Dec. 8, 1970 K. R. JOHNSON ET AL 3,545,166

METHOD AND MACHINE FOR FORMING AND FILLING BAGS

Filed Dec. 8, 1967 18 Sheets-Sheet 1

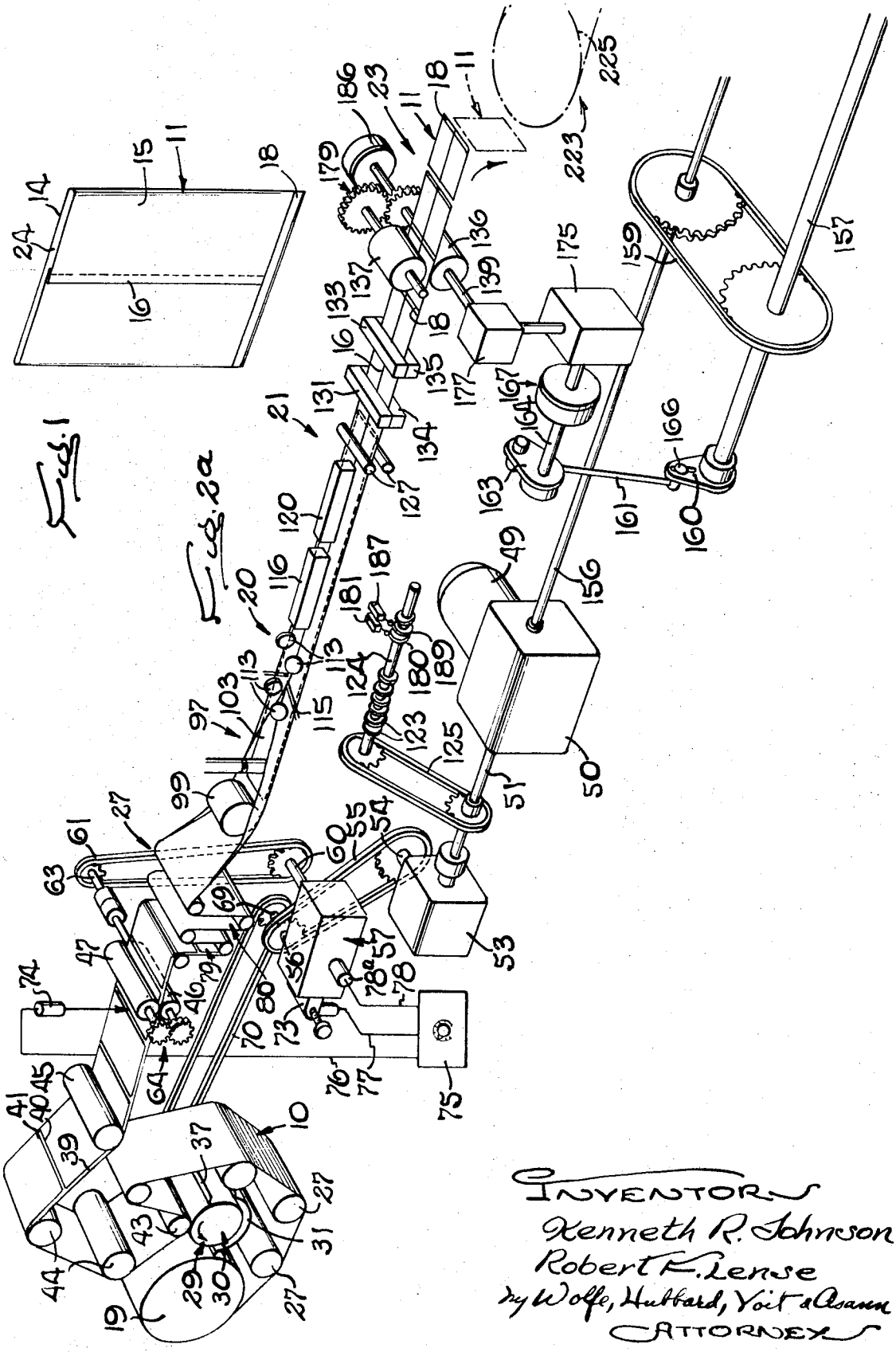

Fig. 1

Fig. 2a

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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Fig. 3

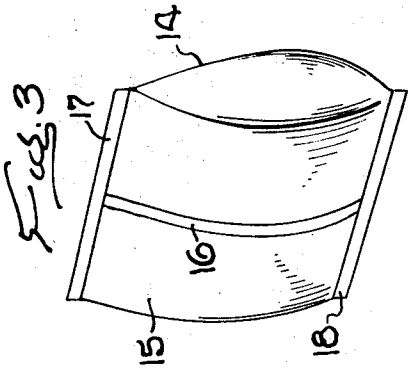
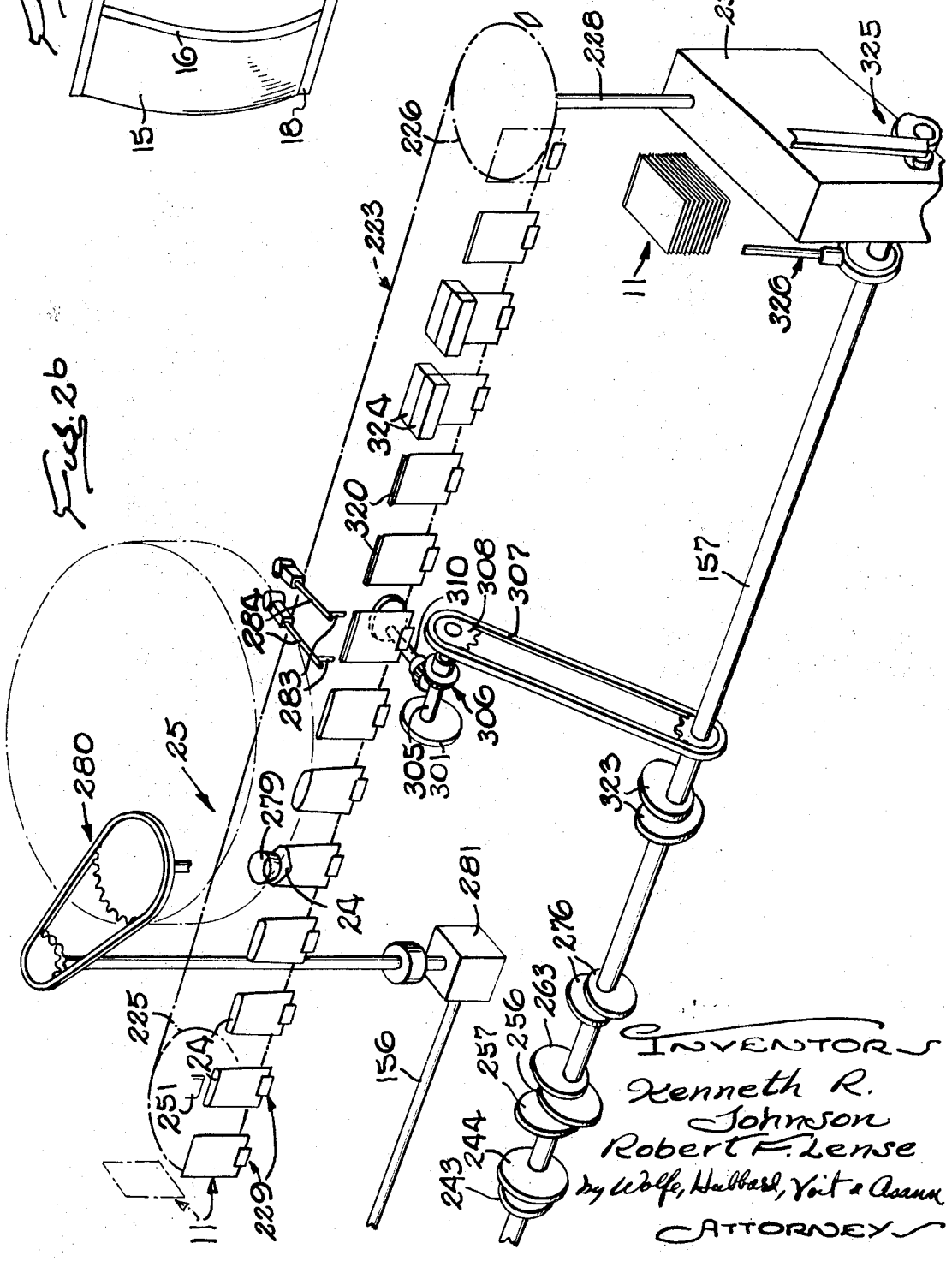


Fig. 2b



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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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Fig. 4

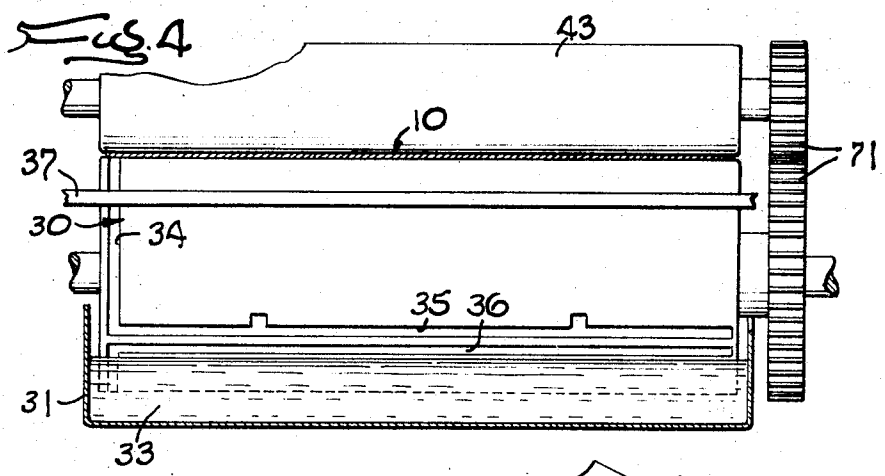


Fig. 5

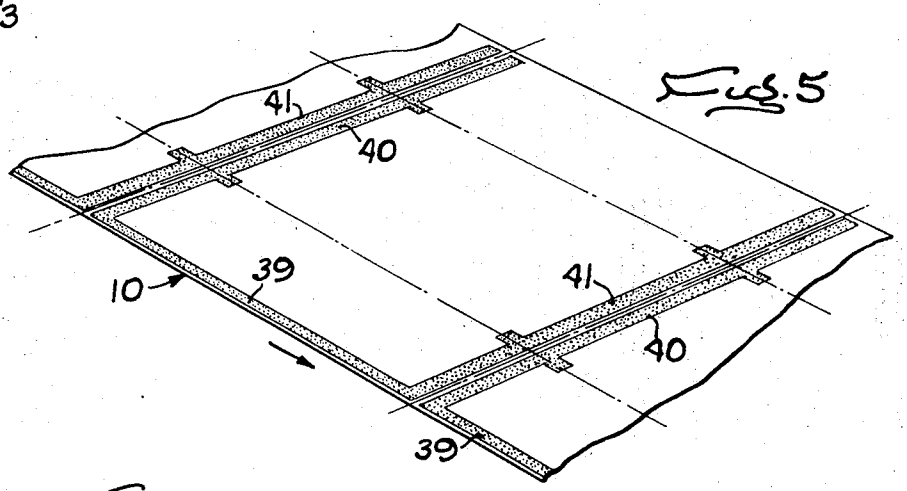
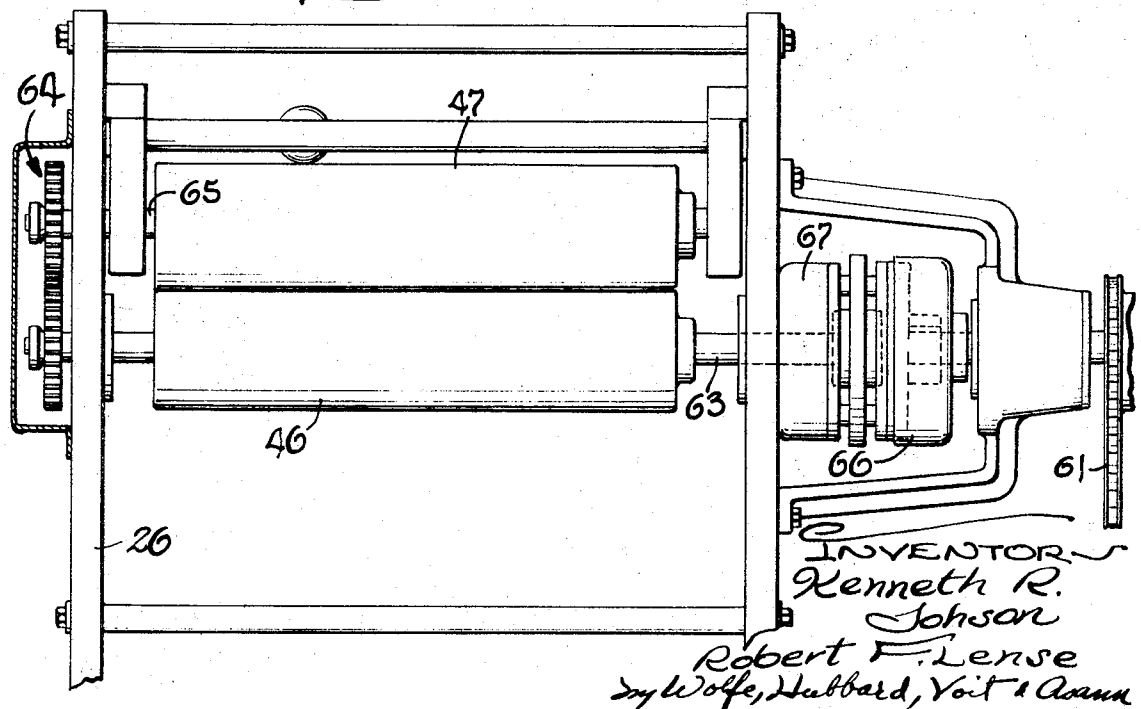


Fig. 6



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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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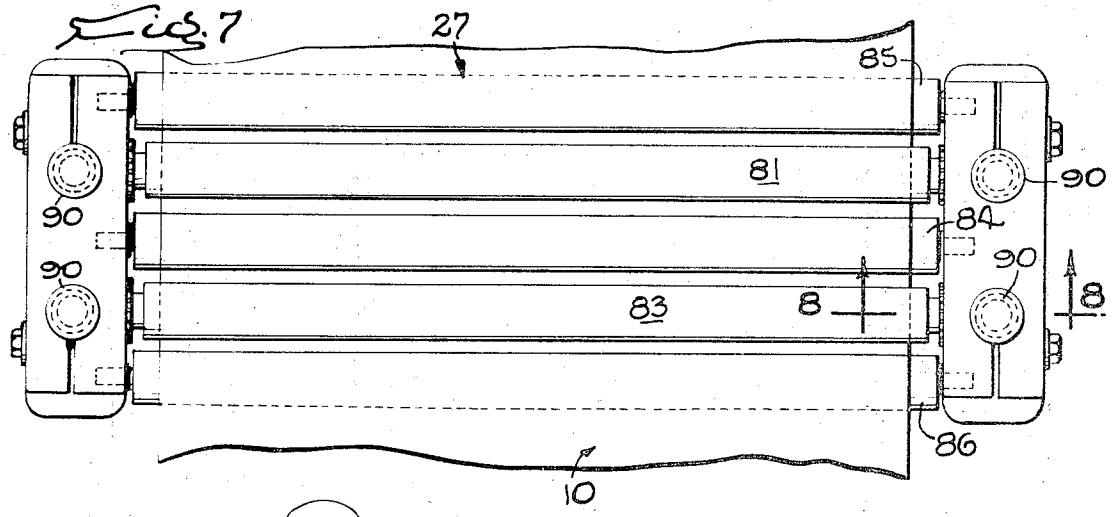
Fig. 7



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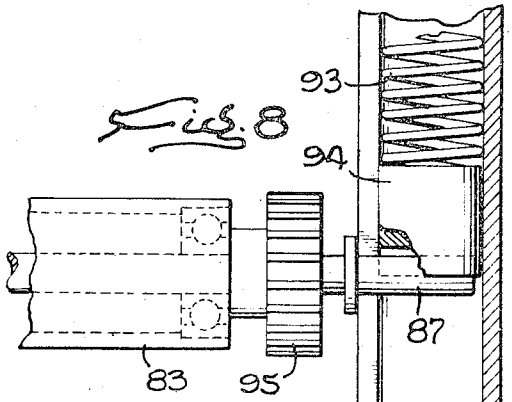

