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Plate et al.

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[54] BAG-MAKING MACHINE

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[52] **U.S. Cl.** **74/125.5,** 226/37, 192/12.2

[51] **Int. Cl.** **F16d 27/10**

[58] **Field of Search** 74/125.5; 192/12.2; 226/37

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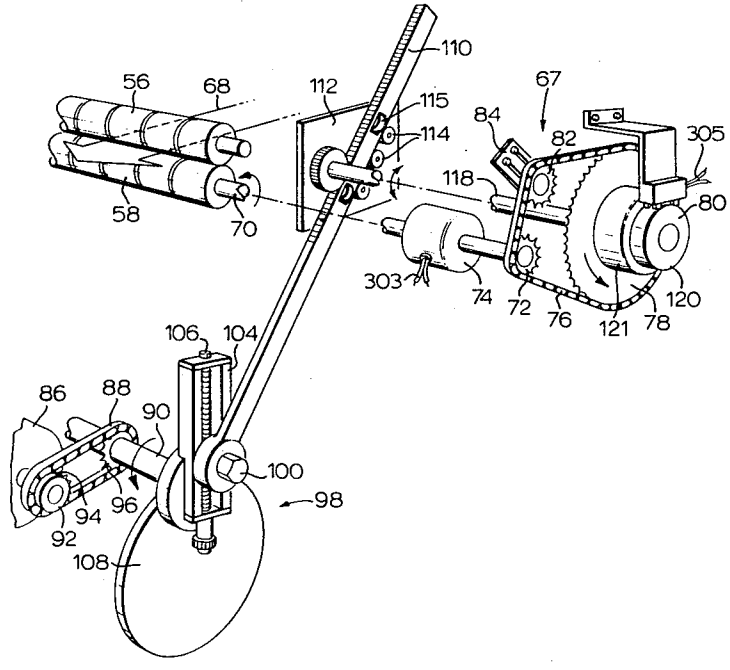
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[57] **ABSTRACT**

A bag-making machine for fabricating bags from tubular, flexible thermoplastic stock material by transversely heat and pressure sealing the stock, advancing a predetermined length of said stock from the machine, and then severing said stock for delivery to a stacking bin while sealing the stock end for initiation of the next bag-making cycle. The machine has a novel draw roller drive, a novel sealer-cutter mechanism, a novel control mechanism and a novel detector for bag jamming.

