Oct. 10, 1967 H. E. KASTING ET AL 3,345,919

CONTINUOUS BAG MAKING MACHINE

Filed Feb. 18, 1965 27 Sheets-Sheet 1

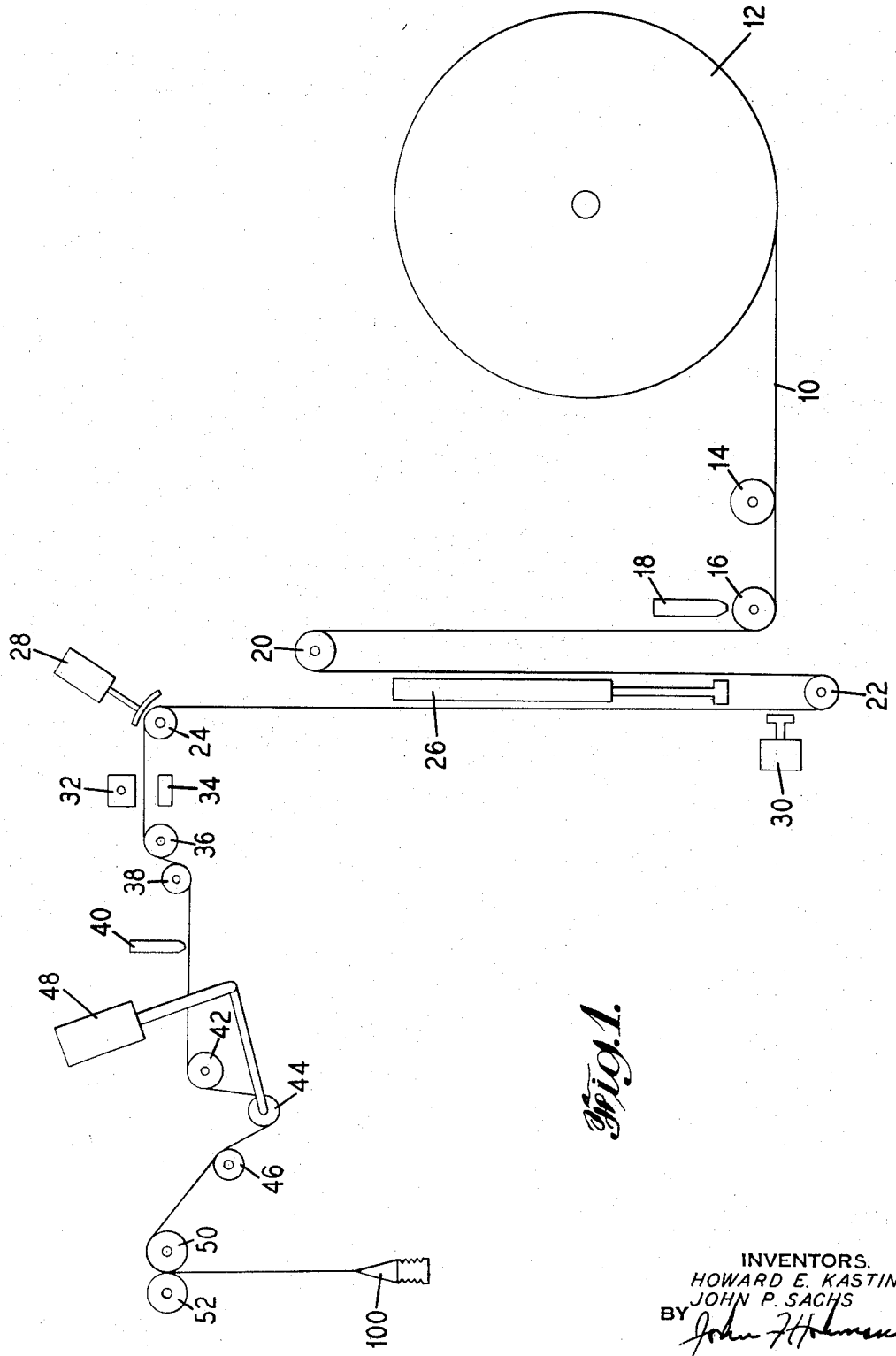

Fig. 1.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY John J. Holmes
ATTORNEY

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CONTINUOUS BAG MAKING MACHINE

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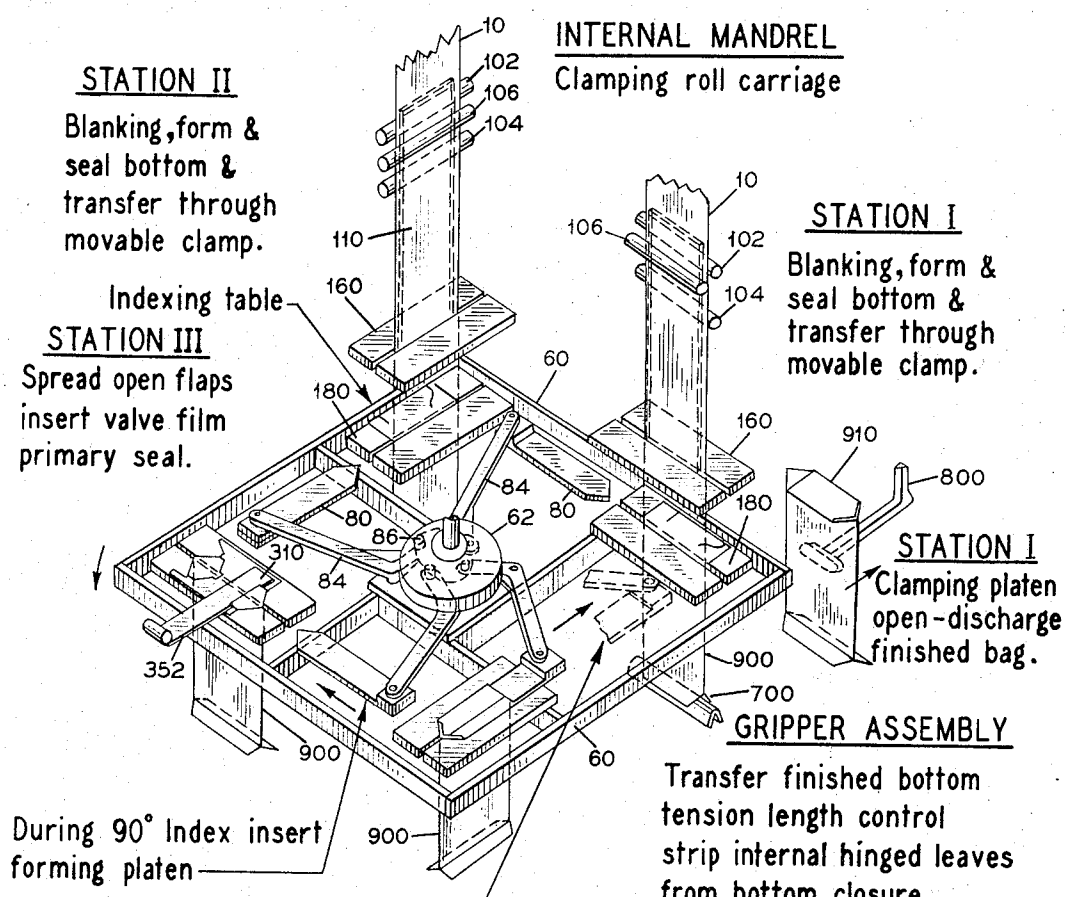
INTERNAL MANDREL
Clamping roll carriage



STATION IV

Foldover side
Flaps heat seal
Top closure.

Fig. 2.

INVENTORS.
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CONTINUOUS BAG MAKING MACHINE

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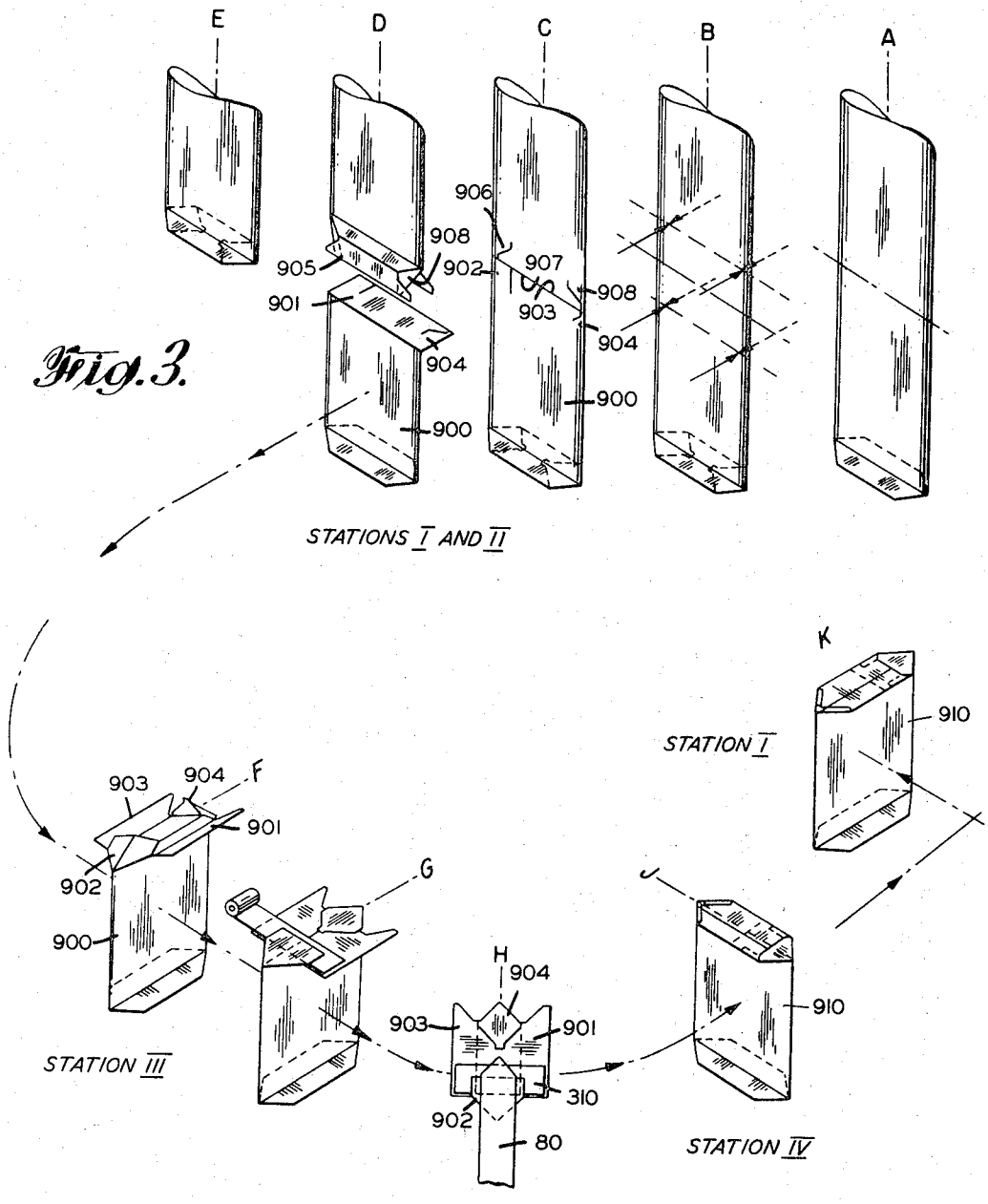
Fig. 3.



INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS

BY John F Holeman

ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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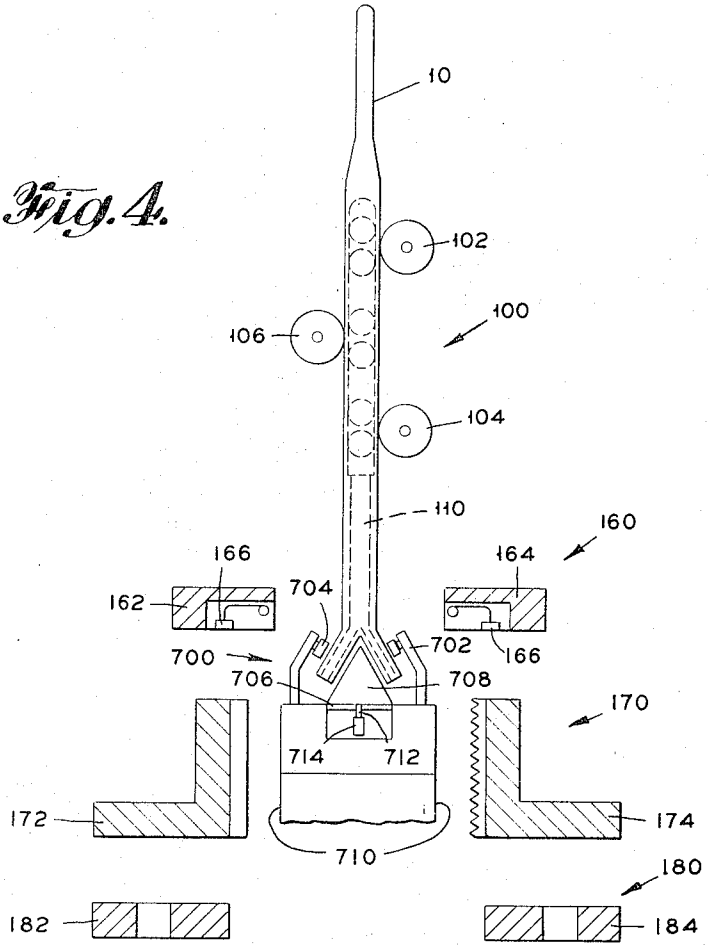
Fig. 4.