Fig. 9

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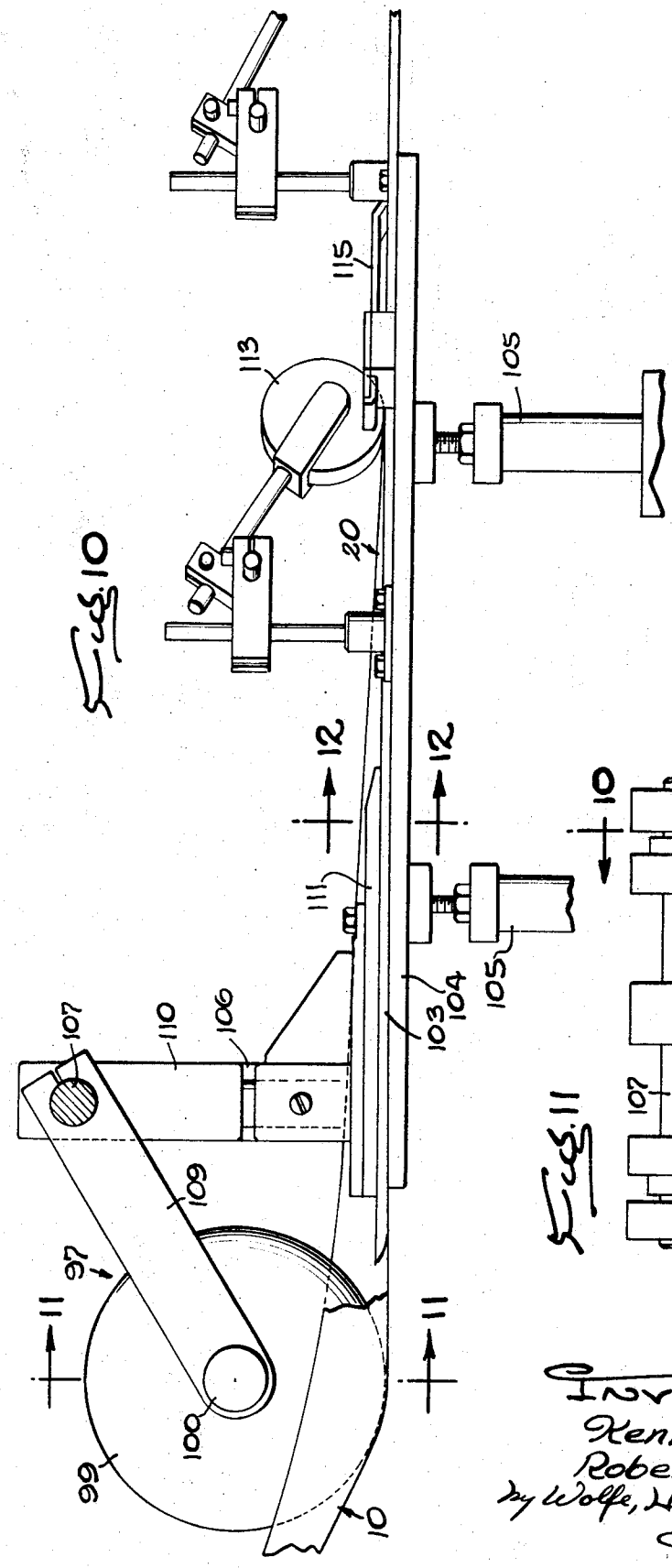

Fig. 10

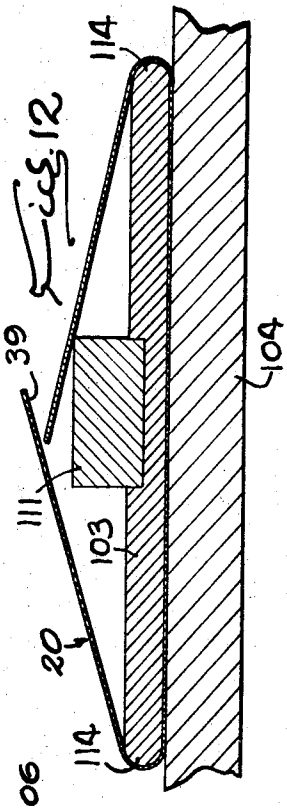

Fig. 12

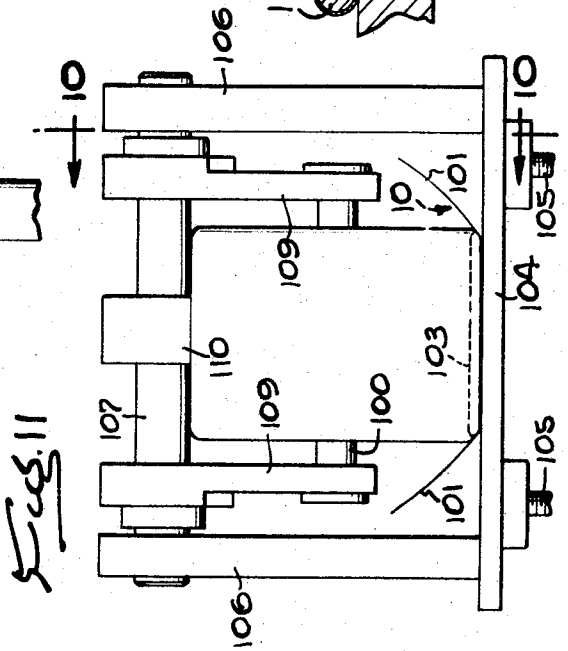

Fig. 11

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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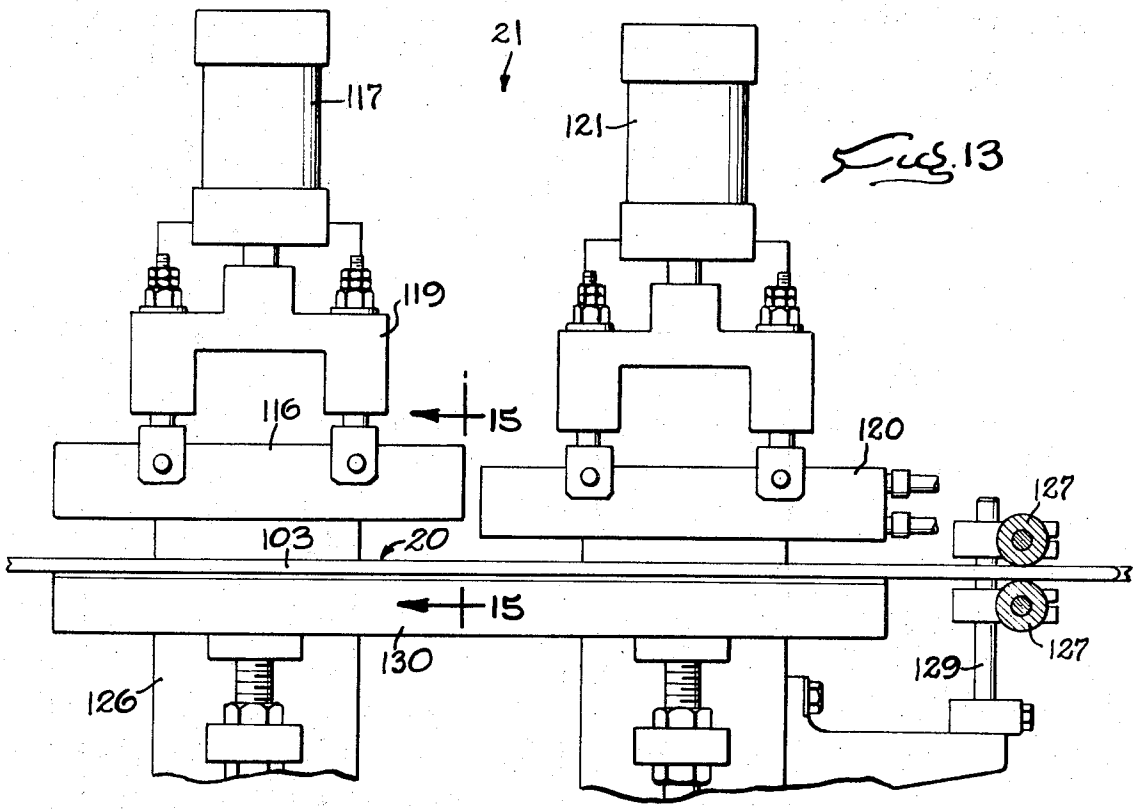


Fig. 13

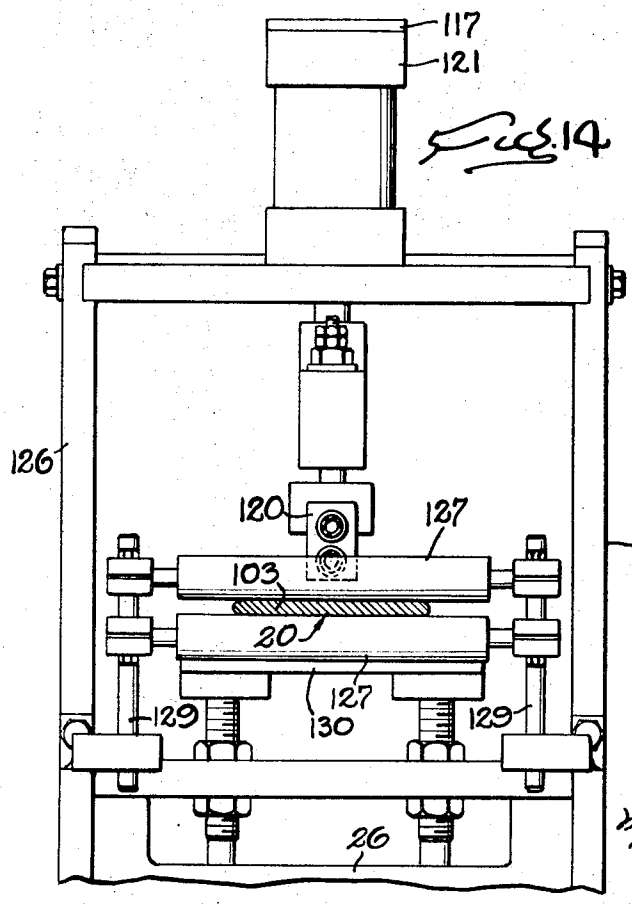
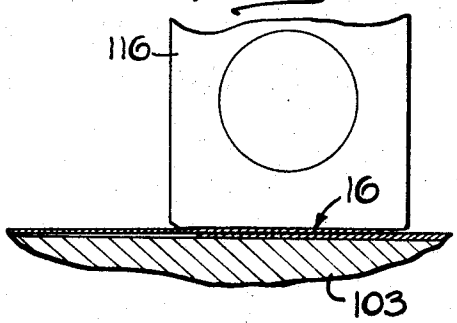


Fig. 14

Fig. 15



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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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Fig. 16

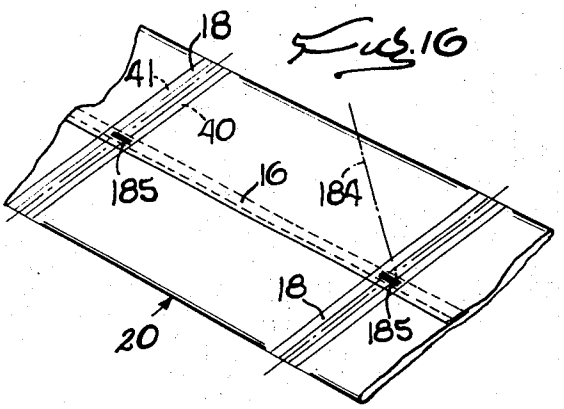

Fig. 17

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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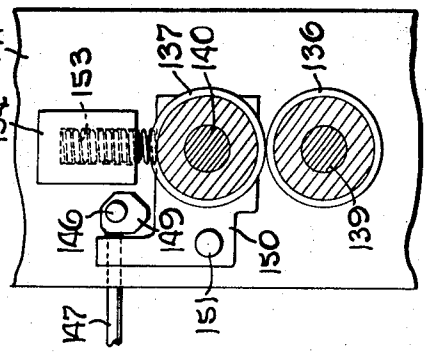

Fig. 19

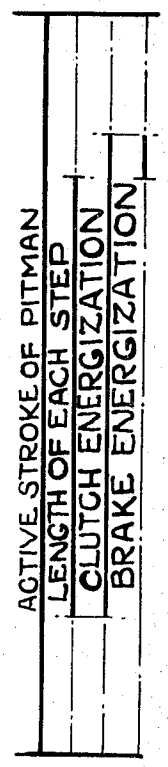

Fig. 20

Fig. 18

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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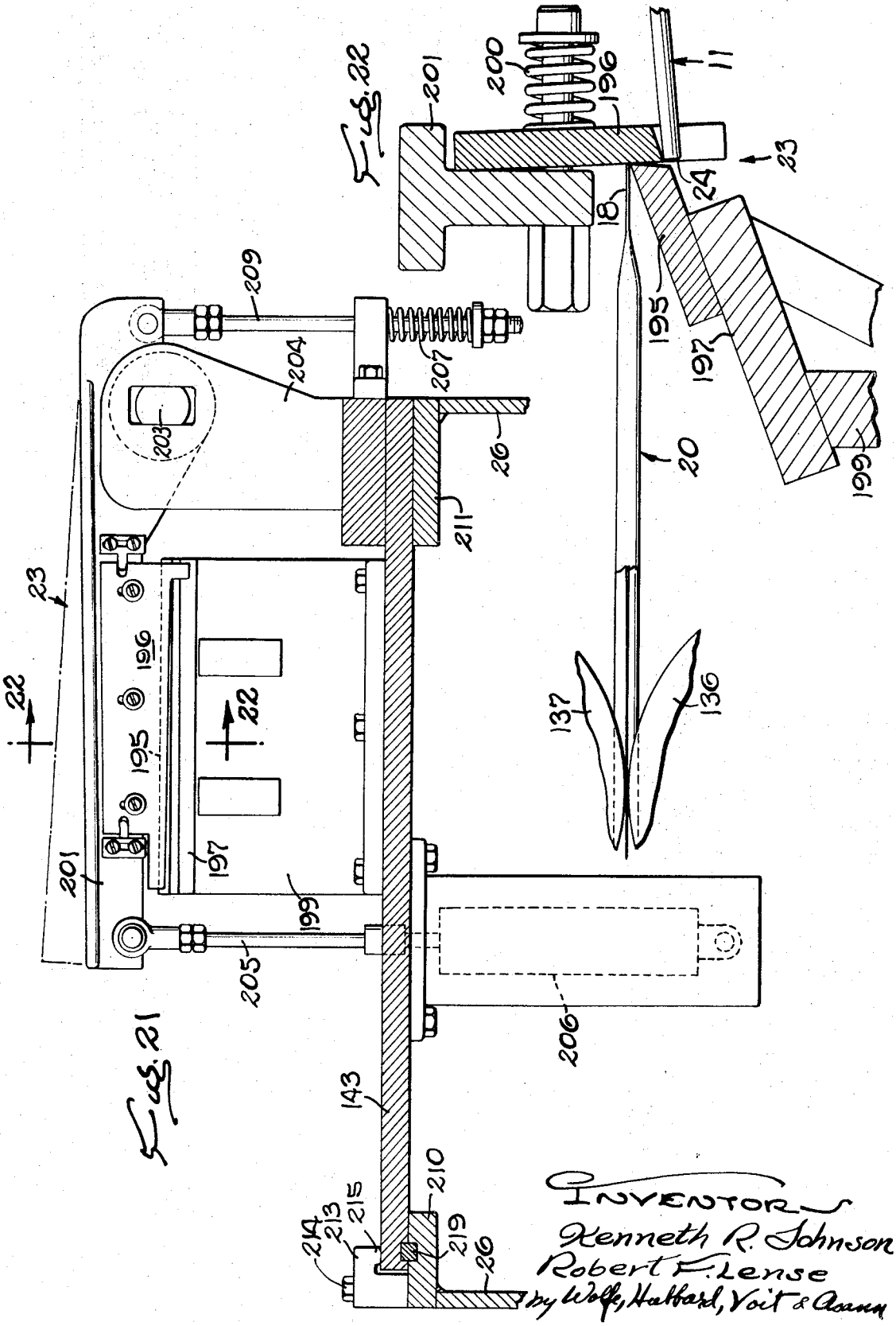