3 Claims, 8 Drawing Figures



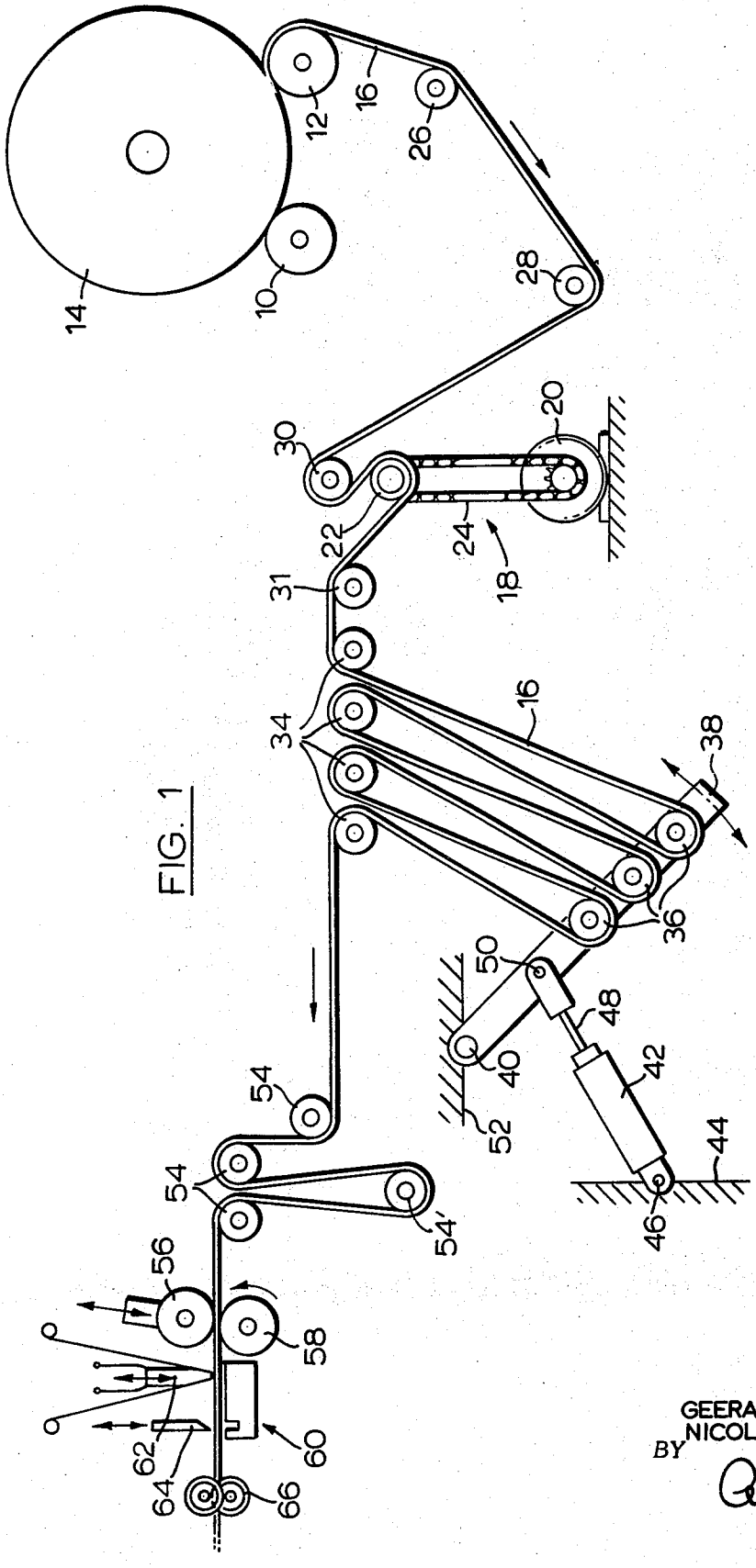


FIG. 1

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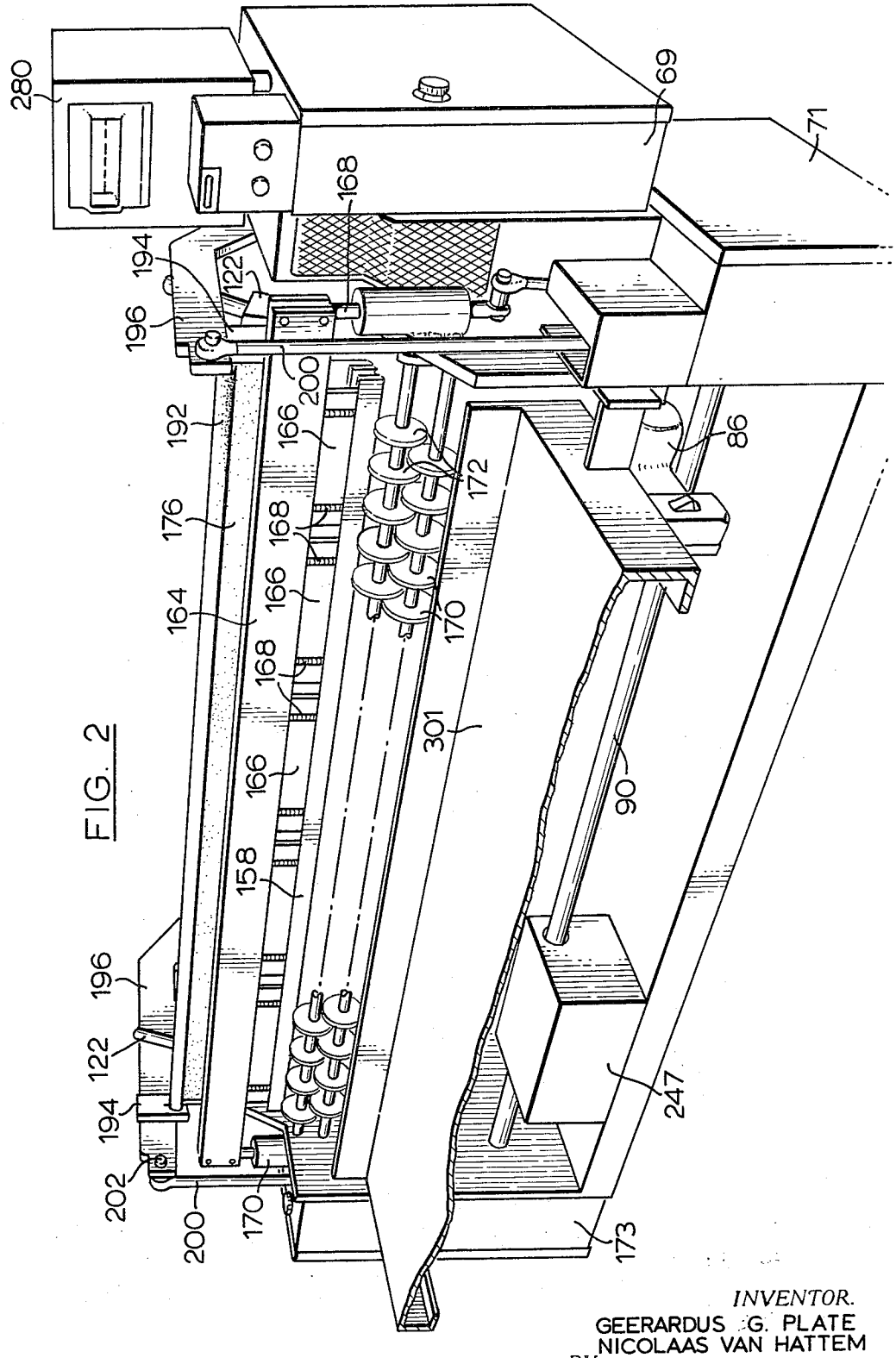


