Dec. 28, 1965 C. E. CORY 3,225,507

BAG CLOSING AND TYING MACHINE AND METHOD

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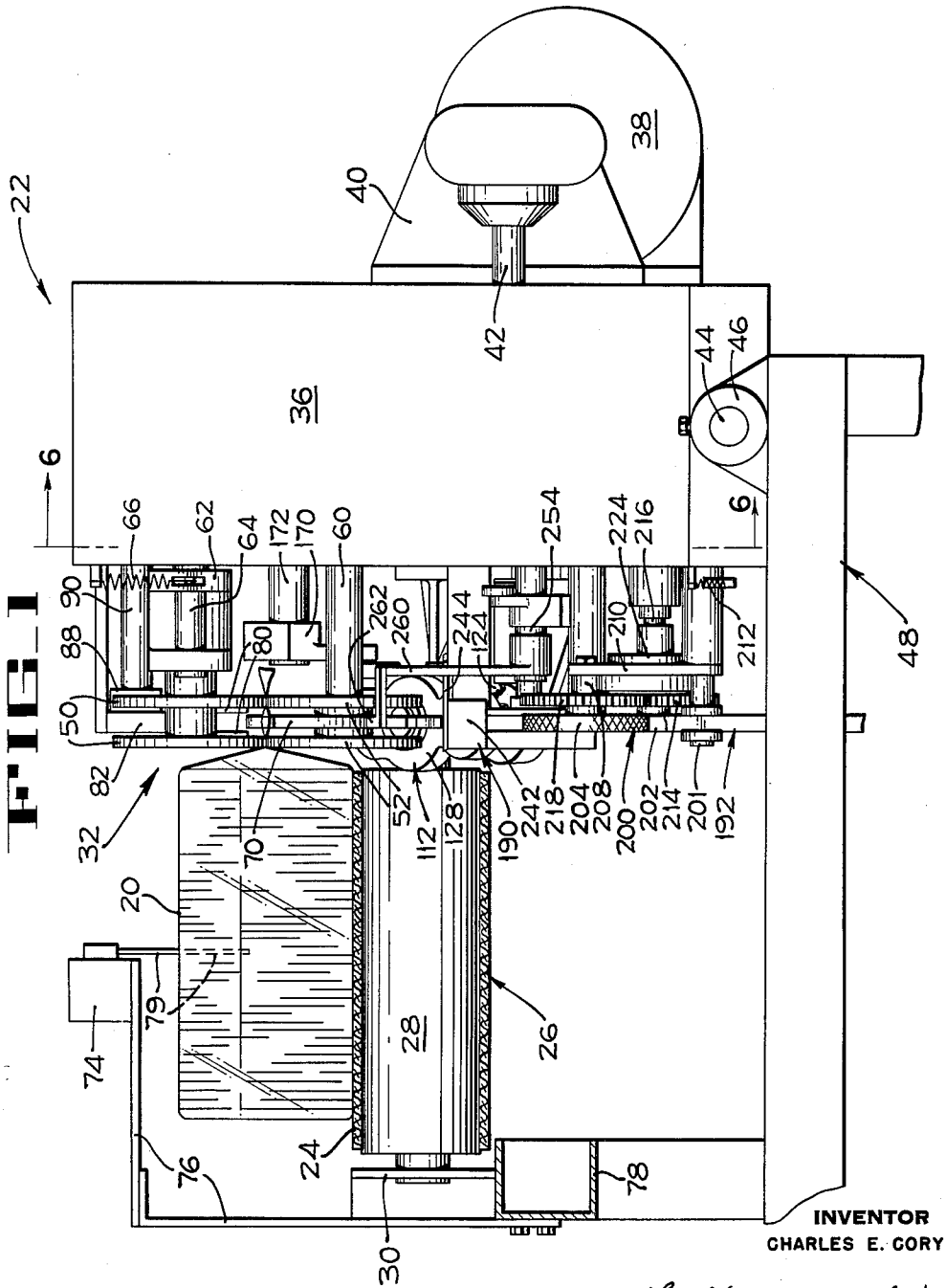


FIG. 1

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BAG CLOSING AND TYING MACHINE AND METHOD

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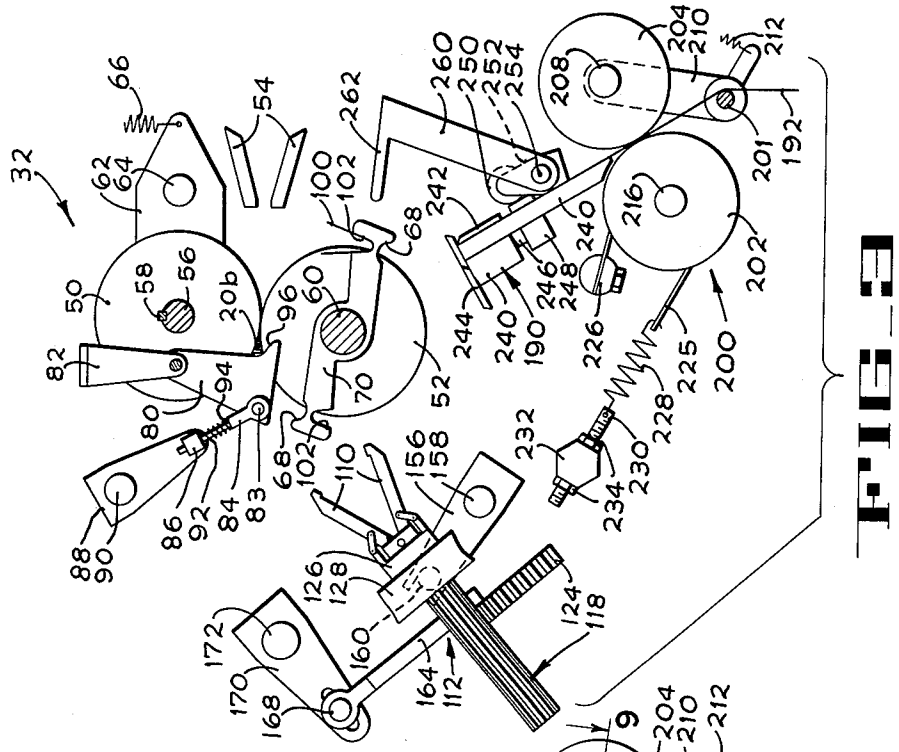


FIG. 3

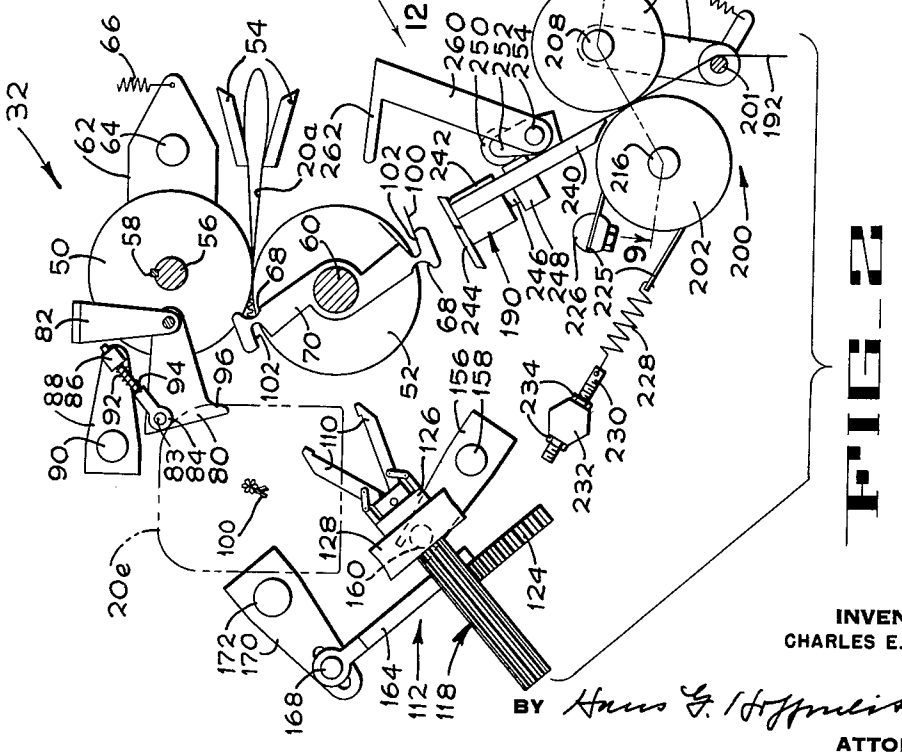


FIG. 2

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BAG CLOSING AND TYING MACHINE AND METHOD

