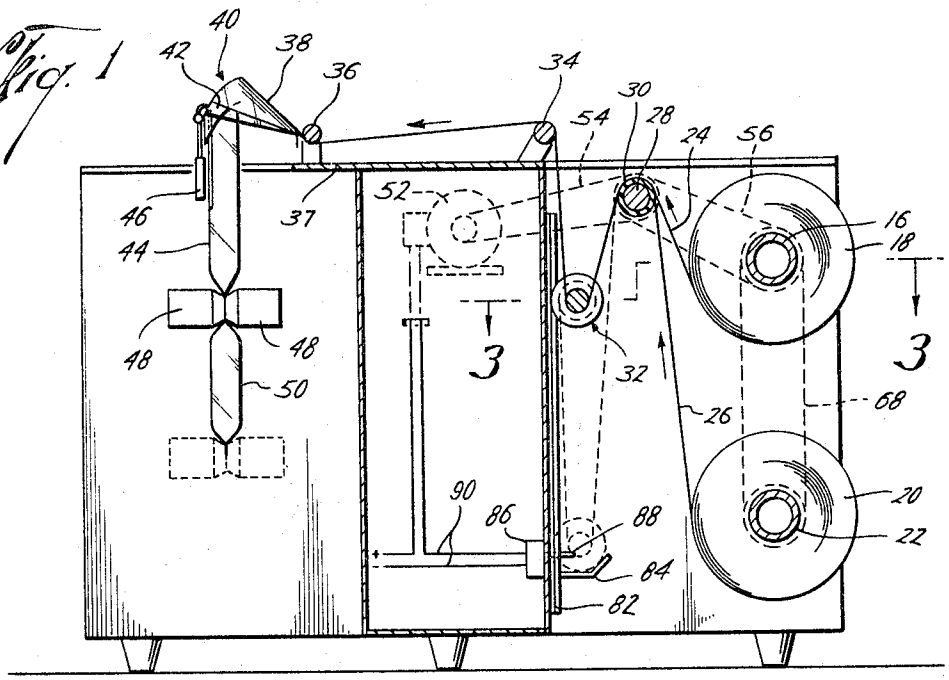
Aug. 23, 1966 H. W. HARRISON 3,267,822

PACKAGING APPARATUS

Original Filed June 28, 1963 5 Sheets-Sheet 1

Fig. 1



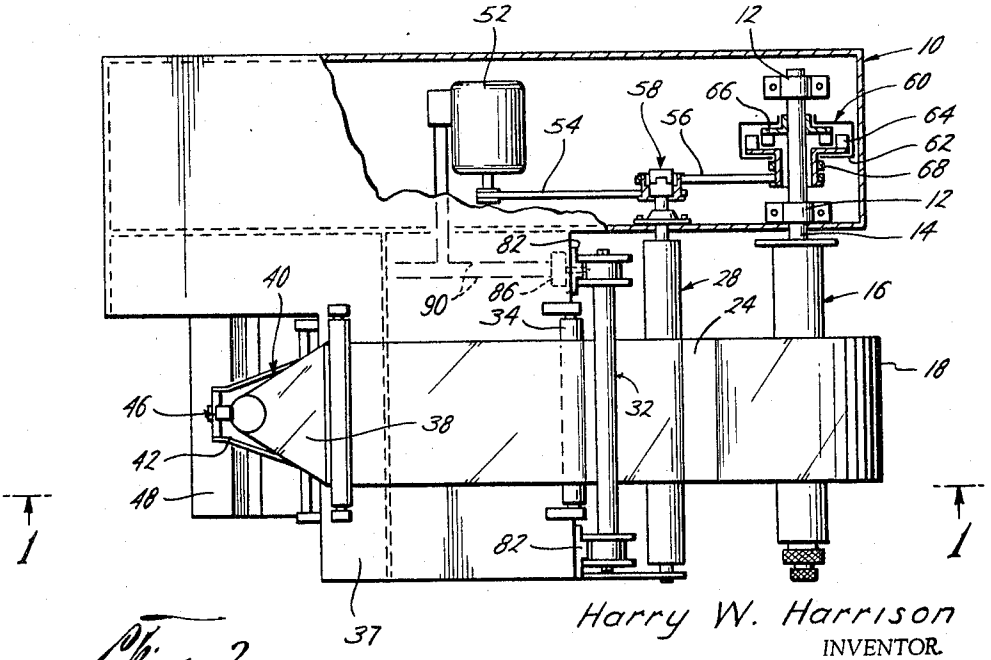


Fig. 2

Harry W. Harrison
INVENTOR.

