United States Patent [19]

Burford et al.

[11] **3,919,829**

[45] **Nov. 18, 1975**

[54] **APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS**

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[21] Appl. No.: **147,143**

[52] **U.S. Cl.** ..... **53/135;** 53/198 A

[51] **Int. Cl.**[2] **B65B 51/08**

[58] **Field of Search** ..... 53/14, 135, 138 A, 139, 53/373; 29/243.57; 140/93.6; 198/165

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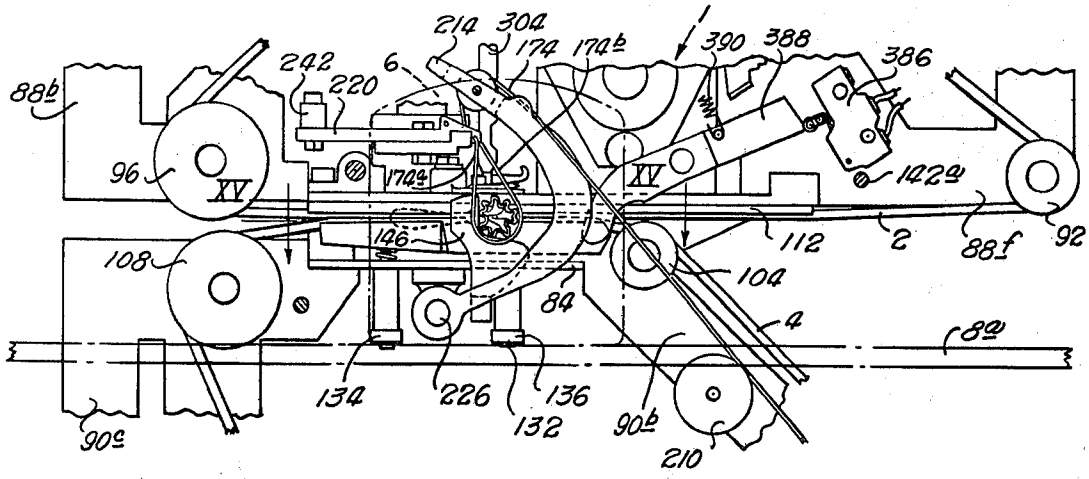
[57] **ABSTRACT**

A package tying device comprising powered belts rotatably mounted on a frame to gather and draw packaging material over a product to be packaged before tying the package closed with a ribbon of wire. Tension of the packaging material is adjustable by varying pressure between the belts and the material to control force applied to draw the packaging material around the product being packaged. Frame on which the belts are mounted is adjustable to facilitate tying at any angle and at any elevation and the belts are formed to gather bags of varying sizes.

A bag stop is positionable across the path of the neck of the bag and the neck is drawn around the stop and through an opening in guide plates to draw the bag around the objects in the bag. The objects in the bag are restrained by the guide plates.

10 Claims, 22 Drawing Figures



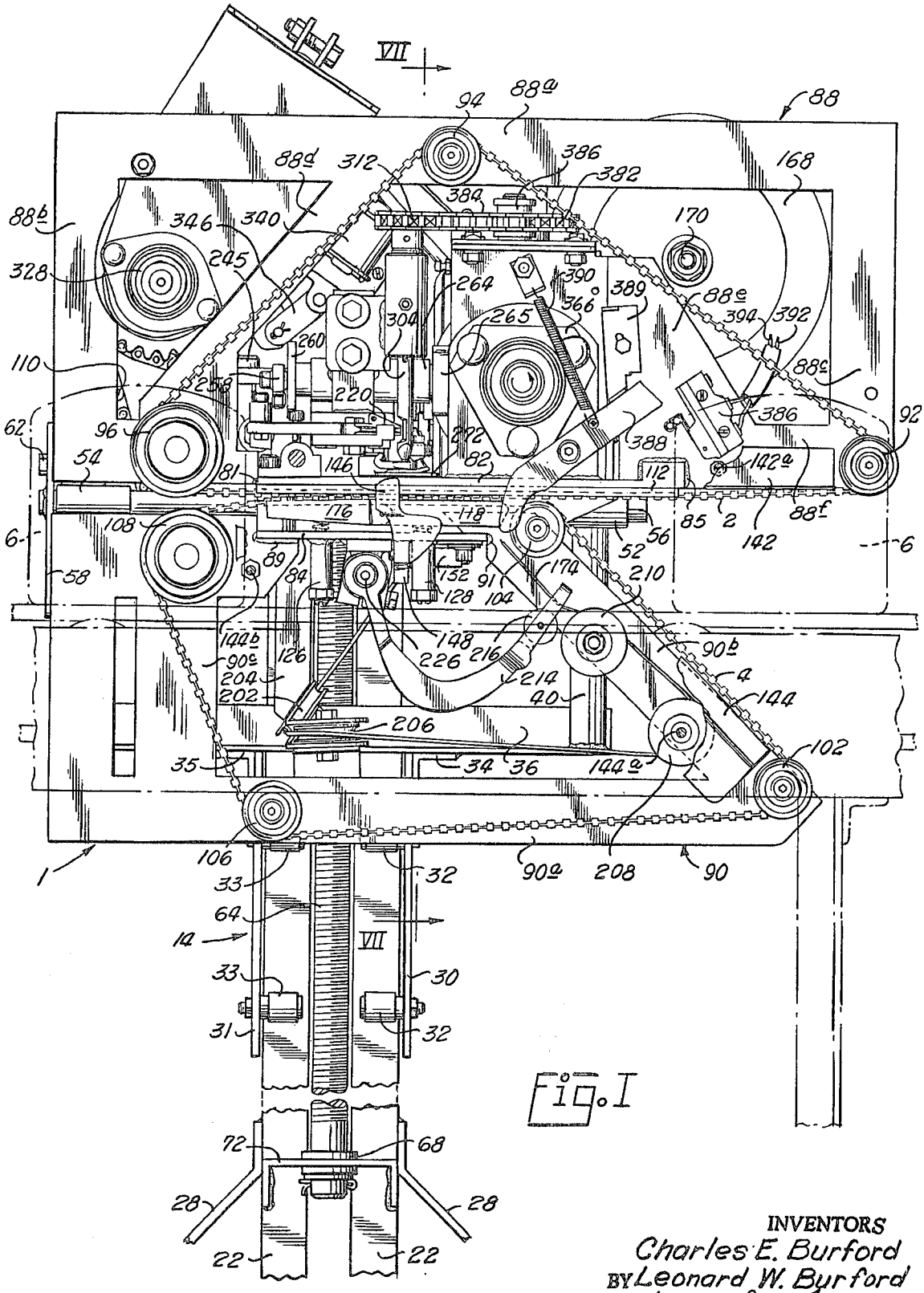


Fig. 1

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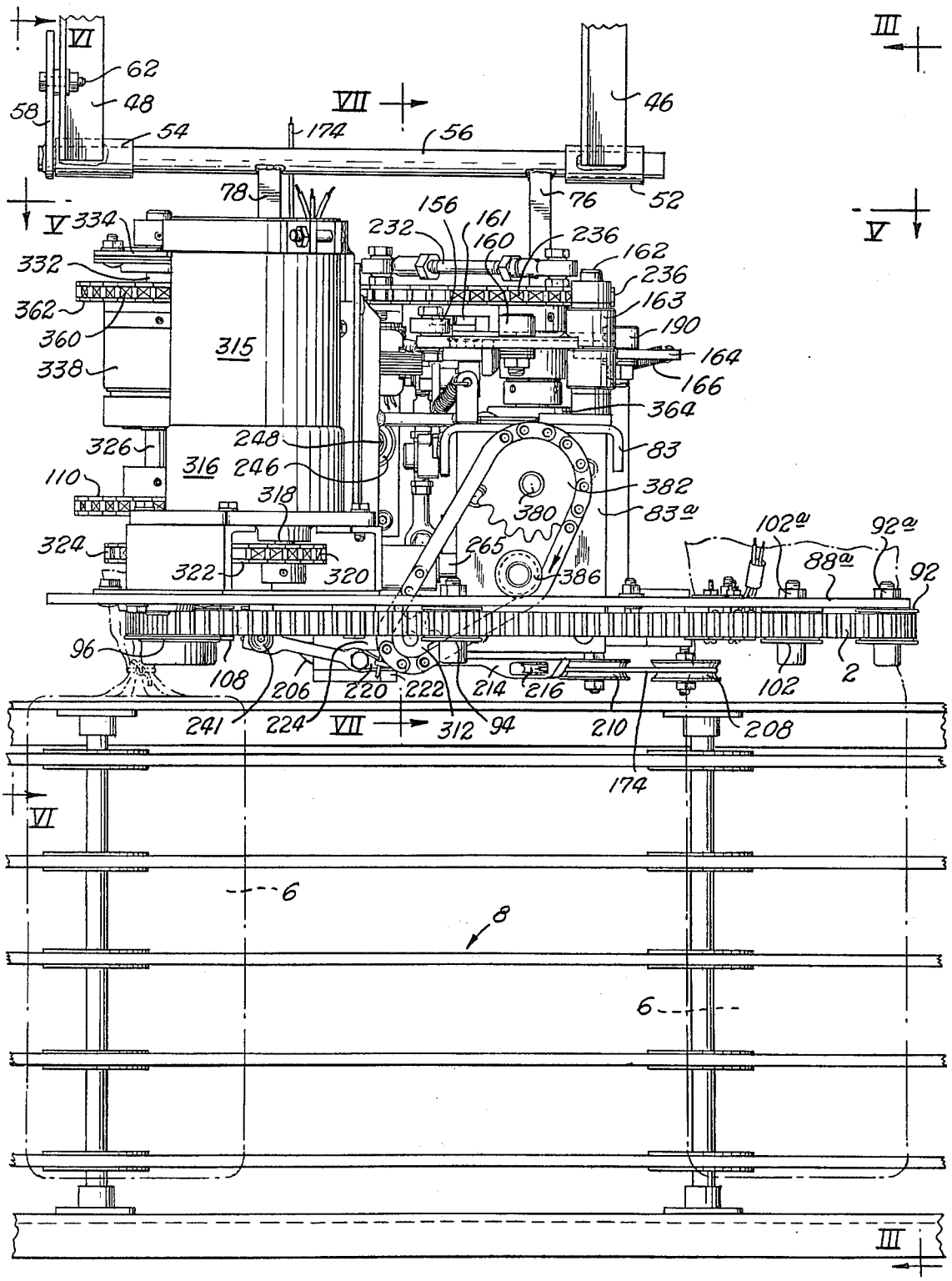

Fig. II

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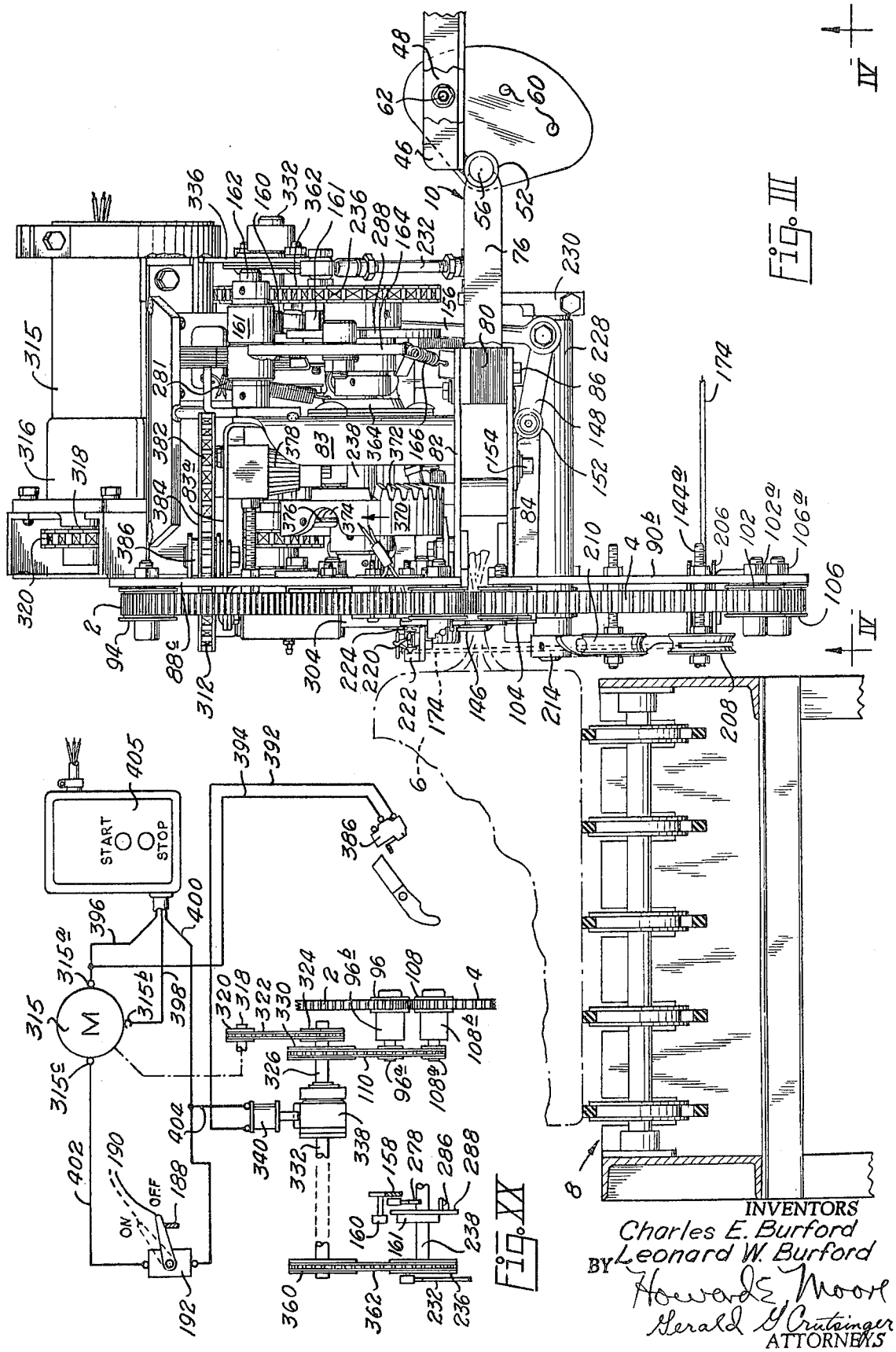