INVENTORS.
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JOHN P. SACHS
BY John F. Hohmann
ATTORNEY

Oct. 10, 1967 H. E. KASTING ET AL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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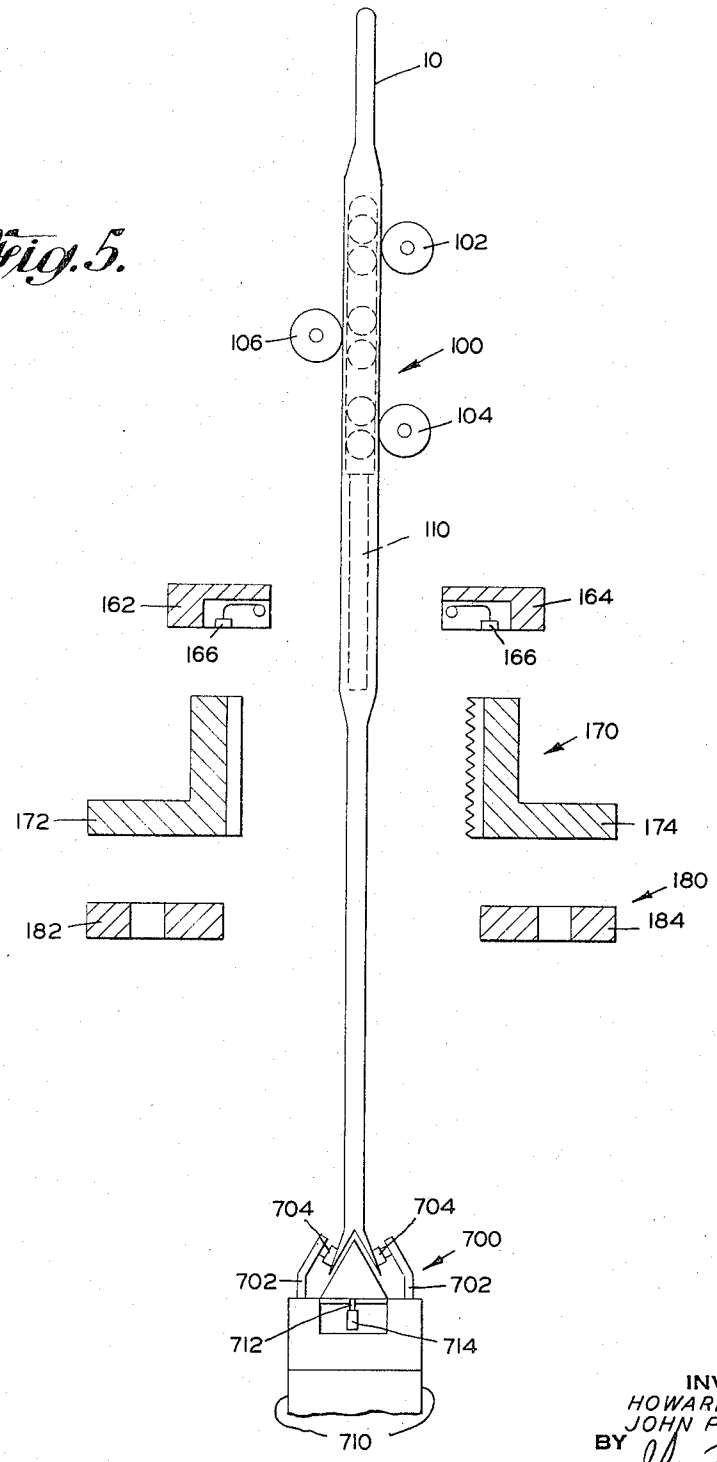
Fig. 5.



INVENTORS.
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Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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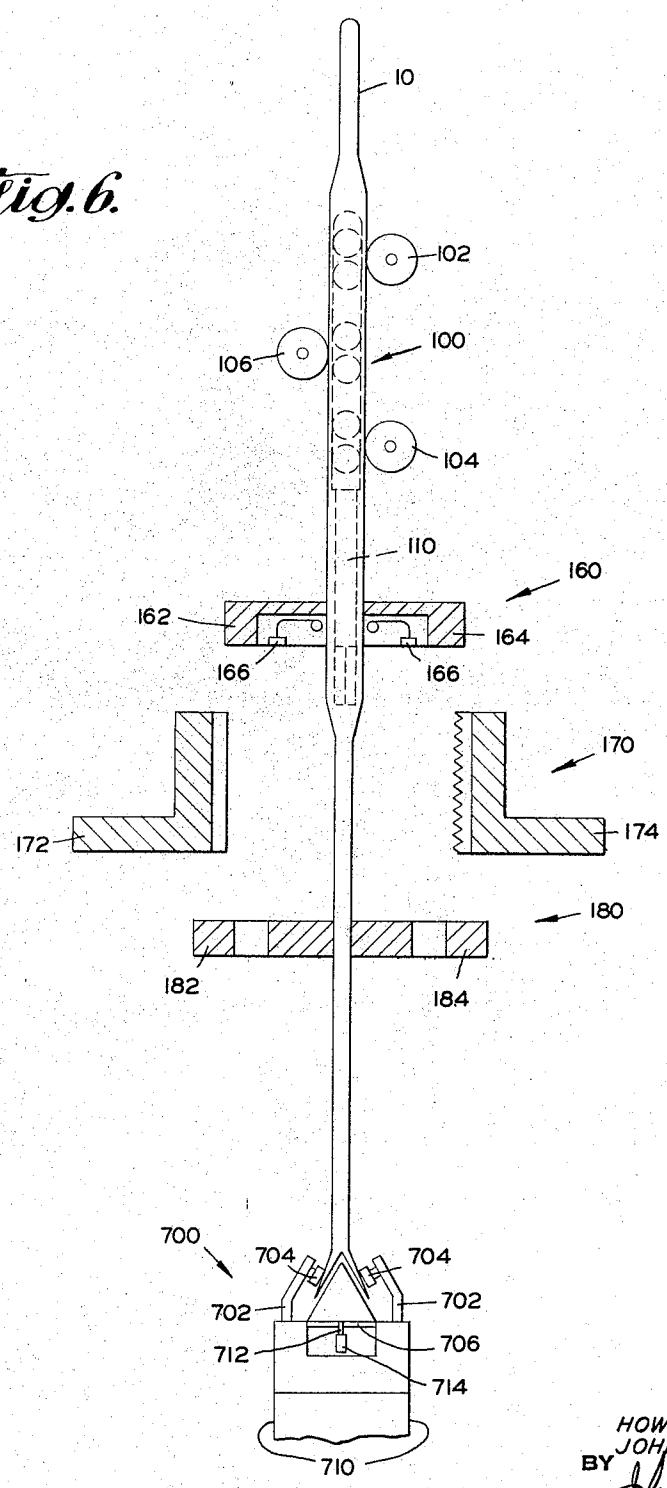
Fig. 6.



INVENTORS.
HOWARD E. KASTING
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CONTINUOUS BAG MAKING MACHINE

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Fig. 7.

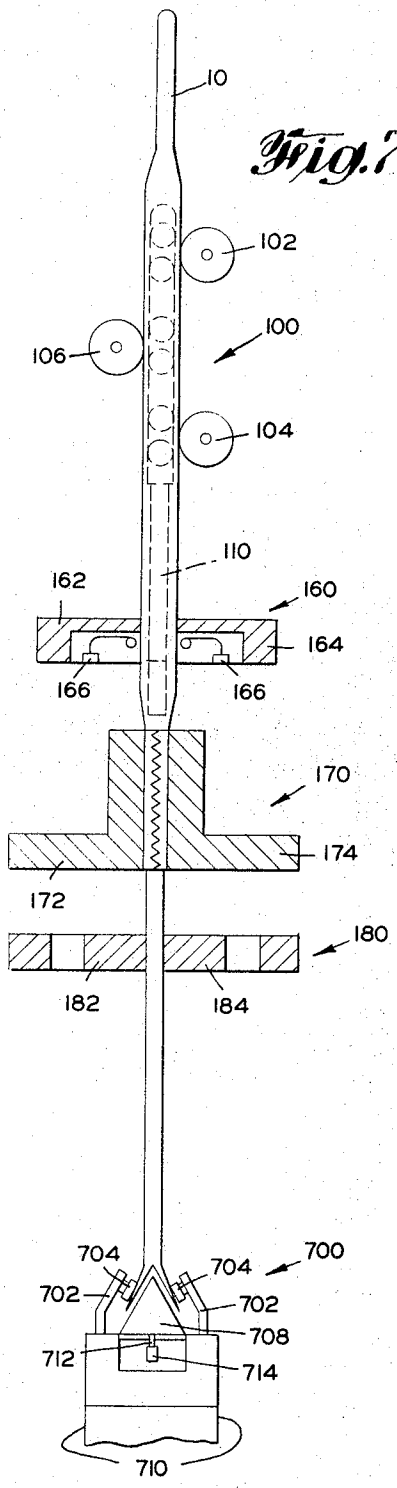
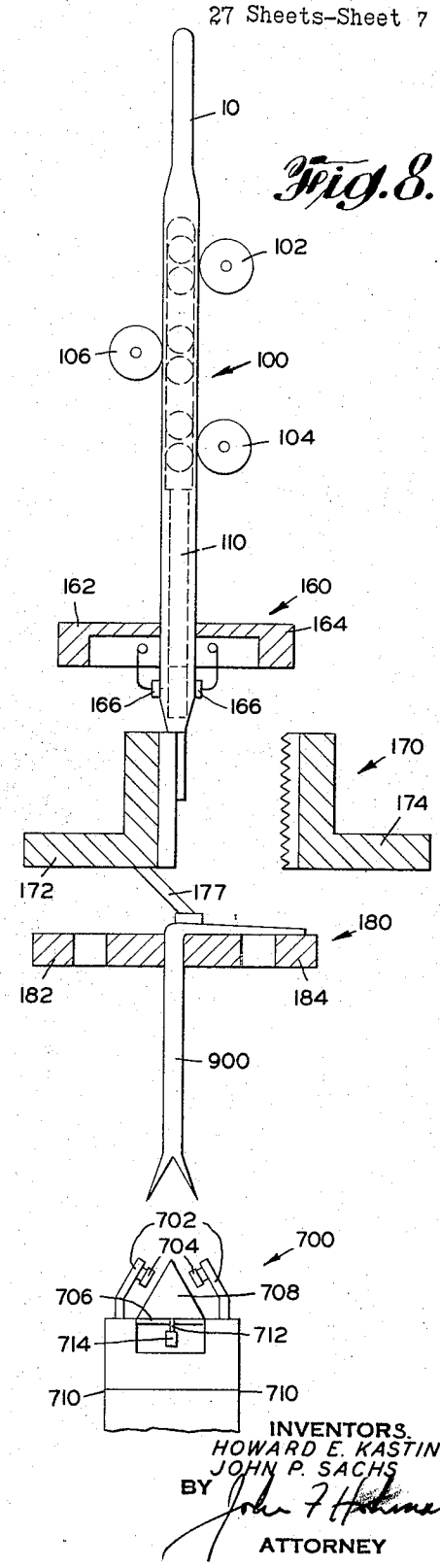


Fig. 8.



INVENTORS.
HOWARD E. KASTING
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CONTINUOUS BAG MAKING MACHINE

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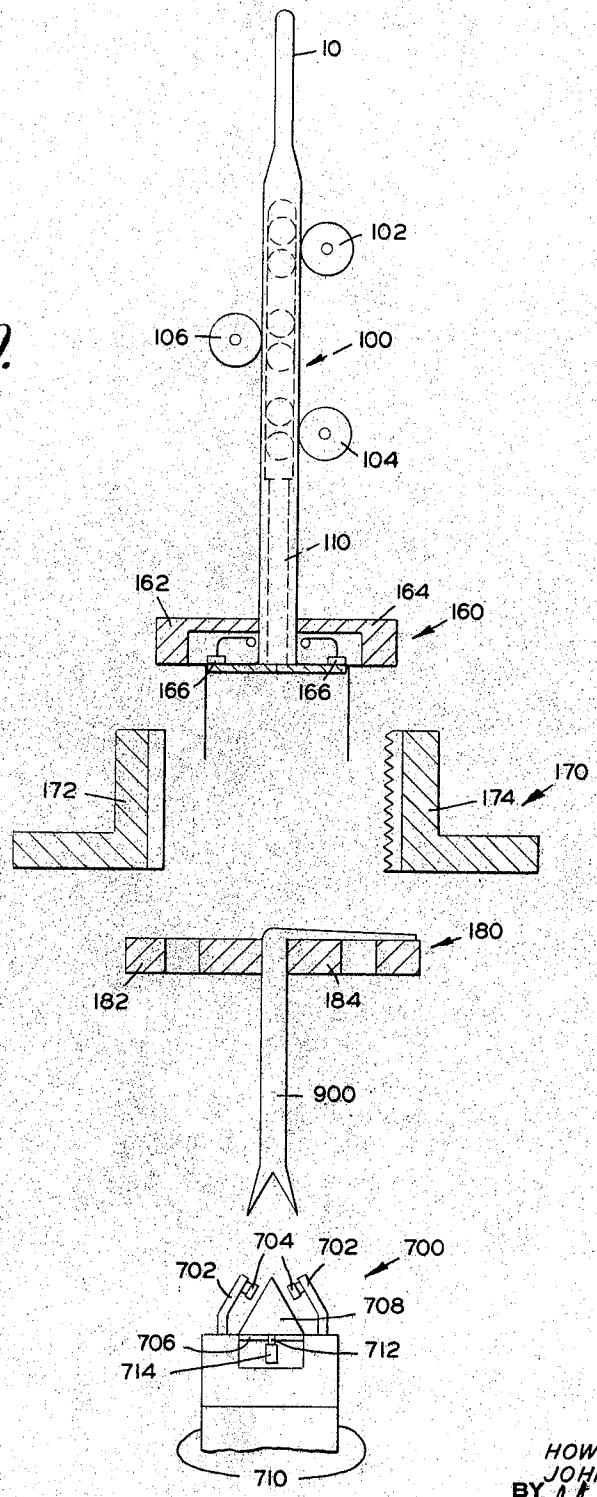
Fig. 9.



