt:

Positionieren der Bandenden in einem Schlitz einer Verdrillanordnung (50), umfassend die Verdrillwelle (52), die sich durch einen Durchgang in der Bandführungsoberfläche (59) erstreckt, wobei sich der Verdrillhaken (54) im allgemeinen parallel zu der Bandführungsoberfläche (59) erstreckt.

5. Verfahren zum Schließen und Sichern eines Beutels nach Anspruch 1, wobei der Schritt des Umgebens des zusammengezogenen Halses mit einem Band (15), das erste und zweite Bandende aufweist, die Schritte umfaßt:

Ergreifen des freien Endes eines Bands (15), das ein erstes Bandende ausbildet, zwischen einem Scherarm (62) und einem Paar von Ambossen (68, 69), die an dem Ende einer Montageplatte (66) ausgebildet sind;
Bewegen des laufenden bzw. Laufendes des Bands (15) zwischen dem Scherarm (62) und dem anderen aus dem Paar von Ambossen (68, 69); und
Bewegen des Scherarms (62) zu dem anderen Amboß (68, 69), um das Band (15) zu schneiden, um ein zweites Bandende auf dem Bandstrang auszubilden und um das freie Ende des Bands (15) ergreifen, so daß der geschnittene Bandstrang eine Schlaufe um den zusammengezogenen Hals ausbildet, und Bandenden (15a, 15b) an den gegenüberliegenden Enden des Bandstrangs aufweist.

6. Verfahren zum Schließen und Sichern eines Beutels nach Anspruch 5, wobei der Schritt des Bewegens des Verteilarms die Schritte umfaßt:

Drehen des Scherarms (62), der eine geformte Oberfläche aufweist, zu Halteroberflächen (68, 69), um sequentiell das Band (15) in eine Ecke (68d, 69d), die zwischen schneidenden bzw. kreuzenden Abschnitten (68c und 68e, 69c und 69e) der Halteroberfläche ausgebildet ist, derart hineinzudrücken, daß ein Zug bzw. eine Spannung auf das Band das Band (15) herausdrückt und hält;
Formen des Bands um einen Punkt (68b, 69b), um das Band weiter zu halten;
Biegen des Bands über eine Schneidkante (68a, 69a) des Halters (68, 69) und Schneiden des Bands.

7. Verfahren zum Schließen und Sichern von Beuteln nach Anspruch 1, wobei der Schritt des Umgebens des zusammengezogenen Halses mit einem Band, das erste und zweite Bandenden aufweist, die Schritte umfaßt:

Umgeben des zusammengezogenen Halses mit einem Drahtband, das in einer Papierabdeckung aufgenommen ist.

8. Verfahren zum Schließen und Sichern von Beuteln nach Anspruch 1, wobei der Schritt des Umgebens des zusammengezogenen Halses mit einem Band, das erste und zweite Bandenden aufweist, die Schritte umfaßt:

Umgeben des zusammengezogenen Halses mit einem Drahtband, das in eine Abdeckung aus Kunststoffmaterial aufgenommen ist.

9. Verfahren zum Schließen und Sichern von Beuteln nach Anspruch 1, wobei der Schritt des Umgebens des zusammengezogenen Halses mit einem Band, das erste und zweite Bandenden aufweist, die Schritte umfaßt:

Umgeben des zusammengezogenen Halses mit einem Band, das aus nicht metallischem Material gefertigt ist.

10. Beutelhals-Bindevorrichtung, umfassend:

eine Bandquelle zum Ausgeben eines Bandstrangs (15), der ein freies Ende und einen zentralen Abschnitt aufweist;
eine Halter-Scheranordnung (60) zum Halten des freien Endes des Bands (15);
eine Verdrillanordnung (50) mit einem Haken (54) benachbart der Halter-Scheranordnung (60);
eine Nadelanordnung (40) zum Ergreifen und Positionieren des zentralen Teils bzw. Abschnitts des Bands (15); und
Mittel zum Drehen der Verdrillanordnung (50), um das Band (15) zu ergreifen und zu verdrillen, um einen Bindestreifen bzw. eine Verbindung auszubilden, **dadurch gekennzeichnet, daß**:

die Verdrillanordnung (50) weiters eine Bandführung (59) umfaßt, die eine obere Oberfläche zur Verfügung stellt, die sich quer relativ zu dem Haken (54) erstreckt;

worin die Nadelanordnung zum Eingreifen und Positionieren des zentralen Teils des Bands benachbart der Bandführung und benachbart der Halter-Scheranordnung (60) vorgesehen ist; und
worin beim Drehen der Verdrillanordnung (50) die Bandführung (59) einen Teil des Bands (15) relativ zu der Richtung ablenkt, die durch den Haken (54) und die Halter-Scheranordnung (60) definiert ist.

11. Beutelhals-Bindevorrichtung nach Anspruch 10, wobei die Mittel zum Drehen der Verdrillanordnung (50) zum Eingreifen und Verdrillen des Bands (15), um einen Bindestreifen auszubilden, umfassen:

einen Elektromotor, der eine Antriebswelle aufweist, die jeweils mit der Halter-Scheranordnung (60), Nadelanordnung (40) und Verdrillanordnung (50) verbunden ist.

12. Beutelhals-Bindevorrichtung nach Anspruch 11, wobei die Verdrillanordnung umfaßt:

eine Verdrillwelle (52);
einen Haken (54) auf der Verdrillwelle (52); und
Mittel (56), die die Antriebswelle des Motors (M3) mit der Verdrillwelle (52) verbinden.

13. Beutelhals-Bindevorrichtung nach Anspruch 11, wobei die Nadelanordnung (40) umfaßt:

eine Nadel (42);
eine Leerlaufwalze (44) auf der Nadel (42); und
ein Getriebegehäuse (46), das die Nadel (42) mit der Motorabtriebswelle angetrieben verbindet.

14. Beutelhals-Bindevorrichtung nach Anspruch 11, wobei die Halter-Scheranordnung (60) umfaßt:

eine Montageplatte (66);
einen Scherarm (62);
einen Greiffinger (64) auf einem Ende des Scherarms (62);
Mittel (65) zum drehbaren Sichern des Scherarms (62) an der Montageplatte (66); und
ein Paar von Ambossen (68, 69) auf der Montageplatte (66), wobei jeder der Ambosse Scheroberflächen (68a, 69a) zugeordnet ist, um einen Bandstrang, der zwischen einem der Ambosse und dem Greiffinger angeordnet ist, zu ergreifen und zu schneiden.

15. Beutelhals-Bindevorrichtung nach Anspruch 11, unter Zusatz von:

einer Materialzusammenziehanordnung (20) zum Raffen bzw. Zusammenziehen von Material, das sich zu dem Band von Binde- bzw. Bandmaterial bewegt, wobei die Zusammenziehanordnung benachbart der Halter-Scheranordnung (60) angeordnet ist.