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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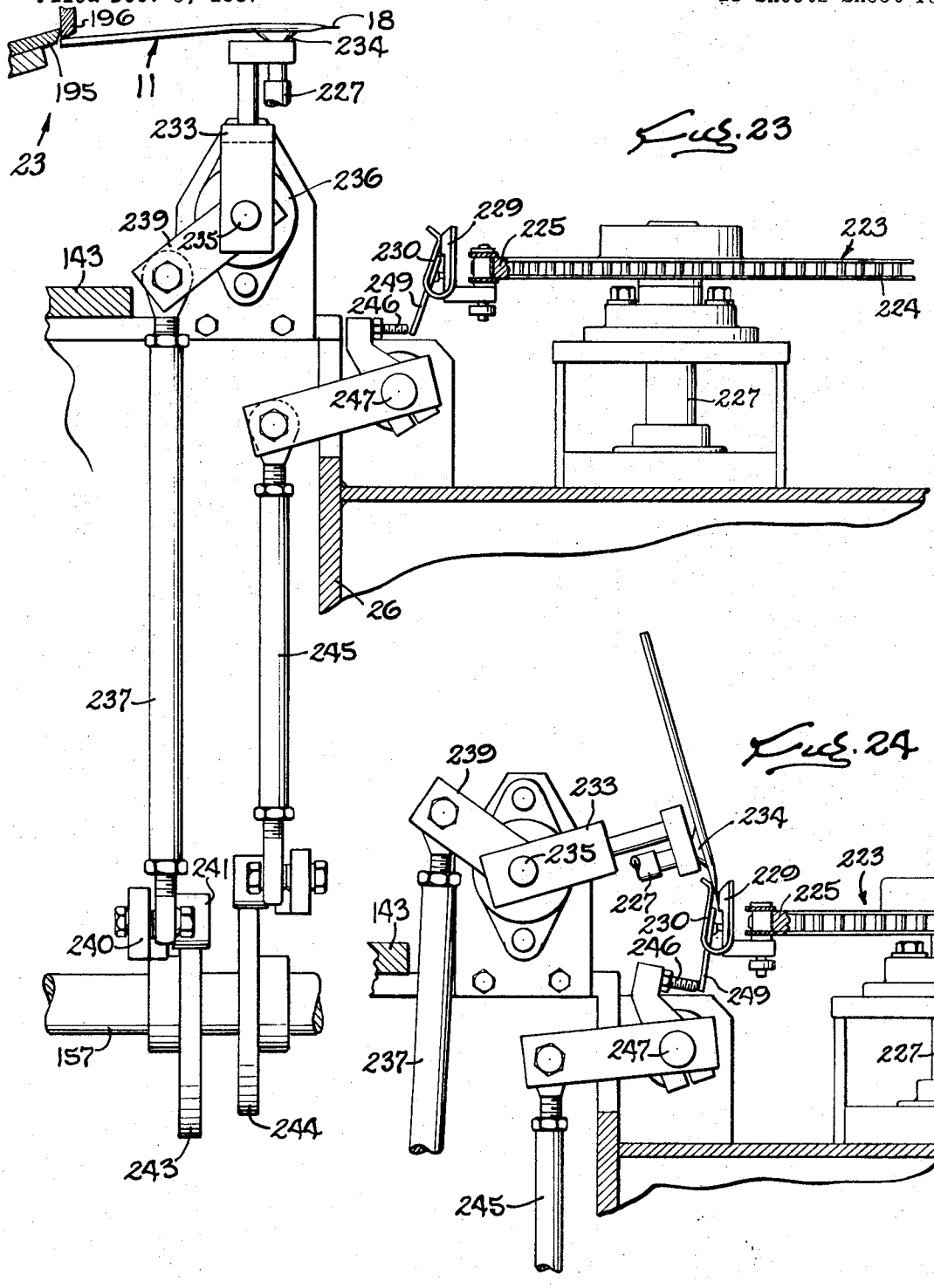

Fig. 23

Fig. 24

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Fig. 25

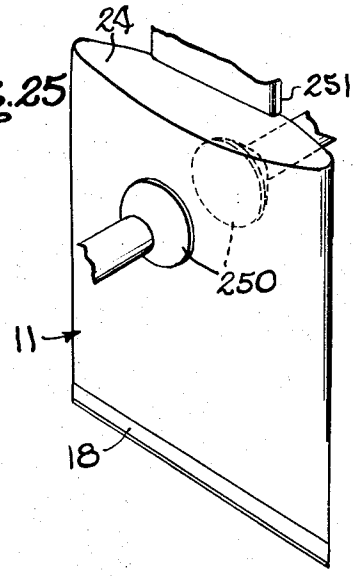

Fig. 26

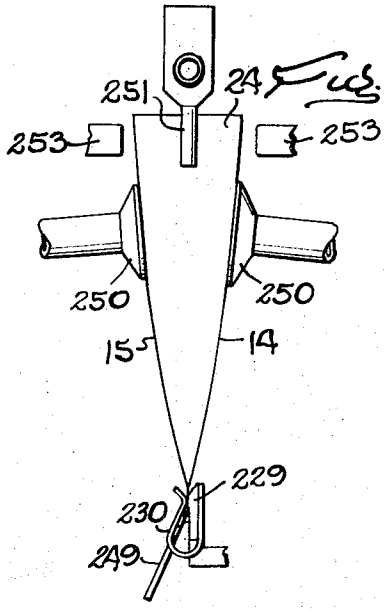

Fig. 27

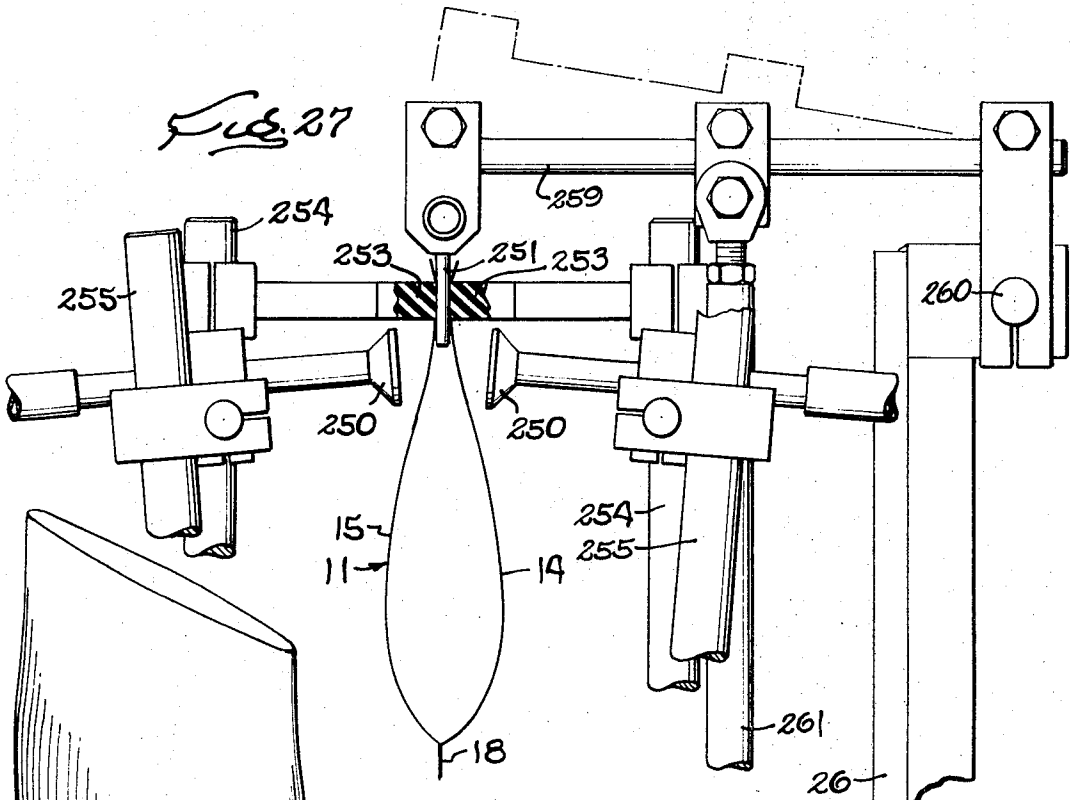

Fig. 28

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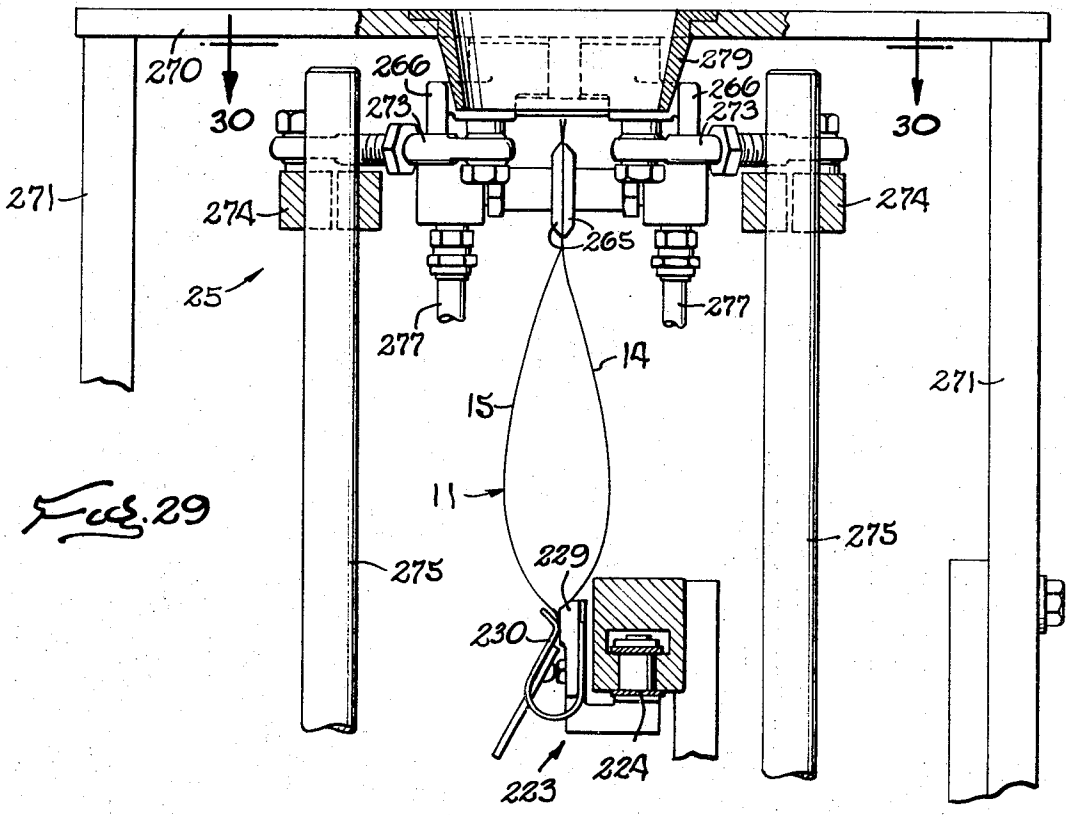
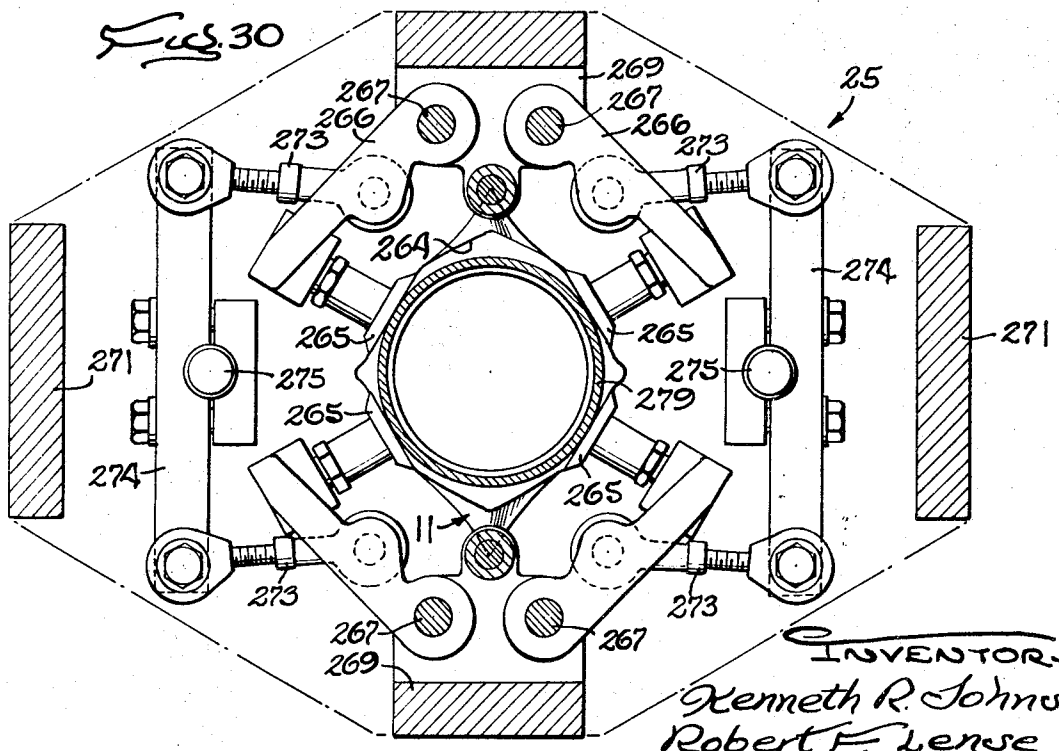


Fig. 29

Fig. 30



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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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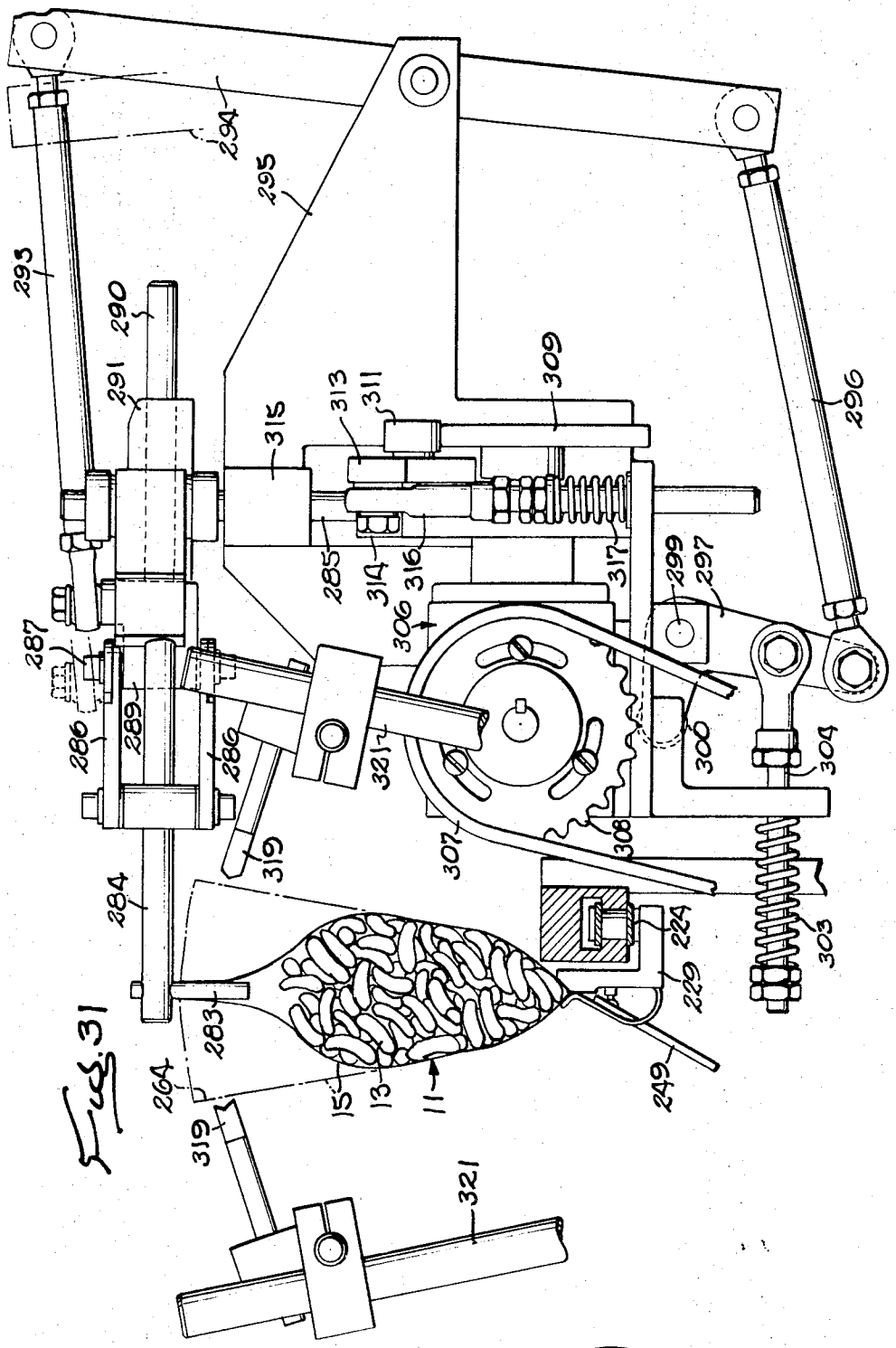