FIG. 2

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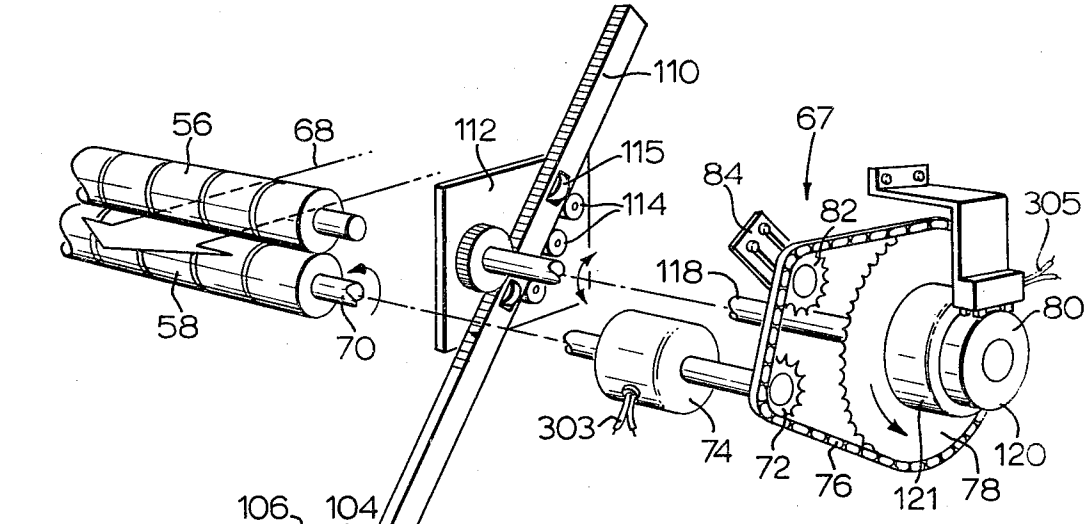
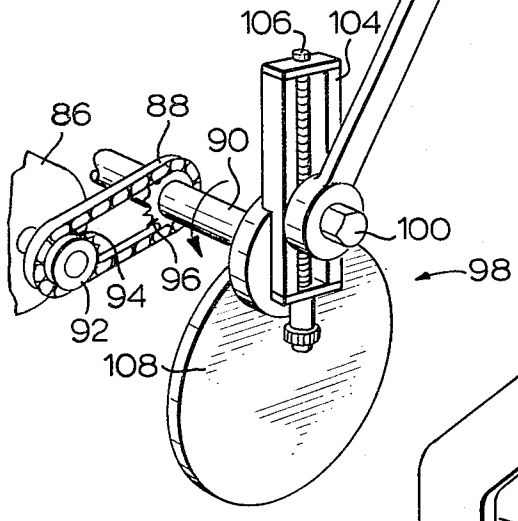