BY Neal L. Conley
ATTORNEY

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PACKAGING APPARATUS

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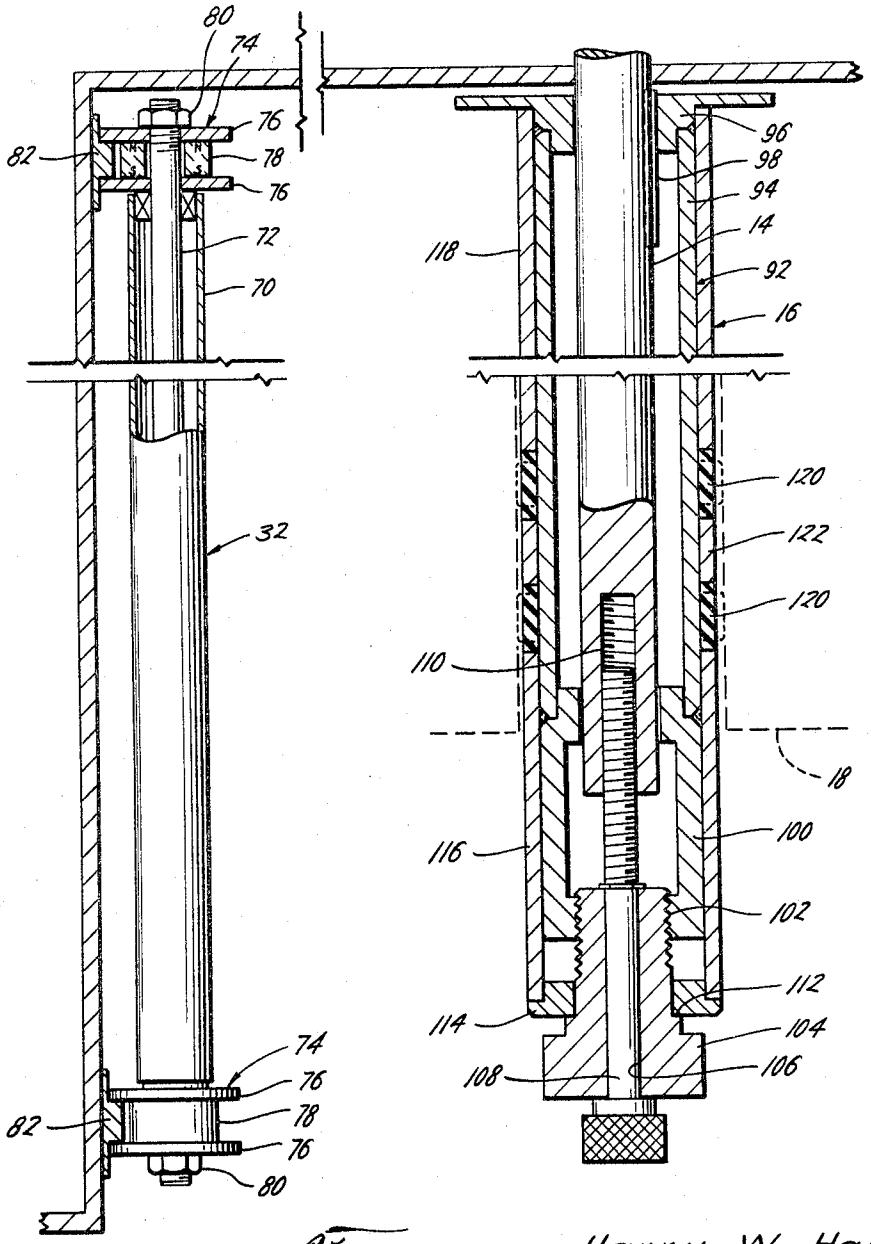

Fig. 3

Harry W. Harrison
INVENTOR.