Fig. 31

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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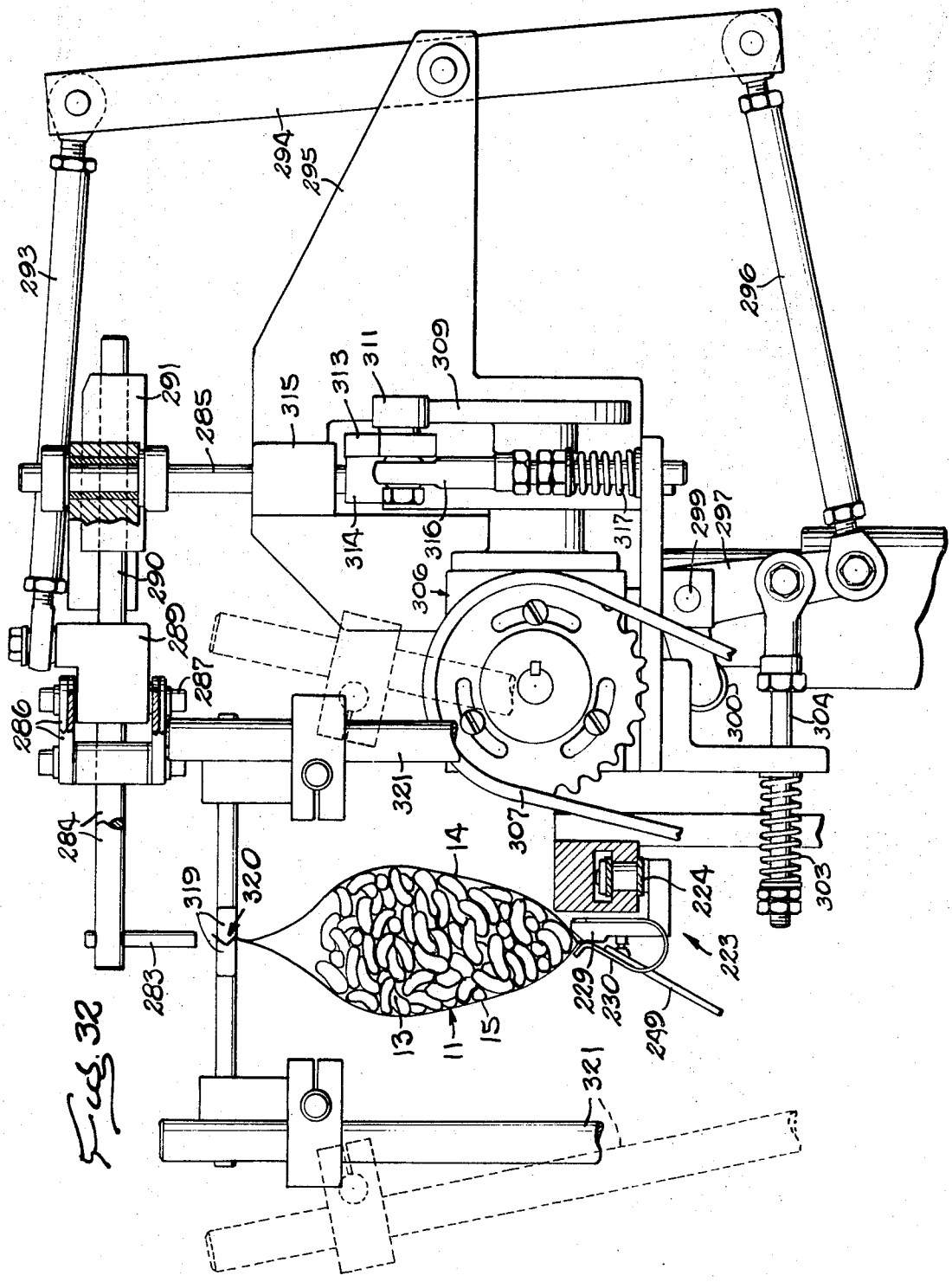

Fig. 32

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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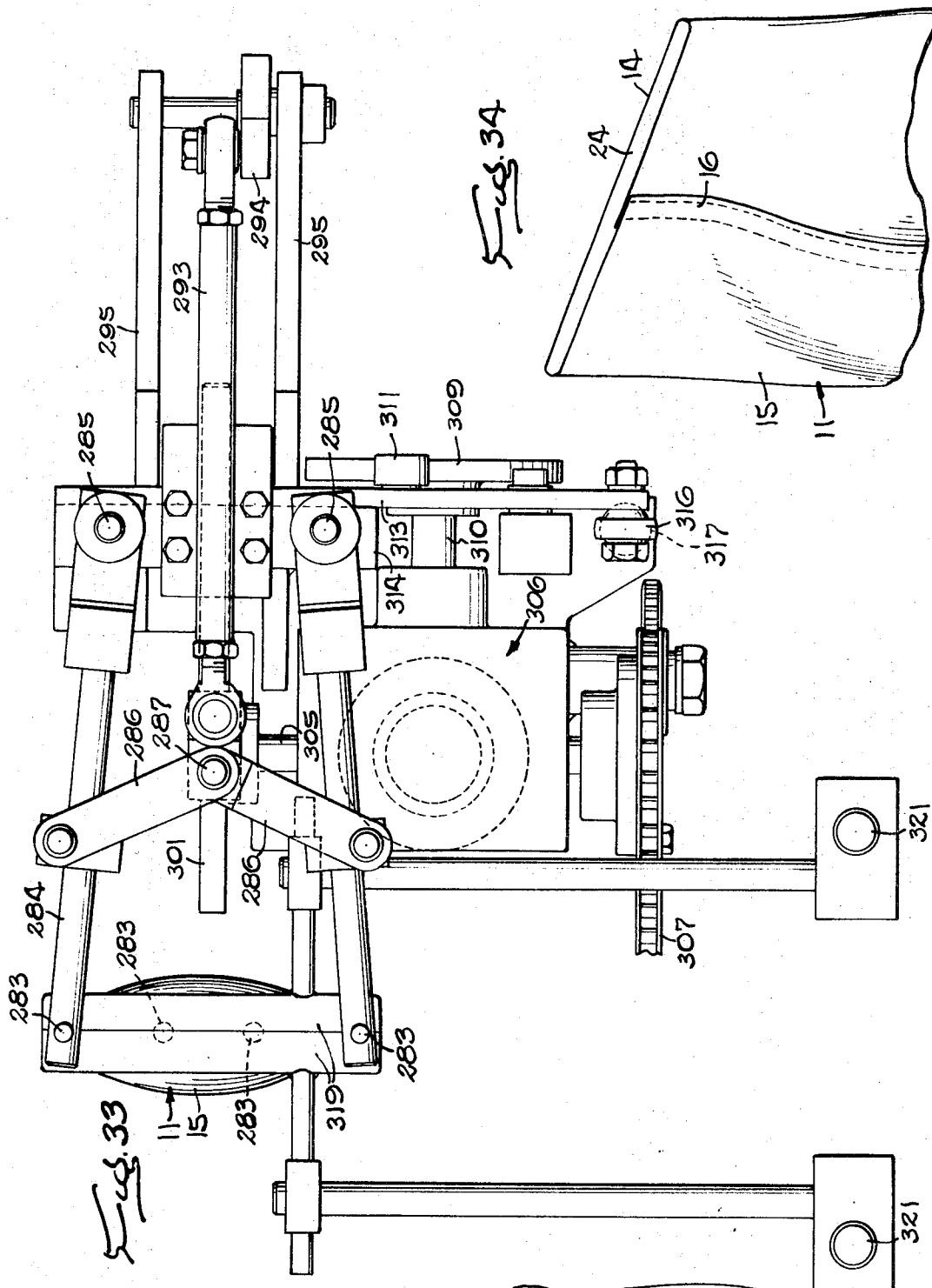

Fig. 33

Fig. 34

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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Fig. 35

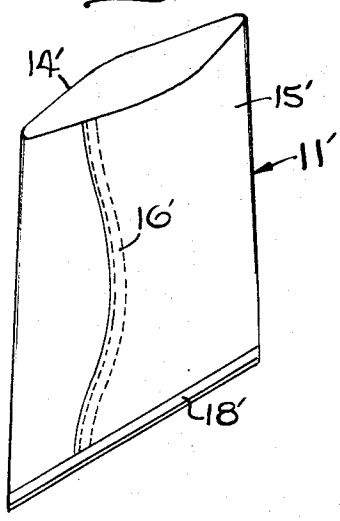


Fig. 36

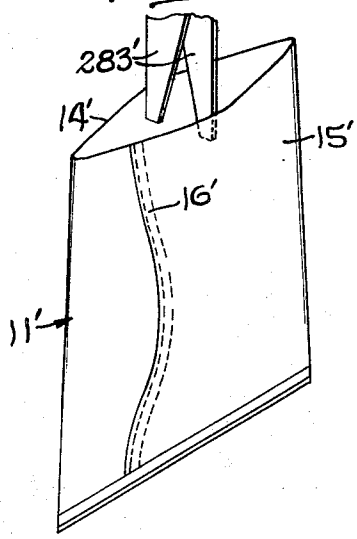


Fig. 37

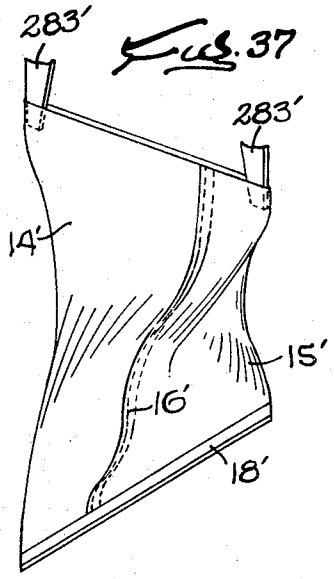


Fig. 38

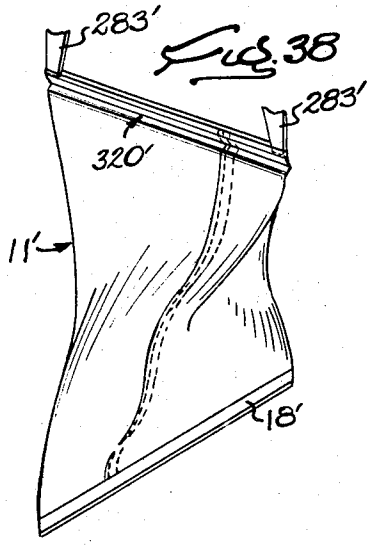


Fig. 39

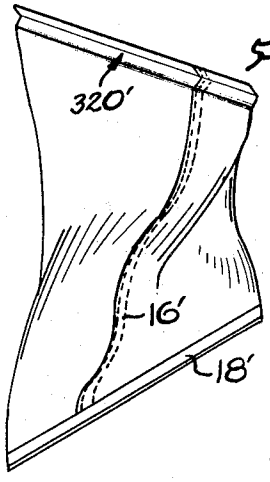


Fig. 40

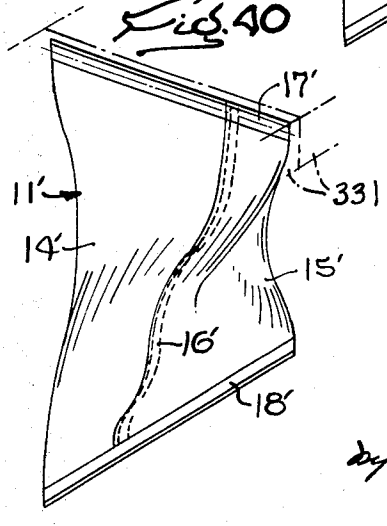
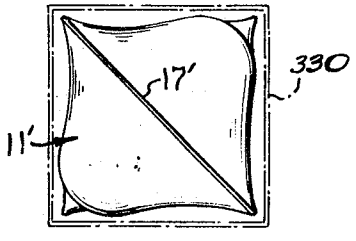


Fig. 41



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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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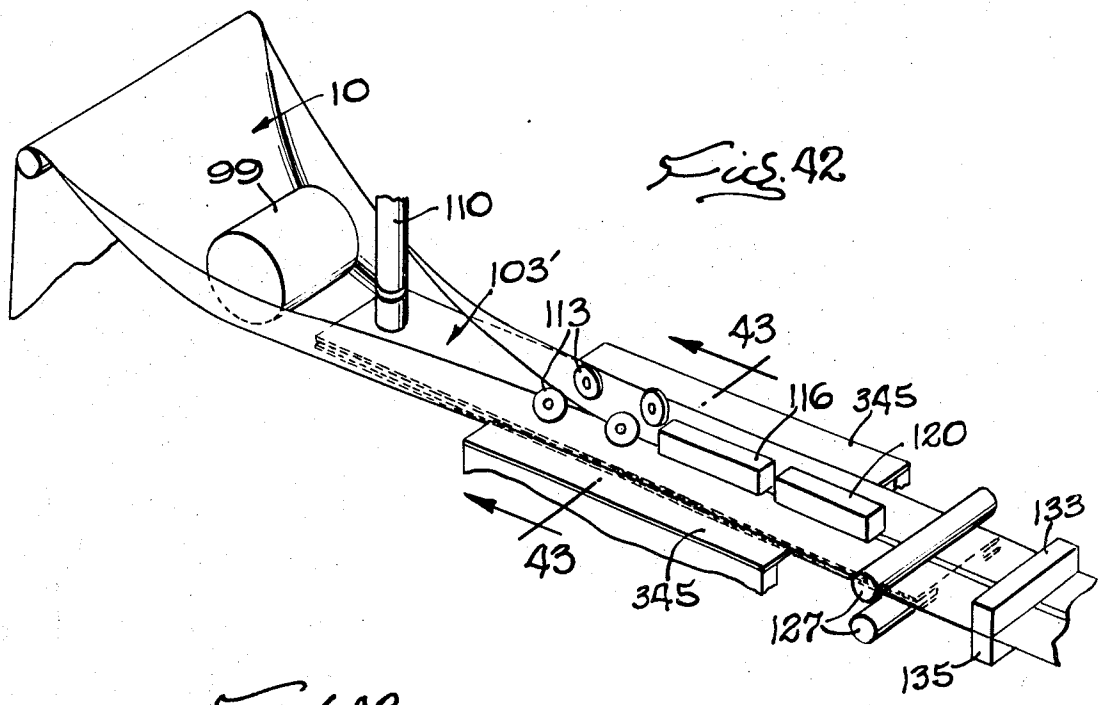
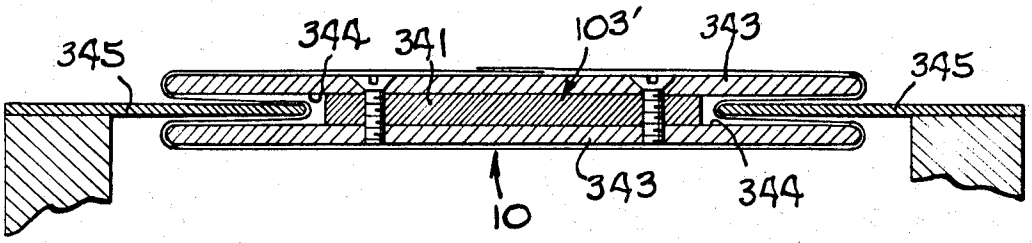


Fig. 42

Fig. 43



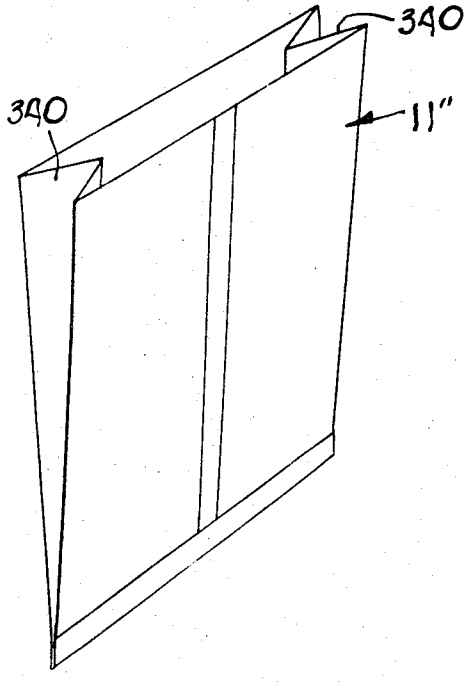


Fig. 44

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METHOD AND MACHINE FOR FORMING AND FILLING BAGS

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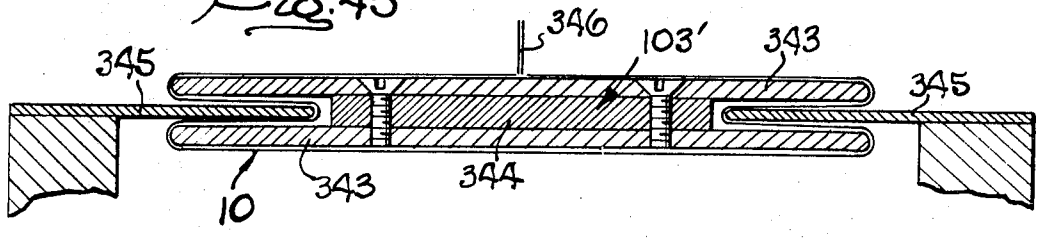
Fig. 45