FIG. III

FIG. XX

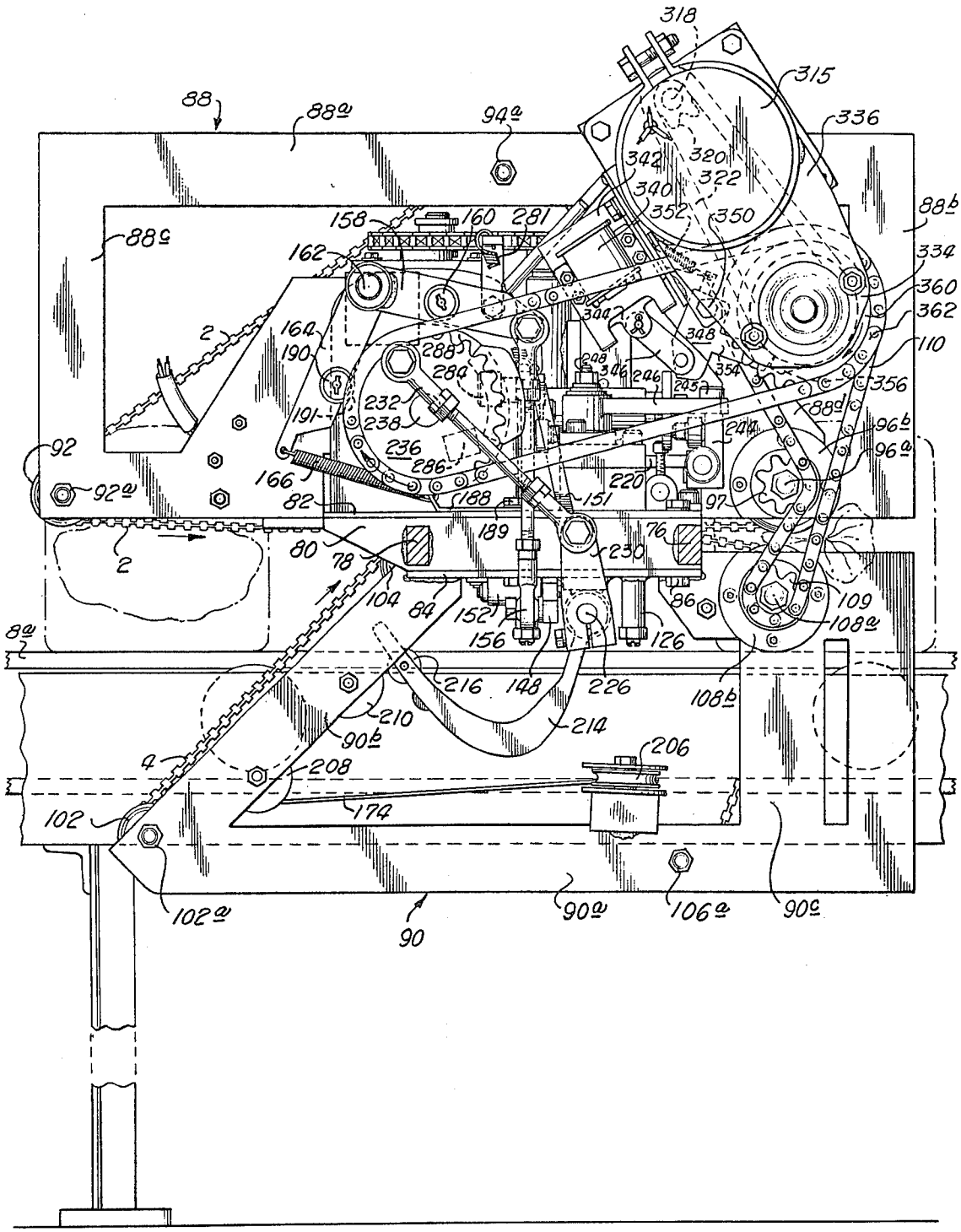

Fig. V

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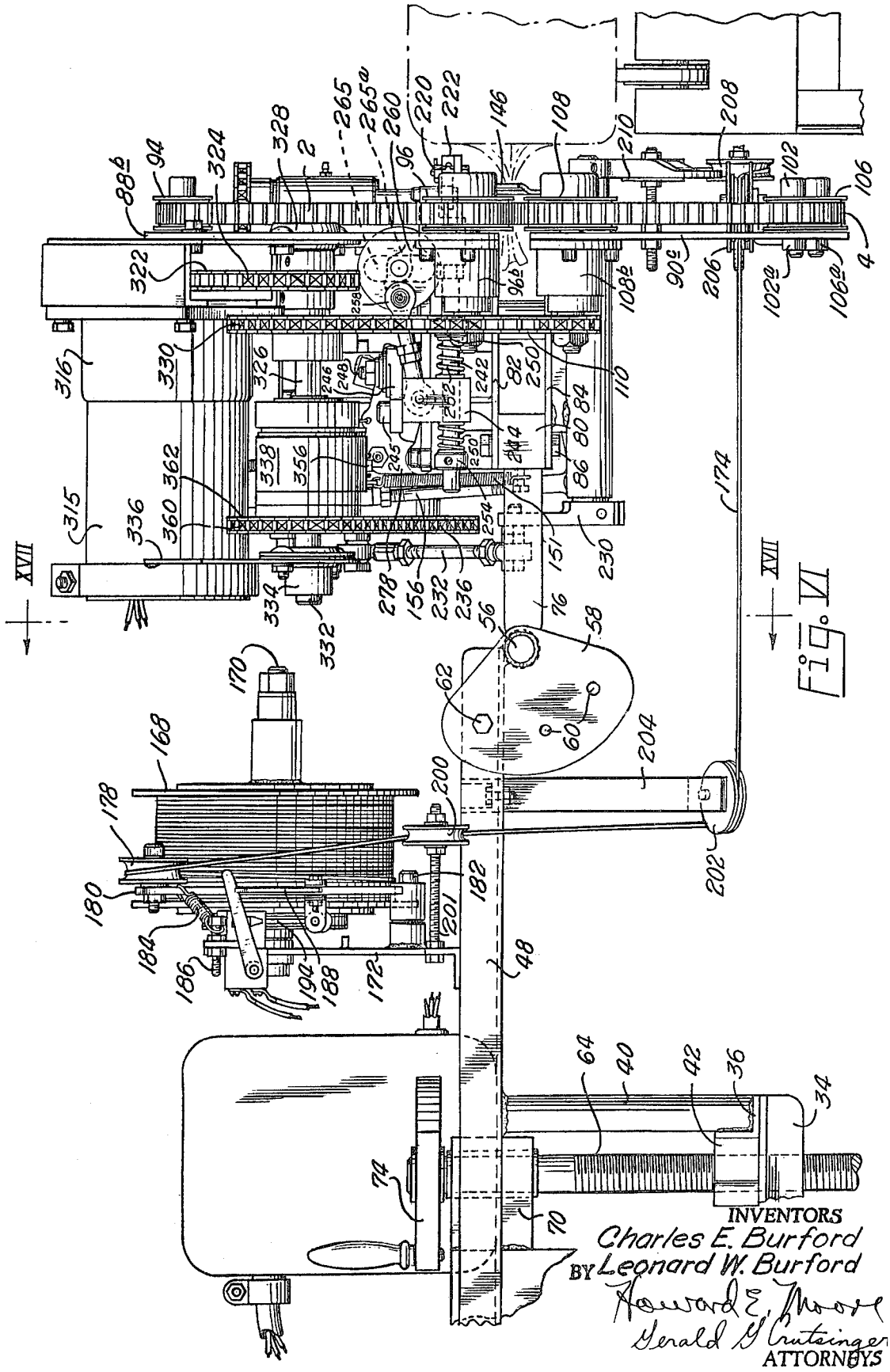
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Fig. VI