BY Neil L. Conley
ATTORNEY

Aug. 23, 1966 H. W. HARRISON 3,267,822

PACKAGING APPARATUS

Original Filed June 28, 1963 5 Sheets-Sheet 3

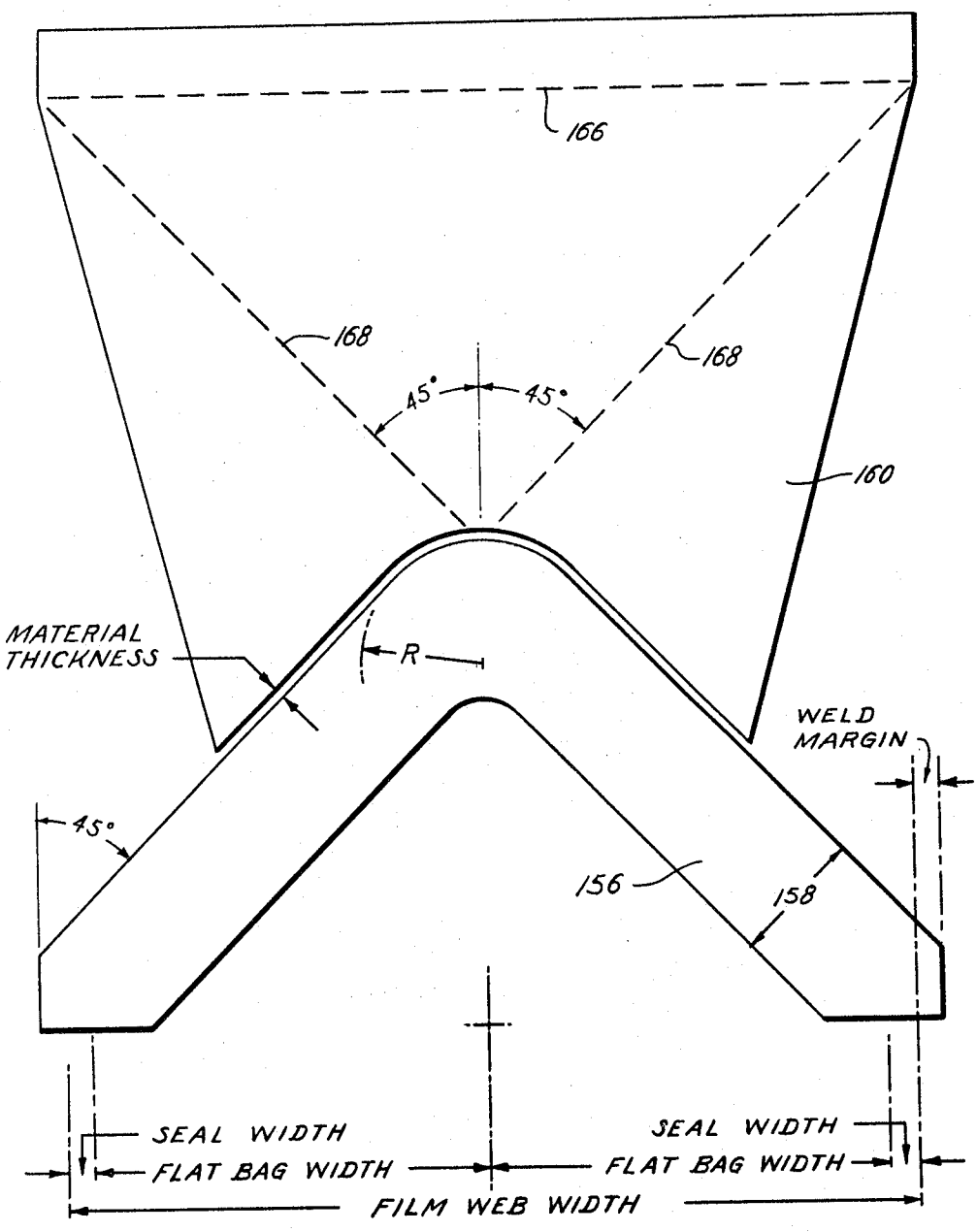

Fig. 4

Harry W. Harrison
INVENTOR.