FIG. 3



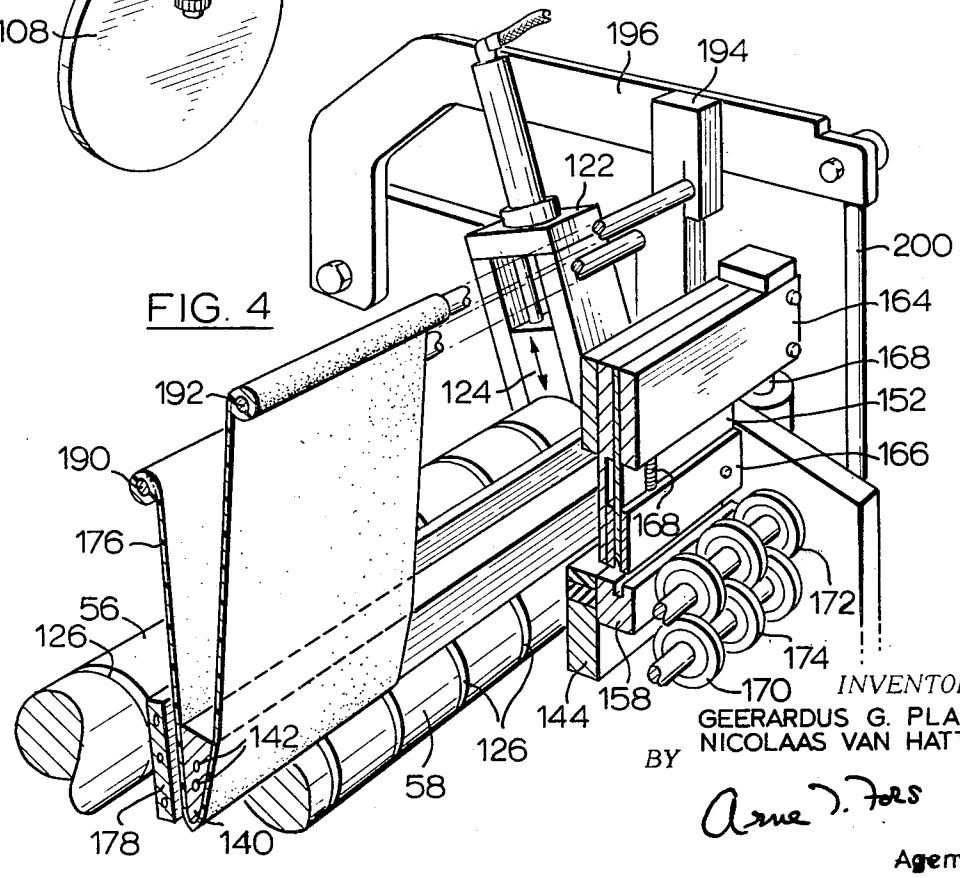


FIG. 4

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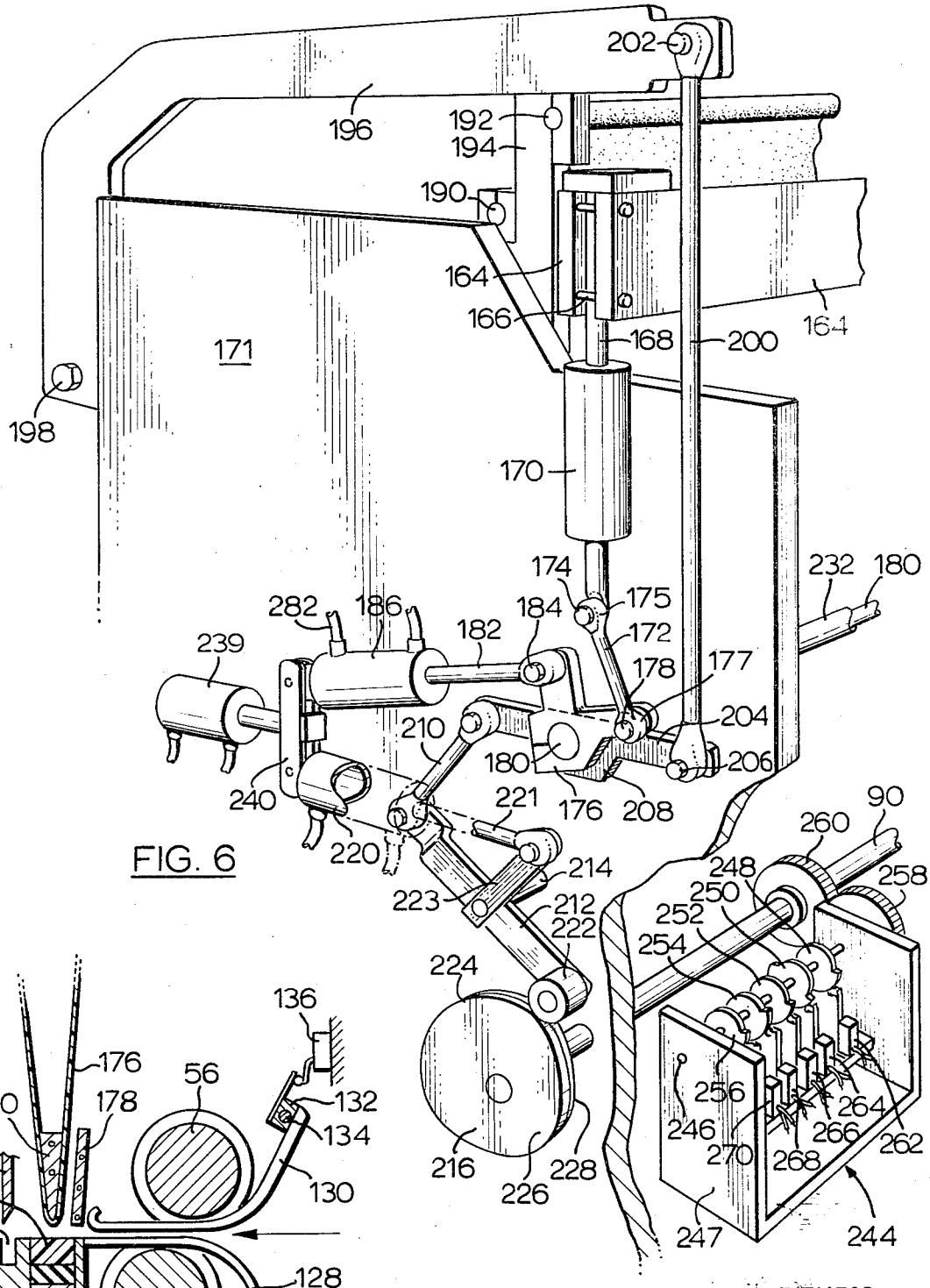


FIG. 6

FIG. 5

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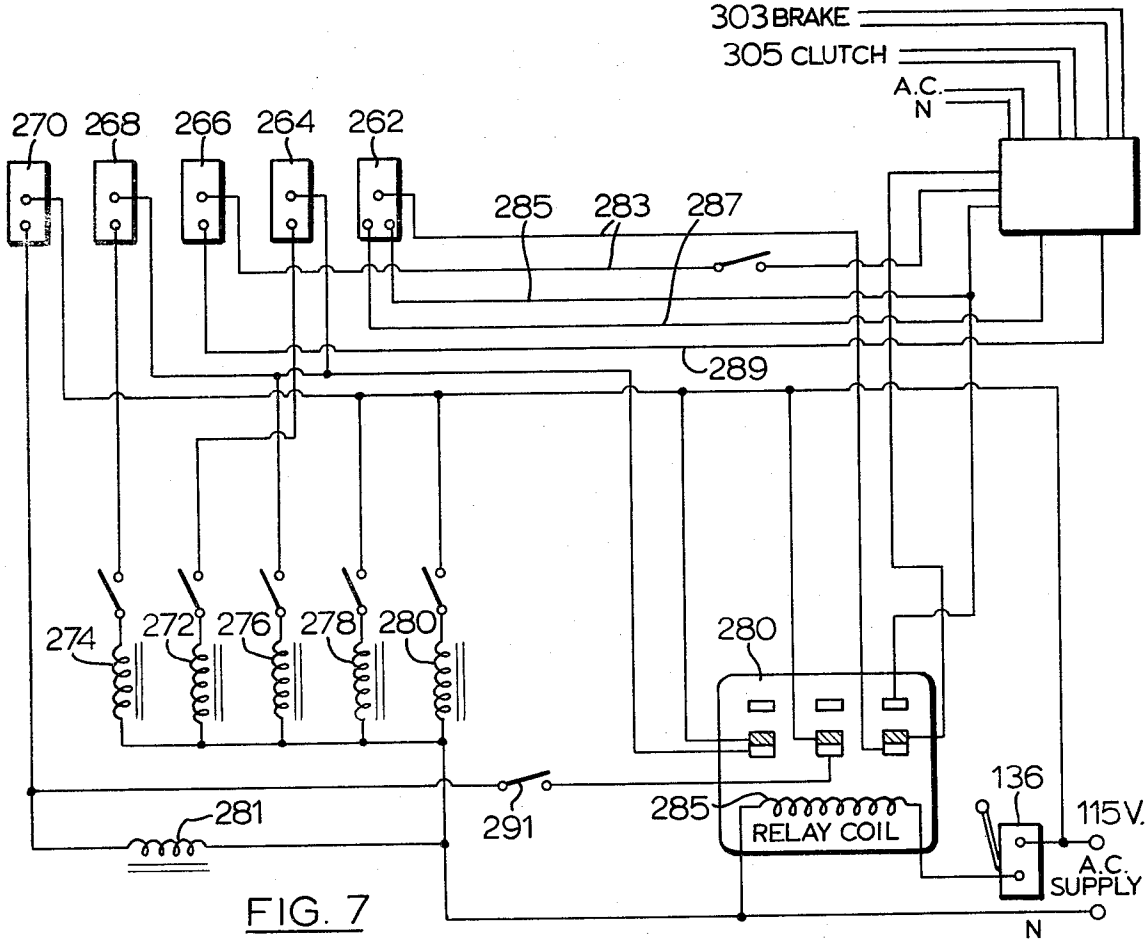