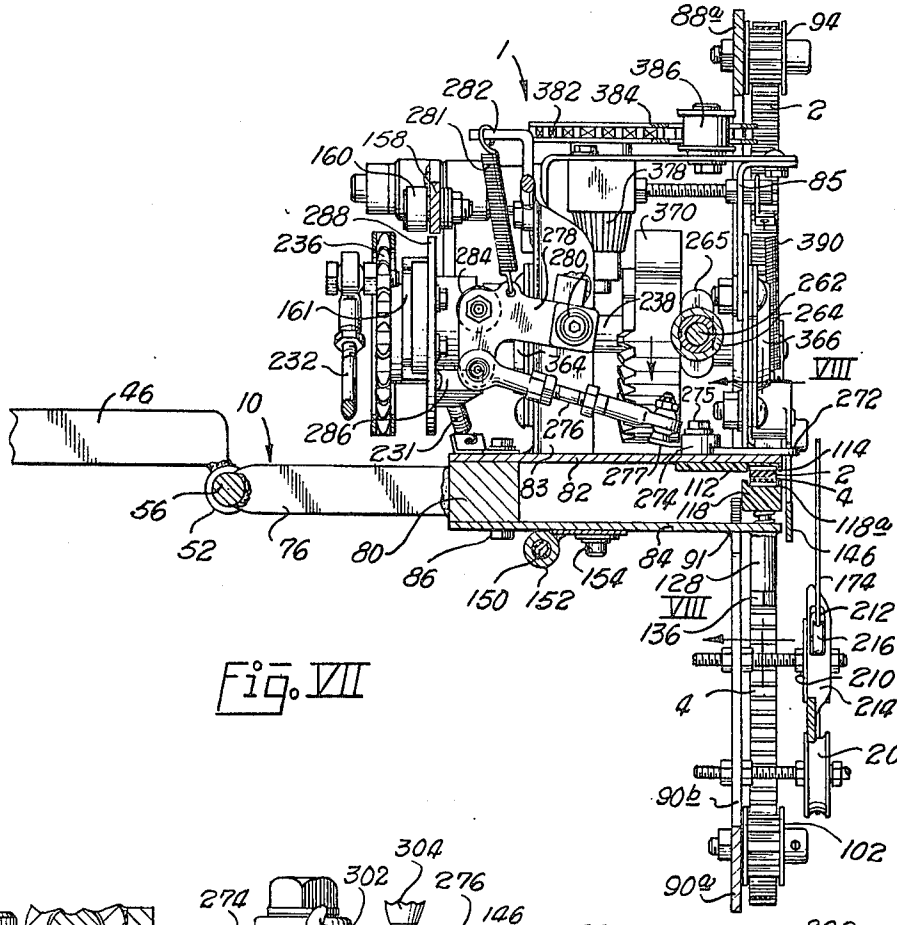

Fig. VII

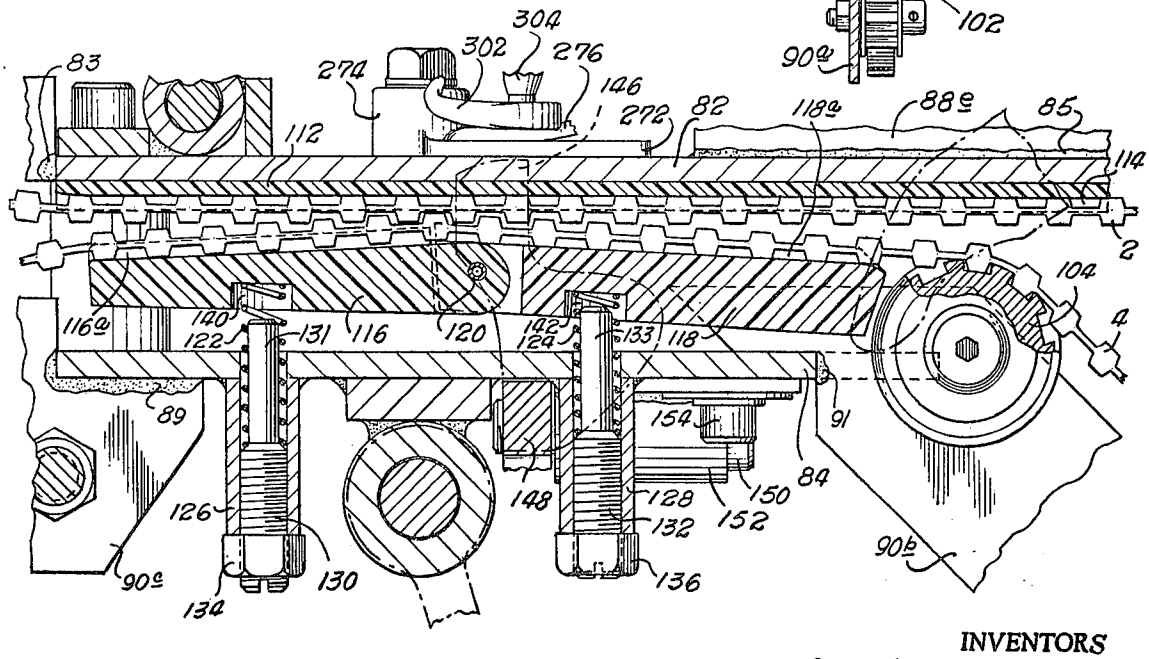

Fig. VIII

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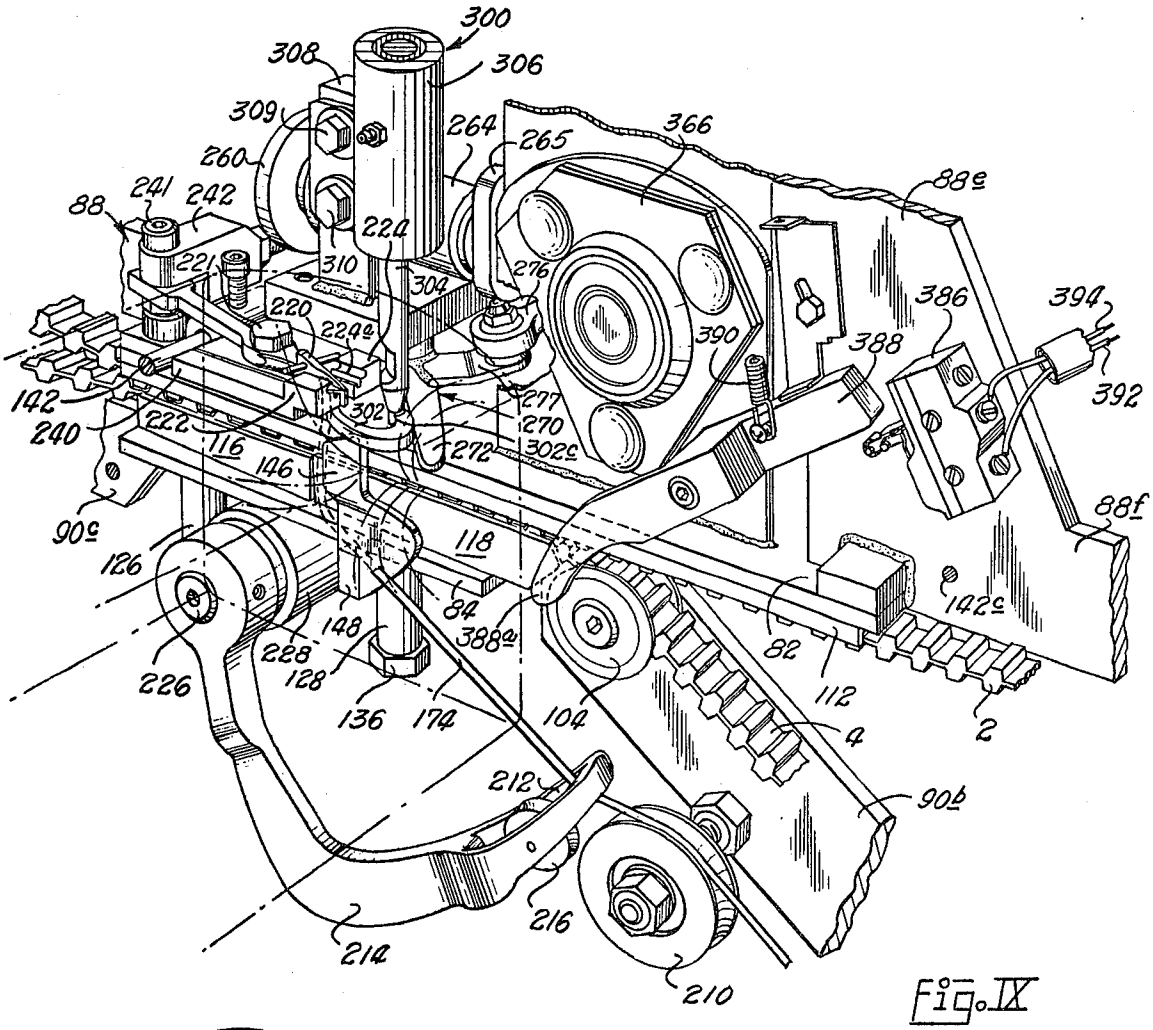

Fig. IX

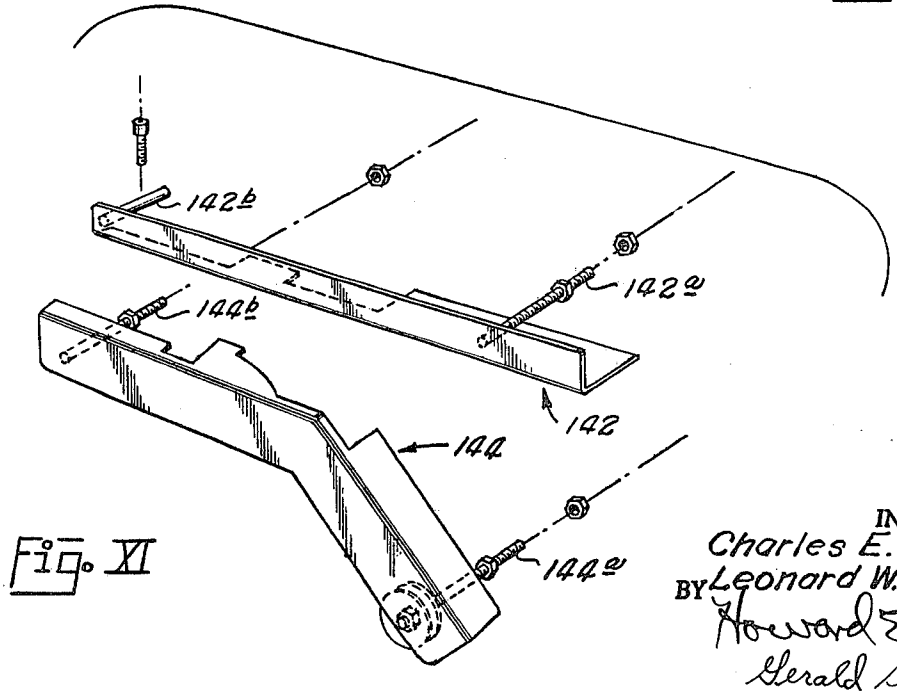

Fig. XI

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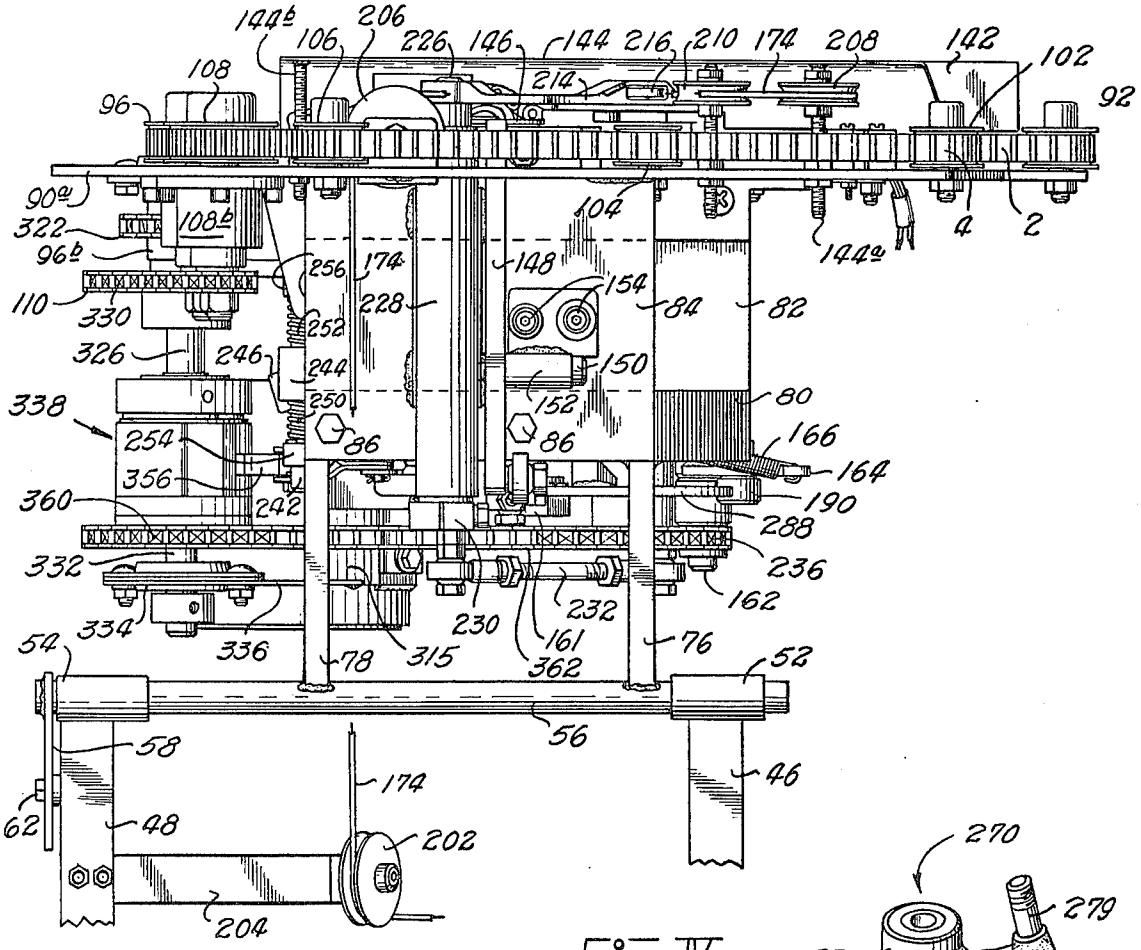

Fig. IV

Fig. X

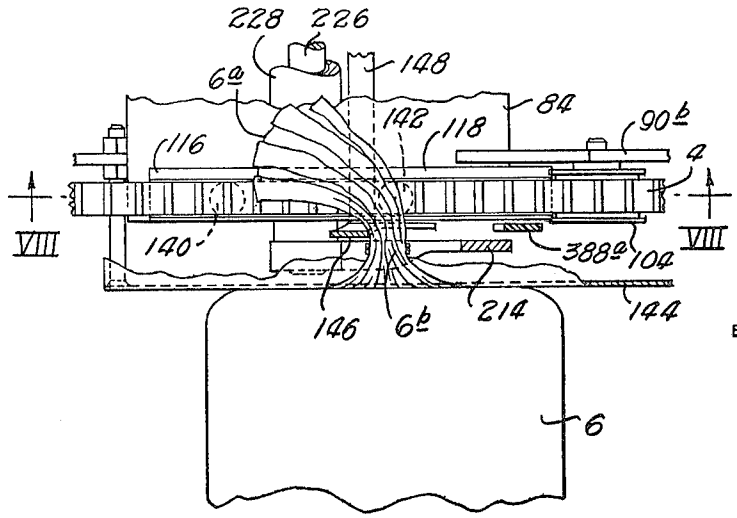

Fig. XV

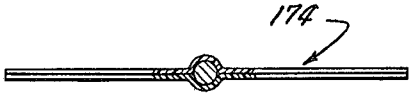

Fig. XVI

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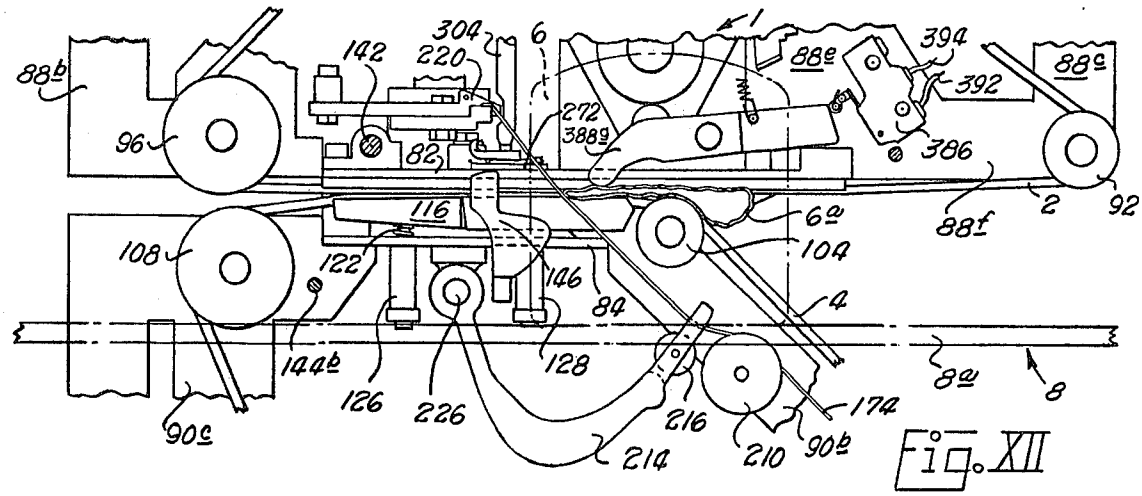