16. Beutelhals-Bindevorrichtung nach Anspruch 15, wobei die Materialzusammenziehanordnung (20) umfaßt:

einen Beutelstophebel (80), der auf einer Welle (85) zur drehbaren Bewegung um eine Achse festgelegt ist;
eine Bremse (82) zum momentanen Verriegeln des Hebels (85) in einer Position, die sich quer zu einem Pfad bzw. Weg derart erstreckt, daß sich der Beutel in Eingriff mit dem Hebel (80) bewegt, um das Material zusammenzuziehen, das sich zu dem Band von Bindematerial bewegt.

Revendications

1. Procédé permettant de fermer et d'attacher un sac, comprenant les étapes consistant :

- à froncer une extrémité ouverte du sac, pour former un col froncé ;
- à entourer le col froncé, d'une bande de ruban (15) ayant une première et une seconde queues de ruban (15a, 15b) ;
- à dévier les queues de ruban par rapport à la bande de ruban (15), suivant un angle suffisant pour empêcher le mouvement longitudinal des queues de ruban ; et
- à faire tourner les queues de ruban par rapport à la bande de ruban, pour torsader la bande de ruban et former un lien ;

caractérisé par les étapes consistant :

- à dévier les queues de ruban par rapport aux rubans et à torsader les queues pour former un lien, comprenant l'étape consistant :

- à faire tourner un crochet de tordoir (54) sur un axe de tordoir (52), de façon adjacente à une surface (59) de guidage du ruban s'étendant latéralement, de sorte que le ruban (15) s'étend généralement de façon parallèle à l'axe de tordoir (52), et lesdites queues de ruban sont tirées par le crochet de tordoir (54) à travers la surface (59) de guidage du ruban et s'étendent généralement de façon perpendiculaire audit axe de tordoir (52) et audit crochet de tordoir (54).

2. Procédé permettant de fermer et d'attacher des sacs selon la revendication 1, l'étape consistant à dévier les queues de ruban par rapport au ruban, comprenant l'étape consistant à dévier les queues de ruban (15a, 15b) par rapport au ruban (15), suivant un angle variant dans une plage comprise entre environ 70 degrés et 120 degrés.

3. Procédé permettant de fermer et d'attacher des sacs selon la revendication 2, l'étape consistant à dévier les queues de ruban (15a, 15b) suivant un angle variant dans une plage comprise entre environ 70 degrés et 120 degrés, par rapport au ruban (15), comprenant l'étape consistant :

- à déplacer les queues de ruban à travers la surface (59) de guidage du ruban, pour enrouler lesdites queues de ruban autour d'un crochet de tordoir (54), pour fixer les queues de ruban (15a, 15b) par rapport audit crochet de tordoir (54), au fur et à mesure que la bande de ruban (15) est torsadée.

4. Procédé permettant de fermer et d'attacher des sacs selon la revendication 1, l'étape consistant à entourer le col froncé, d'un ruban (15) ayant une première et une seconde queues de ruban, comprend l'étape consistant :

- à positionner les queues de ruban dans une fente placée dans un ensemble formant un tordoir (50), englobant ledit axe de tordoir (52) s'étendant à travers un passage dans ladite surface (59) de guidage du ruban, ledit crochet de tordoir (54) s'étendant généralement de façon parallèle à ladite surface (59) de guidage du ruban.

5. Procédé permettant de fermer et d'attacher un sac selon la revendication 1, l'étape consistant à entourer le col froncé, d'un ruban (15) ayant une première et une seconde queues de ruban, comprenant les étapes consistant :

- à engager l'extrémité libre d'un ruban (15) - formant une première queue de ruban - entre un bras de cisaillement (62) et une des enclumes d'une paire d'enclumes supports (68, 69) formée sur l'extrémité d'une plaque de montage (66) ;
- à déplacer l'extrémité courante du ruban (15), entre le bras de cisaillement (62) et l'autre enclume de la paire d'enclumes supports (68, 69) ; et
- à déplacer le bras de cisaillement (62) vers l'autre enclume support (68, 69), pour couper le ruban (15) et former une seconde queue de ruban sur la bande de ruban, et pour saisir l'extrémité libre du ruban (15), de sorte que la bande de ruban coupée forme une boucle autour du col froncé et a des queues de ruban (15a, 15b) sur des extrémités opposées de la bande de ruban.

6. Procédé permettant de fermer et d'attacher un sac selon la revendication 5, l'étape de déplacement du bras de cisaillement comprenant les étapes consistant :

- à faire tourner ledit bras de cisaillement (62) ayant une surface profilée, vers des surfaces de supports (68, 69), pour pousser successivement le ruban (15) dans une partie angulaire (68d, 69d) formée entre des parties d'intersection (68c et 68e, 69c et 69e) de la surface du support, de manière telle que la tension sur le ruban refoule et maintienne le ruban (15) ;
- à mouler le ruban autour d'un point (68b, 69b) pour continuer à maintenir le ruban ;
- à recourber le ruban par-dessus un bord de coupe (68a, 69a) du support (68, 69) ; et

- à couper le ruban.

7. Procédé permettant de fermer et d'attacher des sacs selon la revendication 1, l'étape consistant à entourer le col froncé, d'un ruban ayant une première et une seconde queues de ruban, comprenant l'étape consistant :

- à entourer le col froncé, d'un ruban de fil enrobé dans un revêtement de papier.

8. Procédé permettant de fermer et d'attacher des sacs selon la revendication 1, l'étape consistant à entourer le col froncé, d'un ruban ayant une première et une seconde queues de ruban, comprenant l'étape consistant :

- à entourer le col froncé, d'un ruban de fil enrobé dans un revêtement de matière plastique.

9. Procédé permettant de fermer et d'attacher des sacs selon la revendication 1, l'étape consistant à entourer le col froncé, d'un ruban ayant une première et une seconde queues de ruban, comprenant l'étape consistant :

- à entourer le col froncé, d'un ruban constitué d'une matière non métallique.

10. Appareil servant à lier un col de sac, comprenant :

- une source de ruban servant à distribuer une bande de ruban (15) ayant une extrémité libre et une partie centrale ;
- un ensemble formant support de cisaillement (60) pour maintenir l'extrémité libre dudit ruban (15) ;
- un ensemble formant tordoir (50) comportant un crochet (54) adjacent audit ensemble formant support de cisaillement (60) ;
- un ensemble formant aiguille (40) pour engager et positionner ladite partie centrale dudit ruban (15) ; et
- des moyens servant à faire tourner ledit ensemble formant tordoir (50), afin d'engager et de torsader ledit ruban (15) pour former un lien ;

caractérisé par ledit ensemble formant tordoir (50) comprenant en outre un guide de ruban (59) fournissant une surface supérieure s'étendant de façon transversale par rapport audit crochet (54) ;
où ledit ensemble formant aiguille est prévu pour engager et positionner ladite partie centrale dudit ruban, de façon adjacente audit guide de ruban et de façon adjacente audit ensemble formant support de cisaillement (60) ; et
où, lors de la rotation dudit ensemble formant tordoir (50), ledit guide de ruban (59) dévie une partie dudit ruban (15) par rapport à la direction définie par ledit crochet (54) et par ledit ensemble formant support de cisaillement (60).