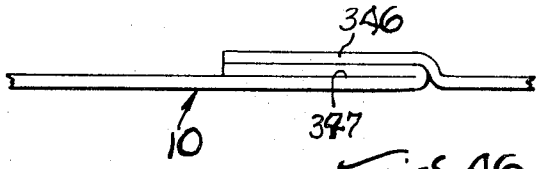


Fig. 46

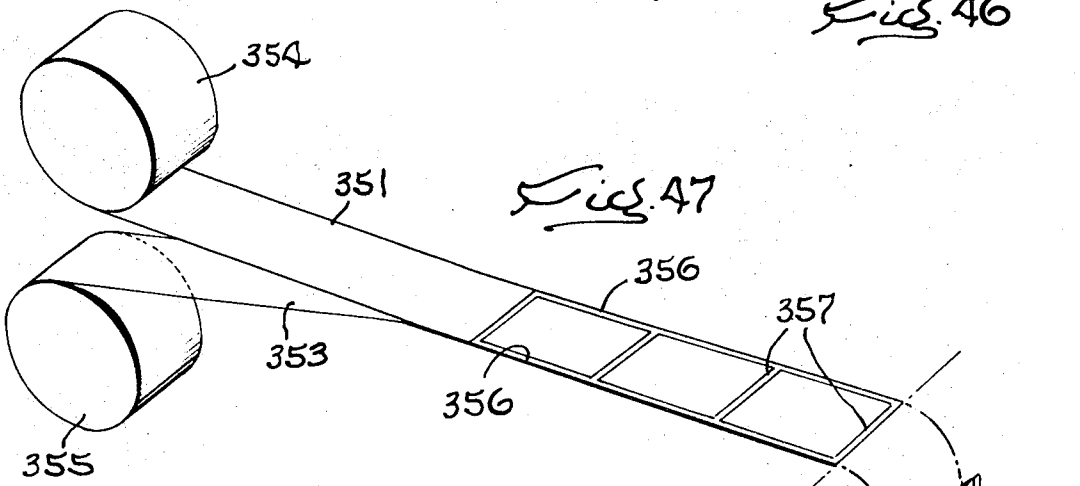
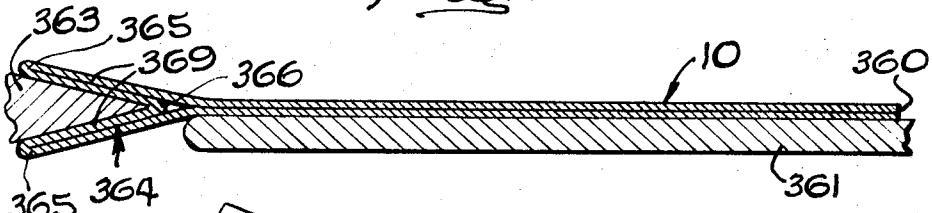


Fig. 47

Fig. 48



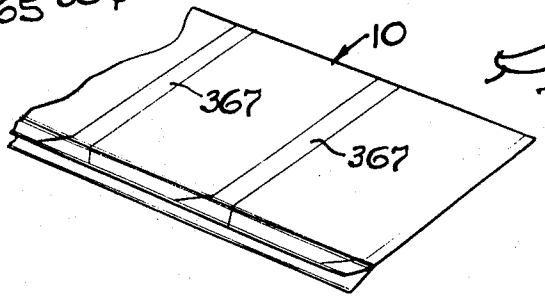


Fig. 49

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United States Patent Office 3,545,166 Patented Dec. 8, 1970

3,545,166

METHOD AND MACHINE FOR FORMING AND FILLING BAGS

Kenneth R. Johnson and Robert F. Lense, Rockford, Ill., assignors to Riegel Paper Corporation, a corporation of Delaware

Filed Dec. 8, 1967, Ser. No. 689,177
Int. Cl. B65b 43/04, 43/30
U.S. Cl. 53—29 14 Claims

ABSTRACT OF THE DISCLOSURE

For forming bags from a continuous web of flexible material and for filling the bags with a quantity of loosely compacted and irregularly shaped particles, the web first is advanced continuously through a coating station where a rotatable drum prints adhesive strips on the web, is advanced step-by-step along a horizontal path through a forming station where the web is folded gradually into a tube with an upwardly facing seam, and then is advanced through a sealing station where some of the adhesive strips are activated to seal the seam and to form the bottom seals of the ultimate bags. Thereafter, the tube is severed along the leading edge of each bottom seal to separate the tube into a number of bags with horizontally facing open ends, the bags are turned into upright positions with the open ends facing upwardly, and then are advanced in spaced relation through a filling station to receive a measured charge of the particles. Before being filled, the body of each bag is expanded with air and the open end of the bag is formed into a generally circular mouth to accommodate a rapidly flowing particle stream of large cross-section. After the bag has been filled, the circular mouth is stretched and flattened and the remaining adhesive strip is activated to seal the mouth and enclose the particles in the bag.

BACKGROUND OF THE INVENTION

This invention relates to a method and machine for forming bags from a continuous web of flexible material such as metallic foil and for filling the bag with a product which herein consists of irregularly shaped and loosely compacted food particles. More particularly, the invention relates to the formation of bags by applying adhesive strips to the web in a predetermined pattern, by folding the web into a tube with a longitudinal seam, by activating the adhesive strips to seal the tube along the seam and along longitudinally spaced lines extending crosswise of the tube, and by severing the tube in the area of the cross-seals to separate the web into a number of individual bags. The bags then are turned into upright positions with the open ends facing upwardly for advancement through a filling station, are filled with a measured charge of the particles, and are sealed across the upper ends to enclose the product in the bags.

SUMMARY OF THE INVENTION

One of the primary objects of the invention is to insure a uniform application of adhesive along each of the strips by printing the strips on the web while the latter is being advanced with a continuous motion and, at the same time, to enable the use of simpler and less expensive mechanisms for forming the bags by advancing the web with an intermittent motion during folding, sealing and severing of the web.

More detailed objects of the invention are to provide a novel mechanism which not only support the bags as the latter are being severed from the tube but which also transfers the bags into upright positions for advancement through the filling station; to provide a new and improved bag opener operable to pull the open end of each bag into a generally circular mouth capable of receiving a rapidly flowing particle stream of large cross-section; and to provide a unique stretcher for flattening the circular mouth before the upper end of the bag is sealed thereby to insure the formation of a uniform and wrinkle-free seal.

The invention also is characterized by a novel method for preparing the relatively flat bags for filling with a comparatively large volume of the loosely compacted particles.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a newly formed bag made by a machine embodying the novel features of the present invention.

FIG. 2*a* is a schematic perspective view of the bag-forming section of the machine.

FIG. 2*b* is a continuation of FIG. 2*a* and is a schematic perspective view of the bag-filling section of the machine.

FIG. 3 is a perspective view of the bag after being filled and sealed.

FIG. 4 is a fragmentary elevational view of mechanism for printing the adhesive strips on the web.

FIG. 5 is a fragmentary perspective view of the web after being printed with the adhesive strips.

FIG. 6 is a fragmentary elevational view of mechanism for advancing the web continuously during printing of the strips.

FIG. 7 is a fragmentary plan view of mechanism for compensating for the changeover from the continuous to the intermittent advance of the web.

FIG. 8 is an enlarged fragmentary cross-section taken along the line **8—8** of FIG. 7.

FIG. 9 is a fragmentary perspective view of parts shown in FIG. 7.

FIG. 10 is a fragmentary cross-section taken along the line **10—10** of FIG. 11 and showing mechanism for folding the web.

FIG 11 is a fragmentary cross-section taken along the line **11—11** of FIG. 10.

FIG. 12 is an enlarged fragmentary cross-section taken along the line **12—12** of FIG. 10.

FIG. 13 is a fragmentary elevational view of mechanism for sealing the tube.

FIG. 14 is a fragmentary end elevation of parts shown in FIG. 13.

FIG. 15 is an enlarged fragmentary cross-section taken along the line **15—15** of FIG. 13 and showing the tube being sealed.

FIG. 16 is a fragmentary perspective view of the tube after being sealed.

FIG. 17 is a fragmentary cross-section taken along the line **17—17** of FIG. 18.

FIG. 18 is a fragmentary cross-section taken along the line **18—18** of FIG. 17.

FIG. 19 is a fragmentary cross-section taken along the line **19—19** of FIG. 18.

FIG. 20 is a time chart graphically illustrating the sequence of actuation of various elements of the drive arrangement in relation to the length of bags being formed.

FIG. 21 is a fragmentary cross-section taken along the line **21—21** of FIG. 17.

FIG. 22 is an enlarged fragmentary cross-section taken along the line **22—22** of FIG. 21.

FIG. 23 is a fragmentary elevation showing the mechanism for supporting and transferring the bags and also showing mechanism for advancing the bags through the filling station.

FIG. 24 is a fragmentary view similar to FIG. 23 but showing the parts in moved positions.

FIG. 25 is a fragmentary perspective view of mechanism for opening the bag.

FIG. 26 is a side elevation of parts shown in FIG. 25.

FIG. 27 is a more comprehensive view of the mechanism shown in FIGS. 25 and 26 and showing the parts in moved positions.

FIG. 28 is a perspective view of the bag after being opened.

FIG. 29 is an elevational view of the bag opener for pulling the open end of the bag into a circular mouth, parts being broken away and shown in section.

FIG. 30 is a fragmentary cross-section taken along the line **30—30** of FIG. 29 with the parts being shown in moved positions.

FIG. 31 is a fragmentary elevational view of the stretcher for flattening the the circular mouth of the bag.

FIG. 32 is a view similar to FIG. 31 but showing the parts in moved positions.

FIG. 33 is a fragmentary plan view of the stretcher shown in FIG. 31.

FIG. 34 is a perspective view of the filled bag after the mouth has been stretched and flattened.

FIG. 35 is a perspective view of a modified bag which may be made by the machine.

FIGS. 36 to 40 are perspective views which schematically illustrate the various sequential steps undertaken to close and seal the modified bag after the bag has been filled with product.

FIG. 41 is a plan view showing the modified bag inserted into a carton.

FIG. 42 is a schematic perspective view showing the machine with a bag-forming section which is modified to make still another type of bag.

FIG. 43 is an enlarged cross-section taken substantially along the line **43—43** of FIG. 42, some parts being omitted for purposes of clarity.

FIG. 44 is a perspective view of a bag which may be made by the machine illustrated in FIG. 42.

FIG. 45 is a view similar to FIG. 43 but showing still a different type of bag being formed.

FIG. 46 is an enlarged fragmentary view of the seam of the bag showing in FIG. 45.

FIG. 47 is a perspective view schematically illustrating the formation of yet another type of bag.

FIG. 48 is a fragmentary elevation view showing bags being formed with bottom gussets.

FIG. 49 is a perspective view of a row of bags formed with bottom gussets.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings for purposes of illustration, the invention is embodied in a packaging machine for converting a continuous strip or web **10** of flexible material such as foil, plastic, or paper into a pouch or bag **11** (FIG. 1), filling the same with one or more measured quantities of product **13** (FIG. 31), and thereafter closing the filled bags. The bag, in the form shown in FIGS. 1 and 3, is generally rectangular in shape and herein is made by folding a web of unbacked metallic foil longitudinally to bring the opposite edge portions of the web in to overlapping relation and thereby form opposing side panels **14** and **15**, the latter panel being interrupted by a seam **16** extending lengthwise of the bag and defined by the overlapped edge portions of the web. The product, which in this instance consists of irregularly shaped and loosely compacted food particles such as cocktail snacks, cereal flakes, or the like, is enclosed in the bag by a seal running along the seam and joining the edge portions, a top seal **17** joining the upper margins of the side panels, and a bottom seal **18** joining the lower margins of the panels.

The machine is operable to form and fill bags **11** of the above character at relatively high speeds and yet

without significantly wrinkling, creasing or causing the formation of small pinholes in the web **10** or the finished bags. This is achieved by drawing a length of the web off of a supply roll **19** (FIG. 2*a*), by folding the web longitudinally while the latter is traveling in a horizontal direction to form a tube **20** with an overlapping seam **16**, and by sealing the tube both along the seam and along longitudinally spaced and transversely extending lines at a station **21** to form the bottom seals **18** of the ultimate bags. Thereafter, the bottom seals are severed along one edge at a cutting station **23** to separate each bag from the web while leaving the bag with a horizontally facing open end **24** (FIG. 1), the bag is turned into an upright position with the open end facing upwardly, and is advanced into a filling station **25** (FIG. 2*b*) where a measured charge of the particles **13** is deposited into the bag through the open end. Before being filled, each bag is opened widely throughout its length to accommodate a large volume of the bulky particles flowing at a rapid rate and, after being filled, is closed across its upper side to form the top seal **17**.

The various operating stations are spaced along the top of an elongated frame **26** (FIGS. 6 and 18) which serves to mount the different mechanisms for forming and filling the bags **11**. For purposes of simplicity, only those parts of the frame necessary to a complete understanding of the invention have been illustrated. Reference may be had to Bartelt Patent No. 2,649,674 for a more detail disclosure of an exemplary frame suitable for use with the present machine.

Herein, the foil web **10** is unwound from the supply roll **19** as the latter turns about a horizontal axis, and is drawn across a series of driven rollers **27** (FIG. 2*a*) to a coating station **29** where strips of adhesive are printed on one side of the web in a preselected pattern, the adhesive strips subsequently being activated to seal the seam **16** and to form the top and bottom seals **17** and **18**. More specifically, the web is drawn across the upper surface of a printing drum **30** (FIGS. 2*a* and 4) which is driven rotatably about a horizontal axis and which turns within a trough **31** containing a bath **33** of hot melt adhesive. As the lower surface of the drum rotates counterclockwise through the trough, the adhesive is picked up on the surface and also accumulates in a shallow circumferential groove **34** (FIG. 4) formed near one end of the drum and in a pair of axially extending grooves **35** and **36** spaced approximately one-fourth of an inch from each other around the circumference of the drum. With continued rotation of the drum, a doctor blade **37** extending parallel to the drum scrapes the adhesive from the surface but leaves the adhesive remaining in the grooves so that the web, upon being pressed against and drawn across the upper surface of the drum, receives a coating of adhesive in a pattern which is correlated with the arrangement of the grooves. The groove **34** prints a strip **39** (FIG. 5) of adhesive along one edge portion of the web for subsequent use in sealing the seam **16** while the grooves **35** and **36** print a series of longitudinally spaced strips **40** and **41**, respectively, extending crosswise of the web. Each cross-strip **41** is spaced longitudinally from but disposed closely adjacent to one of the cross-strips **40** and ultimately is activated to form the bottom seal **18** of the bag. The cross-strip **40** is disposed in leading relationship with respect to the adjacent cross-strip **41** and is activated to form the top seal **17** after filling of the bag.

As the web **10** travels across the drum **30**, it is pressed into firm contact with the drum surface by a pinch roller **43** disposed above the drum. Thereafter, the web is guided upwardly around a set of rollers **44** positioned against the uncoated side of the web to allow the adhesive to dry before the web is advanced beneath a roller **45** and along a horizontal path with the adhesive strips facing upwardly.

According to one aspect of the invention, the web **10** and the printing drum **30** are advanced with a continuous motion while the strips **39** to **41** are being printed on the web to insure that the strips will be precisely defined, ac-

curately located and formed with a uniform application of adhesive. The web, however, is folded, sealed and severed while being advanced intermittently or step-by-step along a horizontal path to enable the use of more simple and less expensive mechanisms for performing these operations. The web is advanced rapidly through steps equal in length to the length of the bags **11** and then dwells for a longer interval while being sealed and severed. Thus, to establish a proper phase relationship between the continuous and intermittent motions of the web and to make the two motions compatible, the web is advanced continuously through a distance equal in length to one step during the combined time consumed by a dwell and an intermittent advance of one step, and provision is made to accumulate and tension all of the web continuously advanced during a dwell in the intermittent motion.