Fig. XII

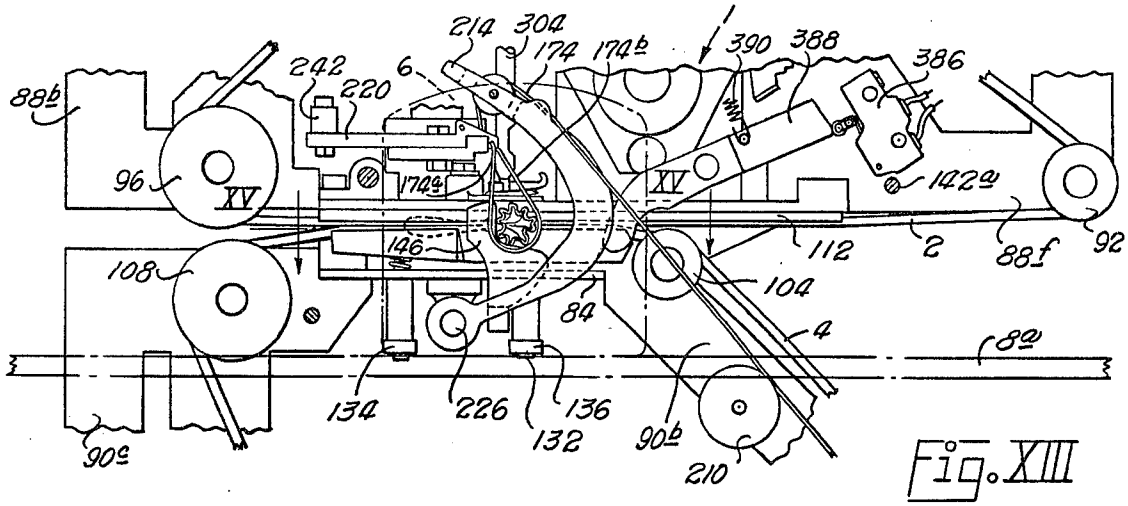

Fig. XIII

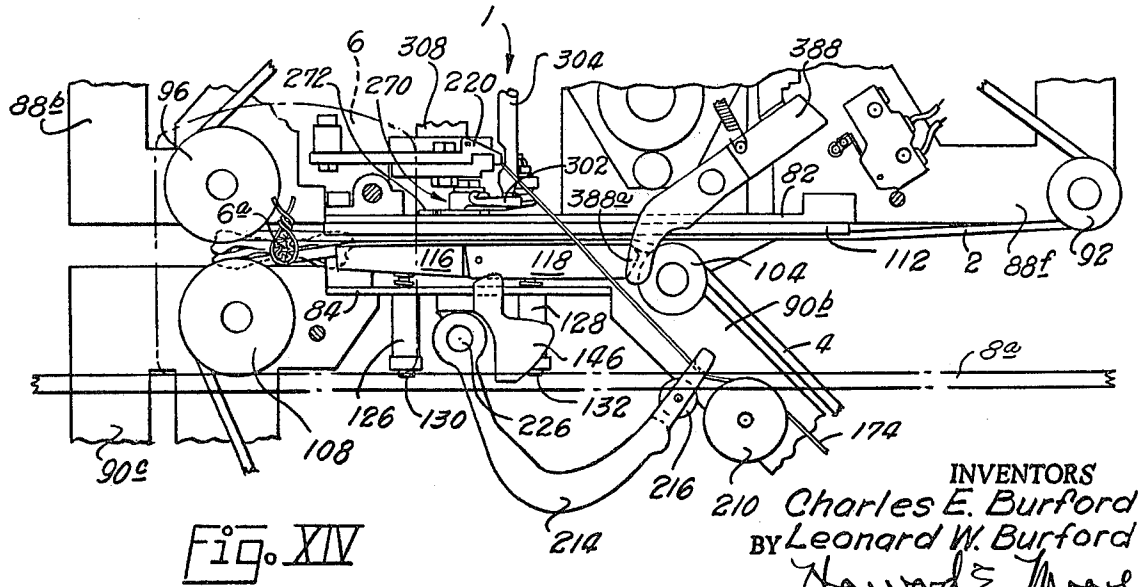

Fig. XIV

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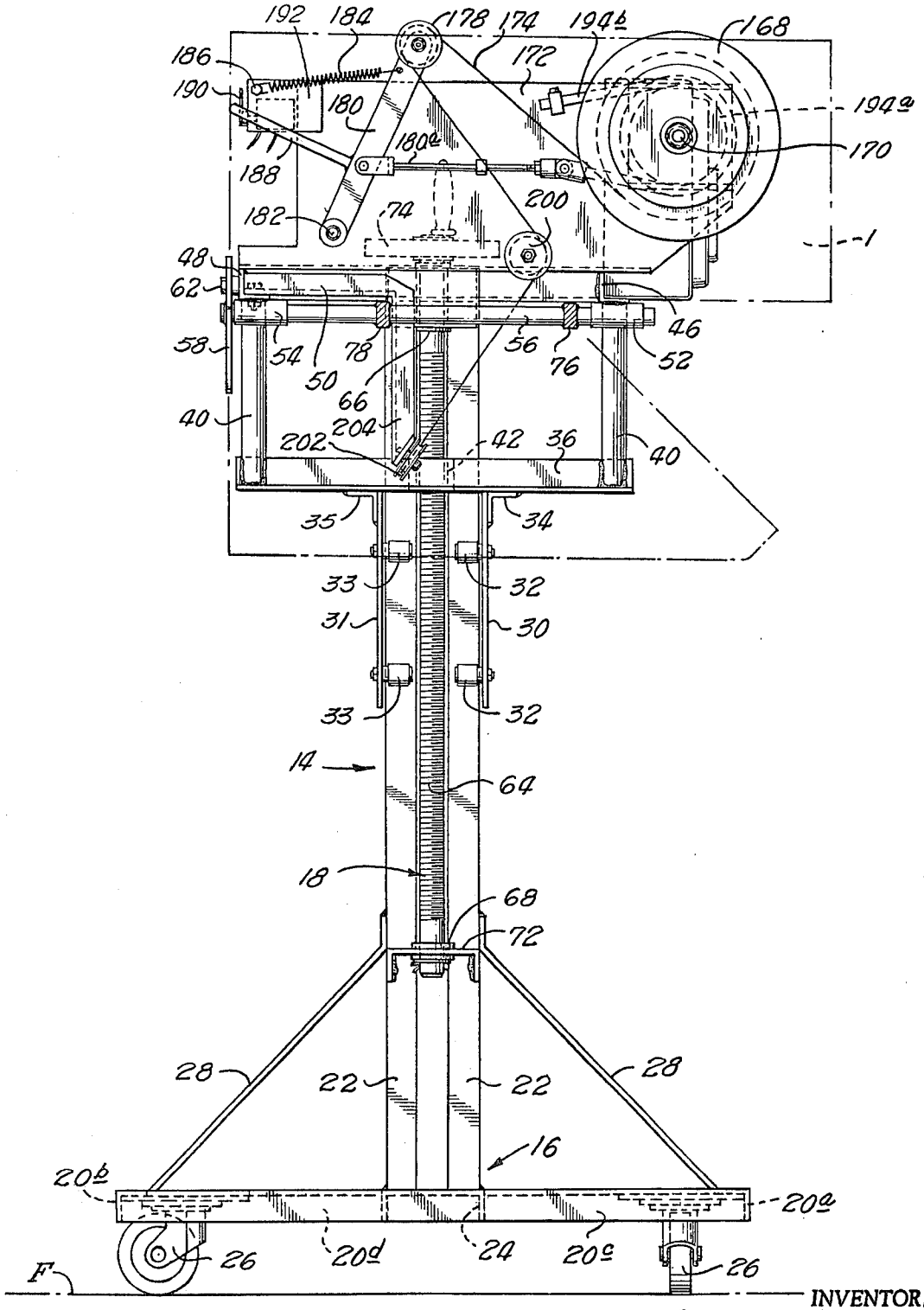

Fig. XVII

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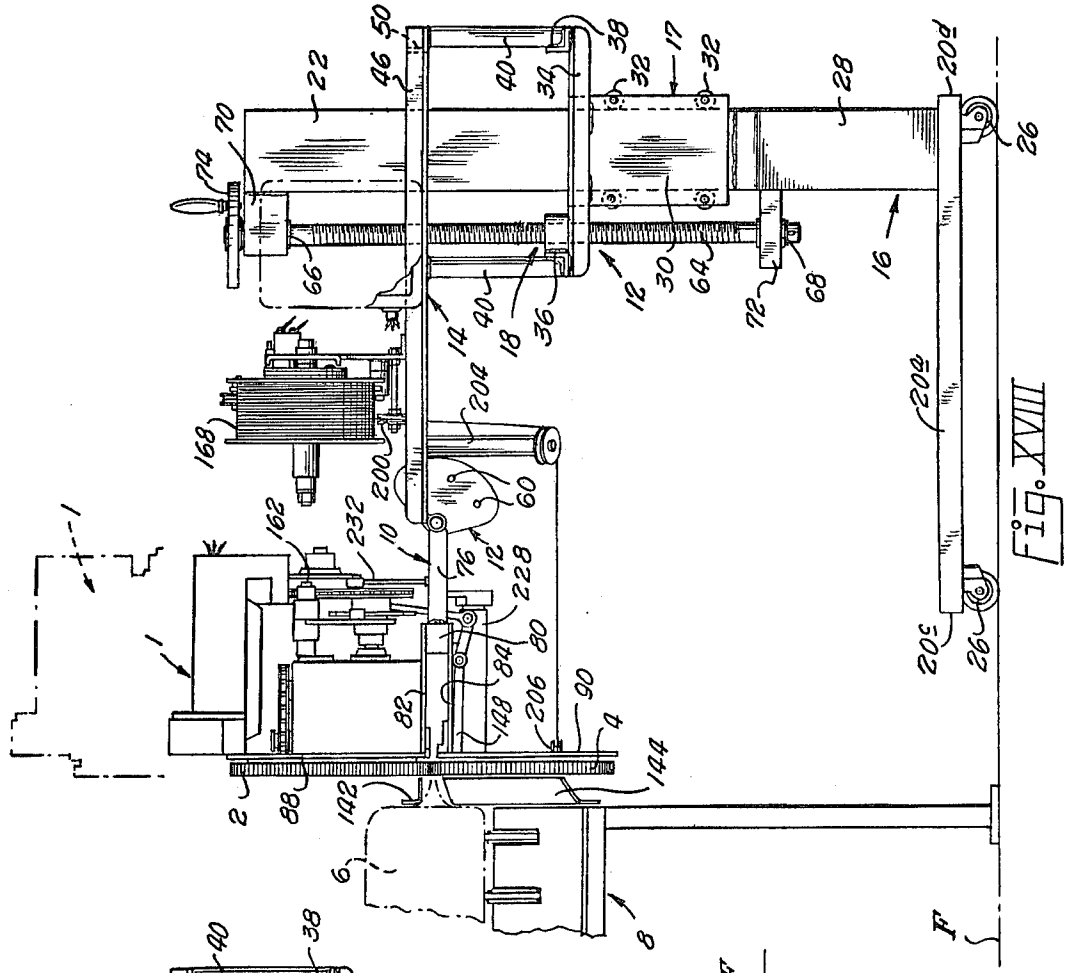