11. Appareil servant à lier un col de sac selon la revendication 10, lesdits moyens servant à faire tourner ledit ensemble formant tordoir (50), afin d'engager et de torsader ledit ruban (15) pour former un lien, comprenant :

- un moteur électrique ayant un arbre d'entraînement relié à chacun des ensembles tels que l'ensemble formant support de cisaillement (60), l'ensemble formant aiguille (40) et l'ensemble formant tordoir (50).

12. Appareil servant à lier un col de sac selon la revendication 11, ledit ensemble formant tordoir comprenant :

- un arbre de tordoir (52) ;
- un crochet (54) monté sur ledit arbre de tordoir (52) ; et
- des moyens (56) reliant ledit arbre d'entraînement dudit moteur (M3) audit arbre de tordoir (52).

13. Appareil servant à lier un col de sac selon la revendication 11, ledit ensemble formant aiguille (40) comprenant :

- une aiguille (42) ;
- un rouleau tendeur (44) monté sur ladite aiguille (42) ; et
- une boîte de vitesses (46) reliant ladite aiguille (42), par entraînement, à l'arbre de sortie dudit moteur.

14. Appareil servant à lier un col de sac selon la revendication 11, ledit ensemble formant support de cisaillement (60) comprenant :

- une plaque de montage (66) ;
- un bras de cisaillement (62) ;
- un doigt préhenseur (64) monté sur une extrémité dudit bras de cisaillement (62) ;
- des moyens (65) permettant de fixer en rotation ledit bras de cisaillement (62) sur ladite plaque de montage (66) ; et
- une paire d'enclumes supports (68, 69) placées sur ladite plaque de montage (66), chacune desdites enclumes supports étant associée à des surfaces de cisaillement (68a, 69a) pour prendre et couper une bande de ruban positionnée entre l'une desdites enclumes supports et ledit doigt préhenseur.

15. Appareil servant à lier un col de sac selon la reven-

dication 11, comprenant en outre :

- un ensemble collecteur de matière (20) servant à collecter de la matière se déplaçant vers ledit ruban de matière du lien, ledit ensemble collecteur étant positionné de façon adjacente audit ensemble formant support de cisaillement (60).

16. Appareil servant à lier un col de sac selon la revendication 15, ledit ensemble collecteur de matière (20) comprenant :

- un levier d'arrêt de sac (80) monté sur un arbre (85) pour un mouvement rotatif autour d'un axe ;
- un frein (82) servant à verrouiller momentanément ledit levier (80) dans une position s'étendant à travers un trajet tel, que le col du sac se déplace en s'engageant avec ledit levier (80), pour collecter de la matière se déplaçant vers ledit ruban de matière du lien.

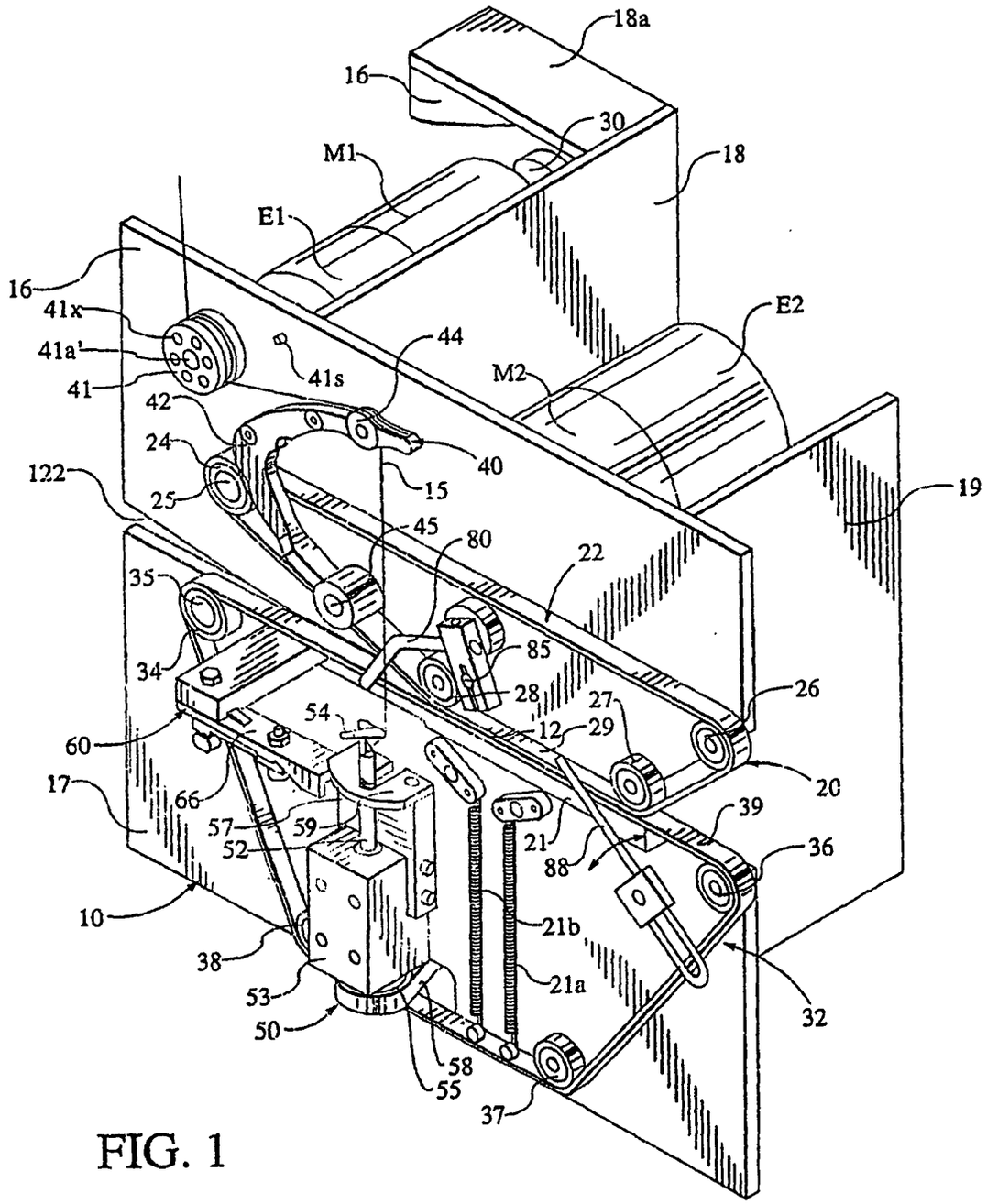
18a
16
30
M1
18
E1
16
41x
41a'
41
41s
44
42
M2
E2
24
40
122
25
15
19
45
80
22
35
85
34
28
26
54
27
12
29
60
20
17
66
57
59
39
21
52
88
36
10
21b
38
21a
53
32
50
58
55
37