INVENTORS.
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Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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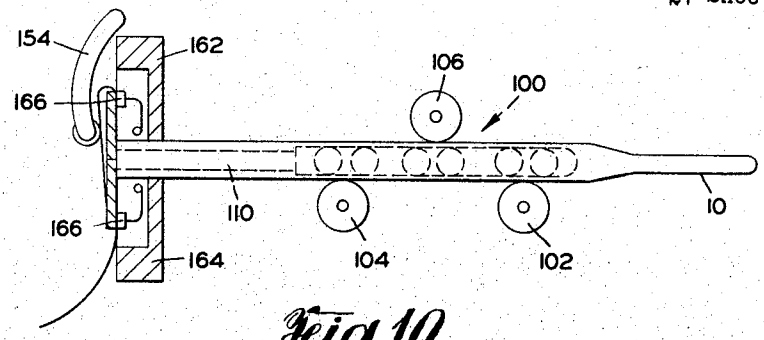

Fig. 10.

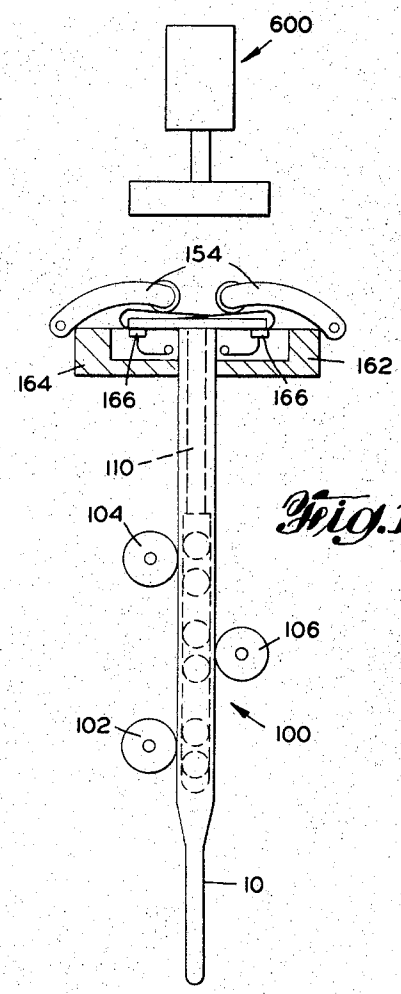

Fig. 11.

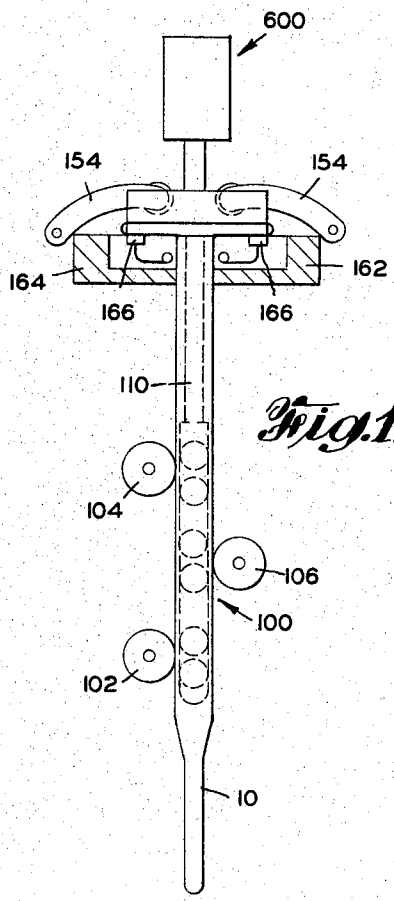

Fig. 12.

INVENTORS.
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CONTINUOUS BAG MAKING MACHINE

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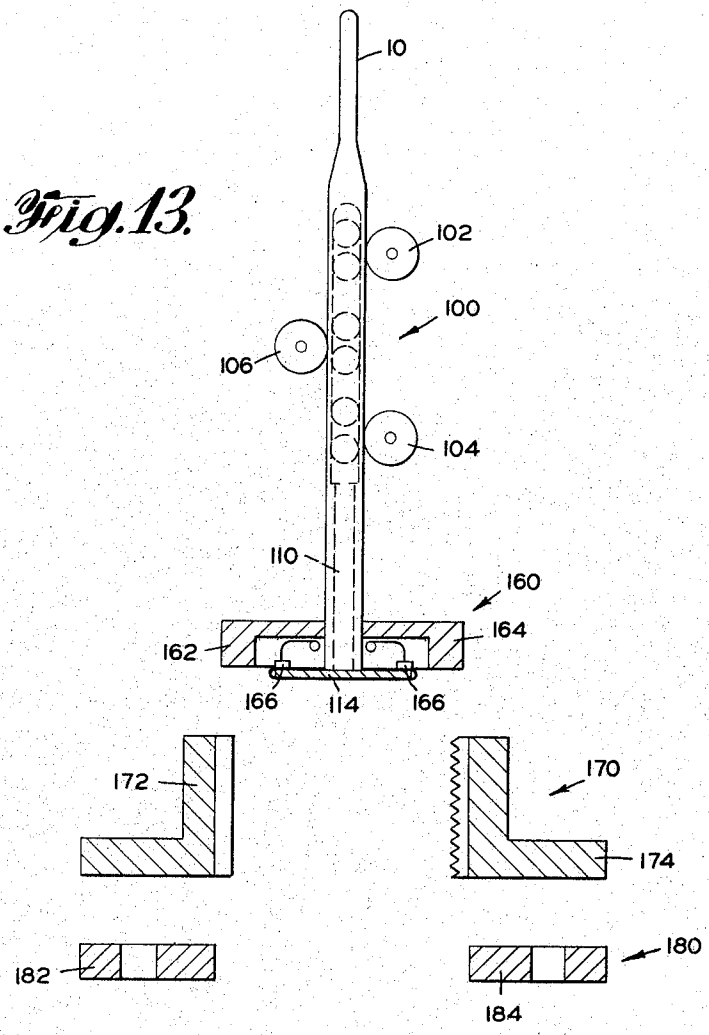
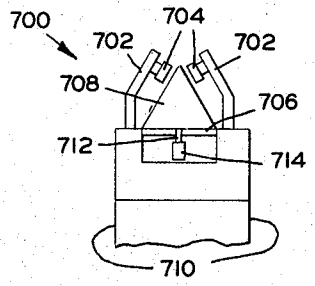
Fig. 13.





INVENTORS.
HOWARD E. KASTING
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CONTINUOUS BAG MAKING MACHINE

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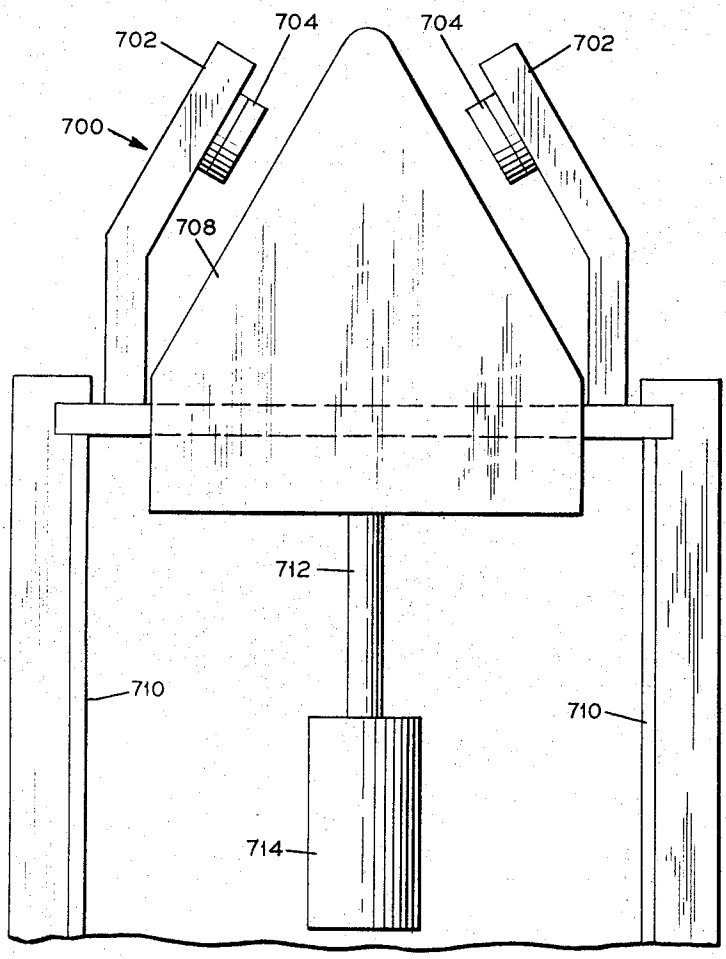

Fig. 14.

INVENTORS.
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CONTINUOUS BAG MAKING MACHINE

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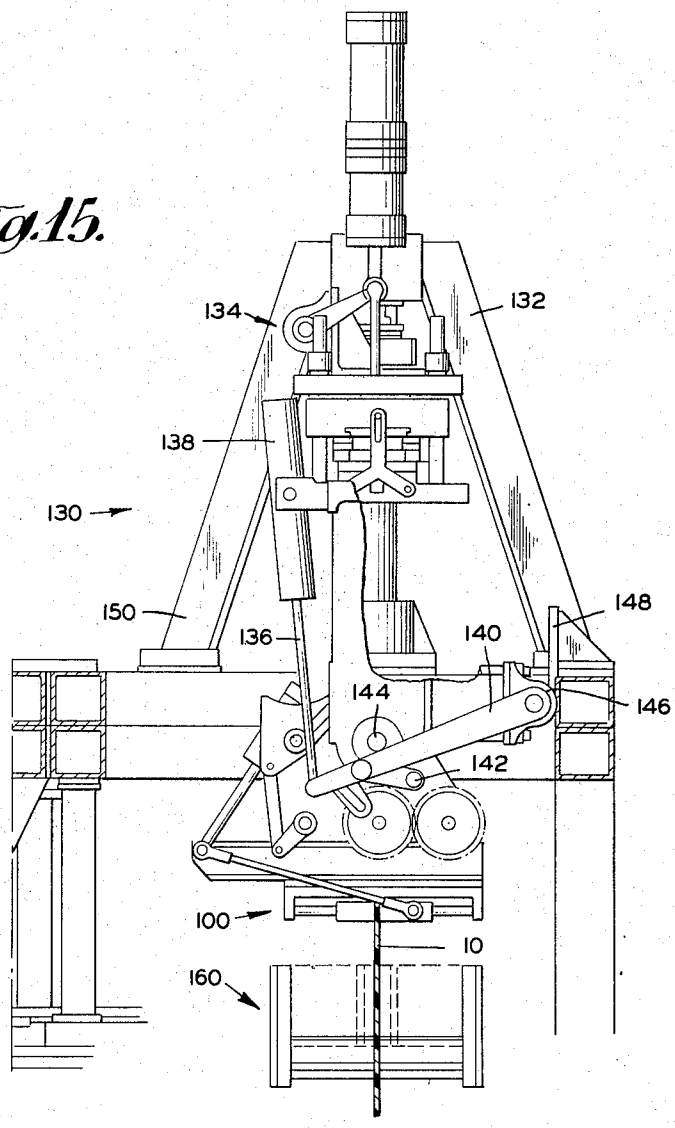
Fig. 15.



INVENTORS.
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JOHN P. SACHS
BY
ATTORNEY

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CONTINUOUS BAG MAKING MACHINE

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Fig. 16.

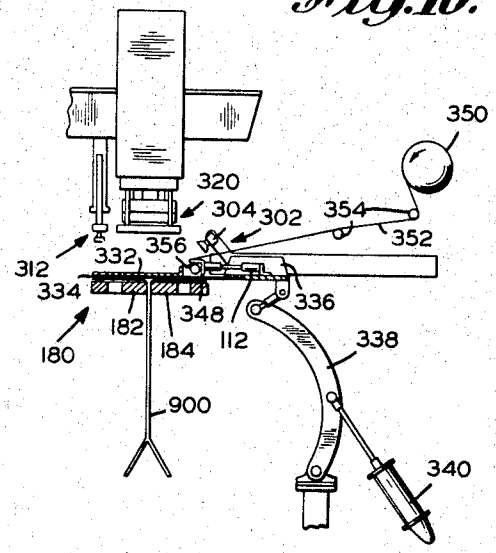


Fig. 17.