Fig. XVIII

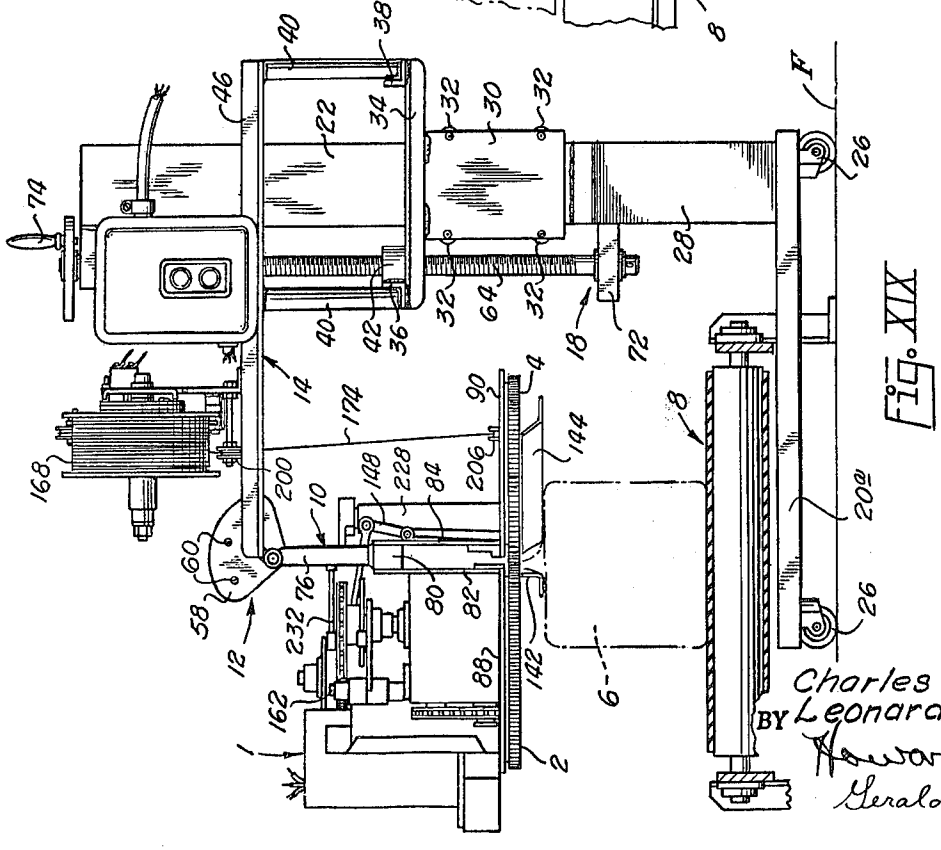

Fig. XIX

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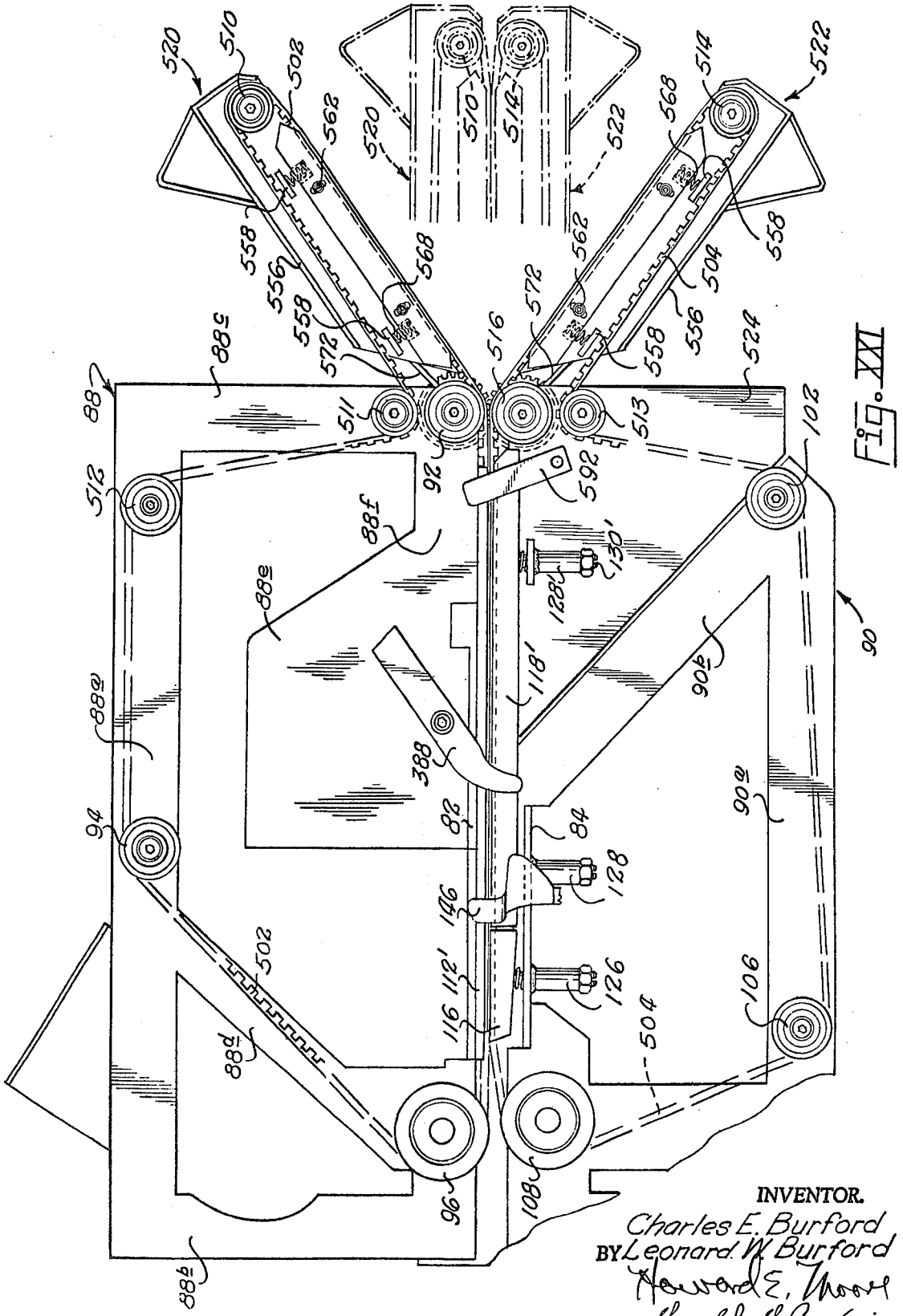

Fig. XX

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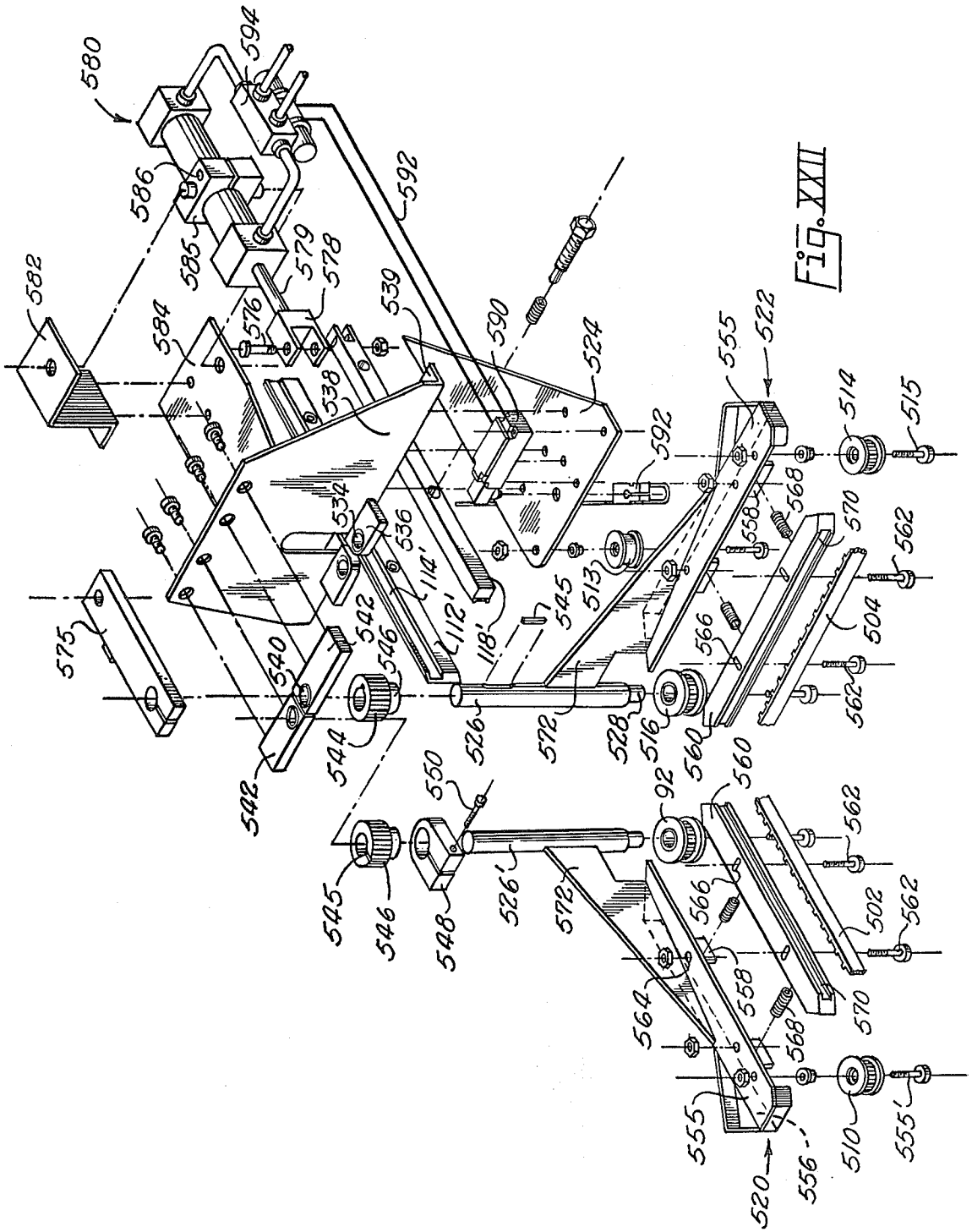

Fig. XXII

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APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS

BACKGROUND OF INVENTION

Many methods have been employed for closing and sealing the ends of flexible packages and wrappers. For example, in the baking industry, it is customary to wrap bread or other bakery products in plastic bags, one end of said bag being sealed by heat or suitable adhesive, and the other end of said bag being closed by a deformable wire-like ribbon tie, to allow resealing of the bag after a portion of the contents have been removed.

Apparatus of the type disclosed in U.S. Pat. No. 3,138,904 to Earl E. Burford entitled "METHOD AND APPARATUS FOR TYING PACKAGES AND WRAPPING MATERIALS" and U.S. Pat. No. 3,059,670 to Charles E. Burford and Leonard W. Burford entitled "WIRE TWISTING TOOL", offer significant improvements over methods and apparatus which had been previously employed.

The apparatus hereinafter described offers improvements over the structure described in the above mentioned Burford patents to increase the versatility of the apparatus and to increase the tying rate while providing structure which draws the packaging material to a controlled tension over the product.

SUMMARY OF INVENTION

We have developed a package tying device which employs powered belts for gathering the open end of a package, drawing the wrapping material around the contents of the package to a controlled tension, and tying the package while the package is being moved on a conveyor at a high rate.

The belts are positioned to form a converging mouth to gather the packaging material. The gathered material is moved around a stop member to pull the wrapping material tightly over a product. The tension in the wrapping material is controlled by pressure exerted upon the wrapping material by the belts which tends to draw material around the stop before the tying operation is initiated. The neck of the wrapping material extends through an opening in guide plates and the stop is positioned on the opposite side of the guide plates from the product such that the open bag is pulled around the product restrained by the guide plates.

The tying device is supported by an improved portable frame structure which is adjustable vertically. The tying head is pivotally mounted on the vertically adjustable frame allowing the tying head to be positioned at any desired angle for tying packages. Thus, a single tying apparatus may be employed for tying packages disposed in either a vertical or horizontal position at any elevation. This is a significant improvement over devices heretofore developed because a single tying apparatus may be moved from one location to another to tie packages of varying sizes and shapes which are moved on conveyors of varying design.

Sensing apparatus initiates the gathering, tensioning, and tying sequences when a package is properly positioned relative to the tying head. The tying sequence is controlled independently of the conveyor which is moving the package. Therefore, packages may be irregularly spaced on the conveyor or the speed of the conveyor may be variable without affecting the tying operations.

The second embodiment of the invention described herein has gathering belts which may be moved transversely to engage opposite sides of the neck of a bag positioned therebetween to extract filled bags for example, from bag filling apparatus.

A primary object of the present invention is to provide an improved method and apparatus for controlling tension in packaging material drawn around articles to be packaged.

Another object of the invention is to provide an improved method and apparatus for gathering packaging material and closing the package regardless of the size of the package.

A further object of the invention is to provide an improved method and apparatus for tying flexible packages wherein a tying head is secured to a frame comprising means for moving the tying head vertically and horizontally, and for pivoting the head relative to the frame for tying packages moved to the tying head on a conveyor regardless of the position of the package on the conveyor.

A still further object of the invention is to provide an improved method and apparatus for tying packages wherein the tying operation is triggered by the package such that the tying operation is not dependent upon the speed of a conveyor moving the package.

A still further object of the invention is to provide an improved method and apparatus for constricting the open end of a flexible package, encircling a ribbon of wire around the constricted end of the package while drawing the packaging material over the product under tension, severing the wire from a supply of ribbon, twisting the severed ends together to detachably secure the encircling wire to form a closure in which the constriction, encircling, severing, and twisting steps are carried out at a single station in one continuous operation.

Other and further objects of the invention will become apparent upon referring to the detailed description hereinafter following and to the drawings annexed hereto.