FIG. 1

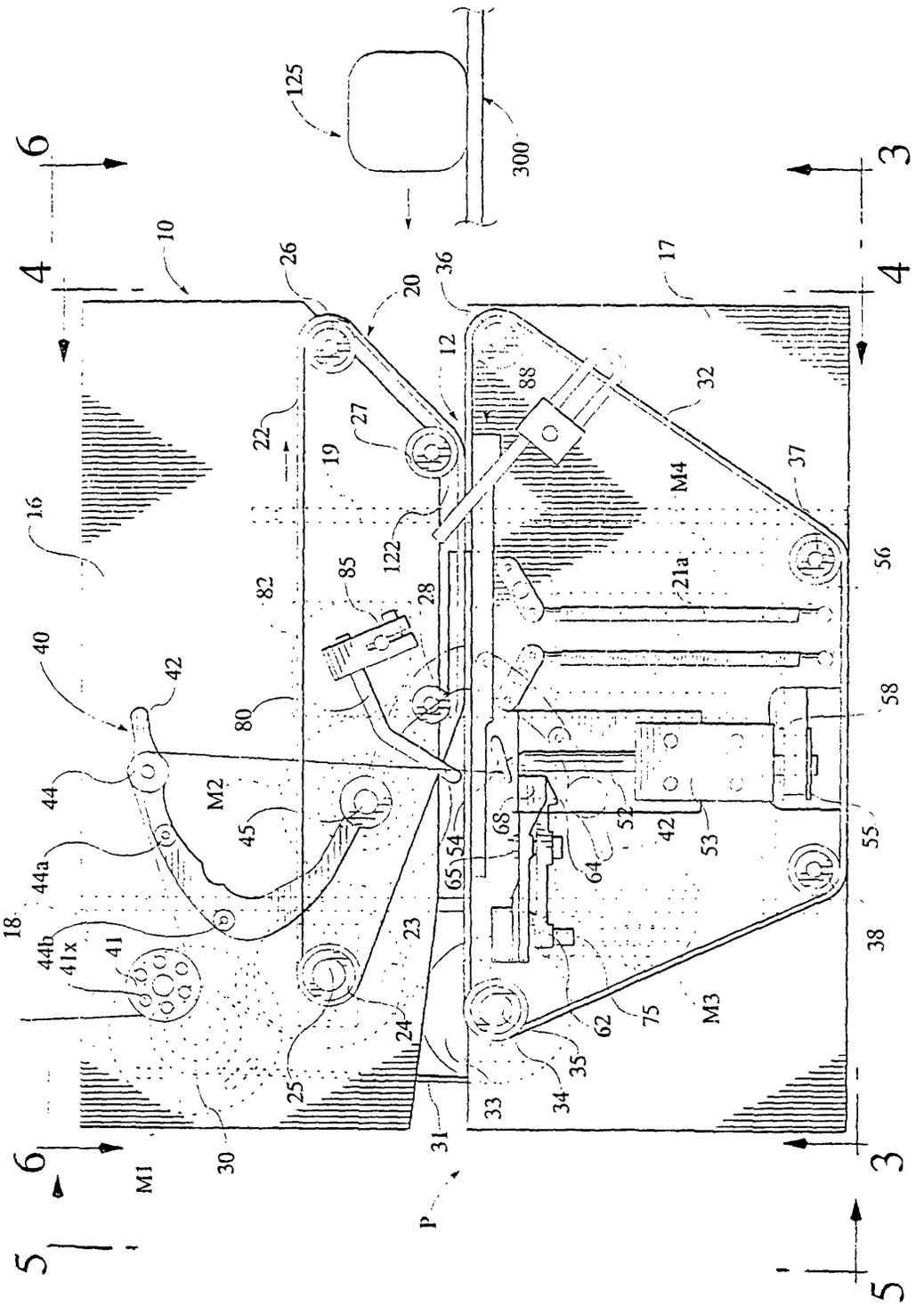
125
300
10
26
20
36
17
12
88
32
22
27
19
M4
37
16
122
85
28
82
21a
56
40
42
80
58
44
M2
45
68
52
42
53
55
44a
54
65
64
18
44b
41x
41
23
38
24
62
75
M3
25
35
34
33
31
30
M1
P
3
4
5
6