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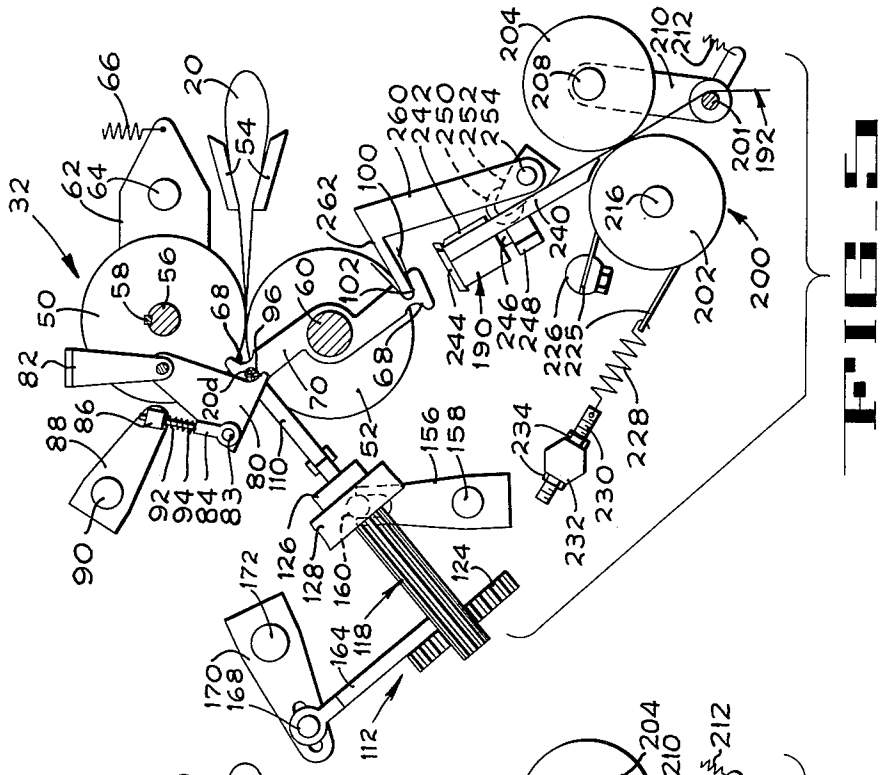


FIG. 5

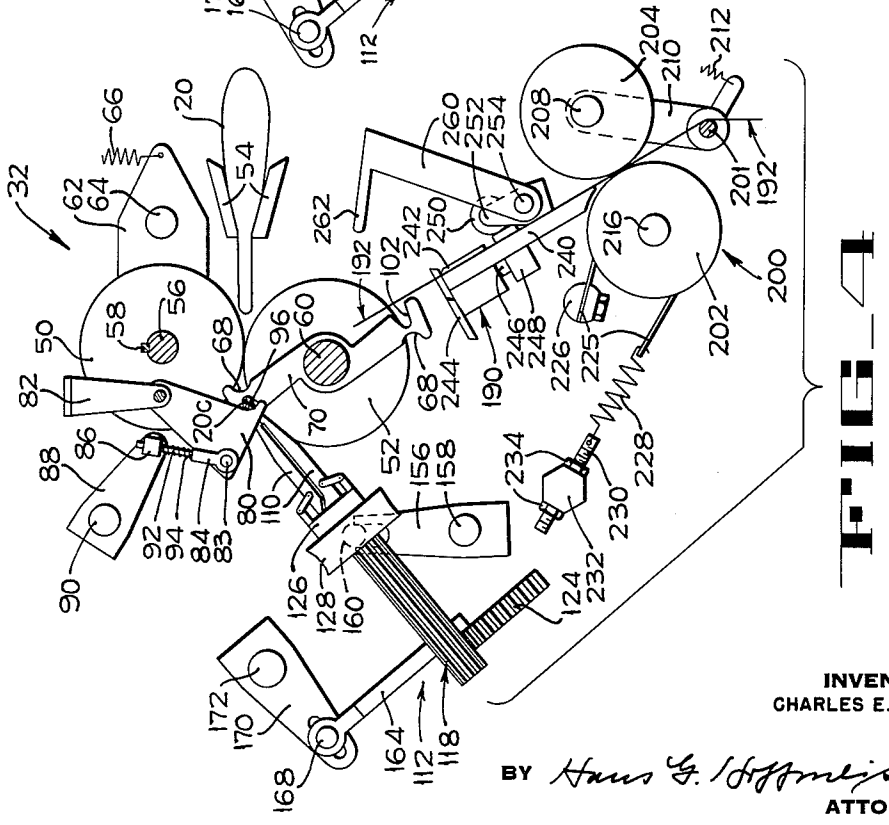


FIG. 4

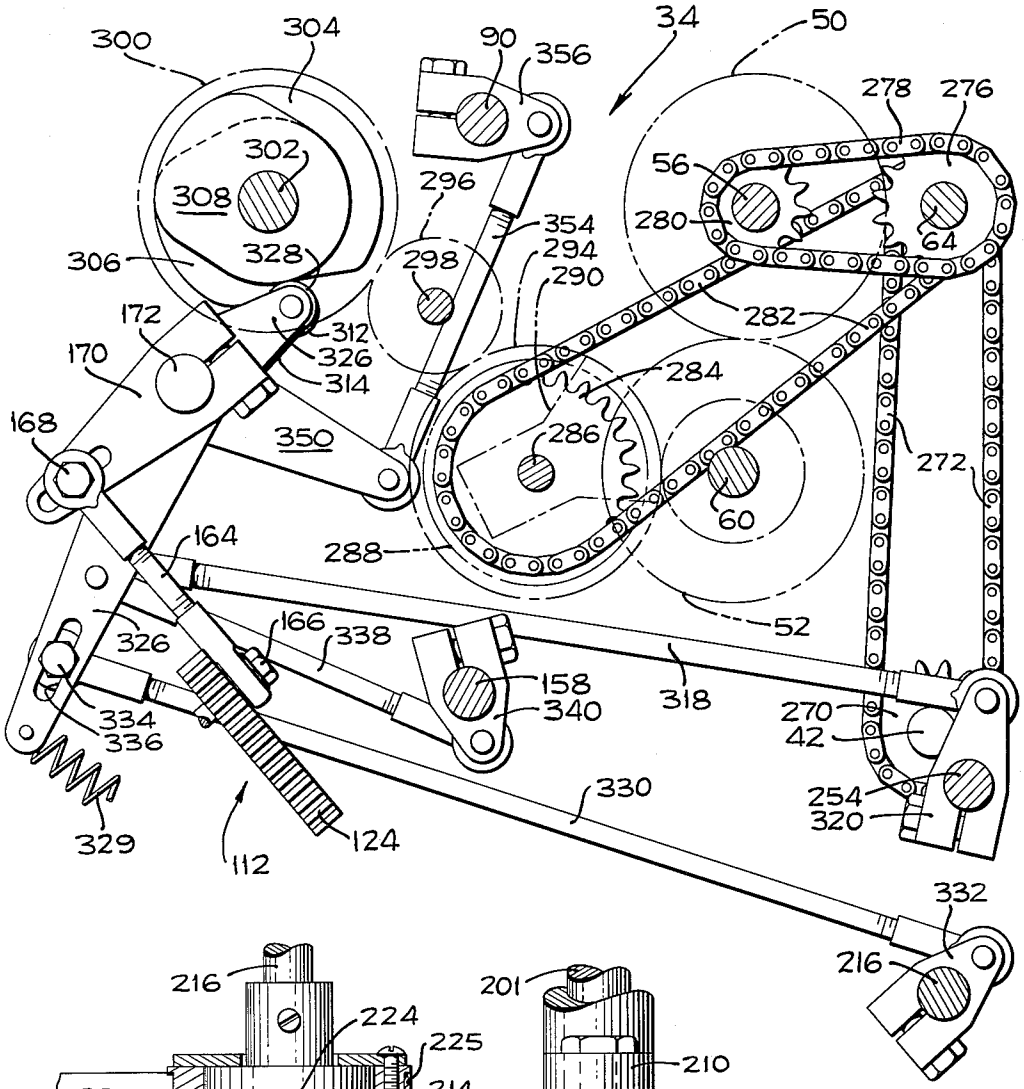
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BAG CLOSING AND TYING MACHINE AND METHOD