To advance the web **10** continuously across the printing drum **30** and at a speed correlated with the subsequent intermittent advance of the web, feed mechanism in the form of two feed rollers **46** and **47** (FIGS. 2*a* and 6) disposed downstream from the guide roller **45** frictionally engage opposite sides of the web and are rotated continuously at a rate determined by the length of web advanced during each intermittent step and by the time elapsing during a cycle of a step and a dwell. Power for rotating the rollers is furnished by an electric motor **49** (FIG. 2*a*) which acts through reduction gearing **50** to drive a shaft **51** connected to a gear box **53**. The output shaft **54** of the gear box is connected by a chain **55** to the input **56** of a variable speed differential **57** which includes one output **60** for driving the feed roller **46** by means of a chain **61** extending from the differential output to a shaft **63** rotatably mounting the roller on the frame **26**. Two meshing pinions **64** (FIG. 6) on the shaft **63** and a shaft **65** mounting the roller **47** transmit the drive to the latter roller. Electrically-actuated clutch and brake units **66** and **67** are connected to the shaft **63** to enable selective starting and stopping of the feed rollers independently of the motor **49**.

The differential **57** further includes a second output **69** (FIG. 2*a*) which is connected rotatably to the printing drum **30** by a drive chain **70**. Through a set of pinions **71** (FIG. 4), the drum rotates the pinch roller **43**, and a suitable drive train (not shown) responsive to rotation of the drum is utilized for rotating the guide rollers **27** and **44**.

Initially, a manual control **73** (FIG. 2*a*) associated with the differential **57** is set to adjust the speed of the feed rollers **46** and **47** to feed the web **10** continuously at a rate substantially compatible with the intermittent advance of the web and, at the same time, the rotational speed of the printing drum is synchronized with the speed of the feed rollers to insure printing of the sets of cross-strips **40** and **41** along lines spaced along the web in accordance with the desired length of each bar **11**. As the printed web is drawn through the feed rollers, an electric eye **74** disposed above the web and alongside the rollers detects the cross-strips to determine the actual speed of the web, and transmits feedback signals indicative of the actual speed to a compartor **75** through a line **76**. The comparator also receives a command signal representative of the desired speed of the web through a line **77** associated with the differential, compares the two signals, and transmits an error signal through a line **78** to a control **78***a* on the differential to advance or retard the rotational rate of the differential output **60** and the feed rollers if the speed of the web should become slower or faster than required.

In order to accumulate and tension the web **10** advanced continuously by the feed rollers **46** and **47** while the downstream portion of the web is dwelling, two compensators **79** and **80** are located at the point of transition from continuous to intermittent motion and store the web during each dwell while maintaining tension on the web as the latter is advanced intermittently through each step. As shown most clearly in FIGS. 2*a* and 7 to 9, the compensators **79** and **80** are disposed immediately downstream from the feed rollers and include a horizontal dancer roller **81** and **83**, respectively, disposed below a central guide roller **84** and between the central roller and one of a pair of upstream and downstream guide rollers **85** and **86** on opposite sides of the central roller. After passing through the feed rollers, the web is trained downwardly over the upstream roller **85** and upwardly around the dancer roller **81** to the central roller **84**, downwardly around the dancer roller **83**, and finally back upwardly over the downstream roller **86**.

As the web **10** downstream from the guide roller **86** dwells between steps, the dancer rollers **81** and **83** are urged downwardly from elevated positions to lowered positions to accumulate and tension the web advanced over the guide roller **85** by the feed rollers **46** and **47** during the dwell. For this purpose, each dancer roller is rotatable on a horizontal shaft **87** (FIG. 8), which is mounted at each end for up and down sliding in a vertically extending slot **89** formed in a tubular guide **90** upstanding from the frame **26**. Telescoped into each guide is a coil spring **93** which is contracted between the upper end of the guide and a plunger **94** bearing downwardly on and locking the shaft **87** against rotation. The springs urge the dancer rollers downwardly to tenison the web as the latter accumulates between the guide rollers during a dwell of the downstream portion of the web and, in response to such downward movement, the dancer rollers are rotated about the shafts **87** with a positive action by means of pinions **95** on the ends of the rollers meshing with racks **96** extending vertically alongside the guides **90**.

At the completion of each dwell, the web **10** is stripped rapidly over the downstream roller **86** and upwardly from the dancer roller **83** as the web is advanced through one step. Such stripping of the web forces the dancer roller **83** upwardly against the resistance of the springs **93** which become loaded to maintain the tension on the web. At approximately the same time, the remaining length of web necessary for completion of the step is stripped from the dancer roller **81**, and the latter roller floats upwardly through a shorter range and loads its associated springs to a lesser degree. Thus, during the next dwell, the more heavily loaded dancer roller **83** will be urged downwardly at a faster rate and to a lower level than the dancer roller **81** and will accumulate somewhat more than half of the web required for the next step. As a result of the use of a pair of dancer rollers instead of a single roller to compensate for the changeover from continuous to intermittent motion, the overall capacity for storing the web is almost doubled without need of increasing the range of movement of the individual rollers. With the shorter range of movement of the rollers, the loading imposed on the springs is more uniform thereby resulting in more uniform tensioning of the web.

Formation of the web **10** into the tube **20** is achieved by a bag former **97** located downstream from the compensators **79** and **80** and operable to receive and fold the web gradually while the latter is traveling horizontally so as to avoid stressing and creasing of the web. As shown in FIG. 2*a* and FIGS. 10 to 12, the bag former includes a forming wheel **99** approximately one-half as wide as the web and journaled for rotation on a shaft **100** disposed below the level of the guide roller **86**. After passing over the guide roller, the web is fed beneath the forming wheel which depresses the center portion of the web to dish the opposite edge portions upwardly as indicated at **101** in FIG. 11. Thereafter, the center portion moves beneath and the dished edge portions move alongside an elongated horizontal forming plate **103** approximately the same width as the roller and about one-eighth of an inch in thickness. The plate extends parallel to the path of advance and overlies a wide platform **104** which is supported on a pair of upright standards **105** projecting upwardly from the frame **26**. Upstanding from opposite sides of the platform are two posts **106** spanned by a horizontal shaft **107** which suspends the forming roller above the web by means of arms **109**

extending between the shafts **100** and **107**. A leg **110** depends from the midpoint of the shaft **107** and is connected to a flat shoe **111** rigid with the upper side of the forming plate and suspending the plate above the platform to establish between the two the vertical clearance necessary to accommodate passage of the central portion of the web beneath the plate.

As the web **10** leaves the wheel **99** and passes beneath and alongside the plate **103**, the dished edge portions **101** of the web are folded gradually around the plate and toward each other into overlapping relation to form the tube **20** with a generally flat shape an with the seam **16** facing upwardly, the adhesive strip **39** being folded over the opposite edge portion of the web and the strips **40** and **41** being disposed on the inner surface of the tube. For this purpose, forming rollers **113** arranged in longitudinally spaced pairs on opposite sides of the web exert frictional forces on the web tending to wrap the same snugly but smoothly around the top of the plate. The rollers are rotatable about horizontal axes inclined obliquely of the web and are arranged to effect a gradual folding of the web. In addition, the edges of the forming plate are rounded as indicated at **114** in FIG. 12 to avoid creasing the web as it is folded around the plate by the rollers. A set of pressing fingers **115** disposed between the pairs of rollers overlies and holds the web as it passes between the rollers.

The tube **20** formed around the plate **103** continues to advance along the plate into the sealing station **21** where an electrically-heated sealing bar **116** (FIGS. 2*a*, 13 and 14) extending longitudinally of the path is brought downwardly into engagement with the tube along the seam **16** to activate the adhesive strip **39** and seal together the overlapping edge portions of the web (see FIG. 15). Advantageously, the sealing bar is operated by a self-contained or modular actuator in the form of a pneumatic ram **117** connected to the bar by a yoke **119** and timed to advance the bar through its downstroke while the tube is dwelling and then to retract the bar prior to the next advance of the tube. After the seam has been heat-sealed and the tube has been advanced through one step, the newly formed seal is hardened by a cooling bar **120** which is reciprocated up and down by a second pneumatic ram **121** and which is maintained at a low temperature by cooling fluid circulated through the bar. The operation of the two rams is controlled in timed relation with the advance of the tube by a pair of cams **123** (FIG. 2*a*) rotatable with a sequence shaft **124** connected to the power shaft **51** by a chain **125**, the cams being operable to command actuation of electrically-operated valves (not shown) for governing the flow of pressurized air to the rams.

As shown most clearly in FIGS. 13 and 14, supporting members **126** on the main frame **26** suspend the rams **117**, **121** and the bars **116**, **120** above the forming plate **103** while a pair of rollers **127** downstream from the cooling bar support the extreme end of the forming plate, the rollers being disposed on opposite sides of the plate and being journaled by posts **129** fastened to the frame. To prevent deflection of the plate as the bars are pressed downwardly into engagement with the tube **20**, an elongated shoe **130** with a coating of Teflon on its upper surface underlies the plate and holds the latter in a horizontal plane while still allowing free advance of the tube.

With the seam **16** sealed and cooled, the tube **20** is advanced off of the downstream end of the forming plate **103** and then dwells at successive intervals beneath a heated cross-sealing bar **131** and a cooling bar **133** (shown schematically in FIG. 2*a*) extending crosswise of the tube. These bars also are reciprocated by pneumatic rams (not shown), and are alined vertically with backing shoes **134** and **135** which underlie and support the tube. Reciprocation of the two bars is timed by the cams **123** on the sequence shaft **124**, and the heated bar is advanced downwardly exactly when one of the adhesive strips **41** is dwelling over the shoe **134** so that the opposing sides of the tube are pinched together and heated along the strip **41** and crosswise of the tube thereby to form the bottom seal **18** of the ultimate bag **11**. After advancing through one step, the newly formed seal then is pressed between the cooling bar and the backing shoe **135** to harden the activated adhesive. Both the heated bar and the cooling bar together with their respective shoes are mounted on the frame **26** for adjustment longitudinally of the tube **10** to enable the formation of bottom seals of bags of various lengths.

To advance the material forming the web **10** and the tube **20** step-by-step past the bag former **97** and through the sealing station **21**, mechanism in the form of two additional horizontal feed rolls **136** and **137** frictionally engage opposite sides of the tube downstream from the cooling bar **133** and are rotated intermittently through precisely controlled arcs to feed the web through steps exactly equal in length to the length of the bags **11**. Herein, the rolls **136**, **137** are fast on shafts **139** and **140** (FIG. 18), respectively, and the latter is journaled at one end in a column **141** upstanding from a supporting platform **143** on the frame **26** and formed with an arm **144** overhanging the feed rolls. Depending from the free end of the arm is a side plate **145** which journals one end of a rockshaft **146** whose other end is journaled in the column above the upper feed roll. By turning the rockshaft clockwise (FIG. 19) with a handle **147** attached to the rockshaft, cams **149** near the ends of the rockshaft may be moved into engagement with a pair of bearings **150** rotatably mounting the shaft **140** of the upper roller thereby to swing the bearings upwardly about pins **151** pivotally connecting the bearings to the column and the side plate. Such upward swinging of the bearings raises the upper roll away from the lower roll to allow manual threading of the bag material through the rolls. The upper roll normally is urged toward the lower roll and into frictional engagement with the material by coil springs **153** contracted between the bearings **150** and seats **154** on the column and the side plate. To prevent the rolls from creasing the edges of the tube, the surfaces of the rolls actively engaging the tube are narrower in width than the tube so that the edges remain rounded as indicated at **155** in FIG. 18 as the tube passes between the rolls.

Rotative drive for the feed rolls **136** and **137** is picked off from the motor **49** by means of a jack shaft **156** (FIG. 2*a*) extending from the gear box **50** oppositely of the shaft **51** and drivingly connected to and continuously rotating an elongated cycle shaft **157** through a chain **159**. As shown in FIGS. 2*a* and 2*b*, the cycle shaft is disposed parallel to the path of advance of the bags **11**, extends to or beyond the right-hand end of the package-filling section of the machine, and is used to drive in timed relation many of the various mechanisms of the filling section as will be explained subsequently. The left-hand end of the cycle shaft, however, is disposed near the feed rolls and need not extend further back upstream since the sealing bars **116**, **120**, **131** and **133** are actuated by the self-contained pneumatic rams and are not reciprocated through mechanical linkages operated by the cycle shaft as has been customary with prior machines of the same general type. Thus, through the use of sealing bars operated by modular actuators, the left end of the cycle shaft may be located near the center of the machine and may be shorter than formerly required thereby reducing torsional deflection in the shaft and resulting in more precise synchronism between the operating mechanisms.

For converting the continuous rotary motion of the cycle shaft **157** into intermittent rotation of the feed rolls **136** and **137**, a first crank **160** (FIGS. 2*a* and 17) on the left end of the cycle shaft is connected by a drive element, herein a pitman **161**, to a second crank **163** fast on a drive connection or shaft **164** journaled at one end in bearings **165** supported by the frame **26**. Thus, during successive half revolutions of the cycle shaft, the pitman is reciprocated first downwardly (FIG. 2*a*) and then up-

wardly to oscillate the connecting shaft **164** back and forth about its axis. The lower end of the pitman is connected to the crank **160** by a pin **166** which may be adjusted within a slot extending radially of the crank to change the throw of the crank and vary the arc of oscillation of the shaft **164**.

Relatively versatile and trouble-free means are provided for transmitting to the feed rolls **136** and **137** the motion of the pitman **161** during its downward or active stroke and then for disconnecting the feed rolls from the pitman during the upstroke of the same thereby to effect intermittent and unidirectional rotation of each roll to advance the bag material step-by-step along the path. In this instance, these means comprise an electromagnetic clutch **167** suspended from the platform **143** by a bracket **169** and including a driving member **170** bushed in a bearing **171** on the bracket and coupled to the shaft **164**. Depending upon the strength of the current supplied for energizing the clutch, the driving member may be coupled selectively and with various degrees of engagement to a driven member **173** connected to the input shaft **174** of bevel gearing **175** housed on the underside of the platform **143**. The output shaft **176** of the gearing drives a second set of bevel gears **177** supported on the upper side of the platform and coupled to one end of the shaft **139** mounting the lower feed roll **136**. Meshing pinions **179** on the opposite end of the shaft **139** and on the shaft **140** of the upper feed roll **137** transmit rotation to the latter roll.

Preparatory to advancing the material, the throw of the crank **160** is adjusted to produce a peripheral movement of the rollers **136** and **137** somewhat greater than the length of the bag **10** to be formed. As the cycle shaft **157** starts through one-half revolution, the pitman **161** is shifted downwardly through its active stroke to turn the shaft **164** in a direction correlated with the direction the feed rolls need to rotate to advance the material. Shortly after the pitman starts through its downstroke, the clutch **167** is energized to transmit rotation of the shaft **164** to the feed rolls through the gearing **175** and **177**. (See the time chart shown in FIG. 20.) Energization of the clutch at the proper time may be effected by a cam **180** (FIG. 2*a*) rotated by the sequence shaft **124** and operable to open and close a switch **181** in the control circuit of the clutch.

With energization of the clutch **167**, the feed rolls **136** and **137** begin advancing the bag material through one step. Movement of the material is measured and detected by a feeler such as a photoelectric scanner **183** (FIG. 17) supported on the platform **143** above the path and operable to direct a light beam **184** against the upper side of the tube. Each time the material advances through a step of desired length, the light beam is intercepted by one of a series of targets **185** (FIG. 16) pre-printed on the upper side of the seam **16** and spaced longitudinally from each other in accordance with the length of the steps. Upon interception of the light beam by the target, the scanner produces an electrical signal indicating the advance of the material through one step. Such signal completes a circuit (not shown) energizing an electromagnetic brake **186** (FIG. 18) housed in the column **141** and mounted directly on the end of the shaft **139** of the feed roll **136**. When energized, the brake abruptly arrests rotation of the feed rolls to stop movement of the tube precisely upon completion of a step of given length and, since the brake acts directly on the feed roll shaft **139** instead of retarding the shaft through the gearing **175** and **177**, the tube stops immediately with little or no overtravel.

As shown graphically in FIG. 20, the electric clutch **167** is held energized while the brake **186** is energized and, during this time, the driving member **170** simply slips with respect to the driven member **173** since the clutch may be energized to a degree permitting such slippage when the motion of the driven member is arrested by the brake. Shortly after energization of the brake and stopping of the feed rolls, a switch **187** is opened by a cam **189** on the sequence shaft **124** to de-energize the clutch and brake simultaneously. Thereafter, the pitman **161** completes its downward or active stroke and then starts through its upstroke to turn the shaft **164** in the opposite direction. The direction of rotation of the feed rolls is not reversed, however, since the clutch is held de-energized until the pitman again has started on its downstroke. In addition, a one-way clutch **190** (FIG. 18) connected to the gearing **177** positively prevents any reverse rotation of the rolls tending to result from the tensioned material.