FIG. 7

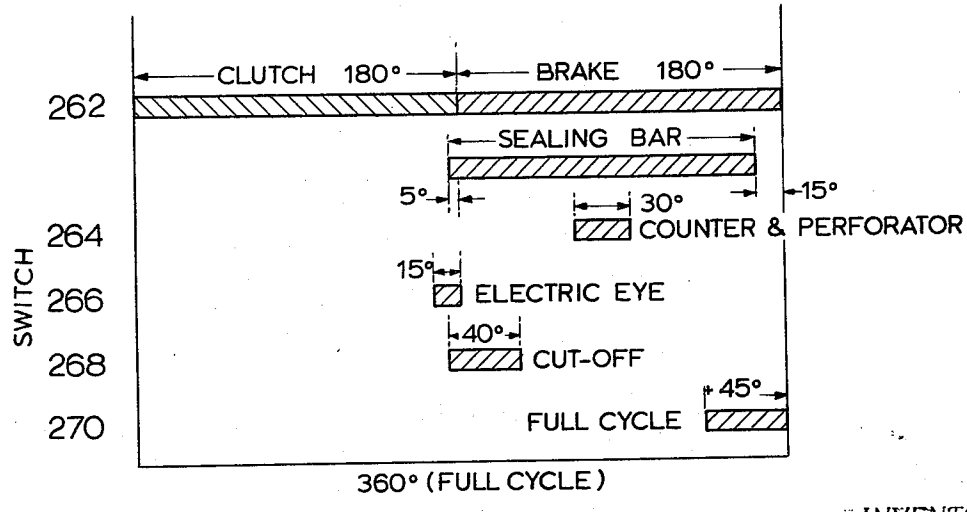


FIG. 8

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BAG-MAKING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to a bag-making machine and more particularly relates to an improved machine for fabricating bags from thermoplastic material of tubular, flexible stock.

It is known to form bags from tubular feed stock of thermoplastic material such as polyethylene or polypropylene by heat and pressure sealing together the opposed sides of a flattened tube of said stock to form a bag bottom while substantially concurrently cutting said stock adjacent the seal for severing the preceding bag from the stock. Each newly-formed bag must then be discharged from the bag-making machine and the stock advanced to the desired position for the next sealing-cutting operation.

Serious disadvantages have heretofore been inherent in conventional bag-making machines. Throughput of stock and discharge of newly-formed bags from the machines have been limited by the dwell time required to apply heat and pressure to opposed sides of flattened stock while stationary to achieve a suitable seal and to cut the stock and by the time required to accelerate each newly-formed bag away from the machine to permit advance of the stock for a repeat of the sealing-cutting operation. For example, it is common practice to accelerate the open end of flexible tubular stock from the bag-making machine to a holding position in a conveyor system for the sealing-cutting operation at which time the stock is transversely heat and pressure sealed and the newly-formed bag severed from the stock material for discharge to a stacking bin. This technique results in air being trapped in the bags as they are discharged requiring a complex conveyor system for rapid discharge of finished bags.

We have found that this problem can be substantially overcome by sealing the open end of the tubular stock material and first discharging the resulting closed end from the machine. The stock is then severed and the newly-formed bag transported a short distance to a stacking bin by simple stacking wheels while the end of the stock material is heat-sealed for a repeat of the bag-making cycle.

It is therefore an important object of the present invention to provide a bag-making machine capable of forming bags from a tubular stock of thermoplastic material at a high rate of throughput.

It is another object of the present invention to provide a machine adapted to discharge bags sealed-end first to obviate entrainment of air and to permit the use of a simplified discharge system.

Another object of the present invention is the provision of heat and pressure sealing and cutting apparatus which is quick and reliable in operation requiring a minimum of dwell time and which provides an effective and reliable seal.

Conventional bag-making machines also are prone to wear due to the sudden stops and starts of the stock drive mechanisms for each intermittent sealing-cutting and stock advance cycle.

It is accordingly another object of the present invention to provide a drive mechanism which will positively advance and stop the tubular stock for the appropriate dwell time for sealing and cutting of the stock with a minimum of wear of the drive components and with a minimum of down-time otherwise required for maintenance.

Malfunctioning of stock drive mechanism or bag discharge mechanism results in stock or bags jamming within the mechanism at the discharge end thereof. Although conventional bag-making machines have means for detecting jam-ups, the machines normally must complete their cycles before shutting down, thus augmenting the jamming problem.

It is still a further important feature of the present invention therefore to provide an improved mechanism for detecting jammed bags within the bag-making machine for immediately and positively shutting down of the machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of our invention and the manner in which they can be obtained will become apparent from the following detailed description of the drawings, in which:

FIG. **1** is a schematic view of the apparatus of our invention showing the general arrangement of component parts;

FIG. **2** is a perspective view of the discharge end of the machine of our invention;

FIG. **3** is an exploded perspective view, partly cut away, of the drive mechanism of the invention;

FIG. **4** is a perspective view, partly cut away, of the heat and pressure sealing, cutting and discharge mechanism of the invention;

FIG. **5** is a perspective view of the control system and actuating mechanisms of the invention;

FIG. **6** is a sectional view of the sealing-cutting and jam-control mechanisms of the invention;

FIG. **7** is a schematic view of the electric circuits of the invention; and

FIG. **8** is a chart illustrating the sequence of operation of the components of the machine.