FIG. 2

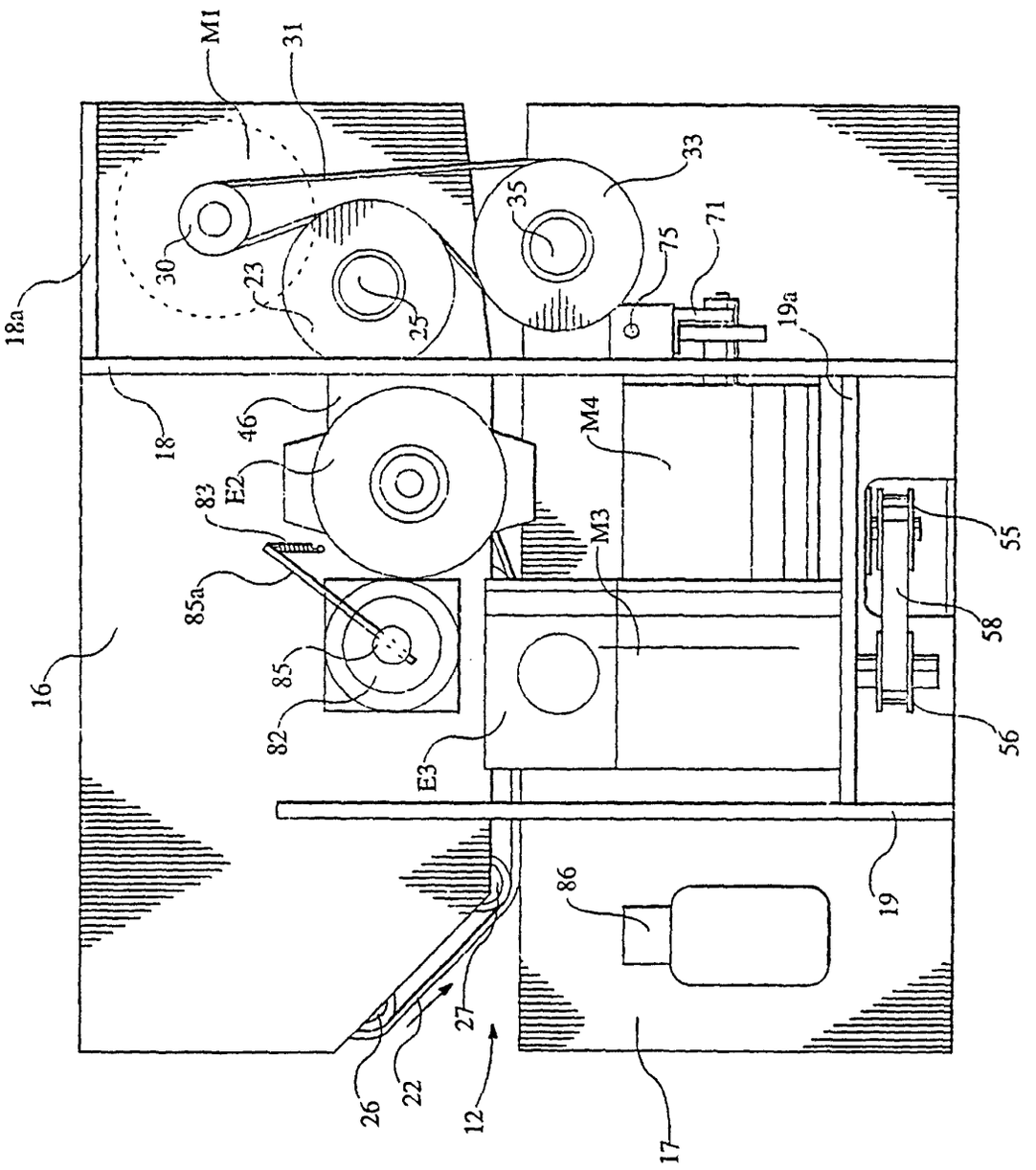
M1
31
33
35
71
75
30
23
25
18a
19a
18
46
M4
E2
83
M3
55
85a
58
16
85
82
56
E3
19
86
27
26
22
12
17

FIG. 3

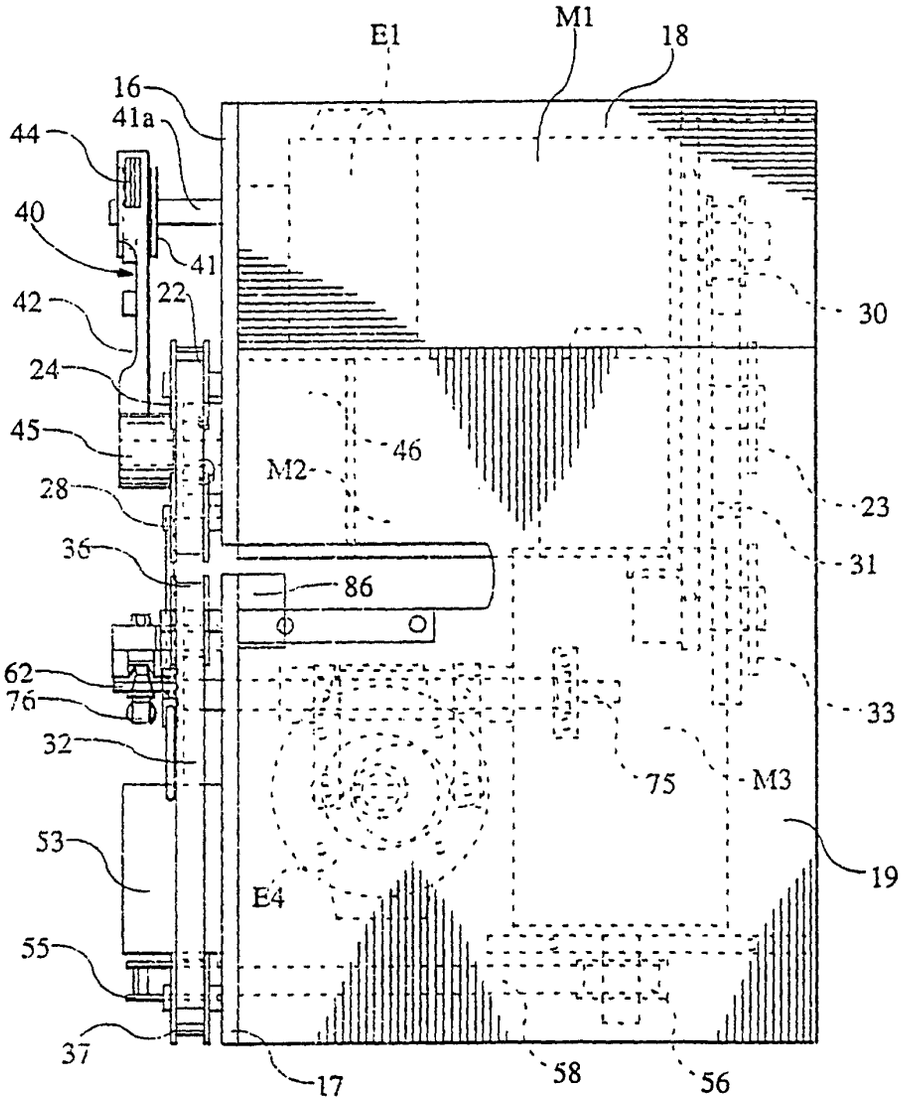
E1
M1
18
16
41a
44
40
41
22
42
24
45
28
36
62
76
32
53
55
37
17
58
56
30
46
M2
23
31
86
33
75
M3
19
E4