DESCRIPTION OF THE DRAWINGS

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

FIG. I is an enlarged fragmentary side elevational view of the tying head;

FIG. II is an enlarged fragmentary plan view of the tying apparatus;

FIG. III is a cross-sectional view taken substantially along line III—III of FIG. II;

FIG. IV is a fragmentary elevational view looking in the direction of arrows along line IV—IV of FIG. III;

FIG. V is a cross-sectional view taken along line V—V of FIG. II;

FIG. VI is a fragmentary elevational view looking in the direction of arrows substantially along line VI—VI of FIG. II;

FIG. VII is a cross-sectional view taken substantially along line VII—VII of FIG. I;

FIG. VIII is a cross-sectional view taken substantially along line VIII—VIII of FIG. VII;

FIG. IX is a fragmentary perspective view of the central portion of the structure illustrated in FIG. I;

FIG. X is a persective view of a stripper arm;

FIG. XI is an exploded perspective view of spaced guide plates connectable to the tying device;

FIG. XII is a fragmentary elevational view similar to FIG. I illustrating the first step of the tying sequence as the package moves to the tying head;

FIG. XIII is a fragmentary elevational view similar to FIG. XII of a second step of the sequence illustrating a gathered neck on the package with the ribbon being positioned for twisting;

FIG. XIV is a fragmentary elevational view similar to FIG. XIII illustrating a third step in the sequence wherein the package is moved away from the tying head after the ribbon has been twisted and severed;

FIG. XV is a cross-sectional view taken substantially along line XV—XV of FIG. XIII;

FIG. XVI is a fragmentary cross-sectional view of a deformable wire-like ribbon tie;

FIG. XVII is an elevational view of the frame upon which the tying device is mounted;

FIG. XVIII is a side elevational view similar to FIG. III, the tying head being positioned to close a horizontal opening;

FIG. XIX is an elevational view similar to FIG. XVIII, the tying head being positioned to close a vertically disposed opening;

FIG. XX is a schematic diagram of the drive means;

FIG. XXI is a schematic view similar to FIG. I of a modified form of the tying device; and

FIG. XXII is an exploded perspective view of the transfer jaw assembly of the modified form of the tying device.

Numeral references are employed to designate like parts throughout the various figures of the drawing.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGS. I and XIX of the drawing, the numeral **1** generally designates a tying head having package gathering and tensioning means, such as belts **2** and **4** secured thereto for forming a gathered neck adjacent the mouth of a bag **6** carried by a conveyor **8.** The tying head **1** is secured to a frame **10** which is secured by adjustable pivot means **12** to a supporting structure **14** which is adjustable vertically.

FRAME

As best illustrated in FIGS. XVII, XVIII and XIX of the drawing, supporting structure **14** comprises a base section **16** and a movable section **17** secured together by elevating means **18.**

The base section **16** comprises members **20***a*, **20***b*, **20***c*, and **20***d* secured together to support suitable guide means, such as upwardly extending stanchions **22** having lower ends secured to channel member **24.**

Casters **26** are secured to base member **16** for moving same over a supporting surface F.

Lateral braces **28** are employed as desired to furnish structural rigidity.

Supporting structure **14** is movable vertically relative to stanchions **22** and comprises spaced plates **30** and **31** having rollers **32** and **33** rotatably mounted thereon in rolling contact with surfaces of stanchions **22.**

Longitudinally extending members **34** and **35** are welded or otherwise secured to the upper edges of spaced plates **30** and **31.** Transversely extending members **36** and **38** are welded or otherwise secured to opposite ends of transversely extending members **34** and **35** forming a substantially rectangular structure with upwardly extending members **40** secured to each corner thereof. An internally threaded sleeve **42** is welded or otherwise secured to transversely extending member **36** as will be hereinafter more fully explained.

Spaced outwardly extending member **46** and **48** are welded or otherwise secured to the upper ends of upright members **40** and a transversely extending member **50** is secured therebetween.

As best illustrated in FIGS. II, III and XVII of the drawing, adjustable pivot means **12** is secured to outwardly extending members **46** and **48.** Bearings **52** and **54** are secured to the outer ends of outwardly extending members **46** and **48,** respectively, and shaft **56** is rotatably secured therein.

A plate **58** is fixedly secured, as by welding, to one end of the shaft **56** and has spaced apertures **60** formed therein. An aperture is formed in outwardly extending member **48** such that bolt **62** is insertable through one of the apertures **60** and through the aperture in the outwardly extending member **46** to lock frame **10** in position relative to outwardly extending member **48** on supporting structure **14.**

We contemplate the use of means other than plate **58** for adjusting the angular disposition of the tying head relative to the frame. For example, it should be readily apparent that lock bolts or set screws will prevent rotation of bearings **52** and **54** on shaft **56.**

Elevating means **18** comprises a screw **64** having its upper and lower ends rotatably secured in bearings **66** and **68,** said bearings being mounted in members **70** and **72** which are secured in spaced apart relation to guide members **22.** Screw **64** extends through internally threaded sleeve **42.** Suitable means suc as handwheel **74** is connected to screw **64** for rotating same.

Frame **10** comprises spaced arms **76** and **77** having outer ends welded or otherwise secured to a cross bar **80** to which spaced plates **82** and **84** are secured by suitable means such as bolt **86.** The inner ends of arms **76** and **78** are secured to shaft **56** such that frame **10** is rotatable with said shaft.

BELT MOUNTING

The component parts of tying head **1** are secured to spaced plates **82** and **84** as will be hereinafter more fully explained. As best illustrated in FIGS. I, V and IX, an upper belt mounting bracket **88,** comprising a substantially horizontally disposed member **88***a* having substantially vertically disposed members **88***b* and **88***c* extending downwardly from opposite ends thereof, is secured as by welding at **81** to the edge of upper plate **82.** Upper belt mounting bracket **88** has a diagonally disposed portion **88***d* extending from a central portion of horizontally disposed member **88***a* downwardly to the lower end of vertically disposed member **88***b*. A mounting plate **88***e* is connected through arm **88***f* to the lower end of vertically disposed member **88***c* and is secured, as by weld **85,** to plate **82.**

Lower mounting bracket **90** comprises members **90***a*, **90***b*, and **90***c* and is secured as by welding at **89** and **91** to lower plate **84.**

Idler pulleys **92** and **94** and drive pulley **96** are rotatably secured to upper mounting bracket **88.**

Idler pulleys **102, 104, 106** and drive pulleys **108** are rotatably mounted on lower mounting bracket **90.**

Each of the idler pulleys has suitable anti-friction means, such as ball bearings, mounted therein such that the pulleys rotate about axles secured to the mounting bracket by suitable means such as nuts **92***a*, **94***a*, **102***a*, **104***a*, and **106***a*.

Drive rollers **96** and **108** are rigidly secured to axles **96***a* and **108***a*, respectively, said axles being rotatably mounted in bearings **96***b* and **108***b*. As best illustrated in FIG. V of the drawing, axles **96***a* and **108***a* have sprockets **97** and **109** secured thereto, said sprockets being rotated in opposite directions by a chain **110** as will be hereinafter more fully described. It should be noted that other power transmission means may be employed for rotating rollers **96** and **108.** We contemplate for example, employing a timing belt in lieu of chain **110** for driving pulleys instead of sprockets **97** and **109.**

As best illustrated in FIG. I of the drawing, belt **2** extends around pulleys **92, 94,** and **96** and belt **4** extends around pulleys **102, 104, 106** and **108.**

Referring to FIGS. VII and VIII of the drawing, a back-up member **112** is secured to the lower surface of upper plate **82** and has an elongated groove **114** formed therein through which belt **2** movably extends.

Back-up members **116** and **118** have ends pivotally connected by a pin **120.** Back-up members **116** and **118** are urged upwardly by springs **122** and **124,** respectively. Internally threaded tubular members **126** and **128** are secured as by welding to plate **84.** Springs **122** and **124** extend through apertures formed in plate **84** and extend into tubular members **126** and **128,** respectively. The pressure exerted by springs **122** and **124** upon back-up members **116** and **118** is controlled by adjusting threaded members **130** and **132** longitudinally through tubular members **126** and **128.** Lock nuts **134** and **136** are provided for locking members **130** and **132** in position relative to tubular members **126** and **128.**

Threaded member **130** and threaded member **132** have reduced portions thereon forming centering pins **131** and **133** around which springs **122** and **124,** respectively, are disposed to prevent lateral deflection of said springs.

Passages **140** and **142** are formed in back-up members **116** and **118,** respectively, for receiving the upper ends of springs **122** and **124.**

Back-up members **116** and **118** have guide ways **116***a* and **118***a* formed therein along which belt **4** movably extends.

As best illustrated in FIG. VIII the surfaces of belts **2** and **4** have projections thereon to facilitate gripping flexible material therebetween. The modified form of the invention hereinafter described has projections on the back of the belts to increase driving force. In the second embodiment, however, projections are not employed on the surface of the belt which engages the neck of the bag. Such modification is desirable in situations where the packaging material tends to tear rather easily.

Pulleys **92, 94, 96, 102, 104, 106,** and **108** have grooves formed therein for receiving the projections on belts **2** and **4,** respectively. The projection and groove arrangement prevents slippage between the belts and pulleys so that an appreciable force may be exerted by belts **2** and **4** on the neck of the package **6** to draw the packaging material tightly around an article being packaged, as will be hereinafter more fully explained.

As best illustrated in FIGS. I, XI, XVIII and XIX, suitable article restraining means, such as guide means **142** and **144** are secured to the tying head **1** adjacent belts **2** and **4** between said belts and conveyor **8.** The upper guide member **142** is secured to the tying head by a bolt **142***a* and a pin **142***b*. Bolt **142***a* is secured in aperture **142***c* in upper mounting bracket **88.** Guide member **144** is secured to lower mounting bracket **90** by bolts **144***a* and **144***a*

BAG STOP

As best illustrated in FIGS. I, IV and V, a bag stop **146** is secured to the outer end of lever **148** which is arranged to reciprocate the stop **146** from the position extending across the opening between belts **2** and **4,** illustrated in FIG. XII of the drawing, to the position illustrated in FIG. XIV of the drawing, wherein the stop is moved downwardly away from the opening to allow a bag to pass. Lever **148** has a pin **150** secured to a central portion thereof, said pin being rotatably journaled in bearing **152** which is secured to lower plate **84** by fasteners **154.**

As illustrated in FIG. V, link **156** has a lower end pivotally connected to an end of lever **148** and an upper end pivotally connected to crank arm **158.** The length of link **156** is adjustable through suitable means, such as turnbuckles, disposed therein.

Crank arm **158** has a cam follower **160** rotatably secured to a central portion thereof and the crank arm has a bearing **163** secured to an end thereof which is rotatable about shaft **162.** A spring **151** is connected to the free end of arm **158** and urges same downwardly to maintain contact between follower **160** and cam **161** and cam disc **288,** hereinafter more fully described.

From the foregoing it should be readily apparent that stop **146** is biased toward the raised position, illustrated in FIG. XII of the drawing, until an upward force is applied to cam follower **160** by cam **161** which causes link **156** to exert an upward force on the end of lever **148** causing stop **146** to be pivoted downwardly.

Material to be packaged is positioned in flexible wrapping material and positioned upon conveyor **8,** FIGS. XII–XIV. Conveyor belts **8***a* move package **6** toward tying head **1.** As package **6** approaches the tying head **1,** the open end **6a** of package **6** is moved adjacent the converging belts **2** and **4** to cause the open end of the package to be flattened and gripped between belts **2** and **4** as illustrated in FIG. XII.

Threaded members **130** and **134** are adjusted to cause back-up members **116** and **118** to exert a desired pressure upon belt **4** to provide desired pressure between belts **2** and **4** and the open end **6***a* of the package. Rotation of belts **2** and **4** moves the open end **6***a* of the package **6** into engagement with stop **146** to begin the formation of a constricted or gathered neck **6***b* of the packaging material.

As best illustrated in FIG. XV, frictional forces between belts **2** and **4** draw the open end **6***a* of package material around stop **146** thereby drawing the package material toward guide members **142** and **144** to cause the packaging material to be drawn to a desired tension around the articles being packaged which are restrained by guide members **142** and **144.**

After the gathered neck **6***b* has been formed and the packaging material is drawn to the desired tension, a wire-like tie is moved around the gathered neck **6***b*, as illustrated in FIG. XIII, and the tie material is twisted to close the open end **6***a* of the package.

After the tying operation has been accomplished stop **146** is retracted to the position illustrated in FIG. XIV of the drawing causing belts **2** and **4** to move the tied neck of the package away from the tying head.

RIBBON FEED AND TENSION

As best illustrated in FIGS. VI and XVII of the drawing a reel or spool **168** of tie material is secured to shaft **170** which is rotatably secured to upwardly extending spool mounting **172.** Tie material **174** is fed from spool **168** and extends around pulley **178** rotatably secured to the upper end of crank arm **180.** Crank arm **180** has a lower end rotatably journaled on pin **182** and a spring **184** has opposite ends secured to crank arm **180** and anchor bit **186** to bias arm **180** toward the position illustrated in FIG. XVII. Crank arm **180** has an actuating lever **188** extending outwardly therefrom and positioned to engage arm **190** of switch **192.**

As will be hereinafter more fully explained, tying material **174** urges crank arm **180** in a clockwise direction, as viewed in FIG. XVII of the drawing. If tying material **174** is broken or otherwise becomes slack, spring **184** urges crank arm **180** in a counter-clockwise direction causing the contact of switch **192** to be opened to deactuate the tying head **1** and the apparatus feeding packages to the tying head, if desired.