With reference now to FIG. **1**, the machine of our invention comprises a pair of surface unwind rollers **10**, **12** upon which a roll of feed stock **14** is seated for rotation as tubular material **16** in flattened form is drawn therefrom. Tubular stock **14** will be of a flexible, thermoplastic material having the heat sealing characteristics of polyethylene or polypropylene.

The capstan drive designated generally by numeral **18** comprises a drive motor **20** operatively connected to rubber-covered drive roller **22** by a chain **24**. Capstan **18** draws feed stock **16** from roll **14** by way of idler rollers **26**, **28** and **30**, the latter roller arranged in conjunction with idler roller **31** relative to drive roller **22** as shown or in abutment with drive roller **22** to provide a satisfactory wrap about drive roller **22** to avoid slippage of feed stock thereon.

The compensator designated generally by numeral **32** comprises a plurality of idler rollers **34** journaled for rotation in a fixed position and a plurality of idler rollers **36** journaled for rotation on arm **38** mounted for pivotal movement by pin **40** at one end thereof. Single-acting pneumatic cylinder **42** connected at one end to support wall **44** by pivot pin **46** and having a piston and rod assembly **48** slidably mounted therein and pivotally connected at the other end to arm **38** by pivot pin **50** is adapted to bias arm **38** in a downward, clockwise position as viewed in FIG. **1** for maintaining stock **16** under tension. Air under about 10 psig pressure, for example, is introduced to cylinder **42** to maintain a constant and uniform pressure on arm **38** regardless of its position.

It will be understood that a tension spring can be used in place of pneumatic cylinder **42** to maintain a pressure on arm **38**. However, a pneumatic cylinder has the advantage over a spring in that the force exerted on arm **38** will be uniform as determined by the pneumatic pressure in the cylinder whereas the pressure exerted by a tension spring will vary as the length of the spring is extended or decreased.

Operatively connected to arm **38** and not shown is a limit control well known in the art which measures the angle defined between arm **38** and a reference plane, such as, for example, between arm **38** and support wall **52**. The control is operatively connected electrically to capstan drive motor **20** whereby upward, counter-clockwise movement of arm **38** will result in capstan drive **18** increasing in speed to draw an increased amount of stock from roller **14** such that arm **38** will return to its normal position as shown schematically in FIG. **1**. As arm **38** reaches a predetermined angle of inclination, drive **20** slows down and/or is stopped; constant tension being maintained on stock **16** at all times by pneumatic cylinder **42**.

A plurality of idler rollers **54** are located intermediate compensator **32** and draw rolls **56**, **58** to permit inclusion of a perforating device in the system if desired. Idler roller **54'** is adjustably mounted to facilitate incorporation of a perforating device.

A pair of draw rollers **56, 58** are located immediately before sealing barrknife section **60**; sealing bar **62** and knife **64** being adapted for vertical reciprocal movement as will become evident as the description proceeds. Stacking wheels **66** are disposed adjacent sealing-cutting assembly **60** for discharging finished bags from the machine.

Although not shown, it will be understood that the foregoing rollers are journaled for rotation and the pivot pins mounted in a rigid steel framework, not shown.

The drive assembly **67** for draw rollers **56, 58** will now be described with particular reference to FIGS. **2** and **3** of the drawings, the travel of feed stock being indicated generally by arrow **68**. Draw roller **58** is driven intermittently in a counter-clockwise direction as viewed in FIG. **3** by shaft **70** having gear **72** secured at one end thereto. An electric brake **74** encircling shaft **70** for positive engagement therewith is adapted to positively stop rotation of shaft **70** and draw roller **58** during the operation of the machine, as will become evident hereinbelow. Shaft **70** is rotated by chain **76** which is driven in a counter-clockwise direction by drive gear **78** connected to electro-magnetic clutch **80**. An idler gear **82** is slidably mounted on support **84** for adjustment of the tension of chain **76**.

Electric motor **86** drives shaft **90** at a constant speed through chain **88** which connects the sprocket gear **94** on motor output shaft **92** to sprocket gear **96** on shaft **90**. Main drive shaft **90** is rotated in a counter-clockwise direction as viewed in FIG. **3** at a speed determined by motor **86** or by a speed controller not shown interconnecting drive shaft **90** with motor **86**; the latter providing variable speed control of shaft **90**.

Eccentric drive **98** comprises a pivot point defined by stub shaft **100** eccentrically mounted on length adjuster assembly **104** having threaded rod **106** mounted therein for rotation to permit variation of eccentricity of shaft **100** relative to the axis of shaft **90**. A counterweight **108** is secured to shaft **90** opposite length adjuster **104** to balance the weight of the said adjuster **104**. A rack **110** is pivotally mounted at one end to stub shaft **100** and is slidably mounted at the opposite end for substantially reciprocal movement within housing **112**. Roller bearings **114** journaled within housing **112** hold rack **110** against pinion **116** which is journaled for rotation within housing **112** as rack **110** is reciprocated. Bearings **115**, mounted as shown in FIG. **3** or mounted in housing **112**, provide lateral support to rack **110**. Shaft **118** having pinion **116** mounted thereon is connected to the armature plate **120** of electromagnetic clutch **80** hereinbefore referred to causing said component **120** of the clutch to rotate back and forth as shaft **118** is rotated by the rack and pinion assembly. As will be discussed in more detail hereinbelow with reference to the operation of the machine, magnet component **121** of clutch **80** connected to drive sprocket **78** rotates drive sprocket **78** in a counter-clockwise direction.

With reference to FIG. **2**, drive assembly **67** is housed within casing **69** and eccentric drive **98** housed within casing **71**.

Turning now to FIGS. **4** and **5**, the sealing-cutting components of our machine will be discussed in detail. The drive roller **56** is adjustably mounted for substantially vertical movement by pneumatic cylinder assemblies **122** having the ends of the shaft of roller **56** journaled in blocks **124**. The pressure of air supplied to assembly **122** controls the pressure of abutment between draw rollers **56,58**.