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FIG_6



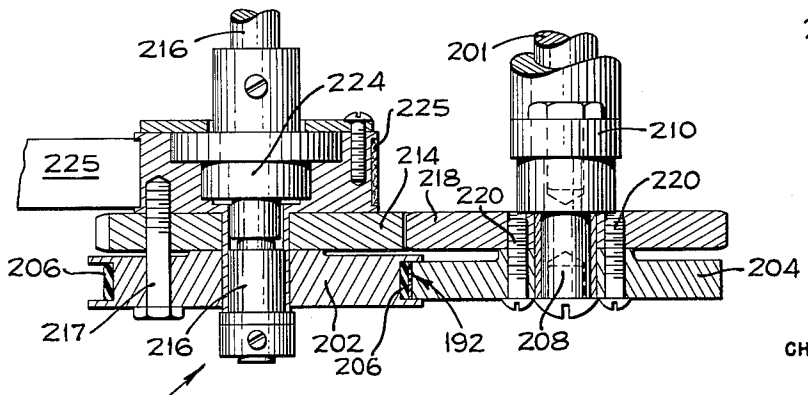


FIG_9

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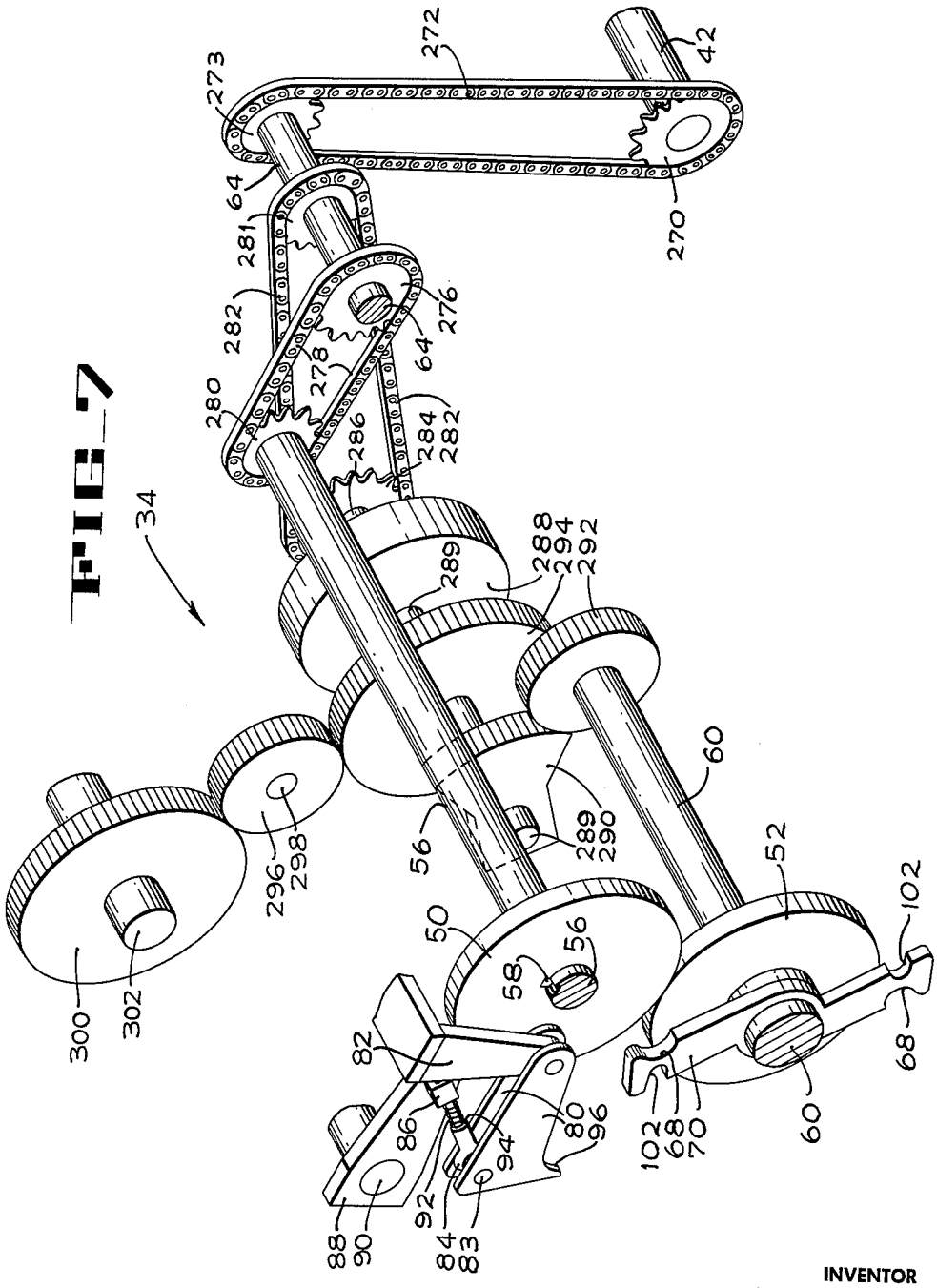
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BAG CLOSING AND TYING MACHINE AND METHOD

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FIG. 7



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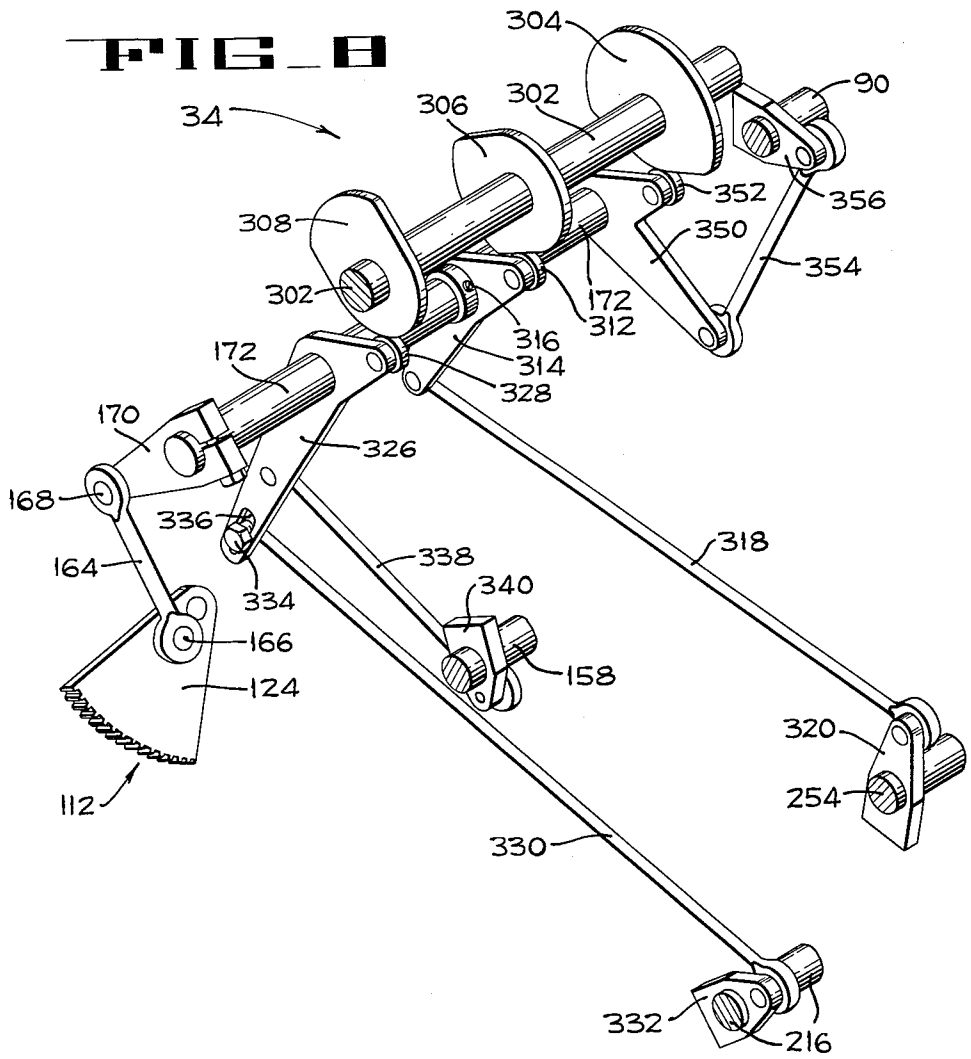
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BAG CLOSING AND TYING MACHINE AND METHOD

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FIG_8



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BAG CLOSING AND TYING MACHINE AND METHOD