BY Neal L. Conley
ATTORNEY

Aug. 23, 1966 H. W. HARRISON 3,267,822

PACKAGING APPARATUS

Original Filed June 28, 1963 5 Sheets-Sheet 4

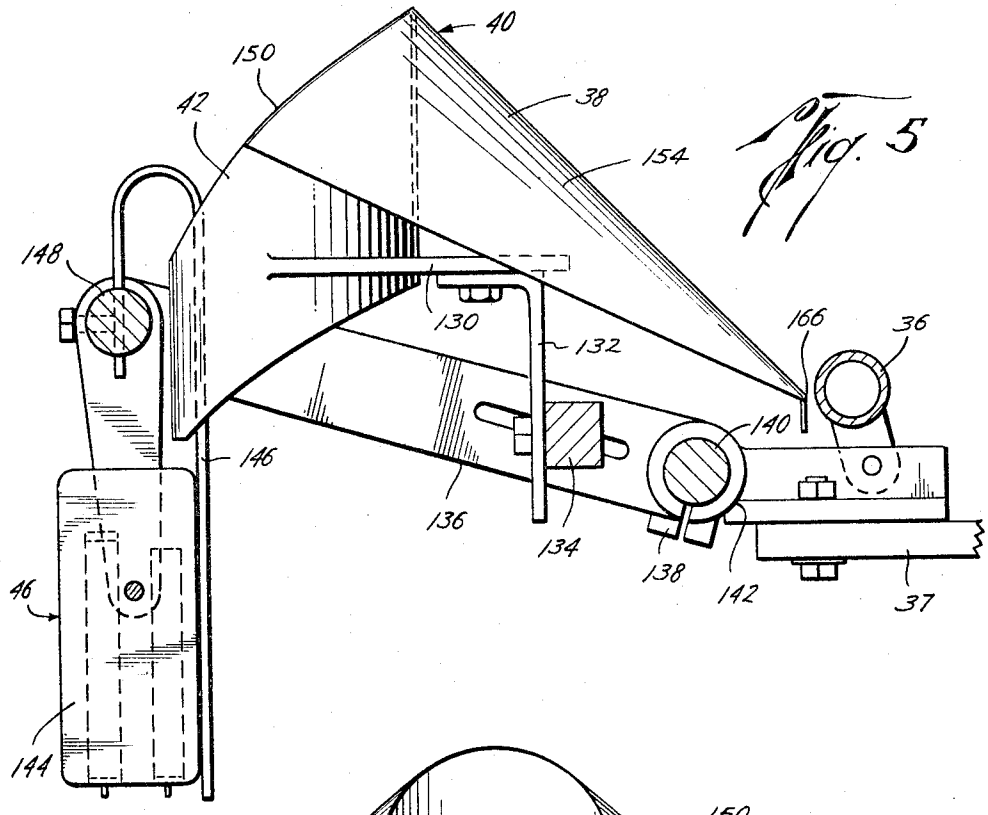

Fig. 5

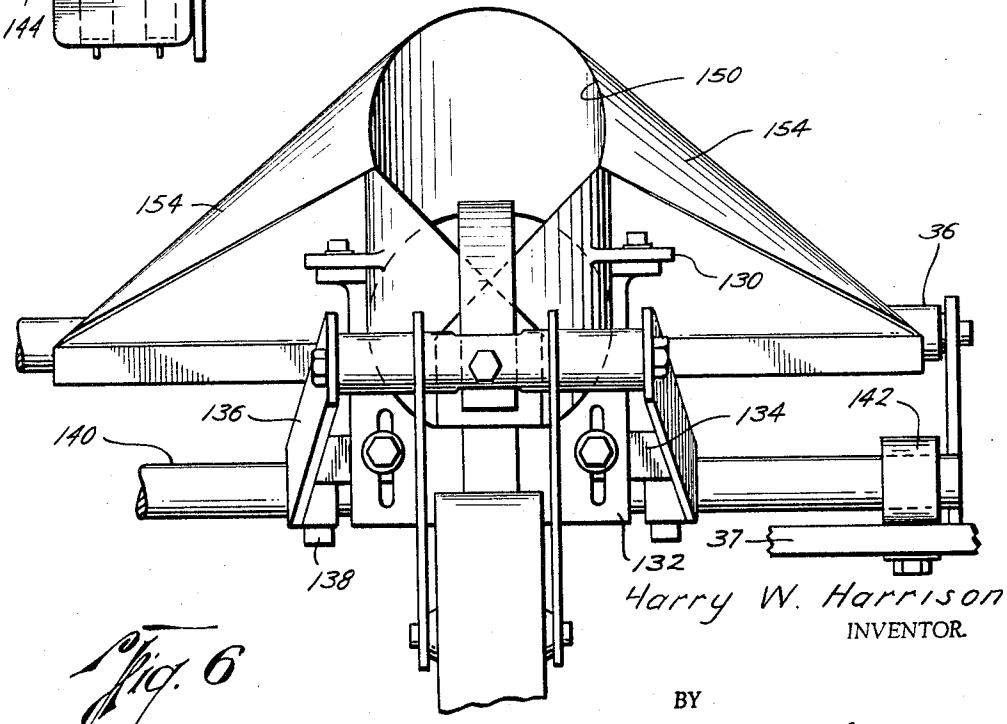

Fig. 6

Harry W. Harrison
INVENTOR.

BY

Neal L. Conley
ATTORNEY

Aug. 23, 1966 H. W. HARRISON 3,267,822

PACKAGING APPARATUS

Original Filed June 28, 1963 5 Sheets-Sheet 5

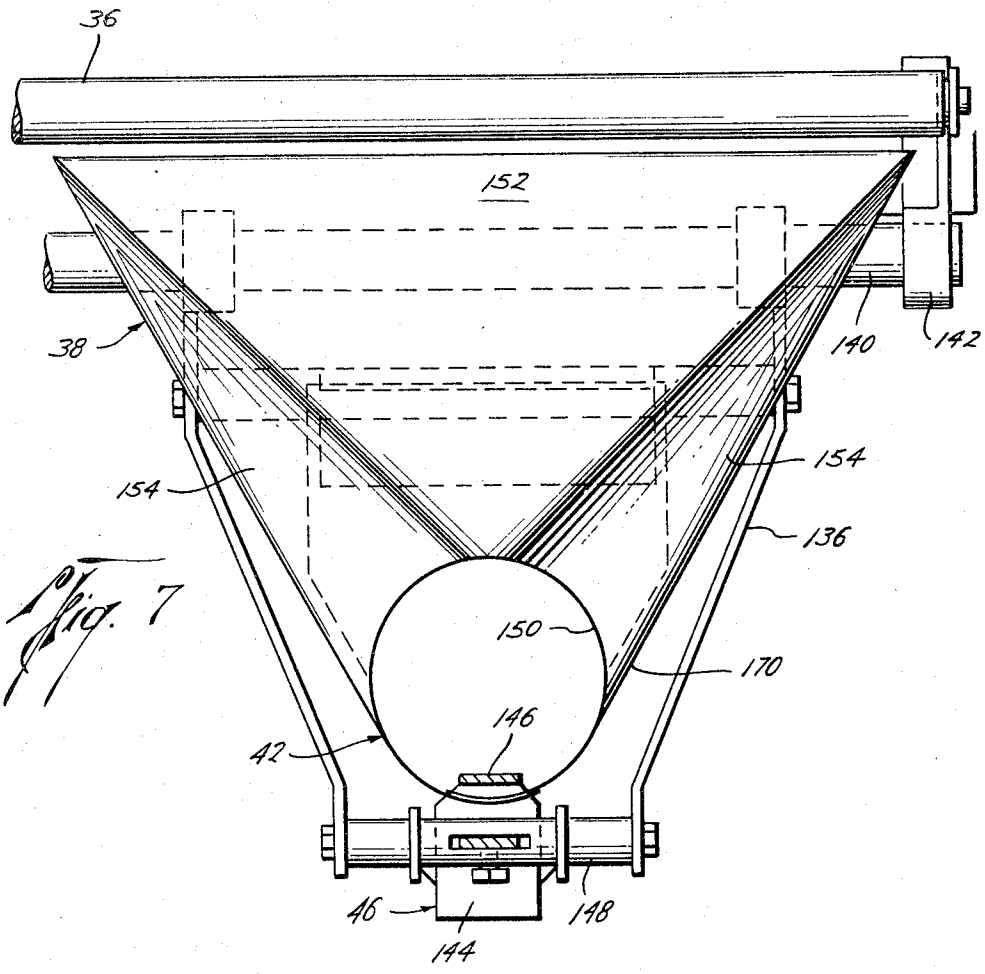

Fig. 7

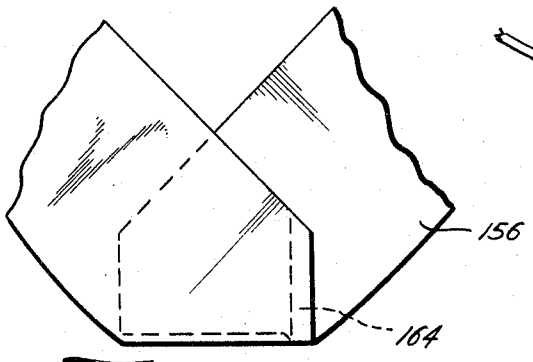

Fig. 9

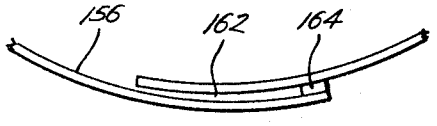

Fig. 8

Harry W. Harrison
INVENTOR.

BY

Wm. L. Conley
ATTORNEY

United States Patent Office 3,267,822 Patented August 23, 1966

3,267,822

PACKAGING APPARATUS

Harry W. Harrison, 2510 Broad St., Houston, Tex.