With the foregoing arrangement, the signal-responsive brake **186** stops the feed rolls **136** and **137** after the tube **20** has been advanced exactly through the desired distance in spite of any slippage between the tube and the rolls. Moreover, the electrically-actuated clutch **167** couples the pitman **161** to the rolls during a sufficient portion of the active stroke of the pitman to insure that the tube actually will be advanced through the necessary distance. By keeping the clutch energized during only an intermediate portion of the active stroke of the pitman, the tube may be accelerated at a faster and more uniform rate and will be dwelling during the time the pitman is moving slowly as a result of the crank **163** moving away from and approaching its dead-center positions.

If bags **11** of different lengths are to be formed, the throw of the crank **160** may be adjusted as necessary to cause advance of the material through steps corresponding to the new length of the bags. In addition, the cams **180** and **189** may be adjusted angularly on the sequence shaft to actuate the control switches **181** and **187** and energize and de-energize the electric clutch **167** shortly after the beginning and shortly before the completion of the new active stroke of the pitman **161**. Accordingly, the electrically-actuated clutch enables easy changeover from one bag length to another and yet is more reliable and trouble-free in service use than previous mechanical clutches used for the same general purpose.

Disposed immediately downstream from the feed rolls **136** and **137** is the cutting station **23** at which the tube **20** is separated into open-end bags **11** by cutting through the tube alongside and just ahead of the leading edge of each bottom seal **18** and along the space separating adjacent adhesive strips **40** and **41**. Such cutting of the tube is effected by blades **195** and **196** (FIGS. 21 and 22) operable with a scissors action and relatively movable transversely of the tube as the tube dwells with te leading edge of the bottom seal just short of the blades after having been advanced between the blades when the latter are separated. Herein, the blade **195** underlies the tube and is fixed to a bar **197** extending along the upper edge of an upright plate **199** fastened to the platform **143**. Cut off occurs as the blade **196** is swung downwardly across the tube to carry its inclined cutting edge across the edge of the fixed blade as shown in FIG. 22. For this purpose, the blade **196** is held under the pressure of springs **200** against the side of a lever **201** overhanging the tube and pivotally connected by a pin **203** to a post **204** upstanding from the platform. The rod **205** of a pneumatic actuator **206** housed beneath the platform is connected to the overhanging end of the lever and is operable to swing the lever and the blade **196** downwardly when the actuator is energized. A cam on the sequence shaft **124** is used to energize the actuator during the initial portion of each dwell and then de-energize the actuator before the next advance of the tube. A coil spring **207** is telescoped over a rod **209** fastened between the platform and the opposite end of the lever and urges the lever and the blade **196** upwardly when the actuator is de-energized so that the tube may be advanced to present the leading edge of the next bottom seal **18** alongside the blades.

The blades **195** and **196** are spaced along the path from the right-hand side (FIG. 2*a*) of the cross-sealing bar **131** a multiple of the feeding movement produced by the rolls **136** and **137**. As a result, the leading edge of one bottom

seal **18** is, by each advance of the tube **20**, correctly positioned between the blades. In addition, the spacing between the blades and the extreme right-hand end of the horizontal path, where the cut-off baks are picked up and turned into upright positions, is equal to the feeding movement produced by the rolls. Such correlation of the feeding movement and the spacing between the blades and the pick-up point is necessary to insure that the bags always will be positioned properly for pick up regardless of the length of the bags. Accordingly, the blades are mounted for adjustment along the path so that, when the arc of rotation of the rolls is changed to feed a different length of material with each step, the blades also may be adjusted as necessary to maintain the blades properly spaced from the cross-sealing bar and the pick-up point.

In other of its aspects, the present invention contemplates mounting the feed rolls **136** and **137** for adjustment along the path as a unit with the blades **195** and **196** in order that a fixed spacing may be maintained between the blades and the rolls at all times regardless of the position of the blades and the length of the bags **11** being formed. To these ends, the platform **143**, which supports the blades, the rolls and their associated drive mechanisms, is adjustable relative to the frame **26** to enable movement of the blades and the rolls in unison simply by making a single adjustment in the position of the platform. Moreover, the shaft **164** drivingly connecting the feed rolls to the cycle shaft **157** is adjustable as an incident to adjusting the platform thereby to leave the feed rolls free for bodily movement while still preserving the drive connection between the rolls and the cycle shaft.

As shown most clearly in FIG. 18, the supporting platform **143** is a flat plate which rests at its opposite side edge portions on a pair of horizontal flanges **210** and **211** projecting inwardly from the frame **26**. An elongated clamping bar **213** is fastened releasably to the flange **210** by cap screws **214** and is formed with a lip **215** bearing downwardly against the platform to lock the latter to the flange. The opposite edge portion of the platform is clamped releasably to the flange **211** by a clamping bar **216** underlying the flange and fastened to the platform by cap screws **217**. To adjust the position of the blades **195** and **196** along the path, the screws **214** and **217** need only be loosened to allow sliding of the platform along the flanges, the platform being guided during such sliding by a key **219** fitted in keyways in the flange **210** and the adjacent edge portion of the platform. Since the feed rolls **136** and **137** also are supported on the platform, they are adjusted along with the blades so that the longitudinal spacing between the rolls and the blades is maintained constant in all adjusted positions of the blades. The spacing, herein 3½ inches, is set to be no greater than is necessary to establish sufficient clearance between the rolls and the blades to accommodate manual threading of the material through the rolls, and, at the same time, is maintained as small as possible to utilize with maximum effectiveness the underlying support provided on the tube **20** by the lower roll **136** during cut off of the bars **11**. Accordingly, by adjusting the rolls with the blades, the spacing between the two need not be increased when forming bags of different lengths and thus the supporting function of the lower roll is not decreased.

To accommodate adjustment of the feed rolls **136** and **137**, the connecting shaft **164** advantageously is formed as two relatively adjustable parts, namely, an internally splined sleeve **220** (FIG. 17) journaled in the bearings **165**, and an externally splined shaft **221** slidably telescoped into the sleeve and connected to the driving member **170** of the clutch **167**. As the clutch and the gearing **175** and **177** are moved with the platform **143** during adjustment of the feed rolls, the splined shaft **221** slides relative to the sleeve **220** to leave the rolls free for such adjustment while still drivingly connecting the rolls to the cycle shaft **157** through the sleeve and the pitman **161**.

Each bag **11**, after being cut off from the tube **20**, is turned into an upright position and is advanced step-by-step through the filling station **25** by a conveyor **223** (FIGS. 2*b* and 23). In this instance, the conveyor includes an endless chain **224** traveling in a horizontal plane and trained around sprockets **225** and **226** which are fast on upright shafts **227** and **228** journaled on the frame **26**, the sprocket **225** being positioned adjacent to and below the cutting station **23** such that one of the curved end runs of the chain is spaced ahead of and beneath the horizontally disposed bags cut from the tube **20** at the cutting station. The bags are held on the chain by upwardly opening U-shaped clips **229** (FIG. 23) spaced along and fastened to the chain and each formed with a spring-metal leg **230** for gripping the bags. A Geneva mechanism **231** (FIG. 2*b*) coupled to the sprocket shaft **228** is driven by the cycle shaft **157** and is timed to advance the chain intermittently through steps equal in length to the spacing between the clips at approximately the same time the feed rolls **136** and **137** are advancing the tube with both the chain and the feed rolls dwelling during the same intervals.

The invention further contemplates a new and extremely simplified mechanism for supporting the bags **11** during cut off, for turning the cut-off bags from horizontal to upright positions with the open ends **24** of the bags facing upwardly, and for delivering the bags to the conveyor **223** for advancement through the filling station **25**. In general, this mechanism comprises an arm **233** (FIG. 23) mounted to turn about a horizontal axis in the cutting station **23** and carrying a gripper **234** operable first to support the leading end of the tube **20** during the downward stroke of the blade **196** and then to swing the newly formed bag downwardly through an arc sufficient to place the bag in a substantially upright position on one of the clips **229** on the conveyor.

More specifically, the gripper **234** is a suction cup mounted on the free end of the arm **233** which is fast on a horizontal shaft **235** journaled for back and forth oscillation in bearings **236** on the frame **26**. Each time the tube **20** is advanced one step between the blades **195** and **196**, the suction cup is positioned beneath the leading end of the tube as shown in FIG. 23 to support the underside of the tube. When the tube dwells, the cup is connected to a vacuum source (not shown) through a line **227** and a valve (not shown) which is actuated in timed relation with the movement of the cup by a cam on the sequence shaft **124**. The cup thus grips and holds the leading bag **11** on the tube as the blade **196** moves through its downstroke to sever the bag from the tube. Thereafter and while the tube is still dwelling, the cup is swung clockwise about the axis of the shaft **235** through almost a ninety degree arc to turn the bag into an upright position. As the cup approaches the lower end of the arc, the bottom of the bag is inserted into one of the clips **229** on the dwelling conveyor **223** (see FIG. 24) and, at the same time, the cup is disconnected from the vacuum source to release the bag. The cup then is swung reversely about the axis of the shaft **235** and back to the position shown in FIG. 23 to receive the next bag as the latter is advanced into cutting position. Although the cup is very simple in construction and moves with a simple arcuate motion, it is effective both to support the bags and to transfer the bags automatically into proper positions for advancement through the filling station.

To swing the cup **234** between its positions, the shaft **235** is oscillated back and forth in response to the up and down movement of a link **237** connected at its upper end to a crank **239** on the shaft and at its lower end to a lever **240** pivoted on the frame **26** and carrying a follower **241** engagable with a cam **243** on the cycle shaft **157**. As the latter rotates, the cam forces the link upwardly and then downwardly during each dwell of the tube **20** to rock the shaft **235** and swing the suction cup. When the cup and the gripped bag **11** approach the lower ends of their arcs, a

differently shaped cam **244** on the cycle shaft forces a second link **245** upwardly to rock a finger **246** on a shaft **247** into engagement with a pivoted operating lever **249** fastened to the resilient leg **230** of the clip **229**. The clip thus is spread open to receive the bag and, after the bag has been inserted into the clip, the link **245** is shifted downwardly to move the finger away from the lever **249** and allow the leg **230** to flex inwardly into gripping engagement with the bag.

After the bags **11** have been transferred to the conveyor **223**, they are advanced edgewise and in spaced relation through the filling station **25** to receive a measured charge of the bulky particles **13**. In accordance with one of its important aspects, the invention contemplates a novel method and apparatus for opening each bag widely throughout its length and around its open end **24** to enable the deposit of a relatively large volume of the particles into the bag in a comparatively short time. In addition, the opened upper end of each bag is stretched after filling of the bag and is returned to a generally closed position in which the upper edges of the side panels **14** and **15** are disposed parallel to one another to avoid crumpling or out-of-plane sealing when the top seal **17** is formed.

In order to open each bag **11** widely, the side panels **14** and **15** are blown apart by a blast of air or other gaseous media such as carbon dioxide injected into the bag thereby to cause the side panels to billow outwardly and away from each other. This occurs after the bag has been advanced through two steps by the conveyor **233**. First, the upper end portions of the two side panels are gripped by a pair of suction cups **250** (FIGS. 25 to 27) connected to the vacuum source and movable away from each other to pull apart the panels and open the upper end of the bag for reception of an air-injector which herein is a nozzle **251** disposed above the path and connected to a source (not shown) of pressurized air. Thereafter, the nozzle is lowered into the bag, and a pair of clamping bars **253** made of yieldable rubber are moved toward each other and into engagement with the upper end portions of the side panels to clamp the same around the nozzle and temporarily seal the upper end of the bag (see FIG. 27). At approximately the same time, the cups **250** are disconnected from the vacuum source to leave the panels free for clamping around the nozzle. A shot of air then is injected into the bag through the nozzle to expand the side panels below the clamping bars as shown in FIG. 27. The body of the bag thus is opened from its originally formed flattened condition (FIG. 1) and assumes generally the shape shown in FIG. 28. As a result of the foil material, the bag tends to retain its expanded shape after escape of the air from the bag.

With the bag **11** expanded by the air, the clamping bars **253** are retracted away from the nozzle **251** and the latter is pulled upwardly out of the bag to free the bag for advancement with the conveyor **223**. The bars and the suction cups **250** are carried on upright rods **254** and **255**, respectively, which are mounted pivotally on the frame and which are rocked back and forth in timed relation with the advance of the bags by cams **256** and **257** (FIG. 2*b*) on the cycle shaft **157**. The nozzle **251** depends from the free end of a horizontal rod **259** whose other end is connected pivotally to the frame **26** by a pin **260**. During each dwell of the bags, a link **261** connected between the ends of the rod **259** is rocked downwardly and then upwardly by a cam **263** on the cycle shaft to insert and retract the nozzle.

Preparatory to filling each bag **11** with a charge of particles **13**, the upper end of the bag is opened widely and is formed into a generally circular mouth **264** (FIG. 30) so that a downwardly flowing particle stream of large cross-section may be deposited into the bag. In the present instance, formation of the circular mouth takes place while the bag is dwelling in the filling station **25** and is effected by grippers in the form of suction cups **265** uniquely arranged in pairs on opposite sides of the bag and swingable into a circular pattern after engaging and gripping the bag. In this way, the upper ends of the side panels **14** and **15** are pulled outwardly and away from each other to form the circular mouth.

As shown in FIGS. 29 and 30, the pairs of suction cups **265** are located on opposite sides of the bag **11** with the cups of each pair disposed in adjacent side-by-side relation near the level of the upper end of the bag. Each cup is carried on the free end of a lever arm **266** whose other end is mounted to swing with an upright pin **267** rotatable in one of a pair of bearings **269**. The latter depend from a plate **270** overlying the cups and supported on standards **271** projecting upwardly from the frame **26** on opposite sides of the path. For swinging the cups, links **273** are connected pivotally between the ends of the arms **266** with the links of adjacent cups being pivoted on a bar **274** coupled to the upper end of an actuating rod **275**. The rods are mounted on the frame **26** for rocking about a horizontal axis extending parallel to the path and are oscillated by cams **276** (FIG. 2*b*) on the cycle shaft **157** to swing the cups in unison back and forth about the axes of the pins.

The pins **267** are arranged relative to one another such that, when the arms **266** of opposing cups **265** are swung toward each other, the opposing cups move into face-to-face relation on opposite sides of a bag **11** dwelling in the filling station (see FIG. 29). At this time, suction is applied to the cups through lines **277** connecting the cups with the vacuum source through a cam-controlled valve (not shown). Each side of the bag thus is gripped at two horizontally spaced points near the upper end of the bag. With the bag gripped, each cup is swung away from its opposing and adjacent cups to pull the gripped points of the bag outwardly as shown in FIG. 30 through arcs sufficiently long, herein about thirty degrees, to form the circular mouth **264** at the end of the bag. In the open position of the cups, each cup is diametrically spaced from and is in spaced face-to-face relation with one of the cups of the other pair.

While the upper end of the bag is being held open by the cups **265**, a charge of the particles **13** is deposited into the bag through a tubular spout **279** (FIGS. 2*b* and 29) alined with and overlying the bag and extending downwardly through a centrally located hole in the plate **270** to a level just short of the open end of the bag. Measured quantities of the particles are delivered periodically into the spout from a hopper (not shown) by a conventional dispensing mechanism **280** (FIG. 2*b*) driven by the jack shaft **156** through gearing **281**. Since the mouth **264** of the bag is held in a wide open condition by the cups during filling and since the bag previously has been opened throughout its length by the shot of air, a large volume of the particles can be deposited rapidly into the bag in spite of the bulkiness and loose compaction of the particles.

Prior to forming the top seals **17**, the circular mouth **264** of each filled bag **11** is stretched and flattened to return the upper ends of the side panels **14** and **15** into generally parallel planes to avoid crumpling and wrinkling of the material during sealing. This is achieved in the present instance by two fingers **283** (FIGS. 31 to 33) which are swung downwardly into the bag as the latter dwells downstream from the filling station **25**. The fingers engage the inside of the mouth at diametrically spaced points and are moved away from each other along a line extending nearly parallel to the bottom seal **18** thereby to draw the upper ends of the opposing side panels inwardly toward one another to their originally formed positions as shown in FIG. 34.

The two fingers **283** depend from the free ends of arms **284** extending above and traversely of the bags and pivotally connected at their opposite ends to upright rods **285**, the two arms being spaced from each other longitudinally of the path. Links **286** pivoted intermediate the

ends of the arms extend toward each other and are connected pivotally by a pin **287** to a block **289** which is rigid with a rod **290** projecting horizontally from and mounted for back and forth sliding through a coupling **291** interconnecting the upper ends of the upright rods **285**. As the rod **290** is moved back and forth through the coupling, the links **286** swing the fingers in opposite directions about the pivot axes of the arms **284** to move the fingers toward and away from each other between the positions shown in phantom and in full in FIG. 33.