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FIG_10

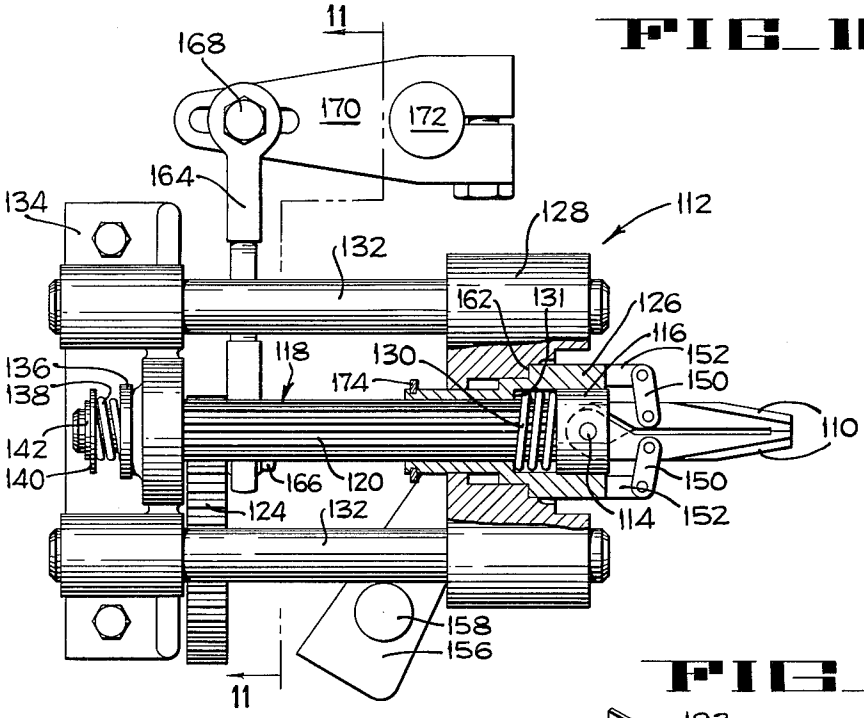
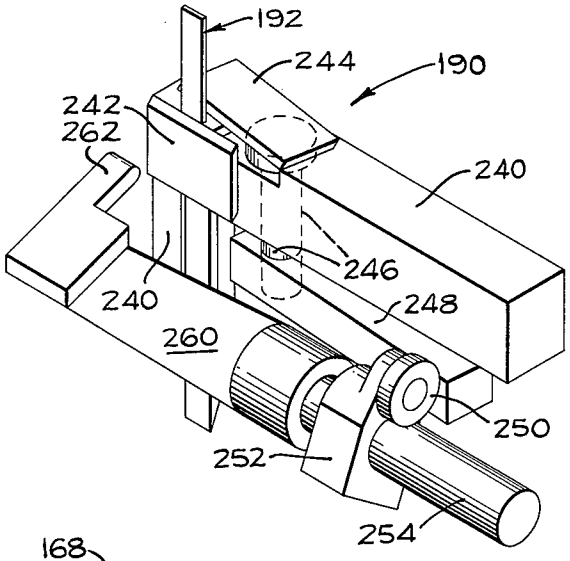


FIG_12



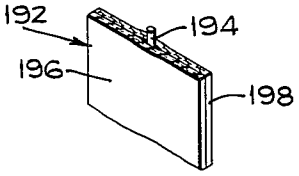


FIG_13

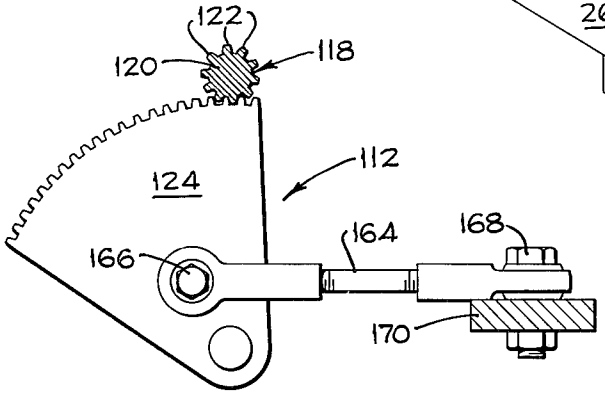


FIG_11

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United States Patent Office 3,225,507 Patented Dec. 28, 1965

3,225,507

BAG CLOSING AND TYING MACHINE AND METHOD

Charles E. Cory, Oakland, Calif., assignor to FMC Corporation, San Jose, Calif., a corporation of Delaware

Filed Oct. 5, 1962, Ser. No. 228,696
10 Claims. (Cl. 53—14)

This invention relates to package making, and pertains more particularly to machines for closing the ends of filled bags.

An object of the present invention is to provide an improved bag closing machine.

Another object of the invention is the provision of a machine for gathering, or pursing, the top of a filled bag into a constricted neck, positioning a wire or other flexible and slightly resilient tie around the neck of the bag, and tightening the tie around the bag neck by twisting the ends of the tie together to effectively close the end of the bag to protect and prevent loss of the bag's contents and yet permit the bag to be opened easily when access to or removal of its contents is desired.

Another object of the invention is to provide an automatic machine which operates dependably to close and tie filled bags in rapid succession and yet which handles the bags so gently so as to avoid damaging the bags or their contents.

Another object is the provision of a bag closing and tying machine in which a high rate of production is attained by performing simultaneously the operations of gathering the neck of one bag, preparing a bag tie for application thereto, and tightening the tie previously applied to the preceding bag.

Another object of the invention is to apply the bag tie to the neck of each bag by means of a tie carrier which also performs the final stages of the neck constricting operation, and which does not retract upon completion of its functions, but travels on in the direction of movement of the bag and thus avoids interference with the next succeeding bag entering the region where gathering and tying thereof take place.

Another object is to provide the tie carrier in the form of a double-ended member, one end of which completes the gathering of a bag neck and places a tie thereon in position to be twisted and tied while another bag tie is being supplied to the other end of the carrier in readiness to be placed upon the neck of the next succeeding bag.

Another object is the provision of an improved mechanism for cutting bag ties of appropriate length from a supply of strip stock and forming each severed tie into a particular shape, and for then transferring the tie and placing it upon a gathered bag neck in partially encircling relation thereto where it is in readiness to be engaged and acted upon by a tie twisting and tightening mechanism.

Other objects and advantageous features of the invention will become apparent from the following description and the accompanying drawings, in which:

FIGURE 1 is a front elevation of the bag closing and tying machine of the present invention, showing in transverse section a supply and discharge conveyor for serving the machine.

FIGURES 2, 3, 4 and 5 are schematic operational views showing successive steps of the bag closing and tying operation performed by the machine of FIG. 1.

FIGURE 6 is a diagrammatic elevation of the driving mechanism of the machine, which may be considered as an enlarged section taken on line 6—6 of FIG. 1.

FIGURE 7 is a schematic perspective showing the power supply portion of the driving mechanism of FIG. 6.

FIGURE 8 is a schematic perspective showing the cams, cam followers and associated linkages included in the driving mechanism of FIG. 6.

FIGURE 9 is an enlarged transverse section through the tie stock feeding mechanism taken on the line 9—9 of FIGURE 2.

FIGURE 10 is an enlarged, partly broken away side elevation of the tie twisting mechanism.

FIGURE 11 is a section on line 11—11 of FIG. 10.

FIGURE 12 is a perspective showing the mechanism for severing the bag ties and supplying them to the tie transferring carrier, viewed in the general direction of the arrow 12 of FIG. 2.

FIGURE 13 is a fragmentary perspective of one type of stock suitable for use in making bag ties in the machine of this invention.

Bags to be closed and tied, one of which is indicated at 20 in FIGURE 1, are supplied in rapid succession to the bag closing and tying machine 22 of this invention upon the upper run 24 of a belt type endless conveyor 26 trained about spaced apart pulleys 28 (one shown in FIG. 1) journalled in brackets 30. The type of bag 20 illustrated in FIGURE 1 is designed as a container for a standard loaf of bread, but it is to be understood that this is merely an exemplary showing since the machine of this invention can be used with equal advantage to close and tie bags of other types, filled with other commodities.

Whereas the operating elements 32 of the machine 22 which engage the bags and the ties are exposed at the side of the machine adjacent the conveyor 26, the driving mechanism 34 therefor (FIG. 6) is contained within a housing 36 (FIG. 1) and is operably connected to the operating elements 32 by shafts journalled in and extending through a side wall of the housing 36. The drive motor 38 and speed reduction unit 40 from which the driving mechanism 34 receives its power are mounted exteriorly of the housing 36 on the side remote from the conveyor 26. The output shaft 42 of the speed reduction unit is journalled in this side of the housing and extends through it to the interior of the housing where it is operatively connected to the drive mechanism 34 as will be explained presently.

The conveyor 26 is illustrated in FIGURE 1 as being horizontal so that the filled bags 20 carried thereby lie flat on their sides with their open ends extending to and beyond a side of the conveyor for presentation to the closing and tying machine 22 as they advance past it. Under certain circumstances of installation however, it may be advantageous that the conveyor be tilted so that whereas the filled bags advance along a horizontal path they are tipped upward and toward the machine 22 thus keeping their open ends uppermost as an aid in preventing spilling of commodities in powdered or granular form or existing in separate pieces. To make the machine 22 adaptable for use in connection with either horizontal or tipped supply conveyor, it is mounted by means of trunnions 44 (one shown in FIG. 1) projecting from the front and rear walls of the housing 36 and journalled in bearings 46 which are mounted upon a frame 48 which may also provide support for the above mentioned brackets 30 in which the conveyor pulleys 28 are journalled.