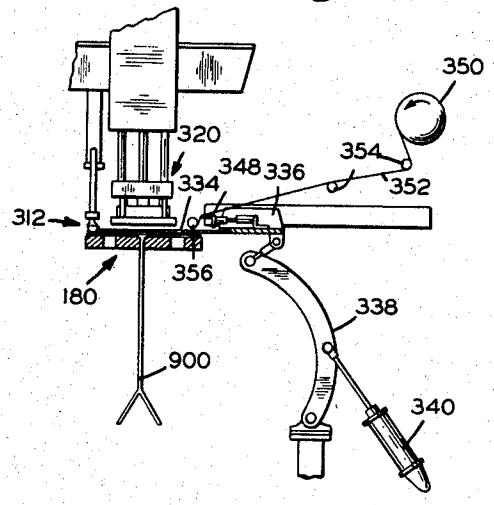
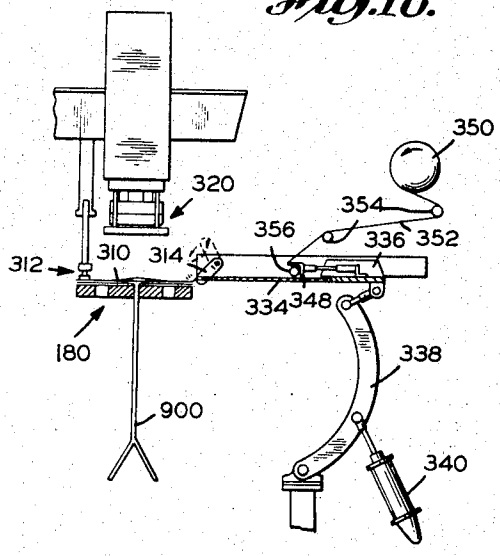


Fig. 18.



STATION III

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS

BY John J. Holcomb

ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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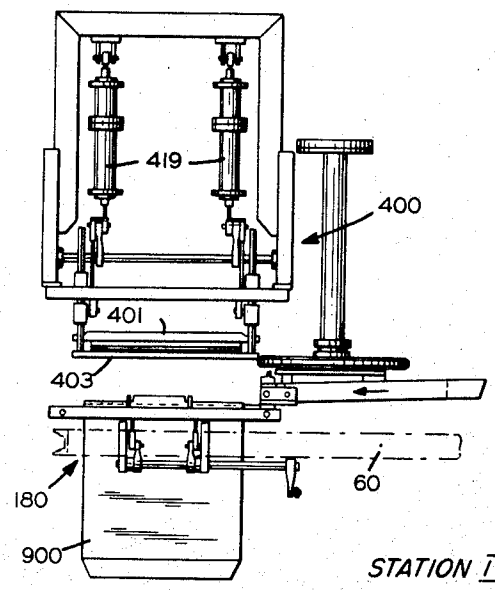
Fig. 19.



STATION IV

Fig. 20.

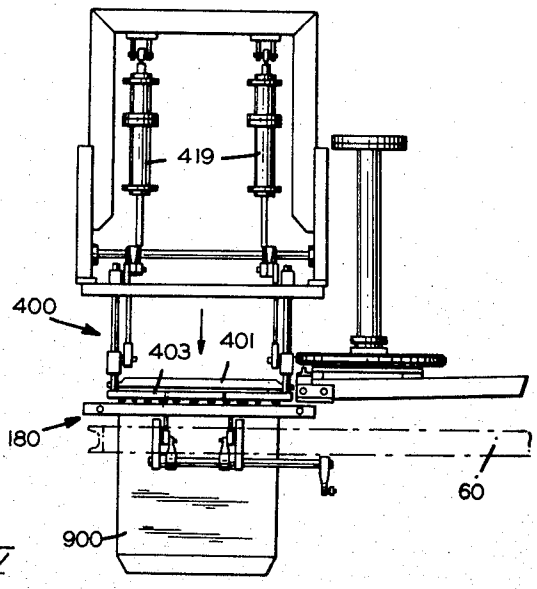
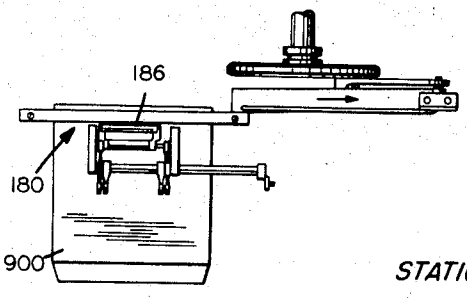
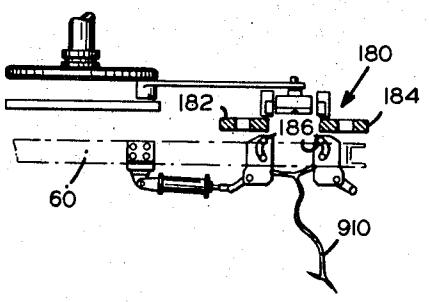


Fig. 21.



STATION IV

Fig. 22.



INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS

BY

ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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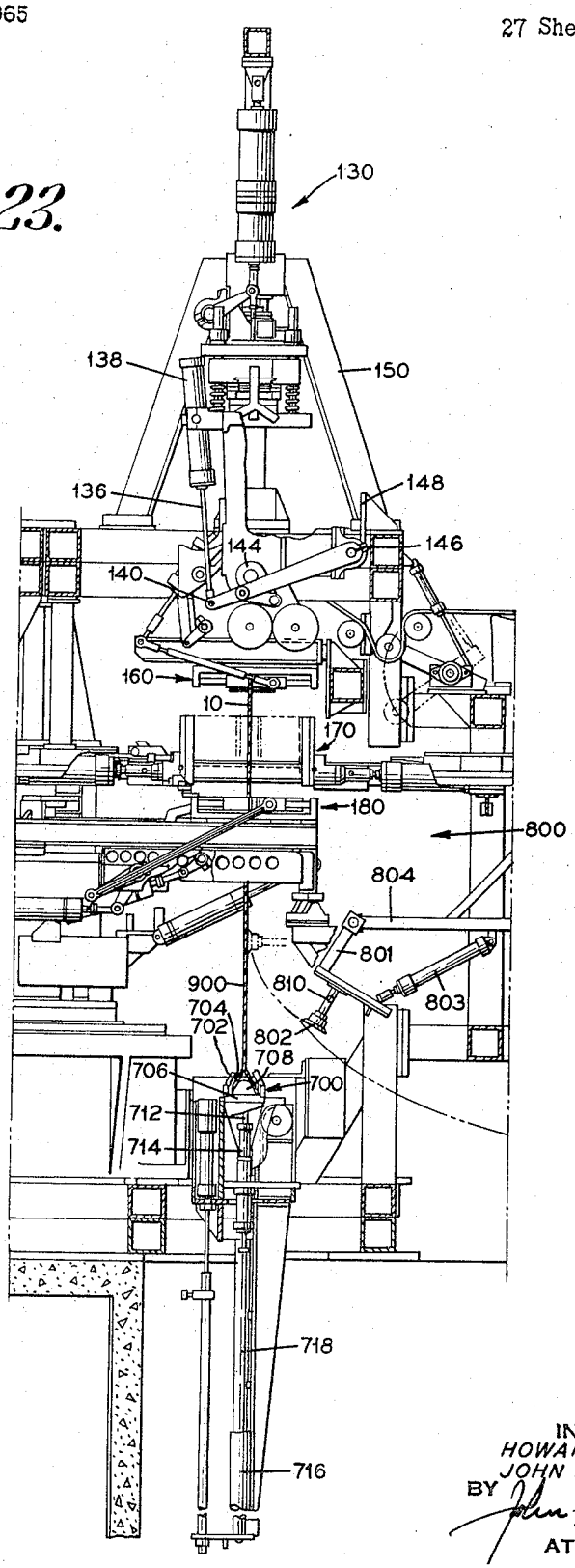
Fig. 23.



INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY John F. Holzwarth
ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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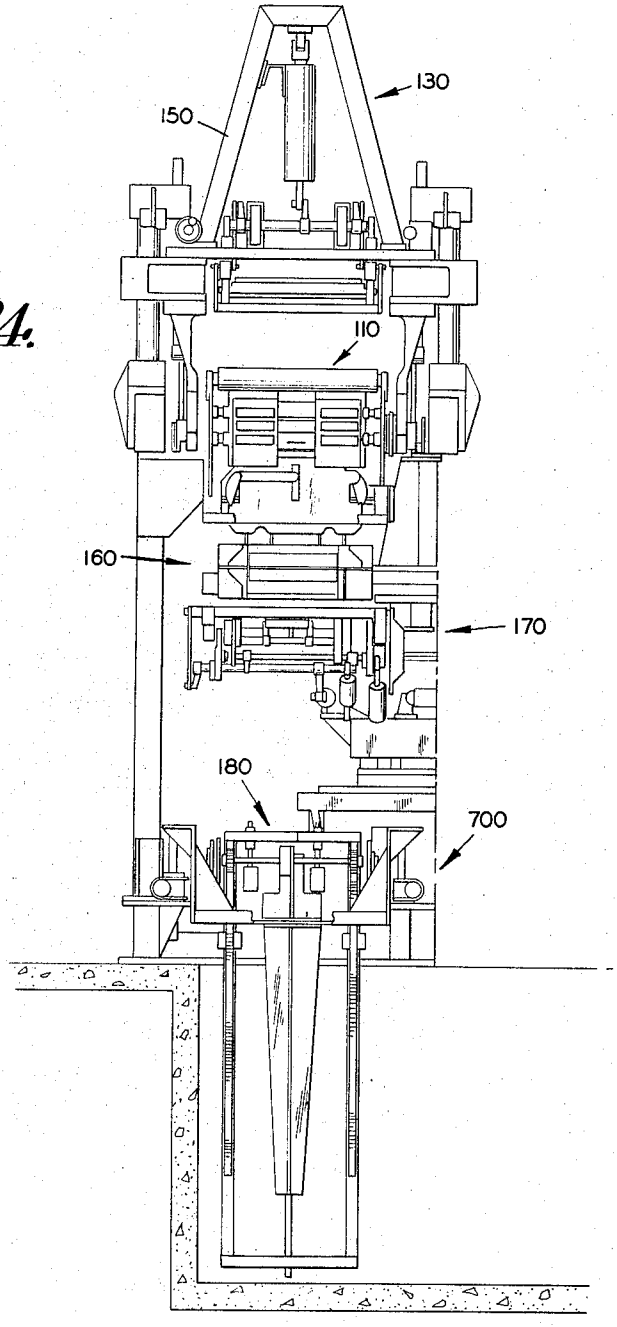
Fig. 24.



INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY John J. Hohmann
ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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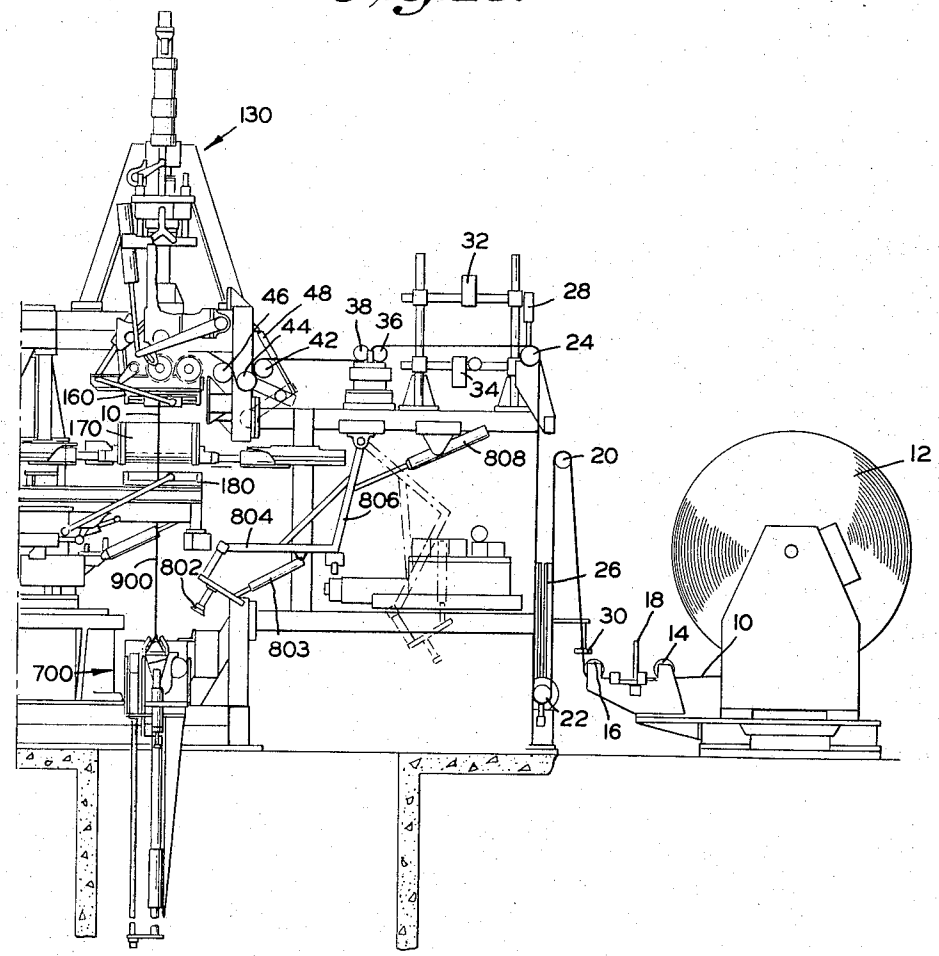
Fig. 25.



INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY John J. Hohmann
ATTORNEY

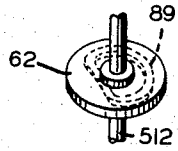


Fig. 26.