Original application June 28, 1963, Ser. No. 291,539. Divided and this application Sept. 30, 1963, Ser. No. 312,774

7 Claims. (Cl. 93—82)

This invention relates to package making apparatus, and more particularly it relates to substantially automatic equipment by which bags are formed from a heat sealable web material such as polyethylene sheet material, wax paper and the like. This application is a division of my copending application Serial No. 291,539, filed June 28, 1963.

Packaging apparatus by which a continuous web of sheet material is shaped into tubular form and a plurality of packages are formed from this tubular material are well known. One example of such apparatus is shown in the patent to Zwoyer, U.S. Patent No. 1,986,422, issued January 1, 1935.

In such prior art apparatus the web material is fed from a web supply roll through some sort of tensioning device such as a festooner, and thence over a former where the flat sheet material is formed into an elongated vertically disposed tube in which the longitudinal edges of the strip material overlap. Means are there provided for sealing the overlapping longitudinal edges together, and a pair of jaws is provided for clamping the tube below the former and sealing the tube transversely of the longitudinal seal. These jaws are provided with means for severing the packaging material intermediate the transverse seal. During the forming of the transverse seal the jaws move downwardly away from the former so as to pull more of the web material over the former. During such downward movement the product is dropped into the tube. When the jaws reach the bottom of their stroke the package therebelow is severed and the jaws release the tube and move upwardly to grip it again above the level of the product therein. The cycle is then repeated.

In order to insure smooth, wrinkle free transformation of the flat web into a tube it is necessary that the web material be under a certain amount of tension. This tension must be rather accurately controlled however in order to avoid breaking the web material. The present invention provides means for accurate maintenance of a desired tension on the web material throughout the bag forming process. In the accomplishment of such control a novel former is utilized to obtain accurate transformation of the web with minimum tension on it. The novel structure of the former of this invention also greatly facilitates the initial threading of the web therethrough of the rethreading of the web in the event of a break during operation.

This invention also contemplates the provision of a packaging machine which is readily adaptable to the making of a plurality of packages of the same or different sizes at the same time or at different times. The means for controlling the tension on the web further comprises a festooner intermediate the supply roll and the former, and a power roll intermediate the festooner and the supply roll and further comprises apparatus for maintaining a constant torque on the supply roll.

Accordingly it is an object of this invention to provide novel packaging apparatus wherein a web material is formed into substantially tubular packages for products.

Another object of the invention is to provide packaging apparatus wherein a high degree of control is maintained over the tension on the web being formed into packages.

Still another object of the invention is to provide novel packaging apparatus adapted to be utilized to form one

or a plurality of packages of the same or different sizes without any major changes in the apparatus.

Still another object of the apparatus is to greatly facilitate the threading of the web into a packaging machine and for decreasing the possibility of damage to the web during such threading or during operation of the packaging machine.

For a better understanding of these and other objects of the invention reference is now made to the accompanying drawing wherein

FIGURE 1 is an elevational view, partly in section, of a preferred embodiment of the invention, the section being taken along line 1—1 of FIGURE 2, and parts being shown in broken lines to facilitate understanding;

FIGURE 2 is a plan view of the embodiment of FIGURE 1, parts of which are shown in section;

FIGURE 3 is an enlarged horizontal sectional view of a portion of the embodiment shown in FIGURES 1 and 2, taken at line 3—3 of FIGURE 1;

FIGURE 4 shows the method of construction of a preferred embodiment of the former of this invention;

FIGURE 5 shows an enlarged elevational view of a preferred embodiment of the former of this invention;

FIGURE 6 is a front view of the embodiment of the former shown in FIGURE 5;

FIGURE 7 is a plan view of the embodiment of the former shown in FIGURES 5 and 6;

FIGURE 8 is a fragmentary view of the longitudinal seam forming portion of one embodiment of the former of this invention; and

FIGURE 9 is a fragmentary elevational view of the longitudinal seam forming portion shown in FIGURE 8.

Reference is now made to FIGURES 1 and 2 of the drawing for a detailed explanation of one embodiment of this invention. As shown, a housing **10** is provided with a pair of bearings **12** which rotatably mount a shaft **14** which in turn extends laterally outwardly from the housing and has mounted thereon a spindle **16** for carrying a web supply roll **18**. Below roll **18** another web supply roll **20** is mounted on a similar spindle **22** which in turn is mounted upon shaft bearings which are not shown. To make a bag having a double wall, web is fed from both supply rolls at the same time. However if it is desired to make only a single wall bag then only one web supply roll is used. The webs **24** and **26** is fed from the bottom of the supply rolls over a power roll **28** which has a friction surface **30**. The friction surface may be, for example, a rubber coating or other material having a high coefficient of friction with the web material. After passing over the power roll the web passes under a festooning roll **32**, and thence over a first idler roll **34** and a second idler roll **36** mounted on a plate **37** extending from the housing **10**. The second idler roll is closely adjacent to the back **38** of the former **40**, and the back **38** is substantially tangent to this roll. Thus the web passes along the surface of the back **38** of the former and down through the tubular portion **42** of the former to form a tube extending vertically below the former. As it passes from the former the tube **44** is engaged by heat sealing means **46** which may be of a type well known in the art for providing a longitudinal seal on the overlapped edges of the web material. The tube **44** is then engaged by a pair of jaws **48** which contain means for effecting a transverse seal across the tube and also means for cutting off the tube intermediate the transverse seal to form a closed bag **50**. Such jaws are well known in the art, so no detailed description is necessary here. As the jaws engage the bag they begin to move downwardly to the position shown in broken lines, whereupon the transverse cut is made and then the jaws release and are moved back up to reengage the tube.