In either case, the filled bags 20 which are to have their open ends closed and tied are fed to the machine 22 while lying on their sides, either flat or inclined, and advancing sideways, so as to present their open ends successively to cooperating upper and lower pairs 50 and 52, respectively, of gathering wheels (FIGS. 1–5). As each open bag top approaches the gathering wheels it encounters guiding, or camming, surfaces lying in a plane parallel to the direction of bag movement and sloping toward each other in that

direction. These camming surfaces, which may be provided by edges of a protective guard or cover (not shown) which partially encloses the operating elements **32**, or may be rails **54** as shown diagrammatically in FIGURES 2–5, are so placed that the open bag ends pass between them and as a consequence of the converging nature of the camming surfaces **54** are partially collapsed or flattened by them, thus facilitating entry of the region of the bag adjacent its open end (hereinafter called the "bag end region") into the nip between the upper pair **50** and the lower pair **52** of gathering wheels, as illustrated in FIGURE 2.

The upper pair **50** of gathering wheels are rigidly secured to a constantly rotating shaft **56** for uninterrupted rotation therewith, as by a key **58**. The direction in which the upper gathering wheels **50** are driven is clockwise as viewed in FIGURES 2–6. The lower gathering wheels **52** are in the nature of idler wheels inasmuch as they are freely rotatable upon another shaft **60** parallel to and spaced below the upper gathering wheel shaft **56**. Each lower gathering wheel **52** is in planar alignment with one of the upper gathering wheels **50** and the gathering wheels of each pair are spaced apart axially along their respective shafts **56**, **60**, so as to accommodate other mechanism therebetween as is presently to be explained. The upper gathering wheel shaft **56** is carried at the outer end of a support arm **62** (FIGS. 2–5) pivotally mounted adjacent its other end upon a shaft **64** and urged constantly by a spring **66** in such a manner that when a partially flattened bag end region is caught in the nip between the two pairs of gathering wheels it will be engaged thereby sufficiently tightly to be flattened therebetween and driven forward thereby, as indicated at **20***a* in FIG. 2.

The speed of rotation of the gathering wheels is such that a bag end region caught in the nip between the wheels **50** and **52** is advanced thereby at approximately the same speed that the remainder of the bag **20** is advanced on the conveyor **26**. As the bag end region is advanced it is effectively collapsed into a flattened condition so that as it emerges at the downstream side of the gathering wheels and encounters a stationary abutment the end region is gathered, or pursed, thus forming the bag end region into a neck of greatly reduced transverse dimensions as compared with the body of the bag **20**, as indicated at **20***b* in FIGURE 3.

The initial phase of this gathering, or pursing, operation occurs within a recess **68** (FIGS. 2–5), one of which is provided in each end of a rotatable, multiple acting, double ended, tie transfer member **70**, as illustrated in FIGURE 2. This double ended lever **70** is rigidly secured to the lower gathering wheel shaft **60** (FIGS. 2–6) which is rapidly rotated through one-half of a revolution in response to closure of a sensing switch **74** (FIG. 1) mounted upon a bracket **76** extending upward from a longitudinally extending member **78** of the frame **48**. The sensing switch **74** is so positioned above the conveyor **26** that its sensing element **79** is engaged and moved by each filled bag **20**, so as to close the switch **74** to engage a single revolution clutch as will presently be explained, and thereby effect the mentioned 180 degree movement of the tie transfer member **70**, just as the trailing edge of a flattened bag end region is passing through the nip between the upper and lower gathering wheels **50** and **52**. Thus the abutment against which the initial phase of the gathering operation occurs is suddenly removed from its position wherein it interrupted forward movement of the leading edge of the flattened bag end region and wherein a substantial portion of the bag end region has been bunched or gathered against it. However, before this removal of the abutment occurs its place is taken by a pair of secondary gathering fingers **80** (FIGS. 2–5) which are pivotally mounted in spaced apart planes between the two upper gathering wheels **50** upon a bracket **82** rigid with the frame **48**. The two secondary gathering fingers **80** are spaced apart sufficiently to permit the ends of the tie transfer member **70** to move freely therebetween, the latter being secured to the shaft **60** between the two lower gathering wheels **52** which, as above stated, are freely rotabtale upon the shaft **60**.

The two secondary gathering fingers **80** are held in alignment with each other by a pivot pin **83** (FIGS. 2–5) which rigidly interconnects them and upon which one end of a connecting rod **84** is engaged. The other end of the connecting rod **84** extends slidably through a block **86** which is pivoted to the outer end, a crank arm **88** which is rigidly secured to and extends radially from a shaft **90** (FIGS. 2–6). A spring **92** (FIGS. 2–5) under compression between the block **86** and a shoulder **94** on the connecting rod **84** pushes the secondary gathering fingers **80** from their retracted position shown in FIGURE 2 to their operating position shown in FIGURE 3, when the crank arm **88** turns clockwise as viewed in these figures. However, the spring **92** permits the secondary gathering fingers **80** to yield slightly for a purpose presently to be explained. Aligned arcuate recesses or pockets **96** are provided in the two secondary gathering fingers **80** adjacent their outer ends in position to move into register with the gathering recess **68** of the tie transfer lever **70** within which the bag end region is being gathered at the time that the fingers **80** move into their operative position.

During each interval of rest between successive actuations of the tie transfer lever **70** a bag tie **100** is bent to substantially V-shape form and is seated within a V-shaped notch **102** in the leading edge of that arm of the tie transfer lever which is opposite the arm against which a bag end region is being gathered. As stated, actuation of the tie transfer lever **70** to reverse its position occurs just as the trailing edge of a bag end region is passing through the nip between the gathering wheels. Consequently, the sudden rotation of the tie transfer lever **70** through a half revolution causes the end of the lever within whose notch **102** a bag tie **100** has just been seated to overtake the trailing edge of the bag end region and thus place the bag tie **100** upon the neck being formed in partially encircling relation therewith, i.e., with the two diverging ends of the tie (the two arms of the V) in embracing relation with the neck. Moreover, the tie transfer lever **70** does not complete its one-half revolution until the bent portion or crotch of the V has passed the line of tangency of the upper and lower gathering wheels, with the result that as the tie transfer lever **70** completes its half revolution it crowds the trailing edge of the bag end region farther forward than it would be carried by the gathering wheels themselves, and presses the thus completely gathered back neck firmly against the secondary gathering fingers **80** as indicated at **20***c* in FIGURE 4. It is to accommodate such final movement of the tie transfer lever and permit such squeezing of the neck **20***c* into a highly compacted, substantially cylindrical form that the spring **92** is provided upon the push rod whereby the secondary gathering fingers **80** are propelled into their operative position. This arrangement ensures completion of the stroke of the tie transfer lever and efficient compacting of the neck **20***c* without harmful interference between the secondary gathering fingers **80** and the tie transfer lever **70** as the latter completes its one-half turn.

While the bag neck **20***c* is thus held under compression between the secondary gathering fingers **80** and the leading edge of one arm of the tie transfer lever **70**, with a bag tie in partially encircling relation therewith, a pair of opposed twisting jaws **110** (FIGS. 2–5 and 10) move forward so as to receive the two diverging ends of the bag tie **100** therebetween, whereupon the jaws **110** swing together, clamping the two ends of the tie together, thus completing the encircling relationship of the tie with the bag neck. The twisting jaws **110** then rotate through approximately one and one-half turns, twisting the two ends of the tie together and thereby tightening the tie upon the bag neck and thus completing closure of the bag, as indicated at **20***d* in FIGURE 5. The twisting

jaws **110** then open, return to their withdrawn position and rotate in the opposite direction for one and one-half turns thus placing them in readiness for the next cycle of operation, as illustrated in FIGURES 2 and 3. Simultaneously therewith the secondary gathering fingers **80** are returned to their withdrawn or idle position, thus releasing the bag whose end region has been closed and tied, permitting the conveyor **26** to carry it away from the bag closing and tying machine **22**, as indicated at **20***e* in FIGURE 2 and to any suitable point of discharge.

An important feature of the present invention is that immediately upon arrival of the tie transfer lever **70** in the position wherein the leading edge of one of its arms crowds the gathered bag end region forward compactly against the secondary gathering fingers **80** (FIG. 4) the trailing edge of the same end of the lever is in position to intercept the leading edge of the next successive bag end region and thus commence the operation of gathering it into a neck before the secondary gathering fingers **80** are retracted and while the operation of twisting the bag tie and tightening the same upon the neck of the preceding bag is taking place. This is one of the factors that contributes to the high output rate of the machine **22** of this invention inasmuch as the time interval which must be permitted between entry of successive bags into the machine **10** is considerably shortened as a result of the fact that a succeeding bag can enter the machine and the operation of gathering its end region into a neck can be started while the neck of the preceding bag is being tied and the tie thereon is being tightened.