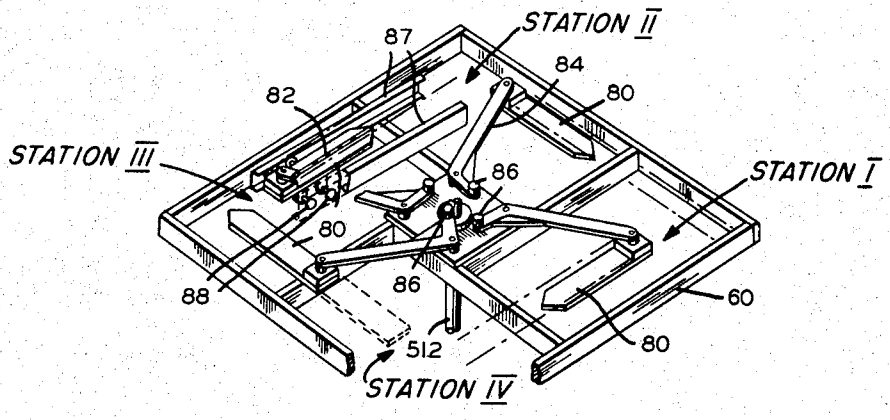


Fig. 27.

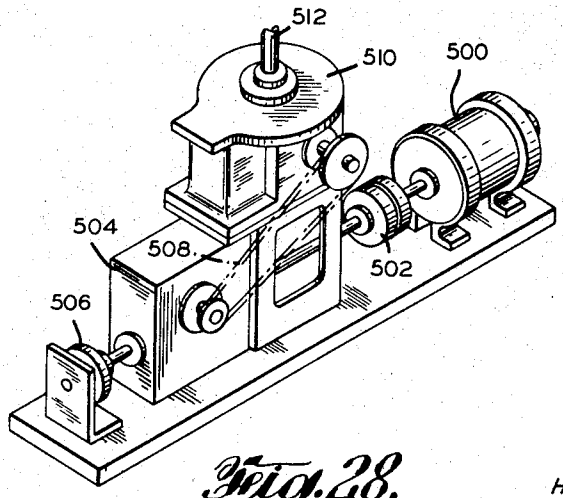


Fig. 28.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
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Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

Filed Feb. 18, 1965 27 Sheets-Sheet 19

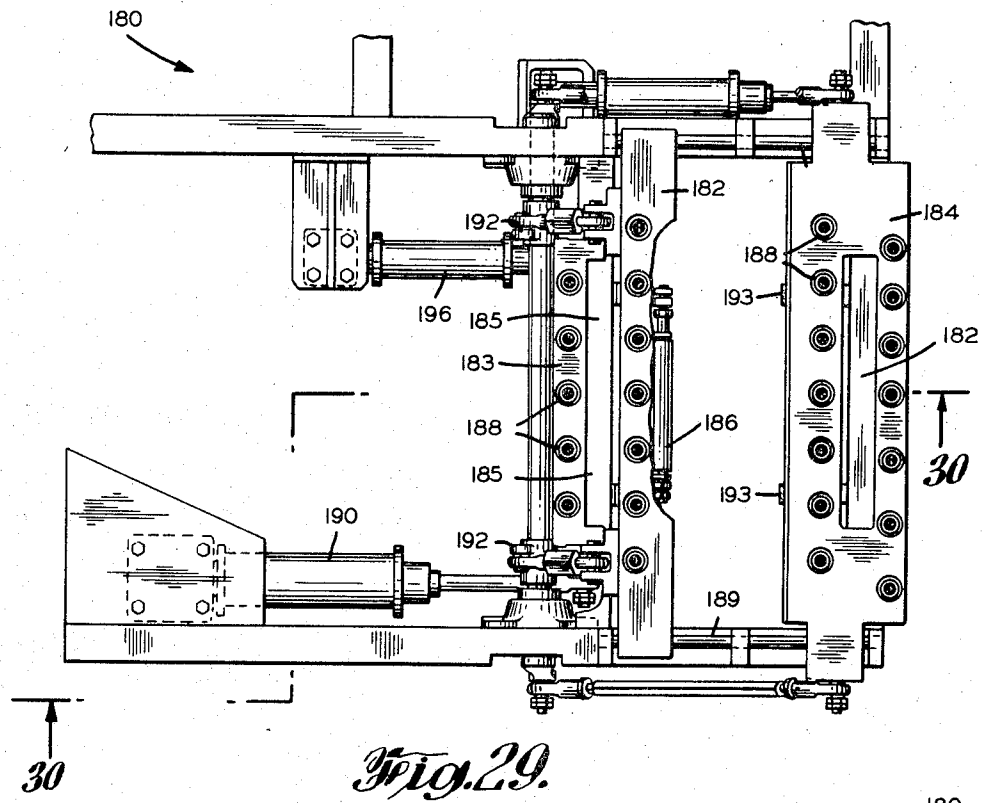

Fig. 29.

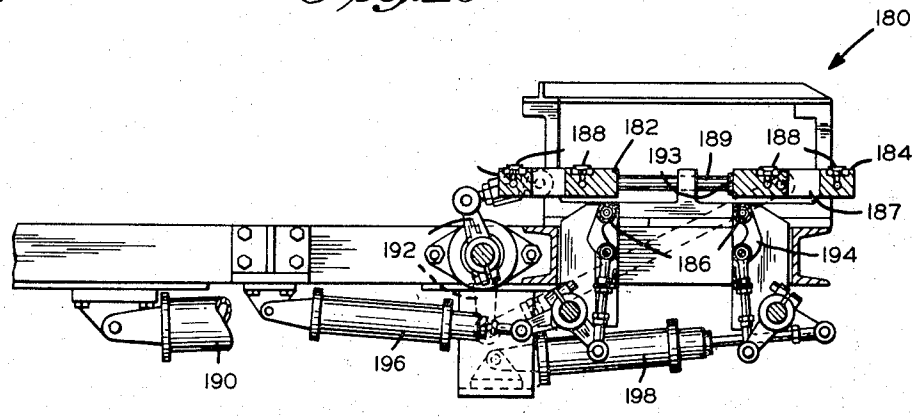

Fig. 30.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS

BY

ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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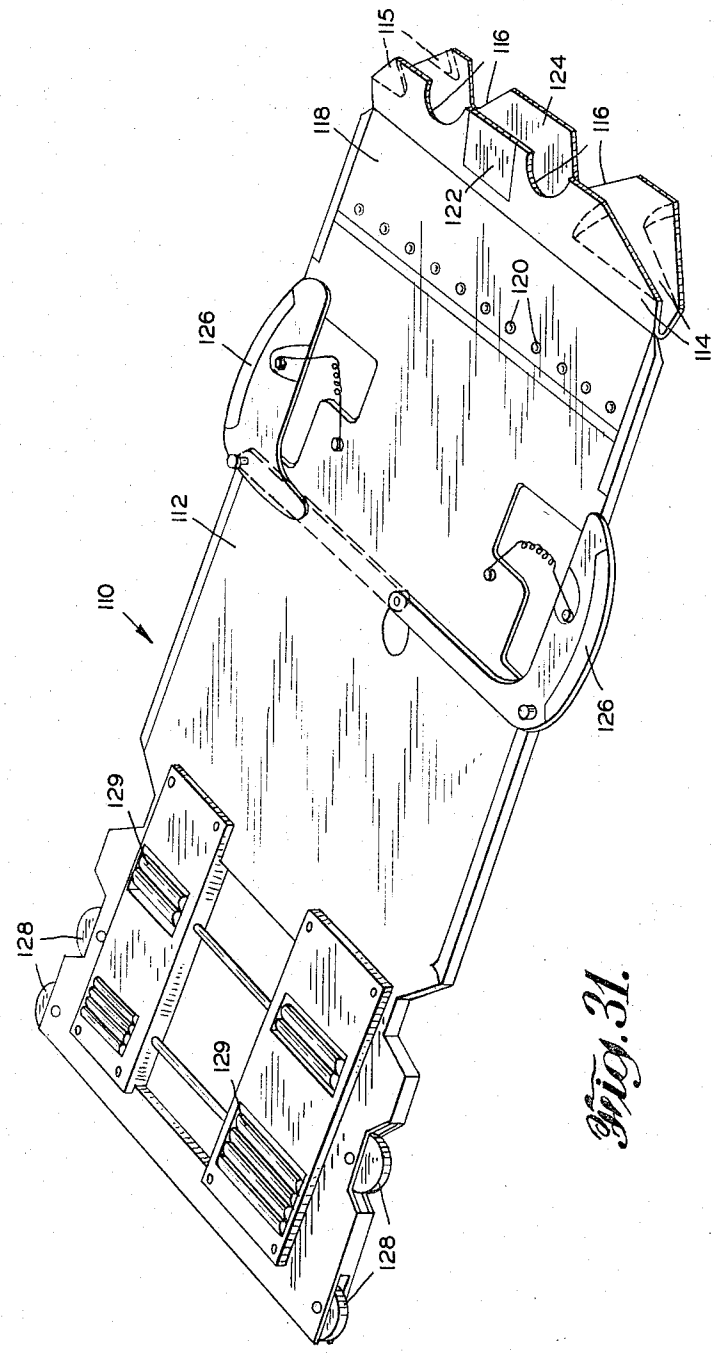

Fig. 31.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY John J. Holmes
ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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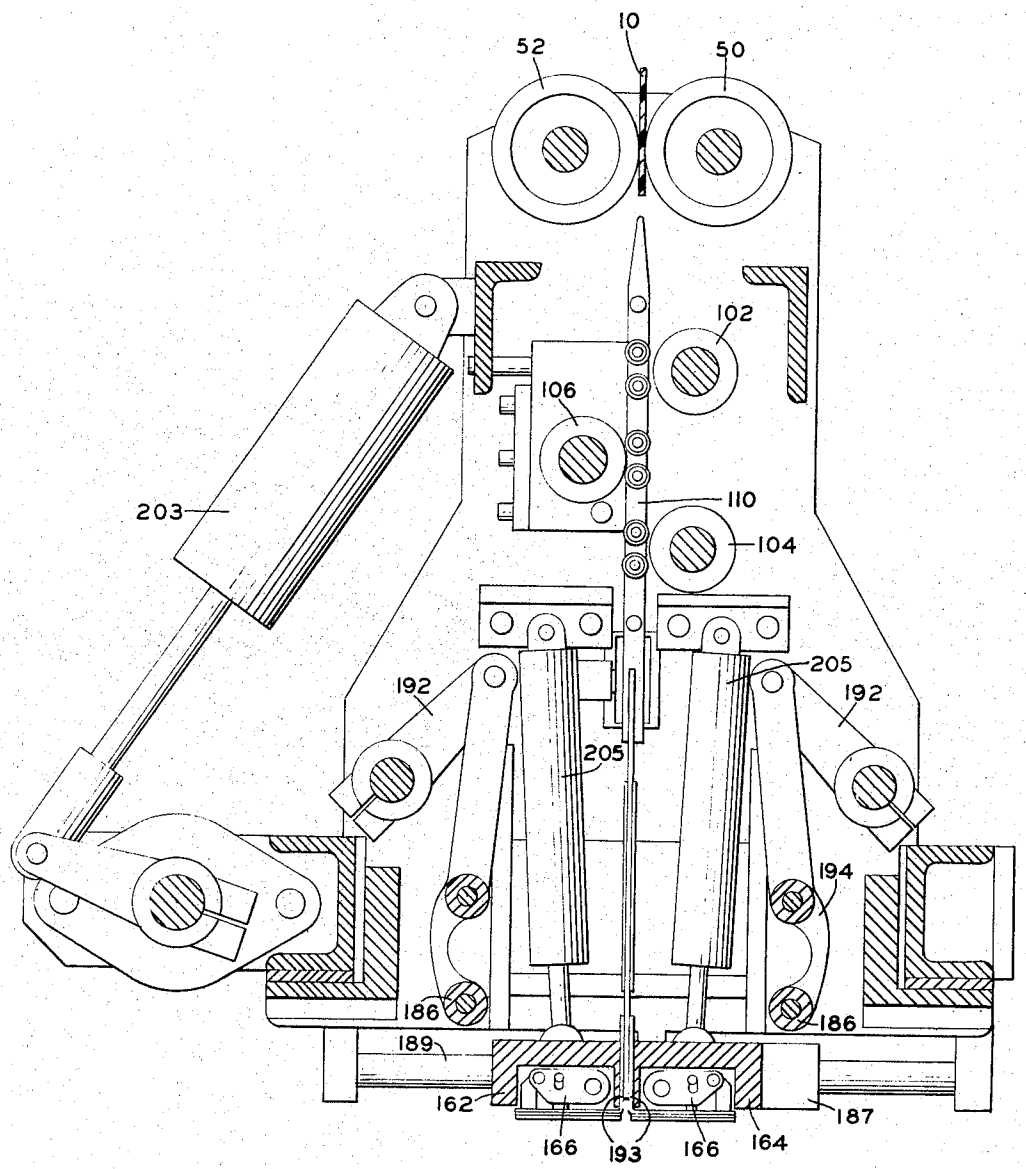

Fig. 32.

INVENTORS.
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BY
ATTORNEY

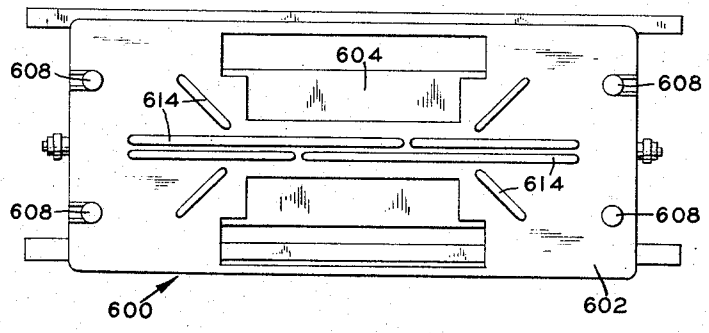

Fig. 33.