FIG. 4

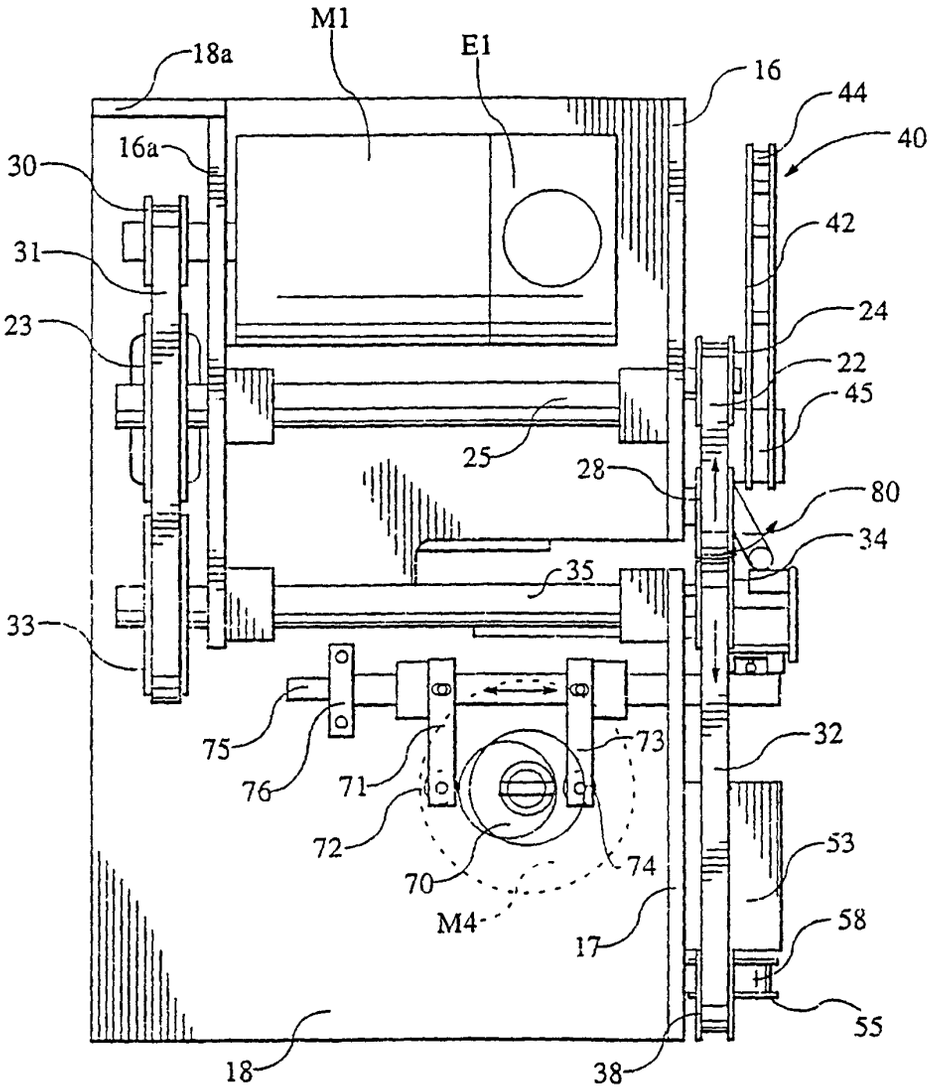
M1
E1
18a
16
44
40
16a
30
42
31
24
23
22
45
25
28
80
34
35
33
32
75
73
76
71
72
70
74
M4
53
17
58
55
18
38