The construction and manner of operation of the mechanism **112** which actuates the twisting jaws **110** can best be understood by reference to FIGURES 8, 10 and 11. The two jaws **110** are pivoted by a common pin **114** to a relatively large head **116** on the forward end of a shaft **118**. The shank portion **120** of the shaft **118** behind the large end **116** thereof is in the nature of a spline inasmuch as elongate gear teeth **122** are formed throughout the full circumferential extent thereof. Thus, intermeshing engagement is maintained between the toothed shank portion **120** and a sector gear **124** even though the shaft **118** partakes of axial movement of considerable extent. The forward end of the splined shaft **118** is slidable axially within a cylindrical jaw actuating cage **116** which is so fitted to a crosshead **128** that the cage **126** can both rotate and move axially relatively thereto. Forward axial motion of the shaft **118** relative to the cage **126** is resisted by a coil spring **130** under compression between the large head **116** and a shoulder **131** within the bore of the cage **126**. The crosshead **128** is slidably mounted upon two spaced, parallel guide rods **132** rigidly secured to a bracket **134** within which the splined shaft **118** is journalled for both free rotation and limited axial movement. The shaft **118** is journalled in and extends beyond the bracket **134** to receive a stop washer **136** and a cushioning spring **138** which are retained in operative position on the shaft **118** by another washer **140** and a snap ring **142**.

A link **150** is pivoted to each jaw **110** a short distance forward from the common pivot pin **114** and each link **150** is pivoted to an ear **152** projecting forward from the jaw actuating cage **126**. The parts are so proportioned and arranged that when the spring **130** moves the splined shaft **118** axially forward relatively to the actuator cage **126**, the links **150** draw the jaws **110** apart to their open position (FIGS. 2 and 3), and when the actuator cage moves forward with respect to the splined shaft in opposition to the force exerted by the spring **130** the links **150** push the jaws together to their clamping position (FIGS. 4 and 8).

Means are provided for sliding the crosshead **128** forward on the guide rods **132** immediately after the tie transfer lever **70** has been actuated to remove one of its ends from in front of a bag neck and to cause its opposite end to place a bag tie on the bag neck in position to be engaged and twisted by the twisting mechanism **112**. A crank arm **156** (FIGS. 2–5 and 10) is secured at one end to a shaft **158** and the bifurcated other end of the crank arm embraces a pin **160** rigid with and projecting from the crosshead **128** (FIGS. 2–5). When the shaft **158** is turned clockwise as viewed in FIGS. 2–5, the crank arm **156** moves the crosshead **128** forward, i.e., to the right as viewed in these figures. Throughout the major portion of such forward motion of the crosshead **128** the shaft **118** is likewise carried forward due to the pressure of the spring **130**. When this forward motion has progressed to the extent that the open jaws **110** embrace the flared ends of the bag tie **100** that has been placed upon the bag neck, motion of the shaft **118** is arrested by engagement of the washer **136** with the bracket **134** as shown in FIG. 10. However, forward motion of the crosshead **128** continues briefly, and since a shoulder **162** on the jaw actuating cage **126** engages a complementary shoulder on the crosshead, the cage **126** likewise continues to move forward, compressing the spring **130**. This continued forward motion of the cage **126** relative to the shaft **118** causes the links **150** to swing the jaws **110** toward each other and thus to engage the projecting ends of the bag tie **100** and to squeeze them together, thereby completing the encirclement of the neck by the bag tie.

Upon completion of the clamping movement of the jaws **110** the sector gear **124** is actuated to rotate the shaft **118** and thereby twist the ends of the bag tie **100** tightly together so as to tighten the tie upon the bag neck and thus complete the closure of the bag. This is accomplished by means of a connecting rod **164** (FIGS. 8, 10 and 11) pivoted by a pin **166** to the sector gear **124** and connected by another pivot pin **168** to a crank arm **170** rigidly secured to a rock shaft **172** to which the necessary reciprocatory rotary motion is imparted at the appropriate time by means presently to be described.

This twisting operation requires approximately one and one-half turns of the shaft **118**, and immediately upon its completion the crank **156** turns counterclockwise as viewed in FIG. 10, to retract the crosshead **128**. During the initial stage of the crosshead's retraction the spring **131** holds the shaft **118** in its forwardmost position while the jaw actuating cage **126** retracts, thus causing the links **150** to pull the jaws **110** apart and thereby release their grasp upon the twisted bag tie. Immediately thereafter the rear face of the crosshead **128** engages a snap ring **174** on the shank portion of the cage **126** so that throughout the rest of the return stroke of the crosshead **128** the shaft **118** and jaws **110** are returned to their retracted, idle position.

At approximately the same time that the shaft **118** and twisting jaws **110** are retracted the secondary gathering fingers **80** are likewise retracted. This clears the path for the completely closed bag which is thus released to be carried onward by the conveyor **26** and discharged from the bag tying machine **22**.

As stated above, while the tie transsfer lever **70** is idle between successive actuations thereof, a bag tie **100** is severed from a supply of strip stock, bent to substantially V-shaped configuration, and seated within the V-shaped notch **102** of the opposite arm of the tie transfer lever **70** from that against which the end region of a bag is being gathered. The mechanism for performing these functions is indicated at **190** and is best shown in FIGS. 2–5, 9 and 12.

Whereas various forms of tying devices are adaptable for use in connection with the machine **22** of the present invention one type that has proven entirely satisfactory is that which is shown in the Halstead Patent No. 2,732,001. As shown in FIG. 13 this tie material comprises a flexible and slightly resilient wire **194** sealed between two strips **196** and **198** of paper or other flexible sheet material.

The strip stock **192** is fed to the severing and forming mechanism **190** by a feeding mechanism **200** (FIGS. 2–5

and 9), which draws it from a supply roll (not shown) rotatably supported in any convenient location. After passing around a suitably positioned guiding roller or rod **201** (FIGS. 2–5) it enters the nip between two opposed feeding discs **202** and **204**. As best shown in FIG. 9 a peripheral groove is formed in the disc **202** and a lining **206** of suitable friction material is seated within the groove. The periphery of the opposed disc **204** extends into the groove so as to compress the strip stock **192** tightly against the band of friction material and thus insure advance of the strip stock **192** when the discs **202** and **204** are turned. The disc **204** is rotatably mounted upon a shaft **208** carried at the outer end of an arm **210** (FIGS. 2–5) which is freely mounted upon the guide rod **201** and is urged by a spring **212** toward the disc **202** so as to exert the necessary pressure against the strip stock **192**.

The grooved disc **202** is freely rotatable upon a shaft **216** (FIGS. 2–6, 8 and 9) as is also a gear **214** (FIG. 9) which is rigidly secured thereto as by a plurality of bolts **217**, one of which is shown in FIG. 7. The opposed disc **204** likewise has a gear **218** affixed thereto by screws **220**, and the two gears **214** and **218** are enmeshed with each other. The two gears **214** and **218** are of the same pitch diameter which substantially corresponds to the effective diameter of the discs **204** and **206**. Because of the intermeshing engagement of the gears **214** and **218** they insure that the two discs **202** and **204** will rotate simultaneously and in opposite directions so as to positively effect advancement of the strip stock **192** when they are turned so that their strip engaging portions move toward the tie severing and forming mechanism **190**.

Such motion of the strip feeding discs **202** and **204** is accomplished by oscillation of the shaft **216** in opposite directions of rotation. Inasmuch as it is desired to actuate the feeding mechanism **200** only when the nip between the two discs is moving toward the tie severing and forming mechanism **190** the gear **214** and the disc **202** are connected to the shaft **216** by means of a one way clutch **224**. Since this clutch is of conventional design subject to purchase upon the open market the details of its construction need not be shown and described herein and it will suffice for the purposes of the present disclosure to state that when the shaft **216** is rotated counterclockwise as viewed in FIGS. 2–6 and 8, the clutch **224** effects similar rotation of the gear **214** and disc **202** but when the shaft **216** is rotated clockwise as viewed in these figures the gear **214** and disc **202** remain motionless. As a precautionary measure to positively prevent such reverse turning of the disc **202** a braking strap **225** is trained around the circumferential surface of the driven element of the one way clutch **224**. The end of the strap **225** toward which the disc **202** turns when feeding the strip stock **192** is immobilized by an anchoring clamp **226** (FIGS. 2–5), whereas the other end of the strap **225** is connected by a spring **228** to an adjustment screw **230** extending loosely through an anchoring post **232** and releasably locked thereto when the spring **228** has had desired tension imposed thereupon by lock nuts **234**. When the disc **202** turns counterclockwise as viewed in FIGS. 2–5 the spring **228** yields, permitting the strap **225** to move with the turning disc far enough to relieve its tension and to thereby so loosen it that feeding movement of the discs **202** and **204** is unhampered. However, if and when the disc **202** tends to rotate clockwise, the unyielding nature of the anchoring clamp **226** does not permit any such loosening of the strap, and reverse rotation of the disc **202** is prevented.