A motor 52 within the housing provides power to the power roll 28 through a belt 54, and to the supply roll 18 through a belt 56. Motor 52 is preferably of the variable speed type, having a speed range from zero up to its maximum speed so that the velocity of the power roll may be set to exactly the correct speed of feed required for the web. The belt 54 engages an overrunning clutch 58 of a type well known in the art, so that when the motor 52 is running the power roll 28 is driven through the clutch 58, but when the motor is not running the power roll is left free to turn. The belt 56 driven from the clutch 58 engages a slip coupling 60. Slip coupling 60 may, for example, comprise a fluid clutch. In the embodiment shown, the belt 56 engages the housing 62 of the slip coupling and causes the housing to rotate. The housing is free to rotate with respect to shaft 14 extending therethrough. A plurality of vanes 64 are attached to the inside of the housing and these engage a liquid or a finely divided solid within the housing, which in turn engages an impeller 66 carried in the housing. Impeller 66 is attached to shaft 14 so that rotation of the housing causes rotation of the impeller which thereby causes the shaft 14 to rotate.

It will be noted in FIGURE 1 that rotation of the power shaft 28 in a counterclockwise direction to feed web off the supply rolls causes the web supply rolls to turn in a clockwise direction. However the slip coupling and other drive mechanism exerts a force on the web supply rolls tending to turn them in the same direction as the power roll so that there is a tendency for the force applied to the web supply rolls to rewind the web onto these rolls. Since the frictional surface on the power roll is engaged with the web it insures a positive unwinding of the web off the supply rolls in opposition to the torque supplied to the supply rolls through the slip coupling. It will be noted that supply roll 20 is driven from the slip coupling 60 by means of a belt 68 which drives another slip coupling (not shown) mounted on the shaft of spindle 22.

The festooning roll 32, as more clearly shown in FIGURE 3, comprises a tube 70 which is rotatably mounted on a shaft 72. Each end of the shaft 72 has mounted thereon a wheel 74. Each wheel 74 comprises a pair of discs 76, and a tubular permanent magnet 78 is held between each pair of discs. A nut 80 at each end engages the wheels to hold the assembly together. Each wheel rides on a track 82 mounted vertically on the housing, the tracks 82 being made of a ferromagnetic material so that the permanent magnets 78 retain the wheels 74 in engagement therewith at any position of the festooning roll.

Looking back at FIGURE 1 again it will be seen that near the lower end of the tracks 82 a shelf 84 is provided as a lower limit for the festooning roll. Just above the shelf 84 a limit switch 86 is attached to the housing and has a finger 88 extending therefrom adapted to be engaged by one of the wheels 74 when the festooning roll is almost at the lower limit of its movement. The switch 86 is in the circuit formed by electrical conduits 90, which provide electrical power to the motor 52 used to drive the power roll, and provide the reverse torque for the web supply rolls.

FIGURE 3 shows in section a preferred embodiment of the spindle 16. The spindle comprises a rigid body portion 92 which includes a tubular element 94 attached, as by welding, to a flanged member 96 which is keyed, as by means of a key 98, to the shaft 14. The other end of the tubular element 94 is attached to a centering element 100 which fits loosely around the outboard end of the shaft 14. The element 100 is provided with a female thread which is engaged by corresponding threads on a knob 104. The knob 104 has a longitudinal bore 106 through which a bolt 108 extends. The threads of the bolt 108 engage corresponding threads 110 formed in the end of the shaft 14. The knob 104 is provided with a shoulder 112 engaging a collar 114 which is fitted around the knob with a close slip fit. The collar 114 in turn engages a sleeve 116 which has a close sliding fit on the rigid body portion 92. A similar sleeve 118 abuts the flanged member 96. Intermediate the sleeves 116 and 118 a plurality of resilient expansible rings 120 surround the rigid body member 92 and are spaced apart by means of spacers 112. The expansible rings 120 may, for example, be made of soft synthetic or natural rubber.

It will be appreciated that the bolt 108 holds the spindle on the shaft 14 and by means of this bolt the longitudinal position of the spindle can be varied as desired. The outside diameter of the spindle is designed to fit loosely within the bore of a spool of web material to be placed thereon. Then by turning the knob 104 the sleeves 116 and 118 are made to move longitudinally toward each other to compress the expansible rings 120 so that these rings are caused to expand into engagement with the bore of the spool, thereby positively retaining the spool on the spindle, so that rotation of the spindle will cause rotation of the spool.

The operation of the apparatus of this invention should be apparent from the foregoing description. The friction surface 30 of the power roll 28 produces a force on the web sufficient to overcome the force transmitted to the supply roll through the slip coupling 60, so that the rotation of the power roll causes web to be fed from the two web supply rolls 18 and 20. This web is fed downwardly under the festooning rool 32 and then up over the idler rolls 34 and 36 to the former 40. It will be apparent that when no web material is being pulled through the former there will be no movement of the web between the festooning roll and the former. Thus during this period, while the web is being continuously fed to the festooning roll, the festooning roll moves vertically downwardly toward the shelf 84 and the finger 88 of limit switch 86. However, the engagement of jaws 48 with the tube 44 formed in the former causes a downward movement of this tube which pulls the web material through the former. This motion causes the festooning roll to move vertically upwardly. The speed of the motor 52 is adjusted so that the power roll speed is such that for a given velocity of reciprocation of the jaws 48 the festooning roll oscillates over a relatively narrow vertical range on the tracks 82. If, however, the speed of the power roll is a little too great so that the festooning roll is gradually lowered to the shelf 84, the contact of this roll with the finger 88 of limit switch 86 shuts off the current to the motor 52 so that the power roll ceases to feed web to the festooning roll. Then upon the next stroke of the jaws 48 the festooning roll is lifted upwardly, and the switch 86 is released so that the motor 52 again starts running and the apparatus operates as before.