A brake **194** frictionally engages shaft **170.** As needle **214** forms a loop of tie material around the gathered neck of bag **6,** the force of inertia and force exerted by brake **194** cause the reel **168** to remain stationary momentarily as crank arm **180** is rotated in a clockwise direction. The force of spring **184** overcomes the force of inertia allowing reel **168** to rotate feeding the tie material until arm **168** returns to the position illustrated in FIG. XVII at which time brake **194** stops the reel **168.** Brake **194** comprises a pulley secured to rotate with reel **168.** A V-belt **194***a* frictionally engages the pulley **194***b* when arm **180** is in the position illustrated in FIG. XVII to prevent rotation of said reel. When arm **180** pivots toward reel **168,** lever **180***a* allows belt **194***a* to become slack releasing pulley **194***b* allowing reel **168** to rotate.

Taut tie material functions as a stop and stop **146** is unnecessary except in instances wherein appreciable force must be exerted to draw the bag to a desired tension over the product.

From pulley **178** tying material **174** extends around pulley **200,** rotatably journaled on mounting pin **201.**

Suitable means such as pulley **202,** rotatbly mounted on bracket **204,** is provided to direct tying material **174** substantially perpendicularly of the plane of belts **2** and **4.** As best illustrated in FIG. V of the drawing, pulley **206** is rotatably secured to lower mounting bracket **90** and tying material **174** extends around said pulley and around pulleys **208** and **210** rotatably secured to angularly disposed portion **90***b* of lower mounting bracket **90.**

From pulley **210,** tying material **174** extends through opening **212** in needle **214,** see FIGS. I and VII, said needle **214** having a sheave **216** rotatably mounted thereon. The end of the ribbon of tying material **174** is secured by holding finger **220** (FIGS. II and XII–XIV) against cooperating abutment plates **222** and **224,** as will be hereinafter more fully explained.

TYING ASSEMBLY

As best illustrated in FIGS. I, IV and V, needle **214** is fixedly secured to shaft **226** rotatably journaled in bearing **228** secured to plate **84.** Crank arm **230** is secured to the opposite end of shaft **226,** said crank arm being connected through link **232** to sprocket **236** which is rotatable with shaft **238** as will be hereinafter more fully explained.

From the foregoing it should be readily apparent that rotation of sprocket **236** imparts an oscillating motion to arm **230** causing needle **214** to move from the position illustrated in FIG. XII of the drawing to the raised position illustrated in FIG. XIII and then back to the position illustrated in FIG. XIV.

As best illustrated in FIG. IX, holding finger **220** is pivotally secured by a bolt **221** to a plate **240** secured to upper mounting plate **82.** The outer end of holding finger **220** is pivotally connected by pin **241** to a link **242** which extends through an aperture in slider block **244.**

As best illustrated in FIG. VI, slide block **244** is pivotally connected through pin **245** to arm **246** pivotally mounted on axle **248.**

Link **242** has springs **250** and **252** disposed thereabout between block **244** and collars **254** and **256** secured to said link. A link **258** is pivotally connected between block **244** and disc **260** which is secured to a shaft **262** rotatably journaled in bearing **264.** Shaft **262** has a pin or dog **365***a* secured thereto to rotate said shaft one-half revolution each time gear segment **370** moves through one revolution, as will be hereinafter more fully explained.

From the foregoing it should be readily apparent that rotation of disc **260** causes holding finger **220** to oscillate between abutment plates **222** and **224** for gripping the ribbon of tying material **174.**

As best illustrated in FIGS. IX and X, a stripper arm assembly **270** is employed to engage the end of the packaging material to remove the ribbon of tying material from the twister hook.

Referring to FIG. X, the stripper arm assembly comprises a stripper arm **272** having one end secured to a bearing **274,** said stripper arm having a crank **277** extending outwardly therefrom having a mounting pin **279** secured to the outer end thereof. As illustrated in FIGS. VII and IX, bearing **274** is secured by a bolt **275** to upper mounting plate **82** and a link **276** has one end secured to mounting pin **279** and another end secured to bell crank **278.** Crank **278** is pivotally mounted by bearing **280** to mounting bracket **83** extending upwardly from upper plate **82.** Crank **278** is urged in a clockwise direction, as viewed in FIG. VII, by a spring **281** which extends between said crank and bracket **282** secured to the upper end of mounting bracket **83.**

As best illustrated in FIGS. V and VII of the drawing, bell crank **278** has a cam follower **284** rotatably secured thereto and positioned to engage cam **286** secured to cam disc **288.**

From the foregoing it should be readily apparent that rotation of cam disc **288** causes cam **286** to engage follower **284** causing crank **278** to rotate (FIG. VII) to exert a force through link **276** and lever **276** to cause stripper arm **272** to rotate about pin **275** to strip the twisted ends of tie material from twister hook **302.**

As best illustrated in FIGS. I, II and IX of the drawing, twister hook assembly generally designated by the numeral **300** comprises a twister hook **302** extending outwardly from the lower end of a deflected shaft **304** which is rotatably journaled in bearing **306** secured to post **308** by any suitable means such as bolts **309** and **310.** The upper end of shaft **304** has a sprocket **312** secured thereto.

It should be noted that hook **302** is shaped in a spiral, arcuate configuration and has an outer end which is

movable to encircle the ribbon of tying material **174** which is secured between gripper finger **220** and abutment plates **222** or **224.** Rotation of shaft **304** causes the ends of the ribbon of tie material to be twisted around each other as will be hereinafter more fully explained. Shaft **304** is deflected adjacent the lower end thereof such that hook **302** is disposed in a plane transversely of the longitudinal axis of the shaft, said plane intersecting the axis at an acute angle. The specific details of the hook are more fully described in Burford U.S. Pat. No. 3,059,670 on "WIRE TWISTING HOOK" and the disclosure contained therein is incorporated herein by reference. As best illustrated in FIG. IX, V-shaped notch **302***a* is substantially aligned with the central axis of shaft **304** to minimize fatigue stress in the tie material and to form a taut tie.

The power train for driving the elements of the tying head **1** is shown schematically in FIG. XX of the drawing and is best illustrated in FIGS. II, III, IV and V. Motor **315** is connected in driving relation with gear box **316** having a drive shaft **318** to which sprocket **320** is secured.

Chain **322** (FIGS. V and VI) is mounted in driving relation with sprocket **324** which is secured to shaft **326** rotatably journaled in bearing **328.** A second sprocket **330** is secured to shaft **326** in driving relation with chain **110** to rotate sprockets **97** and **109** for moving belts **2** and **4** as hereinbefore described.

Shaft **332,** rotatably journaled in bearing **334** secured to bearing plate **336,** is connected through clutch **338** to shaft **326.**

As best illustrated in FIG. V, a solenoid **340** is secured to the motor mount by bracket **342** and has a movable core **344** connected through a link **346** to clutch actuating lever **348** pivotally secured by a connector **350** to the motor mounting. A spring **352** extends between clutch actuating lever **348** and the motor mount.

A pawl **354** extends outwardly from clutch actuating lever **348** and extends into the path of lever **356** secured to clutch **338.**

When solenoid **340** is de-energized, pawl **354** engages lever **356** to maintain clutch **338** in a disengaged condition. When solenoid **340** is energized, pawl **354** pivots about connector **350** allowing lever **356** to rotate engaging clutch **338** causing shaft **326** and shaft **332** to rotate together.

As best illustrated in FIGS. II, V an VI, output shaft **332** of clutch **338** has a sprocket **360** secured thereto for driving chain **362** which is in driving engagement with sprocket **236** secured to shaft **238** which is rotatably journaled in bearings **364** (FIG. III) secured to mounting bracket **83** and bearing **366** (FIG. IX) secured to mounting bracket **88.** As hereinbefore explained, cam disc **288** is secured to shaft **238.**

As best illustrated in FIGS. III and VII, shaft **238** has a gear segment **370** secured thereto having teeth **372** disposed about a portion, for example, approximately one-half, of the circumference thereof.

Gear segment **370** also has a cutout portion **374** formed therein adjacent pin **376** such that rotation of gear segment **370** moves pin **376** into engagement with pin **365***a* to impart rotation to shaft **262** to rotate holding finger actuator **365** into cutout portion **374** of gear segment **370** to cause disc **260** to rotate 180 degrees to move holding finger **220** from abutment plate **222** to engagement with abutment plate **224** as hereinbefore explained.

Rotation of gear segment **270** also moves teeth **372** into driving engagement with bevel gear **378** which is secured to shaft **380** having a sprocket **382** secured thereto. As best illustrated in FIGS. I, II and III, sprocket **312,** secured to twister hook shaft **304,** is driven by chain **384** which extends around sprockets **312** and **382,** the chain being maintained in a taut condition by idler roller **386.**

As best illustrated in FIGS. I, IX and XX, a switch **386** is secured to upper mounting bracket **88.** Actuator arm **388** is pivotally mounted intermediate opposite ends thereof to mounting bracket **88** and a spring **390** is secured thereto for urging the lower end **388***a* of said actuating lever to a position extending across the space between belts **2** and **4** such that packaging material moved by belts **2** and **4** is moved into engagement with the lower end **388***a* of actuating lever **388** to pivot the upper end of said lever into momentary contact with switch **386** closing the contacts of said switch.

Switch **386** is connected through conductor **392** to one end of the coil of solenoid **340** and through conductor **394** to terminal **315***a* of motor **315.**

As best illustrated in FIG. XX, electrical power is provided to the apparatus hereinbefore described through conductors **396,** connected to terminal **315***a* of motor **315,** conductor **398,** connected to terminal **315***b* of motor **315,** and conductor **400,** connected through switch **192** and conductor **402** to terminal **315***c* of motor **315.** The coil of solenoid **340** is connected through conductor **404** to conductor **400.**

Suitable means such as start-stop switch **405** is provided for connecting conductors **396, 398** and **400** to a suitable source of electrical energy. Suitable safety devices, such as circuit breakers or fusing apparatus may be employed for controlling current and voltage through conductors **396, 398** and **400** if it is deemed expedient to do so.

OPERATION

The operation and function of the apparatus hereinbefore described is as follows:

Before a tying sequence is initiated, the parts of the tying head are in the position illustrated in FIG. IX of the drawing. Start switch **405** is closed and motor **315** is energized by current through conductors **396, 398, 400,** and **402.**

Clutch **338** is disengaged until solenoid **340** is energized.

Power from motor **315** is delivered continuously (FIGS. V and VI) through sprocket **320,** chain **322,** sprocket **324,** shaft **326,** sprocket **330,** chain **110,** sprockets **97** and **109** to drive wheels **96** and **108** causing belts **2** and **4** to rotate continuously.

As illustrated in FIG. XII, a package **6** moving on conveyor **8** has a neck **6***a* which is engaged by belts **2** and **4** and moved therebetween to engage the lower end **388***a* of actuating lever **388** thereby rotating same to close switch **386** which directs current through conductors **392** and **394** to energize solenoid **340.** It should be noted that switch **386** is closed only momentarily and clutch **338** is engaged to rotate shaft **332** one revolution.

As best illustrated in FIG. XIII, the end **174***a* of the ribbon of tie material **174** is initially gripped between holding finger **220** and abutment plate **222** or **224.**

Stop **146** is positioned to extend across the path of the neck **6***a* of the package **6** and the pressure between belts **2** and **4** may be adjusted by manipulating screws

130 and 132 as hereinbefore described. As the neck 6*a* of the package moves between belts 2 and 4 the package material is pulled around stop 146 as illustrated in FIG. XV of the drawing to draw the packaging material taut around the article being packaged by drawing the packaging material through the slot between guides 142 and 144 while articles in the package are restrained by guide plates 142 and 144.

When clutch 338 is engaged after solenoid 340 has been energized, the output shaft of the clutch is rotated causing shaft 338 to be rotated by power transmitted through (FIGS. IV and V) sprocket 360, chain 362, sprocket 236 secured to shaft 338.

Rotation of sprocket 336 moves link 232 (FIG. V) longitudinally to pivot arm 230 thereby rotating shaft 226 to move needle 214 to the position illustrated in FIG. XIII of the drawing to form a loop of tie material around the neck 6*a* of the package. The running end 174*b* of tie material is positioned adjacent holding finger 220.

As illustrated in FIGS. III and VI, rotation of shaft 238 approximately one-fourth of one revolution moves teeth 372 on gear segment 370 into driving engagement with bevel gear 378 to impart rotation through sprocket 382, chain 384, sprocket 312, and shaft 304 to twister hook 302 to initiate twisting of the ends 174*a* and 174*b* of tie material 174.

As twister hook 302 begins to rotate, pin 376 on gear segment 370 (FIG. III) is moved into engagement with pin 265*a* (FIG. VI) to rotate holding finger actuator cam 265 into the cutout portion 374 of cam segment 370 to rotate shaft 262 and disc 260 one-half revolution to pivot holding finger 220 for gripping the running end 274*b* of the ribbon of tie material 174 against abutment plate 224 as a result of force exerted through link 258 and link 242.

Referring to FIGS. II and V, continued rotation of shaft 238 moves cam 161 on cam disc 288 into engagement with follower 160 to pivot cam arm 158 about shaft 162 to impart movement through link 156 and lever 148 to move the stop 146 to the position illustrated in FIG. XIV of the drawing to allow the neck 6*a* of package 6 to move unobstructed along belts 2 and 4.