Thus the strip stock **192** is intermittently advanced to the severing mechanism **242** (FIGS. 2–5 and 12), where it slides along an elongate platform **240** (FIG. 12) and under a stationary shear blade **242** adjacent the discharge end of the platform **240**. A movable shear blade **244** pivotally mounted for movement across the end of the platform **240**, is carried by a shaft **246** (FIG. 12) which extends transversely through the platform **240**. The shaft **246** is rotatable with respect to the platform and the end thereof opposite the shear blade **244** carries a lever arm **248** rigid therewith and extending radially therefrom. The lever arm **248** is engaged by a roller **250** carried by a crank arm **252** extending radially from a shaft **254** which, when turned a few degrees clockwise as viewed in FIG. 12 moves the crank arm **252** and roller **250** in such a manner as to turn the lever arm **248**, shaft **246** and movable shear blade **244**, thereby causing the latter to move across the end of the stationary shear blade **242** and thereby sever the strip stock **192** which passes between the two blades **242** and **244**.

As best shown in FIGS. 2–5, the mentioned shaft **254** extends transversely across the platform **240** and slightly to one side thereof. A tie forming lever **260** carried by the shaft **254** extends radially therefrom past the discharge end of the platform **240** where the shearing blades **242** and **244** are mounted and carries at its outer end a round nosed forming blade **262** in position to enter the notch **102** in the end of the tie transfer lever **70** which is opposite the location where the bag end regions are gathered. Furthermore, the platform **240** and shearing blades **242** and **244** are so positioned that when the strip stock feeding discs **202** and **204** are actuated they propel past the shearing blades **242** and **244** a length of the strip stock **192** suitable to provide one of the bag ties **100**. This length of the strip stock projects closely adjacent the leading edge of the adjacent end of the tie transfer lever **70** so that it overlies the open mouth of the V-shaped notch **102** therein, as shown in FIG. 4.

Upon completion of the strip feeding operation of the discs **202** and **204** the shaft **254** is turned to actuate the shearing blade **244** as above described and thereby sever the projected length of strip stock from the parent supply. Simultaneously with the actuation of the shearing blade **244** lever **260** is turned counterclockwise as viewed in FIGS. 4 and 5, causing its round nosed forming blade **262** to engage the projected length of strip stock at practically the same instant that shearing thereof from the parent supply is completed so that as the forming blade **262** completes its stroke, it pushes the severed length of strip stock into the notch **102**, bending the strip to V-shape form in conformity with the shape of the notch, as shown in FIG. 5. The shaft **254** is almost immediately turned in the opposite direction, thus retracting the lever **260** and its forming blade **262** and removing the pressure of the roller **250** against the lever arm **248**, thereby permitting the latter and the movable shear blade **244** to be returned to their retracted position by a return spring (not shown).

Due to the fact that the wire **194** which constitutes a portion of the bag tie **100** thus formed is possessed of some degree of resilience, it exerts sufficient pressure on the diverging walls of the notch **102** to effectively retain the tie **100** within the notch after the forming blade **262** has been withdrawn and when the tie transfer lever **70** is subsequently reversed to apply the bag tie **102** to the neck of the bag which has just been formed. As a precautionary measure toward this same end, said diverging walls of the notches **102** may be roughened so that the frictional engagement of the ties in the notches is made more secure.

Referring now to FIGS. 6, 7 and 8, means are provided for driving the operating elements **32** so as to attain the synchronized actuation of the bag engaging and tie engaging elements hereinabove described. As already stated, power is supplied to the operating elements by the output shaft **42** (FIGS. 1 and 7) of the speed reduction unit **40**. Within the housing **36** the shaft **42** carries a sprocket **270** (FIGS. 6 and 7) which is connected by a chain **272** to a driven sprocket **273** (FIG. 7) rigid with the above mentioned shaft **64**. Also rigid with the shaft **64** is a sprocket **276** connected by a chain **278** to a sprocket **280** rigid with the shaft **56** upon

which the driven gathering wheels **50** are secured. Consequently the upper gathering wheels **50** are continuously rotated as long as the machine **22** remains in operation, and the cooperating pairs of gathering wheels **50** and **52** are in readiness to receive and start gathering the end region of a bag at any time that a bag to be tied is supplied to them.

The shaft **64** carries still another sprocket **281** (FIG. 7) connected by a chain **282** to a sprocket **284** rigidly secured by the input shaft **286** of a clutch **288**, which as above mentioned, is engaged when the sensing switch **74** (FIG. 1) is closed. Here again the clutch is of conventional design and need not be described in detail herein except to state that when the sensing switch **74** is closed the clutch **288** causes its output shaft **289** (FIG. 7) to turn through one full revolution and then come to rest.

The output shaft **289** of the single revolution clutch **288** carries a sector gear **290** (FIGS. 6 and 7) the arcuate extent of whose toothed portion is such that a gear **292** is engaged thereby and is rotated 180 degrees once each time the output shaft of the one way clutch **288** makes one full turn. This driven gear is secured to the shaft **60** (FIGS. 2–7) upon which the lower gathering wheels **52** are freely rotatable and to which the tie transfer lever **70** is rigidly secured. Consequently, once during each cycle of operation of the machine **22** the transfer lever **70** is caused to reverse its position i.e., remove one of its arms from in front of a bag end region being gathered and cause its other end to apply a bag tie **100** to the trailing portions of the same bag end region as gathering thereof is completed.

The output shaft **289** of the clutch **288** also carries a gear **294** (FIGS. 6 and 7) enmeshed with an idler gear **296** freely rotatable upon a stub shaft **298** and enmeshed with a driven gear **300** rigid with a cam shaft **302** (FIGS. 6, 7 and 8). Three cams, **304**, **306**, and **308**, respectively (FIGS. 6 and 8), are rigidly secured to the cam shaft **302**. The two cams **306** and **308** have the same profile. The hereinbefore mentioned rock shaft **172** (FIGS. 2–6, 8 and 10) which rotates the tie twisting jaws **110** is mounted adjacent the cam shaft **302** and is adapted to be rocked back and forth by a cam follower roller **312** engaging the periphery of the cam **306** and carried by one arm of a bell crank lever **314** fixed to the rock shaft **172** as by a set screw **316**. The other arm of the bell crank lever **314** is connected by a link **318** to a crank arm **320** which is secured to the above mentioned shaft **254** upon whose back and forth rotary movement operation of the bag tie severing and bending mechanism of FIG. 12 depends.

A second bell crank lever **326** is mounted on the rock shaft **172** but is not affixed thereto i.e., it is capable of partaking of rocking motion independently of movement of the shaft **172**. A cam follower roller **328** carried by one arm of the bell crank lever **326** engages the periphery of the cam **308** being held thereagainst by a spring **329** (FIG. 6). The other arm of the bell crank **326** is connected by a link **330** to a crank arm **332** rigid with the shaft **216** (FIGS. 2–6 and 8) which; when turned in one direction, operates the strip stock feeding mechanism of FIG. 9, as above explained. The length of strip stock **192** advanced thereby for the formation of a single bag tie is variable by shifting a pivot screw **334** (FIGS. 6 and 8) which connects the link **330** to the bell crank lever **326**, within an elongate slot **336** in the bell crank lever **326** through which the pivot screw **334** extends and is adapted to be fastened in selected position.

The same arm of the bell crank **326** that is connected to the link **330** and the strip stock feeding mechanism is likewise connected by a link **338** to a crank arm **340** (FIGS. 6 and 8) rigid with the above mentioned shaft **158** (FIGS. 2–6, 8 and 10) to which is affixed the crank arm **156** which projects and retracts the splined shaft **118** and the twisting jaws **110**.

Since both the bell crank lever **314** and the crank arm **170** are rigidly secured to the rock shaft **172** the operation of twisting the ends of a bag tie around the neck of one bag occurs at the same time that the tie for the next successive bag is being cut by operation of the shearing blade **244** and seated within a notch **102** of the transfer lever **70** for the next successive bag. As best shown in FIG. 8 the cam **308** which actuates the strip stock feeding mechanism and the twisting jaw advancing mechanism is somewhat in advance of the cam **306** which actuates the strip stock cutting and bending mechanism and the jaw twisting mechanism. Because of this arrangement the strip stock will be fed into position to be cut before the act of cutting and the act of seating the cut bag tie within a notch **102** occurs and the act of advancing the twisting jaws into position to engage the projecting diverging ends of a bag tie and clamp of the jaws upon the tie will occur before the splined shaft **118** and the twisting jaws **110** are rotated to tighten a bag tie by twisting its ends together.