Rollers **56,58** have peripheral recesses **126** formed at equal intervals along the length of said rollers to receive therein a plurality of stationary fingers **128** mounted on bar **129** and plate **152** and fingers **130** mounted for pivotal movement on bar **132**. Feed stock travelling between rollers **56,58** if jammed, displace fingers **130** upwards by movement of bar **132** about shaft **134** whereby said upward movement of fingers **130** causes limit switch **136** to be actuated to immediately shut down the operation of the machine as will be described. We have found that a 2 inch longitudinal spacing of grooves **126** provides optimum spacing of fingers **128, 130** to immediately detect the presence of jammed stock material at any point along the length of the drive rollers. The grooves **126** have sufficient depth to accommodate fingers **128,130**.

Sealing bar **140** having resistance element **142** passing therethrough for heating of the bar to a predetermined temperature is mounted for vertical reciprocal movement onto and away from support **144** which comprises a steel or the like metal component **146**, foam rubber strip **148** and hard silicon rubber contact strip **150** covered by teflon cloth, all of which are joined together by plate **152**, the latter also functioning as a support for stationary fingers **128** as has been described.

Sealing bar **140** has a sheet **176** of a high temperature material such as polytetrafluoroethylene such as sold under the trademark TEFLON wrapped thereabout to obviate sticking of the bag material to the heated sealing bar during the sealing operation. A water-cooled baffle **178** is disposed intermediate sealing bar **140** and rollers **56,58** to prevent heating of said rollers due to the proximity of the rollers to the sealing bar. Knife blade **152** is likewise water-cooled to prevent heating of said blade.

The cutting edge of knife **152** is adapted to be received within slot **156** formed longitudinally along metal bar **158** which is secured to plate **152** to join sealing components **144, 148** and **150** together. Knife **152** is mounted for vertical reciprocal travel and comprises, as shown most clearly in FIG. **4**, knife blade **152** rigidly secured to support bars **164** and having a segmented guard plate **166** slidably mounted on the face of blade **152** and biased downwardly by compression spring **168** for disengaging truncated stock material from knife blade **152** upon completion of the cutting stroke. Plate **156** abuts the top face of metal bar **158** on the downward travel of knife blade **152** permitting the blade only to enter recess **156**.

Overlapping and staggered pairs of stacking wheels **170,172** are driven by a drive motor, not shown, to engage and corrugate the bag material as it is discharged from the machine for drawing said material from the machine and transporting said material to stacking bins, not shown. Each wheel **170,172** may have a rubber facing **174** for positive, non-slipping engagement with the bag material.

FIG. **6** illustrates the sealing bar and knife actuating and control mechanisms housed in casings **173** and **247** of FIG. **2**. Knife support bars **164** are joined together by bolts **166** to grip rods **168** therebetween at each end such that vertical movement of rod **168** raises and lowers bars **164**. Rod **168** is passed through sleeve-bearing **170** welded to machine side-frame **171** for guided reciprocal travel therein. The lowermost extremity of rod **168** is pivotally connected to link **172** by connector **174** and the opposite end of link **172** is pivotally connected to lever **176** by connector **178**, connectors **174** and **178** being for example bolts threaded into one component part and passing through an eye **175,177** respectively formed in the other part. Lever **176** is keyed onto shaft **180** whereby reciprocal axial movement of piston-rod **182** pivotally connected thereto by connector **184** is transmitted to rod **168** for reciprocal vertical movement thereof. Double-acting cylinder **186** positively advances and retracts rod **182** as will be described in the description of the operation of the machine.

Support rods **190, 192** for teflon sheet **176** are rigidly secured at each end in support bars **194** which are secured to arms **196** adapted for pivotal movement about stub shafts **198** by the vertical reciprocal movement of rod **200** pivotally connected thereto as indicated by connector **202**. The lowermost end of rod **200** is pivotally connected to lever **204** by connector **206** whereby rocking movement of lever **208** transmits motion from link **210** pivotally mounted to arm **212** which pivots about shaft **214** for transmitting eccentric motion from cam **216** mounted on drive shaft **90**. Double-acting cylinder **220** having piston **221** pivotally connected to rod **223** rigidly secured to arm **212** is adapted to hold cam-follower roller **222** of arm **212** against the peripheral surface **224** of cam **216**. Cam **216** is adjustable by having a pair of eccentric discs **226, 228** held together by screws or the like securing means, not

shown, to vary the cam peripheral surface thereof. Pneumatic cylinder **220** also permits raising of arm **212** from engagement with cam **216** when it is desired to disengage the sealing bar while operating the remainder of the machine.

Shaft **180** having lever **176** keyed thereon passes through the width of the machine to the opposite side thereof for actuation of second rod **168**. In like manner sleeve **232** having lever **204** keyed thereon is connected to a lever pivotally mounted on the opposite side of the machine for reciprocal actuation of second rod **200** and second support arm **196**.

Double-acting pneumatic cylinder **239** is connected to cylinders **186** and **220** by a yoke **230** to permit retraction of the sealing bar and knife-cutting mechanism during servicing and inspection.

A control mechanism indicated generally by numeral **244** contains a shaft **246** journaled in housing **247** having supporting cam discs **248, 250, 252, 254** and **256** for controlling, respectively, the clutch and brake mechanism, counter and perforator, electric eye, cut-off and full cycle operations. Shaft **246** is connected to gear **258** which engages gear **260** keyed for rotation on drive shaft **90** for synchronization of said control cams and related limit switches with the cycling of the draw rollers, the sealing bar and the cutting mechanisms. Each of cam discs **248, 250, 252, 254** and **256** is adapted to actuate a limit switch designated by numerals **262, 264, 266, 268** and **270** respectively for energization and de-energization of the respective components, as will become evident in the description of the operation of the machine.