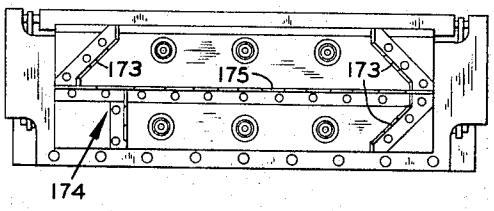

Fig. 35.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY
ATTORNEY

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CONTINUOUS BAG MAKING MACHINE

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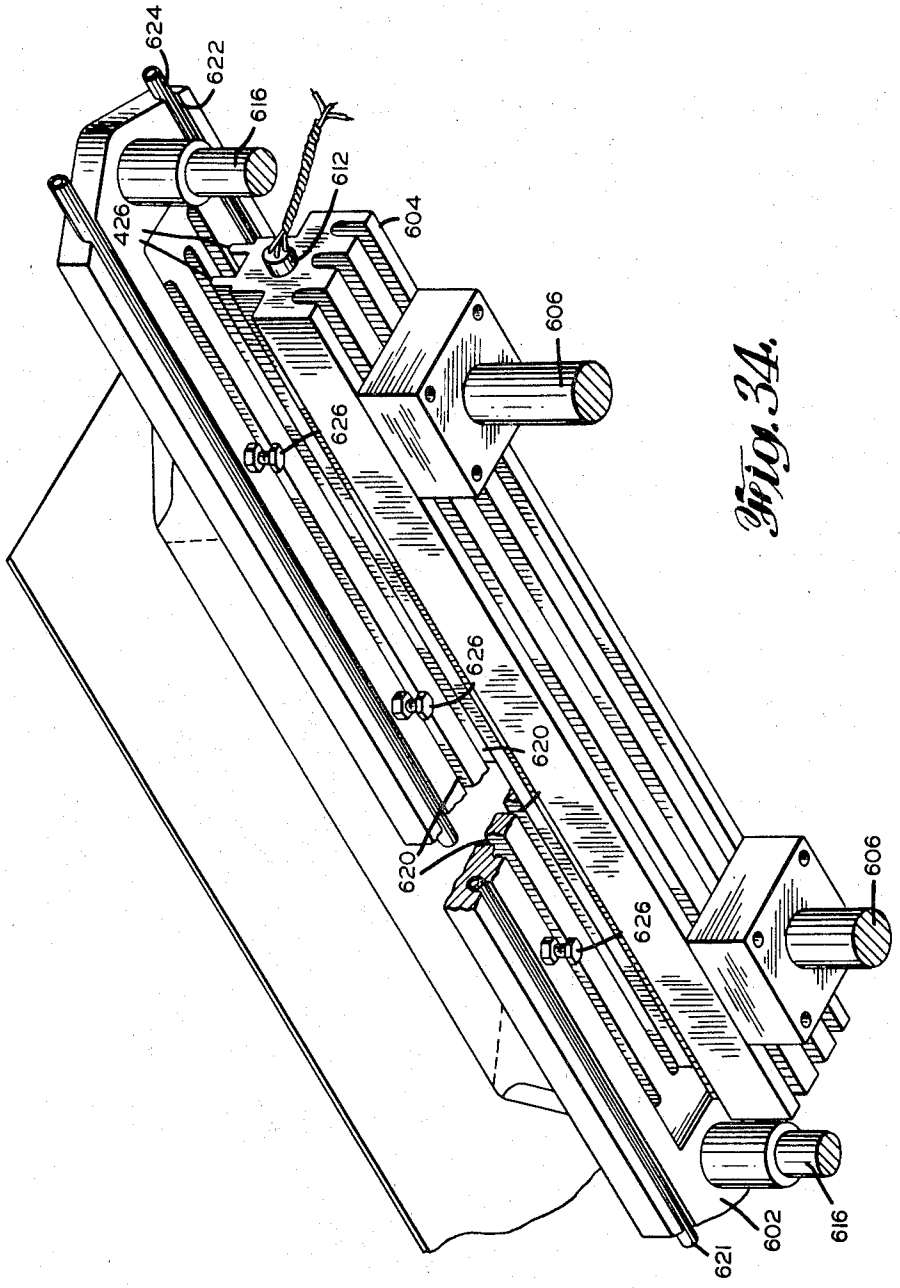

Fig. 34.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS

BY John F. Holzmann

ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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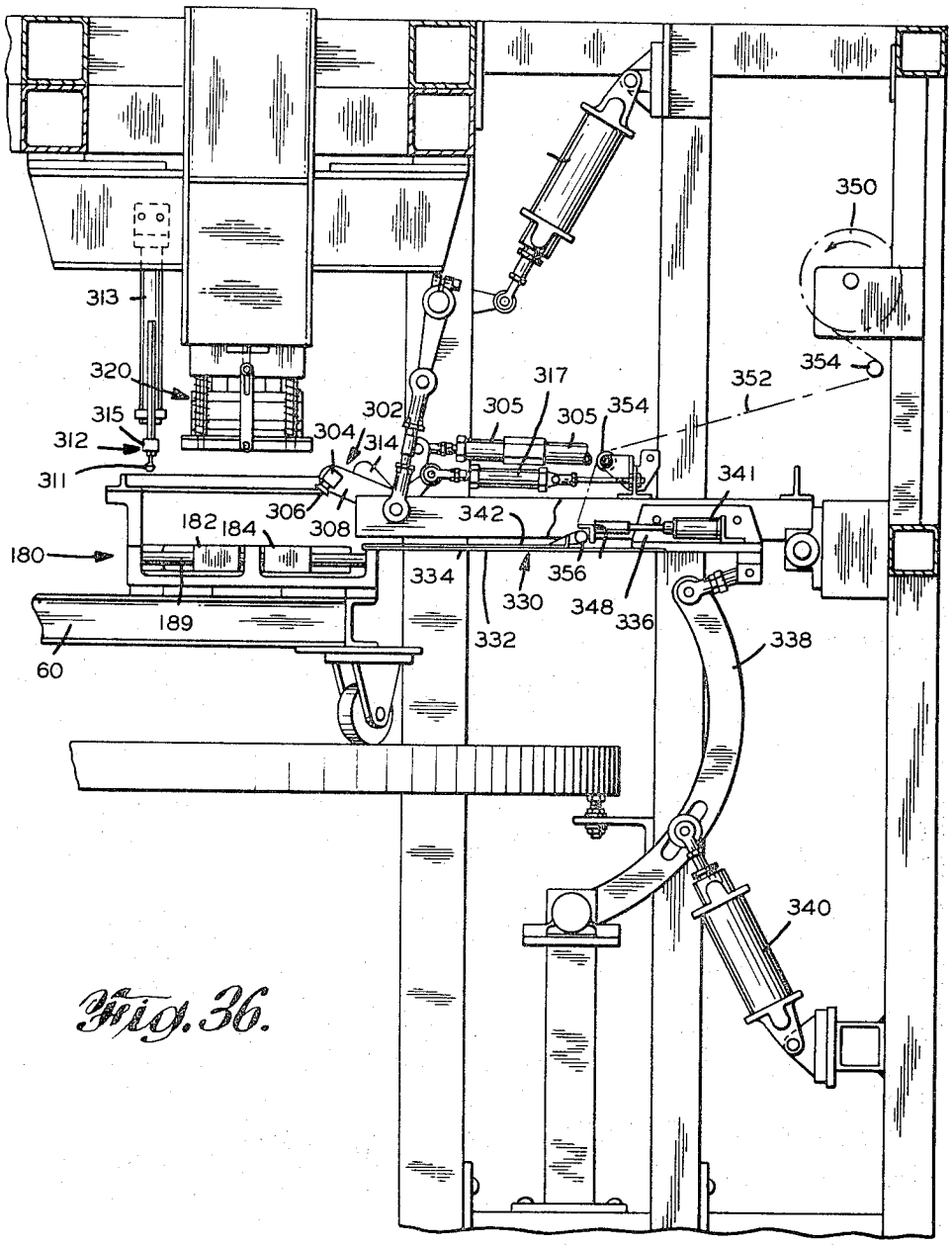


Fig. 36.

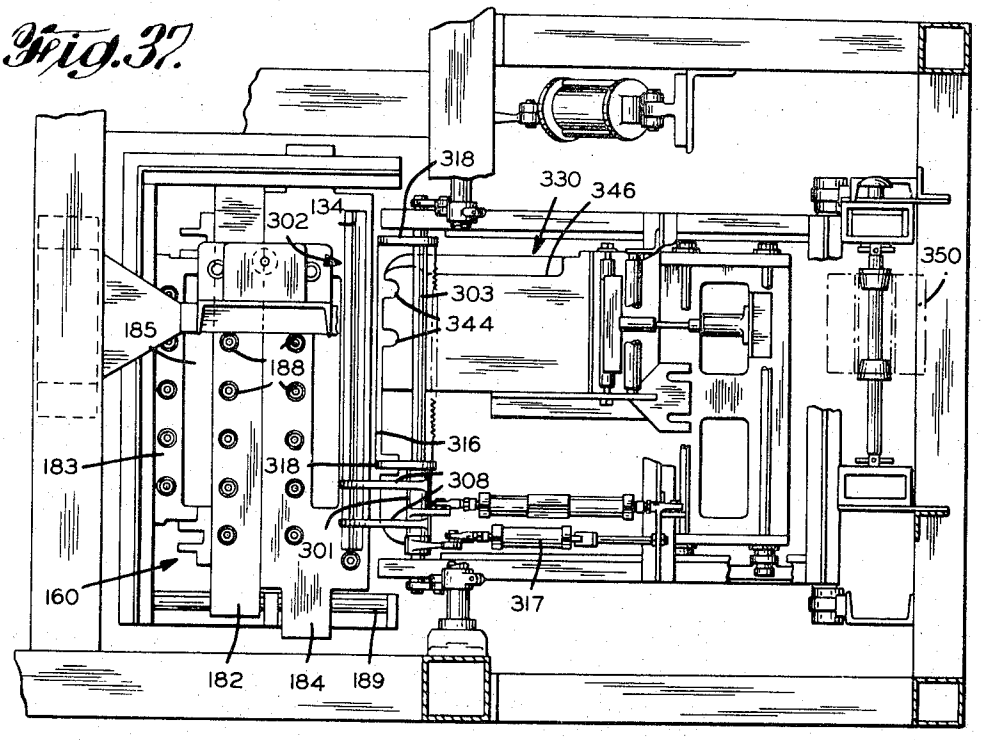
STATION III

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS

BY John J. Holmseen

ATTORNEY

Fig. 37.



STATION III

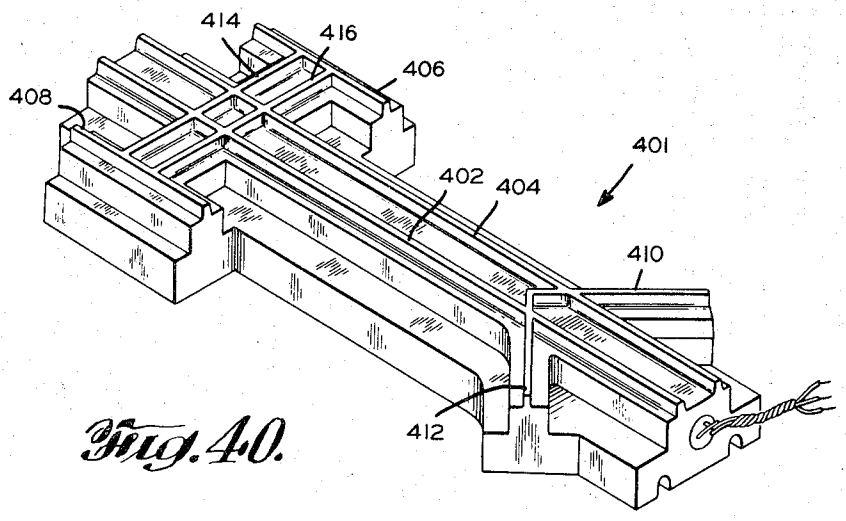


Fig. 40.

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ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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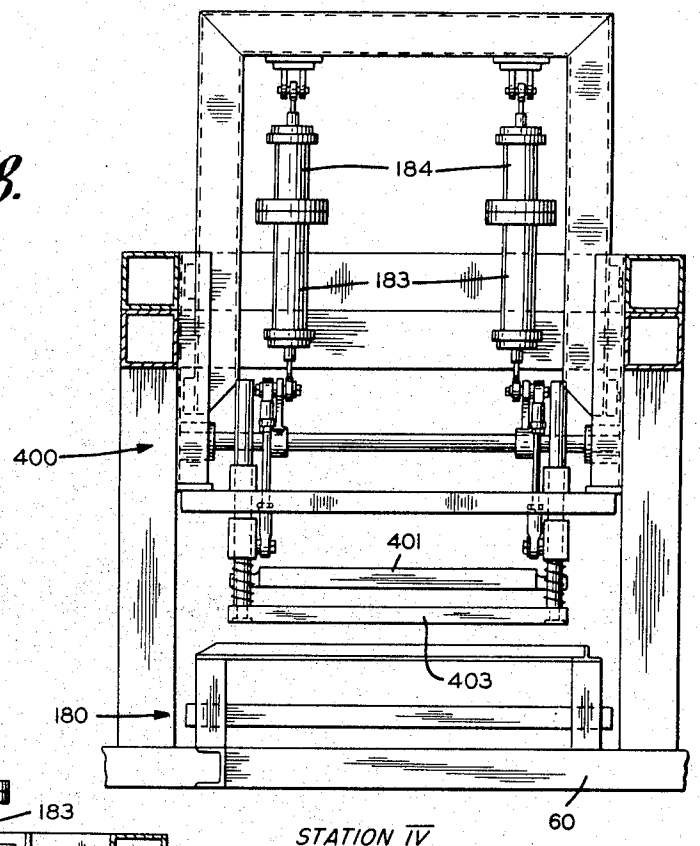
Fig. 38.