In the embodiment of the invention heretofore shown and described it is apparent that tension on the web between the festooning roll and the former 40 is a function of only the weight of the festooning roll. The novel magnetic track for the control of the path of movement of the festooning roll eliminates any possibility of difficulties which would be caused by variations in friction in any other type of apparatus for guiding the festooning roll. Thus the tension on the web between the festooning roll and the former is exact and unchanging under any conditions of operation. Similarly the torque applied to the supply roll is for any speed of the power roll, constant and unchanging, and is sufficient to insure no overrunning of the supply roll. Under any conditions of operation the entire length of the web between the supply roll and the former is maintained under a constant predetermined tension which insures that there can be no slack or sag in the web and that full engagement of the web on the power roll and on the former is obtained under all operations.

The tension on the tube 44 between the former and the jaws 48 is a function of both the weight of the festooning

roll and of the frictional resistance to movement resulting from the passage of the web over the former. Thus the configuration of the former is an important consideration in the regulation of tensions applied to the web.

According to the present invention a former is provided which achieves maximum guiding of the web with minimum contact, and therefore minimum friction, between the web and the former. Such a former is illustrated by the embodiment depicted in FIGURES 4–9, inclusive. Thus the tubular portion **42** of the former and the back **38** are both secured to a plate **130**, which in turn is bolted to an angle frame **132**. Frame **132** is adjustably attached to a crossbar **134** of a tube former support frame **136**, which is pivotally mounted, by means of clamps **138**, on a former supporting shaft **140**. The shaft **140** is attached, by means of brackets **142**, to the plate or shelf **37**.

The outer end of the former support frame **136** supports the heat sealing means **46**, which may for example comprise a heater and thermostat unit **144** positioned to engage the outside of the longitudinal seam formed in the former, and a backup strip **146**. The backup strip is U-shaped, having one leg clamped in a crossbar **148** on the frame **136**, and the other leg extending into the tubular portion **42** to a position opposite the heater and thermostat unit. The heater and thermostat unit **144** preferably is pivotally supported from the crossbar **148** so that it may be swung out of the way when the web is being threaded through the former.

It has heretofore been pointed out that the former comprises a back portion **38** and a tubular portion **42**. It will be apparent from the embodiment shown in the drawings that the back portion is utilized to provide support for the web during its transformation from a flat sheet to a curved sheet, and that the line of juncture **150** between the back portion and the tubular portion serves to complete the transformation into a tubular member. The back portion **38** comprises a planar central section **152** and two curved wing sections **154**. The central back portion **152**, in the embodiment shown, is substantially triangular in shape, having its base adjacent the idler roll **36** and its apex substantially at the center of the line of juncture **150**, and extends at an acute angle, preferably about 45 degrees, with respect to the axis of the tubular portion. Each wing section has a first side corresponding to the adjoining side of the central section, and a second side which is in a plane substantially tangent to the tubular portion **42**. The first and second sides intersect at the end of the base of the central section, and the third side of each wing section coincides with the line of juncture between the back portion and the tubular portion of the former.

FIGURE 4 portrays a preferred method for making the embodiment of the former shown in FIGURES 5–9. As shown, the former may be made from a single flat sheet, preferably stainless steel of about 20 gage thickness, having a width slightly greater (¼ in. to ½ in.) than the width of the film web to be formed. The chevron-shaped portion **156**, which is to be formed into the tubular portion **42**, is laid out first, providing, as shown, sufficient overlap at the edges for a seam and a weld margin. The minimum width **158** of this portion is determined principally by structural considerations, but should be kept as low as possible, and usually is no more than about two inches. The radius R at the apex of the Chevron is determined by the formula $R=W/\pi$, where W is the final bag width desired. As shown, a gap is left between the chevron-shaped portion **156** and the portion **160** for forming the back, this gap being equal to the thickness of the sheet material being used.

After the two portions **156** and **160** are cut out, the chevron-shaped member is rolled into a generally cylindrical form, but with the ends overlapped as shown in FIGURES 8 and 9, by an amount equal to the seal widths plus the weld margin, and spaced apart to form the passageway **162** therebetween, and then welded together as at **164**. When so formed, the tubular portion has substantially parallel oblique ends, thereby affording ample guiding of the tube formed therein throughout its circumference without the use of excess material which would unnecessarily increase the frictional area and unnecessarily complicate the threading of the web through the former.

One edge of the portion **160** is then bent down along the line **166** which forms the base of the triangular planar central section **152** of the back portion. The wing portions **154** are then rolled, beginning at lines **168**, to conform to the curvature of the upper edge of the tubular portion, and then are joined by welding to the tubular portion along the line of juncture **150**, with the apex of the flat central portion at the highest point on the tubular portion.

It has heretofore beeen shown that in the transformation of a flat sheet to a tube, it is desirable to provide support for the sheet material at all bending points in order to equalize the stresses applied during bending and therefore avoid overstressing at one point so as to cause tearing of the sheet material. Thus it has heretofore been thought necessary to provide support for the web throughout this transformation process. However, it has now been found that through a portion of the process no bending stresses are exerted on the web, but only straight tensile stresses. Thus during this particular portion of the process it is not necessary to provide support for the web. This portion is between the line on each wing through which a plane tangent to the tubular portion passes, and the line of tangency of this plane to the tubular portion. This plane is necessarily parallel to the axis of the tubular portion, or vertical, in the embodiment shown. Thus in the plan view (FIGURE 7) this plane appears as a line **170** tangent to the tubular portion **42**.