To reciprocate the rod **290** back and forth relative to the coupling **291**, a link **293** is pivotally connected between the block **289** and the upper end of a lever **294** pivotally connected between its ends to projecting members **295** on the frame **26**. The lower end of the lever is connected to a second link **296** which, in turn, is connected to one arm of a bell crank **297** pivoted on the frame as indicated at **299** in FIG. 31. A follower **300** on the other arm of the bell crank rides over a cam **301** (FIGS. 2*b* and 33) and, through the links **296** and **293** and the lever **294**, shifts the rod **290** rearwardly to close the fingers **283** each time a rise on the cam passes beneath the follower. Spreading of the fingers is effected by a spring **303** telescoped over a plunger **304** connected between the frame and the bell crank and acting to shift the rod **290** forwardly when the follower rides across a fall on the cam. The cam is mounted on one shaft **305** (FIG. 2*b*) of a set of bevel gears **306** housed on the frame beneath the arms **284** and driven by a chain **307** extending from the cycle shaft **157** to a sprocket **308** on the shaft **305**.

Insertion of the fingers **283** into and retraction of the fingers from the bag **11** is achieved with a second cam **309** (FIGS. 2*b* and 31) which is mounted on a second shaft **310** of the gearing **306**. The cam **309** underlies a follower **311** journaled the ends of a lever **313** pivotally connected to the frame **26**. One end of the lever is coupled to a block **314** (FIG. 32) extending between and rigidly connecting the upright rods **285**. As the follower **311** rides over a rise on the cam **309**, the lever **313** slides the rods **285** upwardly through tubular guides **315** on the frame and thereby lifts the arms **284** and the fingers **283** to the elevated positions shown in FIG. 32. When the follower encounters a fall on the cam, the rods are slid downwardly by a plunger **316** connected between the lever **313** and the frame and loaded by a spring **317**.

Initially, the fingers **283** are disposed in their elevated positions shown in FIG. 32 and are spaced close together as shown in phantom in FIG. 33. After a filled bag **11** has been advanced from the filling station **25** and dwells beneath the fingers, the latter are lowered into the circular mouth **264** of the bag. Thereafter, the fingers are spread apart and, during such spreading, engage diametrically spaced points of the mouth to close the mouth and to draw the upper ends of the side panels **14** and **15** into parallel planes. As the fingers start moving upwardly out of the bag, two crimping shoes **319** disposed on opposite sides of the bag are swung together against the mouth to crimp the material and interlock the side panels as indicated at **320** in FIG. 32 thereby to prevent the mouth of the bag from re-assuming its circular shape after the fingers are withdrawn. The shoes are carried on vertically extending rods **321** which are adapted to be swung toward and away from the bag by cams **323** on the cycle shaft **157**.

The bags **11** with the flattened and crimped mouths then are advanced between a pair of heated sealing bars **324** (shown schematically in FIG. 2*b*) which herein are reciprocated transversely of the path to activate the adhesive strips **40** and form the top seals **17** along lines extending parallel to bottom seals **18**. Since the upper ends of the side panels **14** and **15** are disposed in parallel planes when the panels are clamped between the sealing bars, the newly formed top seals are relatively wrinkle-free. In addition, the pressure exerted by the bars irons out the crimped lines **320** formed by the shoes **319**. Finally, the bags are advanced to the end of the conveyor **223** where they are removed from the clips **230** and are arranged in small stacks for subsequent delivery to a cartoning machine. A clip-opening mechanism **325** and transfer mechanism **326** (shown partially in FIG. 2*b*) are mounted on the frame for these purposes and are operated by the cycle shaft **157**.

With only minor modifications, the machine described above may be adapted to form a so-called tetrahedral bag **11'** (FIGS. 35 to 41) in which the panels **14'** and **15'**, are twisted gradually to present four sides each facing in a different direction, the top seal **17'** being formed along a line extending transversely of instead of parallel to the bottom seal **18'**. Such a bag is capable of holding a greater volume of product than a parallel-sided bag made from the same amount of material.

The tetrahedral bag **11'** is formed in the same manner as the bag **11** with the exception that the web **10** is folded along a line offset from the center line of the web in order that the seam **16'** will be offset from the center of the bag and will not be disposed directly at one end of of the top seal **17'** when the side panels **14'** and **15'** are subsequently twisted. After the bag has been filled, the open mouth is stretched by a pair of fingers **283'** (FIGS. 36 to 38) swingable about a horizontal axis extending parallel to the path of advance and operable to pull diametrically spaced points of the upper end of the bag away from each other along a horizontal line extending perpendicular to the bottom seal **18'**. Such pulling twists the side panels to form the tetrahedral shape of the bag. The flattened mouth then is crimped at **320'** (FIG. 38) and finally is heated and sealed by opposing seal bars **331** (FIG. 40) which extend crosswise of the path to form the transversely extending top seal **17'**. In addition to holding a greater volume of product, the tetrahedral bag lends itself quite well to fitting within and filling a carton **330** of square cross-section as shown in FIG. 41.

To illustrate still further the versatility of the machine in making different types of bags, FIG. 44 shows a bag **11''** which is formed with side gussets **340**. Such a bag is made as shown in FIG. 42 by advancing the web **10** beneath the forming wheel **99** and by folding the web around a modified forming plate **103'** (FIG. 43). In this instance, the forming plate **103'** comprises a narrow center section **341** sandwiched between upper and lower sections **343** which are wider than the center section so as to define elongated grooves **344** extending along opposite side edges of the plate. As the web is advanced beneath the forming plate, its longitudinal edge portions are tucked into the grooves by elongated fingers **345** fastened to the frame and projecting inwardly into the grooves between the upper and lower plate sections. With this arrangement, the vertical edge panels of the bag **11''** are formed with distinct V-shaped gussets **340** instead of being rounded and merging smoothly with the side panels as in the bag **11** shown in FIG. 1.

A similar type of bag but with a differently formed longitudinal seal is shown in FIG. 45. Herein, the two edge portions of the web first are folded into upstanding face-to-face relation by fingers (not shown) and then are sealed together by sealing bars which extend longitudinally of the forming plate **103'** but which move transversely of the plate. This forms an upstanding fin **346** extending along the longitudinal center line of the bag, and the fin is subsequently folded over and seald along one of its faces to the adjacent upper face **347** of the web thereby to form a double seam as shown in FIG. 46.

To form a bag **350** (FIG. 47) having side panels each made of different material, two separate webs **351** and **353** are drawn off of a pair of vertically spaced supply rolls **354** and **355** and are advanced step-by-step in a horizontal plane by the feed rolls **136** and **137**. The webs first are sealed together along their opposite side edges to form fin-type side seals as indicated at **356** and then are cross-

sealed in the same manner as in the first embodiment to form the bottom seals **357** of the bags. Thereafter, the bags are severed along the leading edge of the bottom seals, are transferred to the conveyor **223** and are filled as described previously.

In many instances, it is desirable to form bags with bottom gussets and, with relatively minor modifications, the machine of the present invention may be adapted to make such a bag. As shown in FIGS. 48 and 49, a single web **10** may be folded longitudinally with its two edges **360** disposed even with one another and opposite the fold, the folding being effected by a triangular plow (not shown) positioned in a vertical plane. As the folded web is advanced over a supporting plate **361**, the fold is tucked inwardly by a finger **363** to form a generally V-shaped gusset **364** comprising two outer folds **365** and a reverse inner fold **366**. Thereafter, longitudinally spaced cross-seals **367** are formed across the web with the sealing at the gusset occurring only along the opposing faces **369** forming the outer folds and not along those faces which are adjacent the finger **363**. Thus, when the big is filled, the gusset **364** will expand and the bottom of the bag will assume a generally flat shape. Sealing along only the desired lines and faces may be effected by the application of the adhesive strips to the web in a proper pattern.

After the web has been sealed, each gusset bottom bag is severed from the connected strip of bags by cutting through the center of each cross-seal **367** instead of along the leading edge of the seal thereby to leave the bag with a gusset bottom, two finned side seals, and an open top. The bag then is turned into an upright position and is transferred to the conveyor for advancement through the filling station **25**. Of course, it will be realized that bags each having two finned side seals and a bottom formed by a simple fold may be made by eliminating the gusset-forming finger **363**.

We claim as our invention:

1. In a machine for forming bags from a continuous web of flexible material and for filling the bags with a product, the combination of, first mechanism for advancing the web with continuous motion along a predetermined path through a coating station, means in said coating station and operable in timed relation with the advance of the web for applying strips of adhesive along at least one edge portion of the web and along a series of longitudinally spaced lines extending crosswise of the web, a bag former located downstream from said coating station for receiving the web while the latter is traveling in a generally horizontal plane and for folding the opposite edge portions of the web first upwardly and then toward each other into overlapping relation to form a tube with an upwardly facing seam extending longitudinally of said path, second mechanism for advancing said tube step-by-step along a generally horizontal path through spaced sealing and cutting stations with dwells between successive steps, a compensator located between said coating and sealing stations for accumulating and tensioning material advanced by said first mechanism while said tube is dwelling, sealers disposed in said sealing station for engaging the upper side of said tube while the latter is dwelling and for activating the adversive to join said edge portions along said seam and to form cross-seals spaced along and extending laterally of said tube, a severing unit in said cutting station and operable while said tube is dwelling to cut through the tube alongside one edge of said cross-seals to separate the tube into a succession of open-end and horizontally disposed bags, means for gripping each of said bags, turning the bags into upright positions with the open ends facing upwardly, and advancing the bags edgewise and in spaced relation through a filling station, a set of openers disposed in said filling station and operable to engage each side of the bag at a plurality of points to spread the sides of the bag and to form the open end of the bag into a generally circular mouth, a dispenser for depositing a charge of product into each bag through the mouth, stretchers engageable with the sides of said bag at diametrically spaced points around said mouth and movable away from each other to flatten the mouth after the bag has been filled, and means for thereafter closing the flattened mouth to enclose the product in the bag.

2. A machine as defined in claim **1** in which said means in said coating station applies strips of adhesive to said web along a second series of longitudinally spaced lines extending crosswise of the web, the strips of said second series being closely adjacent to but longitudinally spaced from the strips of said first series, said sealers leaving the adhesive on the second strips de-activated and said severing unit being operable in time relation with the advance of the tube along said horizontal path to cut through said tube between said first and second strips and thereby leave said second strips at the open ends of the separated bags, and said means for closing the mouth of the bag being operable to activate the adhesive of said second strips to seal the mouth closed.

3. A machine as defined in claim **2** in which said second strips are disposed in leading relationship with respect to the adjacent first strips as said tube is advanced along said horizontal path.

4. In a packaging machine, the combination of, mechanism for advancing an elongated tube of flexible material step-by-step in a generally horizontal direction along a predetermined path into a severing station, said tube being formed with a series of longitudinally spaced cross-seals extending horizontally across the tube and dividing the tube into a multiplicity of compartments, a cutter disposed above said path in said severing station and movable downwardly through the tube alongside the leading edge of at least some of said cross-seals thereby to cut the tube into a number of bags having open ends facing opposite the direction of advance, an arm mounted in said severing station to turn about a generally horizontal axis and carrying at its free end a gripper positioned vertically of said path and operable to engage one side of each bag before cut-off thereof, means connected to said arm and operable after cut-off of the bag to swing said gripper downwardly and away from said cutter about said axis and through an arc sufficient to turn the bag into a substantially upright position with said open end facing upwardly, a conveyor disposed adjacent said severing station near the end of said path for receiving and supporting said bag as said gripper approaches the lower end of said arc, mechanism for advancing said conveyor to carry said bag along an extension of said path, and a filling mechanism for depositing a charge of product into the open upper end of a bag supported by said conveyor.

5. A packaging machine as defined in claim **4** in which said gripper is positioned beneath said path and is operable to engage the underside of each bag to support the bag during cut-off.

6. A packaging machine as defined in claim **5** in which said gripper comprises a suction cup opening upwardly when said gripper is positioned beneath said bag, and means for connecting said suction cup to a vacuum source when the cup is positioned beneath the bag and for disconnecting said cup from the source as the cup approaches the lower end of said arc.

7. A packaging machine as defined in claim **4** in which said conveyor includes a clip having an upwardly opening mouth disposed near the lower end of said arc for receiving said bag from said gripper.

8. In a method of opening, filling and closing bags initially formed with open ends, the steps of, supporting and advancing the bags edgewise and in spaced relation along a predetermined path with the open ends of the bags facing upwardly, inserting an injector into the open end of each bag, closing the upper end of the bag temporarily around the injector and discharging a shot of gas through the injector and into the bag to cause billowing out of

the sides of the bag, removing the injector and gripping each side of the bag at at least two horizontally spaced points near the upper end of the bag, pulling the opposite sides of the bag away from each other at said points by swinging opposing points outwardly and away from each other through arcs sufficiently long to form a generally circular mouth at the open end of the bag, depositing a charge of product into the bag through the mouth, engaging the mouth at two points diametrically spaced around the mouth and pulling said diametrically spaced points away from each other to stretch and flatten the mouth, and sealing the flattened mouth to enclose the product in the bag.

9. A method as defined in claim **8** further including the step of pulling opposite sides of the bag away from each other prior to insertion of said injector thereby to spread the open end of the bag for easy insertion of the injector.

10. A method as defined in claim **8** further including the step of crimping the sides of the mouth together into interlocking relation after flattening of the mouth and prior to sealing of the mouth, said sealing being effected by the application of heat to the mouth.

11. A method as defined in claim **8** in whch said diametrically spaced points of said mouth are pulled away from each other along a line extending generally parallel to the bottom edge of the bag, and in which said mouth is sealed along a line extending parallel to the bottom edge of the bag.

12. A method as defined in claim **8** in which said diametrically spaced points of said mouth are pulled away from each other along a line extending crosswise of the bottom edge of the bag, and in which said mouth is sealed along a line extending crosswise of the bottom edge of the bag.

13. In a machine for forming packages from a continuous web of flexible material, the combination of, first mechanism for advancing the web with continuous motion along a predetermined path through a coating station, means in said coating station and operable in timed relation with the advance of the web for applying adhesive to the web in a preselected pattern, a package former located downstream from said coating station for receiving the web and for folding the web longitudinally with the opposite edge portions of the web disposed in face-to-face relation, second mechanism for advancing the folded web intermittently through steps of equal length into sealing and severing stations with dwells between successive steps, a sealing unit disposed in said sealing station and operable during successive dwells of the folded web to press against the web to cause said adhesive to form cross-seals spaced along and extending crosswise of the web, a cutter disposed in said severing station and movable while the web is dwelling to cut through the web along said cross-seals thereby to separate the web into a series of packages each having one open end, a compensator located between said coating and sealing stations for accumulating and tensioning any continuously moving web advanced by said first mechanism while said folded web is dwelling during operation of said sealing unit and said cutter, means for gripping each of the packages and advancing the same in spaced relation through a filling station, a dispenser in said filling station for depositing a charge of product into each package through the open end thereof, and means downstream of said dispenser for closing the open ends of said packages.

14. In a machine for forming bags from a continuous web of flexible material and for filling the bags with a product, the combination of, first mechanism for advancing the web with continuous motion along a predetermined path through a coating station, means in said coating station and operable in timed relation with the advance of the web for applying strips of adhesive along at least one edge portion of the web and along a series of longitudinally spaced lines extending crosswise of the web, a bag former located downstream from said coating station for receiving the web while the latter is traveling in a generally horizontal plane and for folding the opposite edge portions of the web first upwardly and then toward each other into overlapping relation to form a tube with an upwardly facing seam extending longitudinally of said path, second mechanism for advancing said tube step-by-step along a generally horizontal path through spaced sealing and cutting stations with dwells between successive steps, a compensator located between said coating and sealing stations for accumulating and tensioning material advanced by said first mechanism while said tube is dwelling, sealers disposed in said sealing station for engaging the upper side of said tube while the latter is dwelling and for activating the adhesive to join said edge portions along said seam and to form cross-seals spaced along and extending laterally of said tube, a severing unit in said cutting station and operable while said tube is dwelling to cut through the tube alongside one edge of said cross-seals to separate the tube into a succession of open-end and horizontally disposed bags, means for gripping each of said bags, turning the bags into upright positions with the open ends facing upwardly, and advancing the bags edgewise and in spaced relation through a filling station, a dispenser in said filling station for depositing a charge of product into the open end of each bag, and means for thereafter closing the open ends of the bags to enclose the product in the bags.

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