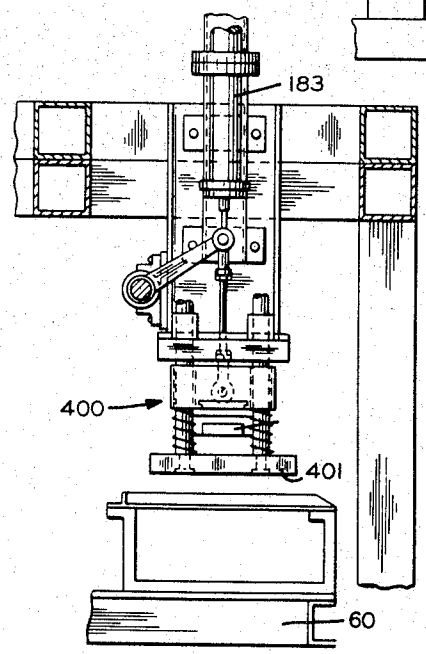


Fig. 39.

INVENTORS.
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BY
John F. Hohmann
ATTORNEY

Oct. 10, 1967 H. E. KASTING ETAL 3,345,919

CONTINUOUS BAG MAKING MACHINE

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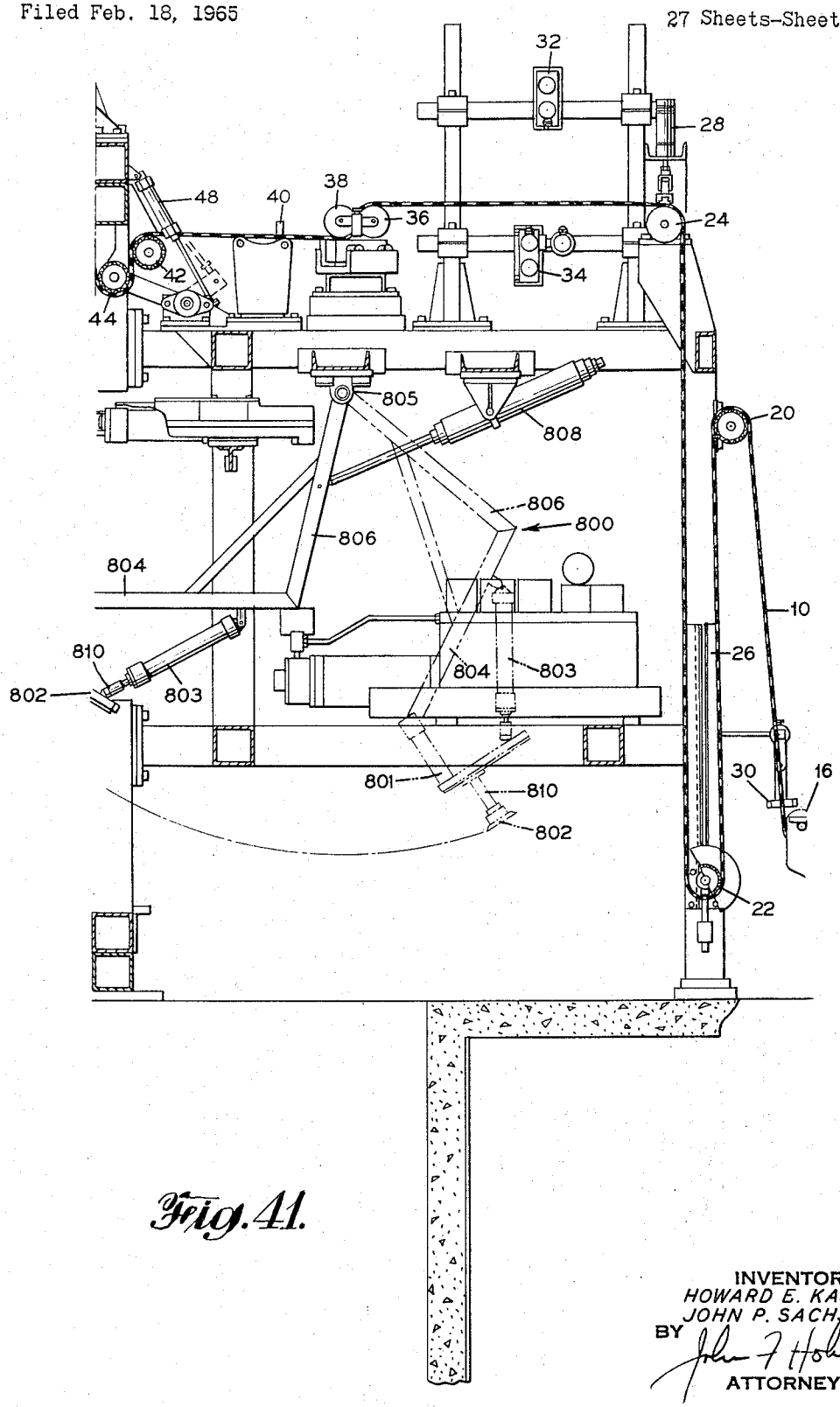

Fig. 41.

INVENTORS.
HOWARD E. KASTING
JOHN P. SACHS
BY John F Holmes
ATTORNEY

United States Patent Office 3,345,919 Patented Oct. 10, 1967

3,345,919

CONTINUOUS BAG MAKING MACHINE

Howard E. Kasting, Pluckemin, N.J., and John P. Sachs, Stamford, Conn., assignors to Union Carbide Corporation, a corporation of New York

Filed Feb. 18, 1965, Ser. No. 433,742
27 Claims. (Cl. 93—8)

This invention relates to a bag making machine. More particularly, this invention relates to an automatic machine for continuously making industrial shipping bags from tubular, heavy gauge thermoplastic film.

It is an object of this invention to provide an improved apparatus for continuously making industrial shipping bags from tubular thermoplastic film.

Another object of this invention is to provide an improved apparatus for making lapped, heat-sealed end closures in tubular thermoplastic film.

A further object of this invention is to provide an apparatus wherein the heat seals in the end closure of the bags are made by utilizing an internal, mandrel-supported work piece or platen.

A still further object of this invention is to provide an apparatus for forming a valved end closure in the tubular thermoplastic film.

Still a further object of this invention is to provide an apparatus for automatically and continuously making industrial bags which apparatus has a significantly increased output capacity.

These and further objects of the invention will become more clear from the ensuing discussion.

In accordance with the present invention, there is provided an apparatus for producing industrial shipping bags having heat-sealed end closures from flattened tubular thermoplastic film, which apparatus comprises means for automatically and simultaneously feeding two separate webs of flattened tubular film to at least two separate and individual stations in the apparatus; an internal mandrel adapted to fit within the flattened tubular film and means for displacing the film relative to said mandrel; means for blanking one end of said tubular film; means for rotating the internal mandrel together with said tubular film; means for infolding a pair of opposed side portions and a pair of opposed end portions in the blanked end of said tubular film over the internal mandrel during rotation to form a first rectangular end closure; means for heat-sealing the infolded side and infolded end portions together forming one end closure; means for counter-rotating said internal mandrel together with the tubular film; means for blanking the other end of said tubular film; means for displacing the tubular film relative to the internal mandrel along the longitudinal axis of said film; means for disposing a flat forming platen within the second blanked end closure; means for infolding the opposed side and end portions at the other blanked end of said film forming a second end closure; means for heat-sealing the second infolded side and end portions together against the flat forming platen; means for withdrawing the flat forming platen from the sealed closure; and means for removing the heat-sealed bag from the apparatus.

In one embodiment of the invention, there is provided an apparatus for receving a flattened, continuous web of tubing of bag-forming material; for blanking flaps into one end of the tubular film; for folding the blanked flaps about an internal mandrel as the mandrel together with the tubing are rotated through a predetermined arc; for sealing the overlapping layers of the bag-forming material into a bottom closure at one blanked end of the tubing; for counter-rotating the internal mandrel and tubing; for blanking flaps in the other end of said tubing;

for displacing the tubing relative to said internal mandrel; for inserting into the other end of the bag a sheet of valve-forming material between overlapped blanked flaps of the bag-forming material; for folding both materials about a forming platen; for overlapping the materials and heat-sealing them into a top closure having a tubular filling valve integral with the closure; and for withdrawing the forming platen to obtain a rugged bag wherein the overlapped areas are substantially as resistant to rupture as the film of the bag walls.

The term "blanking" as employed herein is intended to mean cutting of the tubular film to form flaps and tabs which are later infolded and overlapped when forming the end closures. However, the term "blanking" also encompasses merely severing the plies of the tubular film.

The apparatus of the present invention will become more clear when considered together with the accompanying drawings wherein:

FIGURE 1 is a schematic elevation illustrating the basic elements of a feed mechanism in one embodiment of the present invention;

FIGURE 2 is a schematic isometric view illustrating the basic operating elements of the four stations of the apparatus of the present invention;

FIGURE 3 illustrates the form of the tubular film at various stages throughout the apparatus of FIGURE 2;

FIGURES 4–13 are elevational views illustrating the sequential positions of the various elements in Stations I and II of the apparatus of the present invention through one complete cycle of the operation thereof;

FIGURE 14 is an exaggerated elevational view of a gripper means employed in the apparatus of the present invention;

FIGURE 15 is an elevational view partly in section illustrating one embodiment of the rotating mechanism of the present invention;

FIGURES 16–22 are elevational views illustrating the sequential positions of the various elements of Station III of the apparatus of the present invention through one complete cycle of the operation thereof;

FIGURES 23 and 24 are side and front elevational views, respectively, of the apparatus of Stations I and II;

FIGURE 25 is a side elevational view of the composite apparatus of Stations I and II;

FIGURES 26–28 are isometric views illustrating the drive and control mechanism for the indexing table **60** and forming platen **80** illustrated in the apparatus of FIGURE 2;

FIGURES 29 and 30 are plan and sectional views, respectively, of one of the clamping platen-foldover roll assemblies on the indexing table and in the rotating assembly;

FIGURE 31 is an enlarged isometric view illustrating the internal mandrel assembly **100** shown in FIGURES 23 and 24;

FIGURE 32 is a sectional elevation view of the apparatus for rotating the clamping platen-foldover roll assembly in Stations I and II;

FIGURES 33 and 34 are plan and isometric views, respectively, of the heat-sealer assembly of Stations I and II;

FIGURE 35 is an elevation view of the face of the male cutting member in the apparatus at Stations I and II;

FIGURES 36 and 37 are enlarged side elevation and plan views, respectively, of the flap-spreading and valve-inserting assembly at Station III;

FIGURES 38 and 39 are front and side elevational views, respectively, of the heat-sealing assembly at Station IV;

FIGURE 40 is an isometric view of the face of the heat seal bar in the heat-sealing assembly in Station IV; and

FIGURE 41 is a cut-away side elevational view of the unloading and transfer device and a portion of the feed mechanism at Station I.

The apparatus of the present invention will become more clear when considered in the light of the ensuing discussion taken together with the drawings wherein like reference numerals denote like parts.

In one embodiment of the present invention, there is shown in FIGURE 1 a feed mechanism wherein flattened tubular film **10**, such as between about 3 to 10 mil seamless polyethylene tubing, is continuously and automatically withdrawn from a supply roll **12** which is mounted on an unwind spindle equipped with an electric brake (not shown). The electric brake is always engaged unless otherwise desired. The supply roll is mounted on the unwind spindle such that the roll can be shifted axially by means of an edge sensing device. In this manner, compensation for film mis-alignment can be made automatically as the film is unwound.

Upon leaving the supply roll, the tubular film is passed under idler transport rolls **14** and **16**. At idler transport roll **16**, a sensing nozzle **18** is positioned so as to align the film edge as the film is threaded to idler transport roll **20**. Optionally, two sensing nozzles can be mounted on the same or opposite sides of idler transport roll **16** such that the average of film mis-alignment can be sensed and recorded and the unwound film then be aligned relative to its longitudinal center line.

From idler transport roll **20**, the tubular film is next threaded under idler transport roll **22** and over idler transport roll **24**. Idler transport rolls **20** and **24** are fixedly mounted while idler transport roll **22** is floatably mounted by, for example, seating it in a raceway equipped with racks and pinions. This mounting means can be constructed in such a manner that the length of the raceway is longer than the length of the blanked bag ultimately desired.

Positioned above idler transport roll **22** is a re-set cylinder **26** equipped with a pusher rod extending downward into the mounting means in which idler transport roll **22** is seated. A cylinder-activated rubber clamp **28** is mounted adjacent to idler transport roll **24** such that the rubber clamp can cooperate with the face of idler transport roll **24**. Rubber clamp **28** is pneumatically connected to and synchronized to function with the operation of the top clamping means in Stations I and II as discussed in further detail hereinbelow.

The re-set cylinder **26** is activated when the rubber clamp **28** brakes, or snubs, transport idler roll **24**. At this time, the pusher rod of the re-set cylinder extends downwardly and engages floatably mounted transport idler roll **22**. In this manner, floatably mounted transport idler roll **22** is repositioned at the lower extremity of its housing. Once transport idler roll **22** is repositioned, a limit switch **30**, located at the lower extremity of the housing for transport idler roll **22**, is triggered and acts to re-set the electric brake on the unwind spindle carrying the supply roll **12**.