While stop 146 is in the lowered position cam 286 (FIG. VII) secured to cam disc 288 engages cam follower 284 to exert motion through bell crank 278, link 276, pin 279, crank 277, to rotate the stripper arm assembly 270 about bolt 275 to move the stripper arm 272 beneath twister hook 302 to the position illustrated in FIG. XIV to sever the running end 174*b* of ribbon material from the ribbon 174 by drawing same across a sharp surface 224*a* on abutment plate 224.

As cam follower 284 drops off of cam 286 stripper arm 272 is retracted to the position illustrated in FIGS. IX and XII. As cam follower 160 drops off of cam 161, stop 146 is moved back to the position illustrated in FIGS. IX and XII.

As cam disc 288 completes one complete revolution follower 190 (FIG. V) secured to crank arm 164 is urged into recess 191 formed in the edge of disc 288 as clutch 338 is de-energized when lever 356 is moved into engagement with pawl 354 to stop disc 288 in a starting position for the next tying sequence.

As neck 6*a* of successive packages 6 engage actuating lever 388 the sequence hereinbefore described is repeated.

From the foregoing it should be readily apparent that we have developed a method and apparatus for tying packages and wrapping materials which expeditiously draws wrapping material tightly to a controlled tension around an article by moving the neck of the wrapping material around stop 146 positioned across the path of travel of the neck of the package while wrapping a ribbon of tie material 174 around the neck 6*a* of the package for retaining and securely closing same.

SECOND EMBODIMENT

A modified form of the invention is illustrated in FIGS. XXI and XXII of the drawing. FIG. XXI is similar to FIG. I and numerals hereinbefore employed to designate parts of the first embodiment are employed in the second embodiment to designate corresponding like parts.

The second embodiment differs from the first embodiment primarily in the configuration of gathering belts designated by numerals 2 and 4 in the first embodiment, and by numerals 502 and 504 in the second embodiment.

A first belt 502 extends around drive pulley 96, pulley 92, movable pulley 510, pulley 511, pulley 512, and pulley 94.

Gathering belt 504 extends around drive pulley 108, pulley 106, pulley 102, pulley 513, movable pulley 514, and pulley 516.

Referring to FIGS. I and XXI it should be noted that pulley 104 of FIG. I has been eliminated. Pulleys 511 and 512, FIG. XXI, have been added, each of said pulleys being secured to upper mounting bracket 88, and pulleys 513 and 516, secured to plate 524, have also been provided.

As will be hereinafter more fully explained, arms 520 and 522 are pivotally secured relative to the tying head 1, and are movable from the position illustrated in full outlines in FIG. XXI to the position illustrated in dashed outline to cause belt 502 and 504 to be moved in a transverse direction toward each other for gripping the neck of a bag positioned therebetween such that belts 502 and 504 will move the bag toward bag stop 146.

Belts 502 and 504 have a relatively smooth side and a side with lugs thereon. Belts 2, 4, 502 and 504 may assume other configurations depending upon the specific frictional forces, necessary for a specific operation.

The second embodiment of the invention illustrated in FIGS. XXI and XXII of the drawing substantially comprises the first embodiment hereinbefore described in combination with additional parts which will be hereinafter more fully described.

Plate 524 is secure to lower mounting bracket 90 by any suitable means such as by bolts or by welding. Shaft 526 has a reduced portion 528 on the lower end thereof which extends through opening 530 in plate 524 having pulley 516 rotatably secured to the lower end thereof. A spacer bushing 532 is positioned between pulley 516 and plate 524 allowing the pulley to rotate freely.

Shaft 526 extends through and is rotatably journaled in bearing member 536 which is welded or otherwise secured to mounting plate 538 which is secured to plate 524 by any suitable means such as bolts extending through aligned openings in said plate and in flange 539 on the lower edge of said mounting plate.

The upper end of shaft 526 extends through and is rotatably journaled in opening 540 in lug 542 which is secured to the upper end of mounting plate 538 by any suitable means such as bolts.

A gear **544** is secured to shaft **526** by any suitable means, such as key **545** and set screw **546.** Gear **544** is preferably positioned adjacent the lower edge of lug **542.**

A second shaft **526'** extends through an opening in upper mounting plate **88** and has idler pulley **92** rotatably mounted on the lower end thereof. A gear **545** is secured to shaft **526'** having teeth thereon positioned in meshing relation with teeth on gear **544** on shaft **526.** Gear **545** is a split gear having a slot **546** formed therein such that clevis **548,** tightenable by bolt **550,** may be employed to secure gear **545** to shaft **526'** to cause shaft **526'** to rotate with said gear. Use of clevis **548** and split gear **546** allows adjustment of arm **520** relative to arm **522,** and facilitates mounting gears **544** and **545** in meshing relation.

Arms **520** and **522** are of substantially identical construction, the parts thereon being substantially mirror images of parts on the other arm.

Arms **520** and **522** comprise member **555** and web **556** extending across one edge thereof. An angle member **558** is welded or otherwise secured to the underside of member **555** and belt guides **560** are movably secured to member **555** by bolts **562** extending through openings **564** in member **555** and through elongated openings **566** in belt guide **560.** Springs **568** engage the rear edge of belt guide **560,** the other end of said springs engaging angle member **558** to urge belt guides **560** outwardly of said arm.

Each belt guide **560** has a groove **570** formed in the outer edge thereof in which belts **502** and **504** are slidably disposed.

Pulley **514** is rotatably secured to member **555** of arm **522** by a bolt **515,** and pulley **510** is rotatably secured to member **555** of arm **520** by a suitable connector such as bolt **555'.**

A web **572** is welded or otherwise secured to member **555** of each of the arms **520** and **522** and is secured to shafts **526** and **526'** respectively.

An actuating arm **575** has one end rigidly connected to the upper end of shaft **526** and the other end of said arm is pivotally connected by a suitable connector **576** to clevis **578** secured to rod **579** of pressure actuated cylinder **580.** Cylinder **580** has a piston (not illustrated) slidably secured therein, said piston being connected to piston rod **579.** Means is provided to selectively provide fluid pressure to opposite sides of said piston. We anticipate use of other power means such as belts and pulley, chain and sprocket, gears, or powered shaft and clutch for selectively rotating shaft **526** in a desired direction through a desired arc.

Pressure actuated cylinder **580** is pivotally connected between bracket **582** and inwardly extending ledge **584** by a split pivot block **585.** Cylinder **580** may be moved longitudinally relative to pivot block **585** by manipulation of set screw **586** for adjusting the position of arm **522** relative to the frame.

From the foregoing it should be readily apparent that when fluid pressure is applied to extend piston rod **579,** arm **575** is pivoted causing shaft **526** to rotate to move arm **522** from the position illustrated in full outlines in FIG. XXI to the position illustrated in dashed outline. Since gears **544** and **545** are in meshing relation, rotation of shaft **526** causes shaft **526'** to rotate through an equal angle or a different angle if different sized gears were employed, in an opposite direction thereby moving arm **520** from the position illustrated in full outline to the position illustrated in dashed outline.

When fluid pressure is applied to retract piston rod **579,** arms **520** and **522** are moved back to the position illustrated in full outline.

Comparing FIGS. I and XXI of the drawing, it will be noted that backup member **118'** in FIG. XXII is longer than backup member **118** in FIG. I for controlling the force urging belts **502** and **504** together to regulate frictional force exerted on a bag position therebetween. Tubular member **128'** is welded or otherwise secured to plate **524** and has a threaded member **130°** secured thereto for regulating the pressure exerted by backup member **118'.**

As illustrated in FIG. XXII a switch **590** is secured to plate **524,** said switch having an actuating arm **592** secured thereto, said actuating arm being positionable transversely across belts **502** and **504** such the movement of a bag a controlled distance, for example, past pulleys **92** and **516,** will cause the bag to engage actuating arm **592** to manipulate switch **590** for supplying fluid pressure to cylinder **580** to retract piston rod **579** causing arms **520** and **522** to move to the position illustrated in full outlines for receiving the next article.

Switch **590** is connected through a connector **592** to a valve **594** which may be manipulated for transferring fluid pressure to opposite ends of cylinder **580.** Suitable sensing means, not illustrated, is employed for actuating valve **594** to move arms **520** and **522** to the position illustrated in dashed outlines for grippingly engaging an article.

From the foregoing it should be readily apparent that the first embodiment of the invention may be modified to form the second embodiment by installation of arms **520** and **522,** as hereinbefore described, providing a typing device which is suitable for tying bags or packages on virtually any type of conveyor at any elevation or at any angle.

The first embodiment of the invention is particularly useful for tying bags which are moved toward the tying head on a conveyor. The second embodiment of the invention allows the tying device to extract a bag, for example, from packaging machine, and then transfer the bag through the tying sequence hereinbefore described.

Having described our invention, we claim:

1. Package tying apparatus comprising, a general frame; friction means on the frame to grip a portion of the package; spaced guide means on the frame, said guide means having a slot extending longitudinally therebetween; package stop means on the frame; means to move the package stop means transversely of said slot to a first position between the friction means and the guide means; means to move the friction means relative to the stop means to draw a portion of a package around the package stop to form a gathered neck, said friction means being adapted to draw a portion of the package into pressure contact with said guide means; means on the frame to secure the gathered neck; and drive means secured between the frame and the stop means to move the stop means to a second position wherein the stop means is disengaged from a package moving along said slot.

2. The combination called for in claim **1** with the addition of means associated with the friction means to control surface pressure between the friction means and the package.

3. The combination called for in claim **1** wherein the means on the frame to secure the gathered neck comprises, means to encircle the neck with a wire-like tie;

and twisting means to secure the tie to the neck.

4. The combination called for in claim **1** wherein the friction means comprises endless flexible members; means to movably secure the flexible members relative to the frame, said flexible members being arranged to form a converging section.

5. The combination called for in claim **1** wherein said friction means comprises first and second conveyors secured to the frame in spaced apart relation; and with the addition of a back-up member movably secured to said frame, said back-up member being positioned adjacent at least one of the conveyors; and means for urging the back-up member into pressure engagement with at least one of the conveyors.

6. The combination called for in claim **5** wherein the means to urge the back-up member into pressure engagement with one of the conveyors comprises a spring engaging the back-up member; and with the addition of means secured between the frame and the spring adapted to regulate the pressure exerted by the spring on the back-up member.

7. Package tying apparatus comprising, a general frame; conveyor means movable relative to the frame; a bag stop movably secured to said frame, said conveyor means being adapted to move a bag into engagement with said stop to form a gathered neck; a stripper arm movably secured to said frame; a twister hook movably secured to said frame; a shaft rotatably secured to said frame; means operably connected to said shaft and adapted to rotate said shaft one revolution as a bag is moved toward said stop; feeder apparatus on said frame adapted to form a loop of tie material about a neck of a bag positioned against said stop; feeder actuating means secured to said shaft and operably connected to said feeder means; power transmission means secured to said shaft, said power transmission means being operably connected to said twister hook; stripper actuating means secured to said shaft and operably connected to said stripper arm; and stop actuating means secured to said shaft and operably connected to said bag stop, each of said actuating means being positioned on said shaft such that rotation of the shaft through one revolution forms a loop of tie material about a gathered neck of a bag positioned against the stop, the loop of tie material is twisted, the stop is lowered, and the tie material is stripped from the twister hook in a continuous sequence.

8. A package tying apparatus comprising a general frame; first and second drive means secured to said frame; first and second guide means secured to said frame; a first endless flexible conveyor secured to said first drive means and said first guide means; a second endless flexible conveyor secured to said second drive means and second guide means, said first and second flexible conveyors being positioned to grippingly engage packaging material moved therebetween; a first back-up member on said frame adjacent the first conveyor; a second back-up member secured to said frame adjacent the second conveyor; adjustable means between the second back-up member and the frame adapted to regulate pressure between the second back-up member and the second conveyor; means for positioning a segment of tie material transversely relative to the first and second conveyors; stop means movably secured to said frame; actuating means for positioning said stop means transversely relative to the first and second conveyors, said actuating means being adapted to limit movement of said stop means such that packaging material is moved by the first and second conveyors into engagement with the stop means; means secured to the frame for securing opposite ends of the tie material to close the gathered neck of the bag, said actuating means being adapted to move said stop means to a position permitting movement of packaging material by the first and second conveyors after opposite ends of the tie material have been secured.

9. The combination called for in claim **8** with the addition of packaging material tensioning means secured relative to the frame adapted to cause the packaging material to be drawn to a desired tension over an article contained therein.

10. Apparatus for closing and securing a bag comprising, support means; carrier means on the support means; spaced arms pivotally connected to the support means; second carrier means on each of said arms; spaced friction means movably secured to said first and second carrier means; drive means associated with the friction means; actuating means secured to the arms to pivot the arms relative to the support means to move the friction means into engagement with opposite sides of a bag positioned therebetween; first and second pressure means adjacent at least one of the friction means, said pressure means being positioned in end to end relation; gathering means adjacent the friction means and positioned adjacent inner ends of the pressure means, said gathering means being adapted to form a gathered neck on the bag; means associated with each of the pressure means to control frictional force exerted on a bag positioned between the friction means at positions on opposite sides of the gathering means; and means on the support means for attaching a restraining member around the gathered neck of the bag.

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