By terminating the wing portions at the beginning of this plane of tangency, a substantial area of surface engaged by the web is omitted. Thus the force of friction exerted on the web is greatly decreased, with, as heretofore shown, no decrease in the desirable support of the web. It has been determined that this desirable extent of the wings is achieved when the line of juncture **150** extends approximately 240 degrees around the circumference of the tubular portion, however good results are obtained when the line of juncture has a length of from about 210 degrees to about 270 degrees.

The use of the chevron-shaped element **156** in the formation of the tubular portion also reduces the frictional area contacted by the web. Furthermore such form greatly facilitates the threading of the web into the former, since the height of this tubular portion is such that one can reach through it with the fingers from either the top or the bottom. The former of this invention may be threaded by merely stuffing the web into the top and pulling it out the bottom. The web automatically conforms to the tubular configuration with the longitudinal seal overlap.

An important feature of the packaging apparatus of this invention is its adaptability for use for making bags of different sizes. In the embodiment shown in the drawings, only a single former is used, so that the apparatus makes one package at a time. However, the mounting of the frame **136** supporting the former and the longitudinal seal apparatus is such that a plurality of formers of various sizes may be mounted on the apparatus, either singly or in groups, so as to adapt the apparatus to simultaneously make several bags of the same or different sizes. As an example, a machine may be made to handle a 24 inch wide web material, and can form a bag having a flat width of 12 inches (less the seam width). Alternatively, two frames mounting two formers of smaller size may be mounted side by side on shaft **140**, and the web may be split as it approaches the formers, so that two 6-inch bags are made. If four equal formers are used, four 3-inch bags can be made simultaneously. Furthermore, bag sizes can be mixed, so that, for example, a 2-inch, a 4-inch, and a

6-inch bag can be made at the same time. When more than one bag is made at a time, plural supply rolls may be used or a knife may be mounted on the apparatus to split the web material before it is fed to the formers. Because of the design of the formers and their supporting frames, they may be placed immediately adjacent each other on the shaft 140.

Such adaptability of the apparatus of this invention is made possible by the structure of the former and its support frame. Note that the width of the former is substantially equal to the width of the web being formed, and the frame mounting the former has a lateral width less than the width of the former. This frame is clamped to a shaft which extends the full width of the web supply roll, so that the frame is readily moved or replaced on the shaft. Furthermore, a single pair of jaws 48 comprising heat-sealing and cut-off means have a length such that they are engageable with any size bag or bags that may be formed.

The structural features heretofore described combine to make the apparatus of this invention an exceptionally trouble-free piece of equipment. Shock loading of the web material is virtually eliminated by the tension control features. Rethreading of the machine is greatly facilitated by the design and location of the supply roll, power roll, festooner, and former, and by the fact that these elements are readily accessible. Other features and advantages will be apparent to those skilled in the art. Furthermore many modifications within the scope of the present invention will occur to those skilled in the art upon considering the specific embodiments shown and described herein. Thus the invention is not limited to the specific embodiments but only as set forth by the following claims. It will be noted that the claims are in paragraph form to facilitate examination and study, however such form is not intended to be limiting in any manner, but the claims are to be construed as though such form were not used.

I claim:

1. A former for transforming sheet material into tubular form comprising
a flat central back portion,
curved wing portions, and
a tubular portion,
said central back portion extending at an acute angle with respect to the axis of said tubular portion,
said curved wing portions merging smoothly with said central back portion and intersecting the end of the tubular portion along a line of juncture extending around from about 210 degrees to about 270 degrees of the circumference of the tubular portion,
said tubular portion comprising a substantially chevron-shaped member rolled into tubular form with its ends overlapped and spaced-apart.

2. A former for transforming sheet material into tubular form comprising
a flat central back portion,
curved wing portions, and
a tubular portion,
said central back portion extending at an acute angle with respect to the axis of said tubular portion, and
said tubular portion comprising a substantially chevron-shaped member rolled into tubular form with its ends overlapped and spaced-apart.

3. A former for transforming sheet material into tubular form comprising
a flat central back portion,
curved wing portions, and
a tubular portion,
said tubular portion having substantially parallel oblique ends.

4. A former for transforming sheet material into tubular form comprising
a tubular portion having substantially parallel oblique ends,
a central back portion extending at an acute angle from the long side of one end, and
curved wing portions merged smoothly with said central back portion and engaging said one end along a line extending around from about 210 degrees to about 270 degrees of the circumference of the tubular portion.

5. A former as defined by claim 4 wherein said tubular portion is formed from a substantially chevron-shaped member rolled into substantially tubular form with its ends overlapped and spaced-apart.

6. A former for transforming sheet material into tubular form comprising
a tubular portion,
a flat central back portion extending at an acute angle from said tubular portion, and
curved wing portions merging smoothly with said back portion and joining the end of said tubular portion along a line of juncture terminating at each end substantially at a plane tangent to said tubular portion and substantially in alignment with the edge of one of said wings.

7. A former for transforming sheet material into tubular form comprising
a tubular portion,
a flat central back portion extending at an acute angle from said tubular portion, and
curved wing portions merging smoothly with said back portion and joining the end of said tubular portion
the width of the wings being such that each wing terminates substantially at a plane tangent to the tubular portion and the edge of the wing.

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FRANK E. BAILEY, *Primary Examiner.*

S. ABEND, *Assistant Examiner.*