FIG. 5

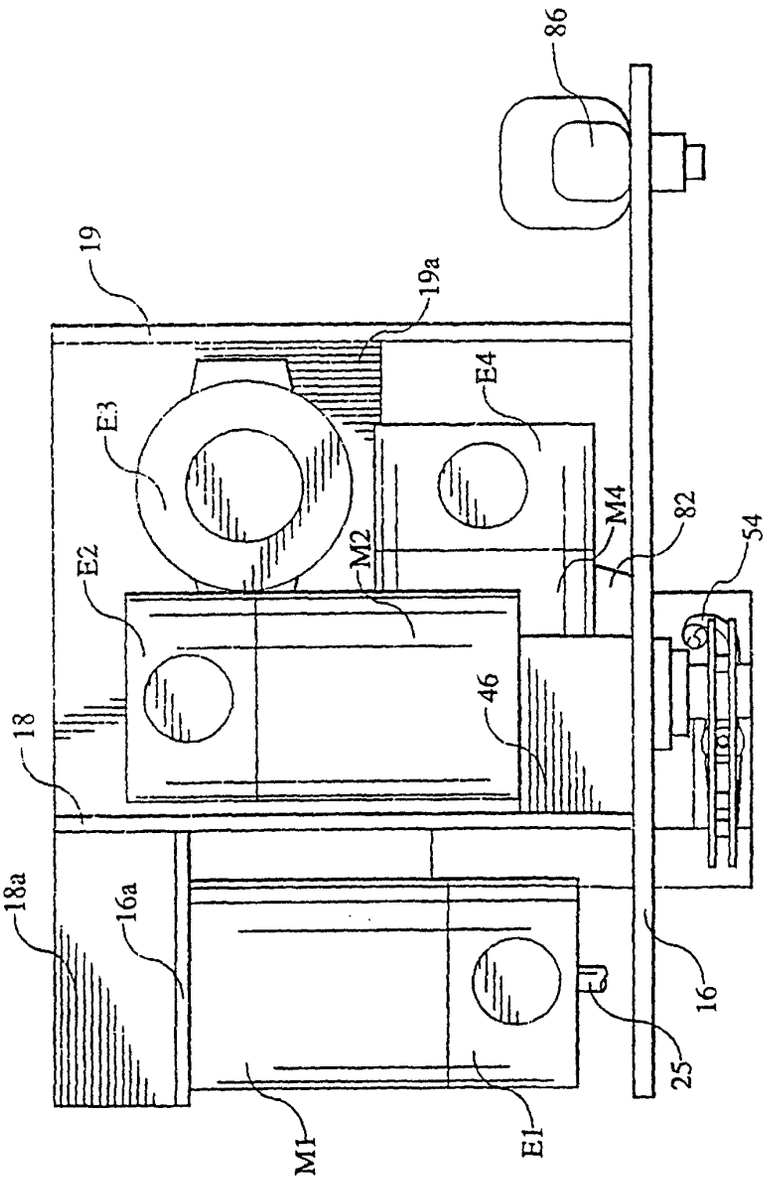

FIG. 6

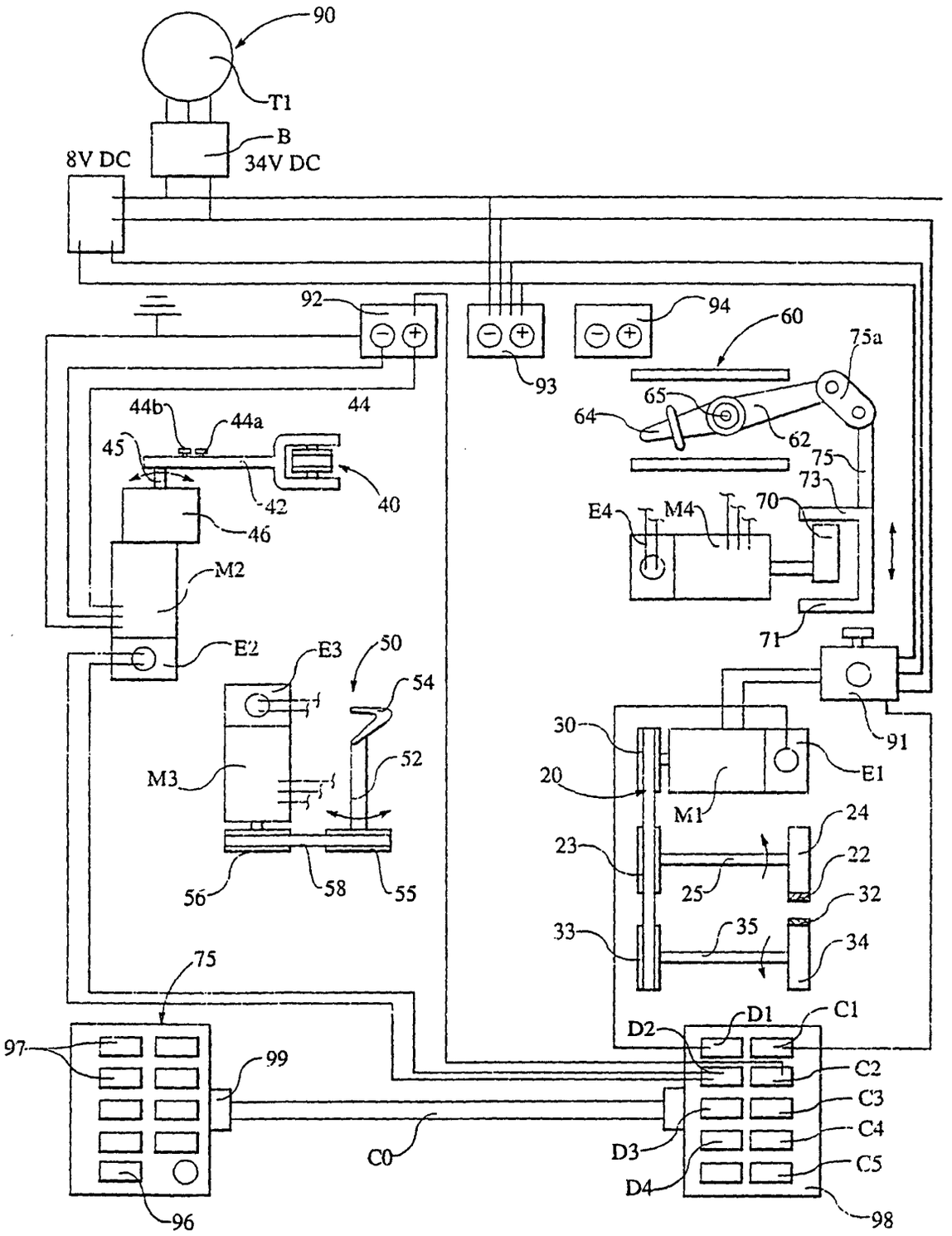
90
T1
B
8V DC
34V DC
92
93
94
60
75a
65
64
62
75
73
70
E4
M4
71
44b
44a
45
44
42
40
46
M2
E2
E3
50
54
52
M3
56
58
55
30
20
M1
E1
91
24
23
22
25
32
33
35
34
75
97
99
96
C0
D2
D1
C1
C2
C3
C4
C5
D3
D4
98

FIG. 7

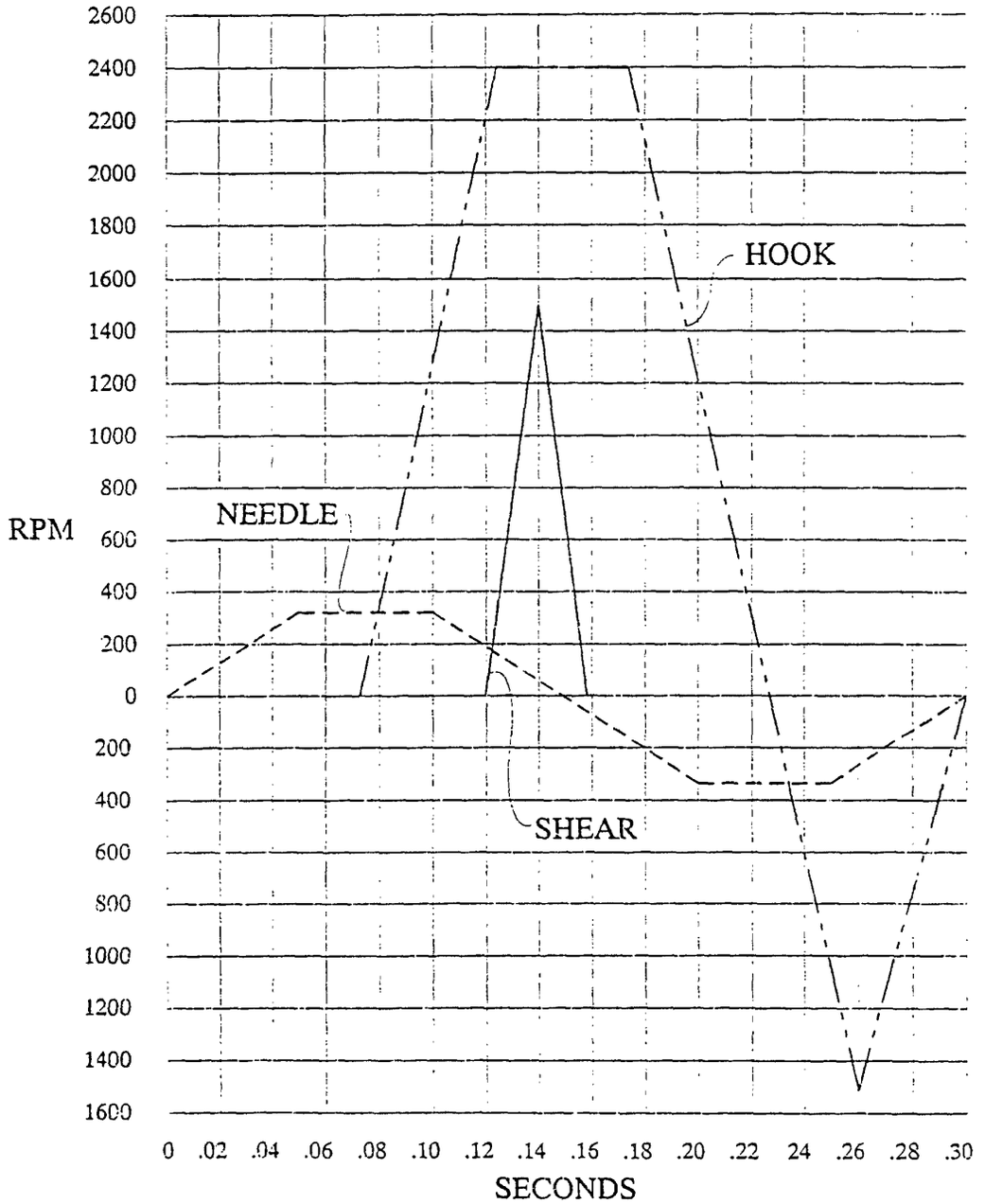
RPM
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
600
800
1000
1200
1400
1600
NEEDLE
HOOK
SHEAR
0 .02 .04 .06 .08 .10 .12 .14 .16 .18 .20 .22 24 .26 .28 .30
SECONDS