Also free to rotate upon the rock shaft **172** is a third bell crank lever **350** one arm of which carries a cam follower roller **352** engaging the periphery of the cam **304** and held thereagainst by suitable means (not shown). The other arm of the bell crank lever **350** is connected by a link **354** to a crank arm **356** rigidly secured to the hereinabove mentioned shaft **90** upon whose back and forth rotary motion actuation of the secondary gathering fingers **80** depends. The cam **304** is so shaped and so positioned on the cam shaft **302** that the secondary gathering fingers **80** are advanced into their operative position in which they are illustrated in FIGS. 3, 4 and 5 a very brief interval before the tie transfer lever **70** is rotated to remove one end thereof from in front of a bag end region being gathered and to complete the gathering thereof by moving the other end of the tie transfer lever **70** behind the bag end region to complete the gathering thereof by pressing it against the secondary gathering fingers **80**. Moreover, the high part of the cam **304** is of such extent and is so related to the cam **308** that the secondary gathering fingers **80** are retained in their operative position throughout the time that the twisting jaws **110** are advanced to and are retained in their operative position by the bell crank lever **326**, link **338** and crank arm **340**, during which interval the jaws **110** are twisted by the action of the cam **306** against the bell crank lever **314**, the crank arm **170** and the sector gear **124**.

While a particular apparatus and a particular sequence of steps for carrying out the present invention have been shown and described it will be understood that both are capable of modification and variation while still employing the principles of the invention. It is to be understood, therefore, that the scope of the invention is to be limited only by the scope and proper interpretation of the claims appended hereto.

The invention having thus been described, that which is believed to be new and for which protection by Letters Patent is desired, is:

1. Bag closing apparatus for closing the open end regions of a series of bags comprising means engageable with the open end region of said bags for flattening the same and propelling the flattened end regions along a predetermined path with one lateral edge of each bag leading, holding means extending across the path to hold said leading edge of a first bag stationary while the trailing parts of the first bag end region continue to advance whereby the bag end region is gathered against said holding means, tie applying means movable in said path and following the trailing lateral edge of the bag end region for applying a bag tie to the gathered bag end region in partially encircling relation thereto, said tie applying means having a surface serving as a holding means for a second bag directly following said first bag and initiating the gathering of the open end region of said second bag, and means engage-

able with the ends of said bag tie for twisting them together to tighten the bag tie around the gathered end region of said first bag during the gathering of the end region of said second bag.

2. Bag closing apparatus comprising means for advancing an end region of a first flexible bag along a predetermined path, means extending across said path to interrupt advance of said bag end region whereby the bag end region is gathered against said interrupting means, bag tie carrying means mounted adjacent said advancing means for movement in said path, means for mounting a bag tie in a notch on one side of said carrying means, and means operable during movement of a bag end region into the gathered position for actuating the tie carrying means to overtake the gathered bag end region and apply the tie carried thereby to said region, said tie carrying means including a recess on the other side thereof facing away from said one side carrying said bag tie, said recess being arranged to interrupt the advance of a second bag following said first bag along said path, and to initiate the gathering of the end region of said second bag, and means for securing said bag tie to said gathered end region of said first bag during the gathering of the end region of said second bag.

3. Bag closing apparatus comprising means for advancing the flattened end region of a first flexible bag along a predetermined path with one lateral edge leading, means extending across said path to prevent advance of said leading edge while the trailing parts of the bag end region continue to advance whereby the bag end region is gathered into a constricted neck, bag ties carrying means mounted adjacent said advancing means for movement in said path, means for mounting a bag tie on said carrying means, means operable during movement of a bag end region into the gathered position for actuating the tie carrying means to overtake the gathered bag end region and apply the tie carried thereby to the same while concurrently placing the carrying means in the path of a second bag advanced by said advancing means so that gathering of the end region of said second bag is initiated against said carrying means, and means for securing said bag tie to said gathered end region of the first bag.

4. Bag closing apparatus comprising means for advancing the aligned flattened end regions of a series of flexible bags along a predetermined path with one lateral edge of each bag leading, means for interrupting advance of the leading edge of a first bag while the trailing parts of the first bag end region continue to advance whereby the bag end region is gathered against said interrupting means, bag tie carrying means movable along said path in overtaking relation to said first bag end region and having a V-shaped notch in its leading surface, means for forming a bag tie into V-shaped form and seating the same in said notch, means for actuating said tie carrying means to apply the V-shaped ties to the gathered first bag end region, and means for twisting the ends of said V-shaped tie together and securing the tie to the gathered first bag end region while said bag remains in the position which it occupied when said V-shaped tie was applied and while the gathering of the end region of a second bag directly following said first bag is initiated.

5. A machine for closing flexible bags comprising means for flattening the open end region of a bag and advancing the flattened end region edgewise along a certain path, a rotatable double ended lever having a recess in the trailing edge and a V-shaped notch in the leading edge of each end part of the lever, means for immobilizing the lever with the recess of one end part of the lever is register with said flattening and advancing means to interrupt advance of the leading edge of the flattened bag end region and thereby initiate gathering of the bag end region into a constricted neck within the associated recess, a movably mounted finger having a bag top gathering pocket therein, means for moving said finger to place its pocket in register with said flattening and advancing means in engagement with the partly formed bag neck to gather the remainder of said bag end region therein, means for seating a bag tie in the V-shaped notch of the other end part of the lever and thereby bending the bag tie to V-shape, means operative after said finger has engaged the partly formed bag top for rotating said lever to compact the bag neck within said gathering pocket and to apply the V-shaped bag tie to the compacted bag neck with the diverging ends of the bag tie in embracing relation thereto, and means engageable with the ends of the V-shaped tie for twisting them together to affix the bag tie to the bag neck in encircling relation thereto.

6. A machine for closing flexible bags comprising means for flattening the open end region of a bag and advancing the same along a certain path, a rotatable double ended lever symmetrical about its axis of rotation and having a recess in the trailing edge and a notch in the leading edge of each end part of the lever, means for immobilizing the lever with the recess of one end part of the lever in register with said flattening and advancing means to interrupt advance of the flattened bag end region and thereby initiate gathering of the bag end region into a constricted neck within the associated recess, a movably mounted finger having a bag top gathering pocket therein, means for moving said finger to place its pocket in register with said flattening and advancing means in engagement with the partly formed bag neck to thereby prolong interruption of advance of said bag end region while the remainder of the bag end region gathers therein, means for seating a bag tie in the notch of the other end part of the lever, means operative after said finger has engaged the partly formed bag top for rotating said lever to compact the bag neck within said gathering pocket and to apply the bag tie to the compacted bag neck with the ends of the bag tie in embracing relation thereto, and means engageable with the ends of the bag tie for twisting them together to tighten the bag tie around the bag neck.

7. A machine for closing flexible bags comprising means for flattening the open end region of a bag and advancing it along a certain path, a rotatable double ended lever having a recess in the trailing edge and a notch in the leading edge of each end part of the lever, means for immobilizing the lever with the recess of one end part of the lever in register with said flattening and advancing means to interrupt advance of the leading edge of the flattened bag end region and thereby initiate gathering of the bag end region into a constricted neck within the associated recess, a movably mounted finger having a bag top gathering pocket therein, means for moving said finger to align its pocket with said flattening and advancing means and in engagement with the partly formed bag neck to thereby prolong immobilization of said leading edge while the remainder of said bag end region gathers therein, means for seating a tie in the V-shaped notch of the other end part of the lever, means operative after said finger has engaged the partly formed bag top for rotating said lever to compact the bag neck within said gathering pocket and to apply the bag tie to the compacted bag neck with the ends of the bag tie in embracing relation thereto and to align the recess in said other end of the lever with said flattening and advancing means, and means engageable with the ends of the V-shaped tie for twisting them together to affix the bag tie to the bag neck in encircling relation thereto.

8. Bag closing apparatus comprising means for continuously moving a series of aligned flexible bags along a predetermined path, a lever extending across said path for interrupting the movement of the leading lateral edge of a first bag and permitting the end region of said

first bag to be gathered against said lever, secondary holding means movable into a position aligned with said lever, means operable during movement of said bag against said lever for actuating the lever and causing it to rotate to overtake the trailing end of said first bag end region and apply a tie thereto while said bag is retained by said secondary holding means, and means for securing said bag tie to the gathered end region of said first bag while the end region of the bag following said first bag is gathered against said lever.

9. The method of closing and tying the mouths of a series of flexible bags which comprises advancing the bags with their open end regions moving in a certain direction, gathering the end region of a first bag into a constricted neck, advancing a bag tie in said direction and following said first bag end region to overtake the same and apply the bag tie to the constricted neck, and twisting the ends of the bag tie together to tighten the bag tie around said neck while said first bag is maintained in the position where said tie was applied, and while the end region of the bag following said first bag is gathered into a constricted neck.

10. The method of closing and tying the mouths of

flexible bags which comprises advancing bags successively in a particular direction along a predetermined path, interrupting advance of the leading part of the end region of a first bag while the trailing part of said end region continues to advance to gather the end region into a constricted neck, overtaking the trailing part of the bag end region with a bag tie moving in the same direction to simultaneously apply the tie to said neck from behind and to place an obstruction in said path in front of the end region of the next succeeding bag, and tightening said bag tie around the neck of said first bag while the end region of said next succeeding bag is advanced into engagement with said obstruction to be gathered thereagainst.

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