FIG. **7** illustrates schematically the electrical circuits of the machine. The several cam-operated limit switches are electrically communicated to the machine components as follows: switches **262,268** communicate a D.C. supply to the machine brake and clutch, switch **262** being a two-pole single-throw switch and switch **266** a single-pole single-throw switch for use with an electric-eye device not shown; switch **264** is a single-pole single-throw switch connected to solenoid **272** for actuating a counter and perforator, if desired; single-pole single-throw switch **268** is connected to cut-off solenoid **274** and to sealing bar solenoid **276**; and single-pole single-throw switch **270** is connected to motor **86**. Switch panel **280** with safety switch **136** are electrically connected to permit immediate shut-down of the machine.

In operation, tubular feed stock **16** is drawn from roll **14** by capstan drive **20** at a rate determined by the control connected to arm **38** of compensator **32**, as is well known in the art. The stock material passes about idler rollers **54,54'** and predetermined lengths of material are drawn between draw rollers **56,58** for positioning under sealing-cutting assembly **60**.

With reference to FIGS. **7** and **8**, switch **262** is actuated such that clutch **80** is energized for about 180° of a bag-making cycle and brake **74** is energized for the remaining 180° of said cycle, whereby the draw rollers are either being positively advanced or braked. Switch **264** is actuated each cycle to energize solenoid **272** which controls a counter device and a perforator, not shown. Switch **268** is actuated with about 5° remaining of the clutch cycle whereby solenoid **274** is energized opening double-acting pneumatic valve **280** to permit air to flow to line **282** of pneumatic cylinder **186** for actuation of piston **182** through lever **176**, link **172**, rod **168** and transfer support bars **164** for downward movement of knife-blade **152** and severing of sheet material thereunder. Severing of the bag material at the end of the draw cycle takes place while the bag still has residual forward motion whereby discharge of the bag by stacking wheels **170** is facilitated and occurs with a continuous motion.

The sealing bar **140** is actuated by cam **216** through cam follower **222** on arm **212**, link **210**, lever **208** and rod **200** to arm **196** which is pivoted about bolt **198** to descend for abutment of bar **140** against back-stop **150**. The sealing operation commences concurrently with actuation of switch **262** for energization of brake **74** and shortly after the cutting operation has commenced and continues for about a dwell time of about 165° which is about 15° short of the completion of the brake cycle such that the sealing bar is retracted when the brake is de-energized and the draw rolls re-engaged by energization of the clutch mechanism **80**.

The sealing bar can be applied over a range of from 100° to 160° of the full cycle depending on the thickness, i.e., gauge, of material used, the nature of material used, temperature of the bar and rate of throughput, i.e., draw length of each bag made.

Upon completion of the sealing operation, cam **216** permits cam follower **222** to be lowered under the bias of a constant pressure in pneumatic cylinder **220** to raise rod **200** and arm **196**. Double-acting switch **262** energizes clutch **80** whereby draw rollers **56, 58** are coupled to the drive motor for rotation and for drawing the next length of stock material therethrough for a repeat of the cutting sealing operation. It will be evident that braking of draw roller **58** occurs when the linear movement of rack **110** has substantially ceased thus resulting in little torque being applied to shaft **70**.

Fingers **130** positioned at spaced intervals along idler roller **56** are pivotally mounted by rod **134** passing through bar **132** such that a jam up of stock material at any point along the length of rollers **56, 58** will result in upward, clockwise movement of fingers **130** for actuation of switch **136** which energizes relay coil **285** to de-energize clutch **80**, energize brake **84**, move pneumatic cylinders **186** and **220** into their neutral position causing the sealing bar and cut-off to move to an upward inoperative position and permits the main drive shaft to complete a full cycle to the beginning of the draw operation and then stop.

What we claim as new and desire to protect by Letters Patent of the United States is:

1. A draw roller drive for a bag-making machine comprising a pair of opposed draw rollers journaled for rotational movement about their shafts, means for biasing one roller against the other for gripping bag-making stock material therebetween, electromagnetic clutch means consisting of an armature plate and a magnet having the magnet operatively connected to the shaft of one of said draw rollers, reciprocating drive means operatively connected to the armature plate of said clutch for converting the unidirectional rotary motion of a prime mover to a back-and-forth rotary motion of said clutch armature plate, electric brake means operatively connected to the shaft of one of said draw rollers for positively stopping the said draw roller, and control means operatively connected to said prime mover for actuating said clutch during rotation in one direction and de-actuating said clutch during rotation in the opposite direction to rotate said draw rollers in one direction only, and control means operatively connected to said prime mover for actuating said brake means to positively stop said draw rollers when said clutch is de-actuated, said clutch and brake control means comprising limit switches communicating with said clutch and brake and operatively connected to said drive motor for synchronization of said clutch and brake with said reciprocating drive means.

2. A draw roller drive as claimed in claim **1**, in which said reciprocating drive means comprises a rack, means for eccentrically connecting one end of said rack to a shaft operatively connected to the prime mover whereby rotational motion of the prime mover is converted to reciprocal motion of said rack, and a pinion engaging said rack journaled for rotation on a shaft operatively connected to said clutch armature plate whereby reciprocal motion of the rack is converted to back-and-forth rotary motion of the pinion and clutch armature plate.

3. A draw roller as claimed in claim **2**, in which said eccentric rack connecting means comprises a threaded rod radially mounted for rotational movement on the shaft operatively connected to the prime mover, a sleeve threaded onto said rod adapted to be moved radially away from and towards said shaft by rotation of the said rod, and a pivotal connector formed on said sleeve interconnecting one end of the rack to the sleeve.

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