FIG. 8

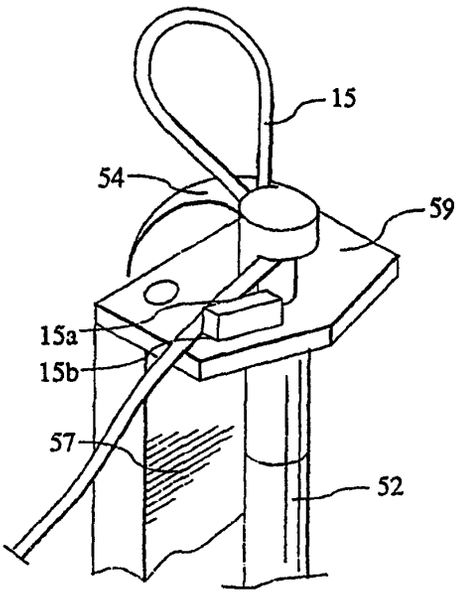

FIG. 9

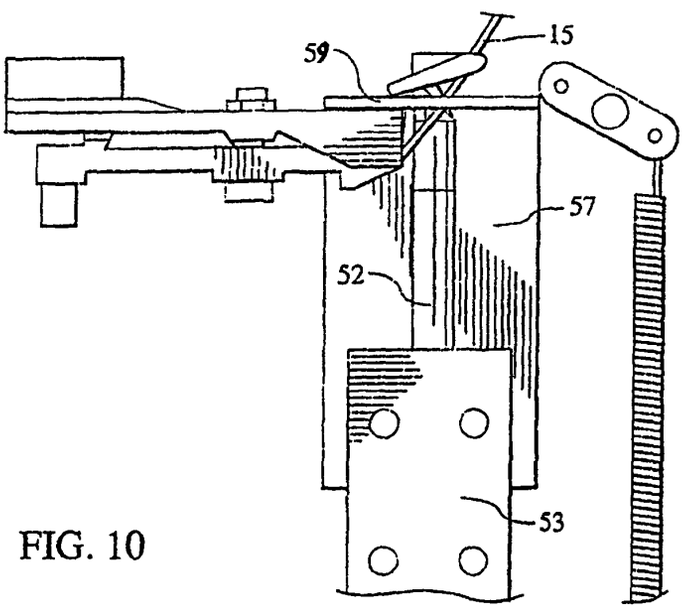

FIG. 10

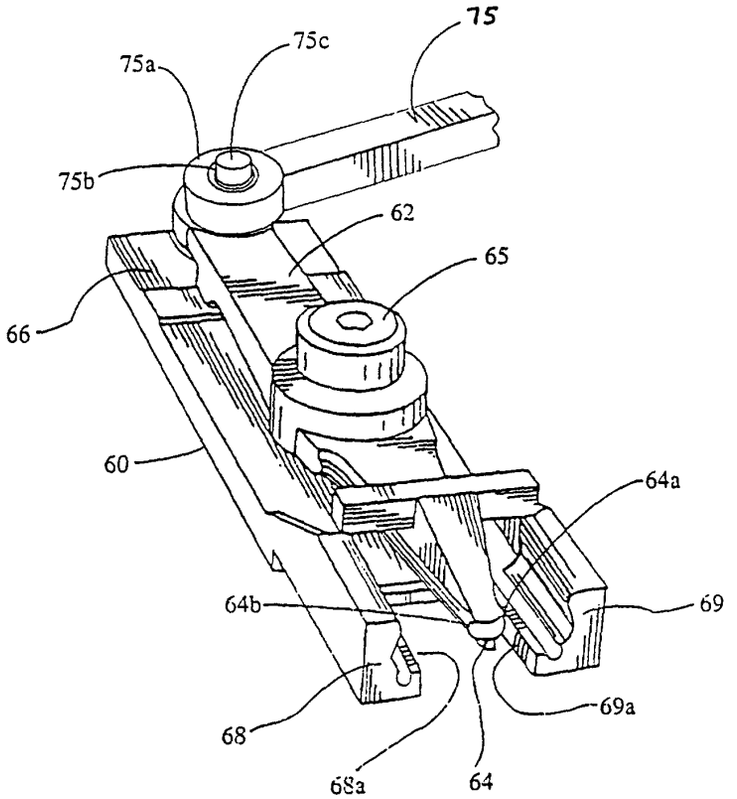

FIG. 11

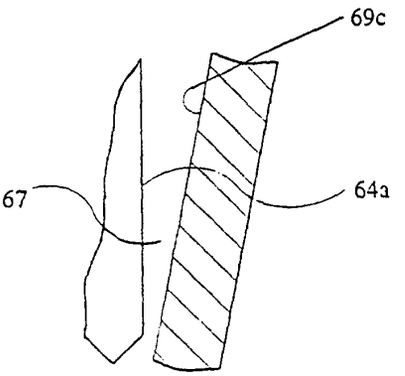

FIG. 13

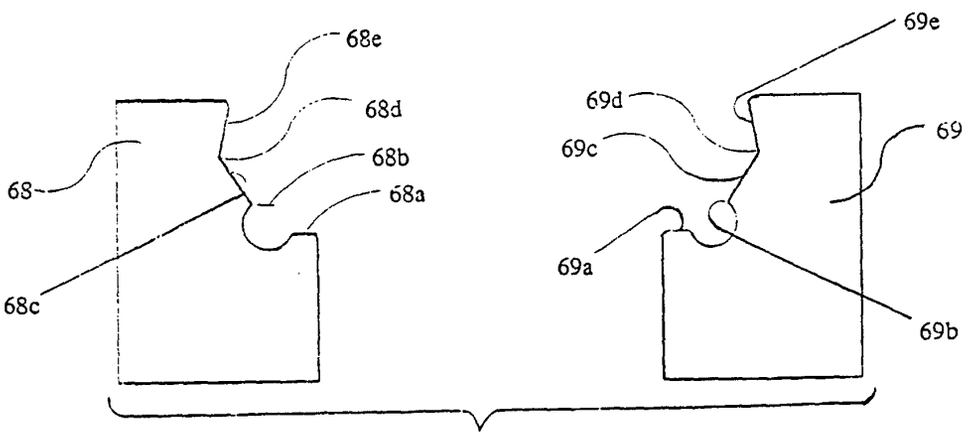

FIG. 12