Upon leaving transport idler roll **24**, the tubular film passes between an electronic sensing mechanism **32** and a light source **34** cooperating therewith before being guided over and under snub rollers **36** and **38**. These rollers are so positioned as not to be in actual contact with each other but are, instead, mounted in camber fashion. Hence, these rollers are mounted so as to form an angle of between about 15° and 20° with respect to a line transverse to the longitudinal center line of the film. Snubber rollers **36** and **38** are also preferably rubber lagged in order to increase the coefficient of friction between each of the said snub rollers and the tubular film.

The electronic sensing mechanism **32** and its cooperating light source **34** are employed such that the film advance mechanism can be stopped and the film feed synchronized with the overall operation of the apparatus. The electronic sensing mechanism and its cooperating light source can be adjusted to accommodate impulses from either dark-to-light or light-to-dark combinations at will.

Light-to-dark impulses are generally generated when transparent, opaque or light colored tubular film with dark printing on it is employed. If the film has no printing on it, light-to-dark impulses can be created by placing a dark dot on the film surface at predetermined intervals.

Conversely, dark-to-light impulses are generally generated when a dark colored film is employed by placing a white dot on the film surface.

The snub rollers **36** and **38** can be activated and controlled by, for example, a pair of sensing nozzles **40** which can serve to align the edge of the unwound film by guiding the longitudinal center line of the tubular film as it passes through the snub rollers.

Each of the pair of sensing nozzles **40** can be mounted on its own traversing track. For example, the traversing tracks can be positioned transveres to the edge of the film and below the lower surface of the tubular film. Each of these traversing tracks can, in turn, be mounted on its own traversing track. The second pair of traversing tracks can be positioned such that they are parallel to and below the first pair of traversing tracks. The sensing nozzles **40** and the traversing tracks in which they are seated can be constructed to operate as a unit in adjusting variations in the width alignment of the film. Further, the sensing nozzles can be mechanically joined, such as by means of a rigid connecting rod, such that movement of one sensing nozzle in one direction is countered by equal movement of the other sensing nozzle in the opposite direction.

The second pair of traversing tracks, positioned parallel to and below the first pair of traversing tracks, can be connected to the first pair of traversing tracks such that the entire mechanism, including the sensing nozzles, is movable as a unit when acting to align variations in film width alignment. Additionally, each pair of traversing tracks can be activated by its own hydraulic cylinder which can, in turn, receive its power from the same source that activates the unwind mechanism of the supply roll. Suitable as a power unit for this purpose is an electric motor-driven pump-servo mechanism which can be adapted to accept pneumatic output-signals from the sensing nozzles and, simultaneously, supply a hydraulic reaction to the respective cylinders of each pair of traversing tracks.

After leaving snub roller **38**, the tubular film is next threaded through transport idler rolls **42**, **44**, and **46**. Transport idler rolls **42** and **46** are fixedly mounted while transport idler roll **44** is rotatably mounted in order to maintain constant tension on the tubular film as it is rotated and counter-rotated at Stations I and II as is set forth in more detail hereinbelow. An air cylinder **48** is pivotably mounted to transport idler roll **44** and acts to return transport idler roll **44** to its original position when the rotating operations at Stations I and II are completed permitting transport idler roll **44** to maintain tension on the tubular film thereby ensuring that the extensible property of the tubular film does not result in undue creepage while, simultaneously, maintaining the axial alignment of the film.

The tubular film is next threaded through a pair of tangentially mounted idler rollers **50** and **52** prior to being guided onto and positioned over the internal mandrel assembly **100** at Stations I and II.

Turning now to FIGURE 2, there is illustrated the basic operating elements of the four stations of the apparatus of the present invention. The automatic machine is comprised of, generally, a rectnagular frame of square, tubular, steel members which support four fixed operating stations identified in FIGURE 2 as Stations I, II, III, and IV. Rotatably mounted on the frame and central to the operating stations is a substantially square, horizontally disposed indexing table **60**. Symmetrically mounted at each corner of the indexing table are four identical clamping platens which are indexed to cooperate with the operations of the fixed Stations I, II, III, and IV.

During the dwell period; that is, the interval during which the rotating mechanisms and the indexing table are at rest, the clamping platens are positioned at the fixed operating stations while sequential operations of cutting, rotating, overfolding and sealing the bag flaps and inserting and sealing the internal filling valve are performed on the bag blanks. Hence, at any given instant during the operation of the automatic machine, at least four bags are in successive stages of completion, two of which are clamped in position by the clamping platens on the indexing table. The operations of cutting, forming, rotating, overfolding and sealing the end closures and inserting and sealing the internal filling valve are performed on the bag blanks when the rotating mechanism and the indexing table are stationary, while insertion and withdrawal of a top forming platen for the top closure of the bag blanks is performed as the rotating mechanisms and the indexing table are rotated from Stations II to III and III to IV. Upon completing the rotation of the rotating mechanisms and the indexing table from Station IV back to Station I, a completed bag is released by its clamping platen and transferred to a take-away conveyor.

The sequential operations performed at Stations I and II occur simultaneously and include receiving the input of the flattened tubular film from their respective, individual feed mechanisms, simultaneously blanking the top and bottom closures in the tubular film, overlapping the flaps and forming the bottom bag closure as the blanked film is rotated through an arc of about 180°, sealing the bottom closure and counter-rotating the tubular film.

At Station III, sequential operations are performed to spread open the flaps which form the top closures of the bags, lay onto the opened flaps a film sheet that subsequently forms the internal filling valve and to seal the valve sheet to one end tab.

As the bag blank is rotated between Stations III and IV, a forming platen is introduced over the extended side flaps and the valve sheet and under the infolded end tab opposite the end tab carrying the valve sheet. At Station IV, the side flaps are infolded, overlapped, and sealed to form a top closure having a tube which opens into the interior of the bag.

As the completed bag is rotated from Station IV to Station I, the internal forming platen is withdrawn, the bag is released from the indexing table and transferred to a take-away conveyor.

It should be understood that, in the embodiment of the present invention, the same operations are performed simultaneously at Stations I and II. Hence, unless otherwise designated, any reference to the operations and mechanisms of Station I is intended to include the same operations and mechanisms at Station II and vice versa.

STRUCTURE OF STATIONS I AND II

Located at Stations I and II is a rotating mechanism as illustrated in FIGURE 15. The rotating mechanism, generally designated as **130**, is trunnion mounted **150** on the rectangular tubular frame above the horizontal surface of the indexing table and is positioned to cooperate with the internal mandrel. The rotating mechanism consists essentially of a frame **132** supporting a clamping roller assembly **134** which acts to keep the internal mandrel in place. A drive cylinder rod **136** extending downwardly from a drive cylinder **138** is pivotably connected to one end of a three-bar linkage **140**. A tie link rod **142** is pivotably connected at one end to the three bar linkage while the other end is pivotably connected by means of a pivot link **144**. The other end of the three-bar linkage is pivotably tied to a stub shaft **146** which is held in a bearing sleeve **148** equipped with ball bearings, the bearing sleeve being mounted to the rectangular tubular frame and accommodating the vertical movement of the stub shaft.

As shown in FIGURES 4–12, there is located at Stations I and II an internal mandrel clamping roll carriage assembly **100**, having an upper clamping platen-foldover roll assembly **160**, a blanking knife assembly **170**, a lower clamping platen assembly **180** mounted on the indexing table and a gripper assembly **700**.

The elements of Stations I and II are shown in more detail in FIGURES 23, 24, and 25. The clamping roll carriage assembly **100** is generally comprised of two vertically spaced apart clamping rolls **102** and **104** on one side of the flattened tubular film **10** and a third clamping roll **106** positioned between rolls **102** and **104** on the other side of the flattened tubular film **10**. All the clamping rolls **102**, **104**, and **106** are rotatably mounted in the rigid support frame **132** and are positioned to mesh with and be in continuous contact with the outer surface of the tube **10** such that a relatively thin, flat, internal mandrel **110** is disposed and supported within the flattened tubular film **10**.

As shown in more detail in FIGURE 31, the internal clamping mandrel **110**, which is adapted to fit within the flattened tubular film **10** and remain there in a fixed position while the tubular film **10** is continuously fed into Stations I and II, comprises, generally, a body portion **112** of sheet metal having a pair of collapsible trapezoidal leaves **114** of a magnetic metal hingeably connected on the bottom edge thereof. The leaves **114** can be spread apart into a substantially horizontal position thereby forming an internal mandrel-supported collapsible work piece or platen against which heat-sealing operations can be conducted. The lower edges of the metal leaves **114** are provided with notches **116** which mate with the gripper fingers **702** in the gripper assembly **700** as described in more detail hereinbelow. The width of the body portion **112** of the mandrel should be slightly smaller than the width of the flattened tubular film **10** in order to permit free movement of the tubular film **10** relative to the mandrel **110**. The metal leaves are hingeably connected to the body portion **112** by means of flexible fabric sheets **118**, such as flexible, heavy duty canvas, cotton duck and so forth. The flexible, fabric sheets are, in turn, bonded to the outer surfaces of the leaves **114**, such as by employing a suitable adhesive, and to the body portion, such as with rivets **120**. A portion of the outer surfaces of the leaves **114** is preferably left exposed, as at **122**, to assure that optimum magnetic contact is made therewith. The inner surfaces of the leaves **114** are permanently bonded to a single sheet of a flexible, heat-resistant material **124**, such as silicone rubber, which hingeably connects the two leaves **114** together while tending to keep the leaves spread apart, and, further, provides a resilient work surface for the heat-sealing operation of the bottom closure as described in greater detail hereinbelow.

In order to provide an internal platen work surface that will be able to accommodate end closures having different and varying dimensions, the trapezoidal leaves are equipped with pivotably mounted leaf extensions **115**. These leaf extensions **115** are pivotably mounted within the body of the trapezoidal leaves and can be extended outwardly from the side edges of the trapezoidal leaves thereby providing an internal work platen against which end closures of different dimensions can be heat-sealed.

The internal mandrel **110** is also equipped with a pair of spring-mounted ears **126** which press outwardly on the fold edges of the flattened tubular film **10** as the film passes over the mandrel keeping the flattened tubular film taut across the surface of the mandrel. The ears **126** are pivotably linked together, as at **125**, such that the ears move together the same distance inwardly or outwardly centering the mandrel **110** within the flattened tubular film **10**.

The mandrel **110** is also equipped with two pairs of discs **128** which are rotatably mounted at the other end of the mandrel and protrude beyond each of the side edges of the body portion **112**. These discs **128** serve to

center the mandrel **110** in a transverse direction as described below.

The internal mandrel **110** is held in place within the flattened tubular film **10** by a series of pairs of small, parallel rollers **129** within the body **112** of the internal mandrel **110** which are rotatably mounted in the internal mandrel so as to cooperate with the vertical clamping rolls **102**, **104**, and **106** outside the flattened tubular film. The rollers **129** are mounted such that their surfaces are caused to protrude above the planar surface of the internal mandrel **110** such that one, outside, vertical clamping roll protrudes inwardly, depressing the wall of the flattened tubular film **10**, and is positioned between the surfaces of each pair of the closely spaced, internal rollers **129**. Stated in another way, each outside vertical clamping roll **102**, **104**, and **106** engages one pair of the closely spaced internal rollers **129**, providing the means by which the internal mandrel **110** is firmly supported within the flattened tubular film **10**. While this supporting means functions through the pressure exerted by the outer vertical clamping rolls **102**, **104**, and **106** upon the internal rollers **129** through the flattened tubular film **10**, which pressure is sufficient to hold the internal mandrel **110** in place within the flattened tubular film **10**, the flattened tubular film **10** is still capable of being displaced relative to the internal mandrel **110** without moving said internal mandrel. This unique feature is possible since all the rolls **102**, **104**, and **106** and **129** are rotatably mounted. When displacement of the flattened tubular film **10** relative to the internal mandrel **110** occurs, it is thusly accomplished with little or no spreading of the flattened tubular film **10**. The internal mandrel **110** is centered transversely; that is, parallel to the axes of the vertical clamping rolls **102**, **104**, and **106** by a pair of rubber covered centering rolls (not shown) which are rotatably mounted on frame **132** such that they are pressed against the rotatable discs **128** on the internal mandrel **110**. The centering rolls and the discs **128** press against each other, through the flattened tubular film **10**, with sufficient force to prevent the internal mandrel **110** from swinging parallel to the axes of the vertical clamping rolls **102**, **104**, and **106**. However, since both the centering rolls and the discs **128** are rotatably mounted, they do not interfere with the displacement of the flattened tubular film **10** relative to the internal mandrel **110**.

In order to prevent a vacuum from being formed when the tubular film **10** is drawn over the internal mandrel **110**, a suitable means for penetrating one ply of the film **10** can be effectively employed. For example, an air injection needle driven by a pneumatic cylinder can be employed to penetrate one ply of the film at predetermined intervals. Such a device can be conveniently mounted, for example, on frame **132** and can be synchronized to function with the feed mechanism.

As illustrated in FIGURES 14 and 23 the gripper assembly **700** is comprised of a pair of gripper fingers **702** each of which have inwardly protruding gripper clamps **704**. The gripper fingers **702** are mounted on gripper mounting plate **706** such that one gripper finger is angularly disposed opposite the other gripper finger and separated by the gripper wedge **708** therebetween.

The gripper mounting plate **706** is vertically movable by means of cooperating racks and pinions **710** mounted in guide racks and is pneumatically driven by air cylinder **714** so that the wedge **708** can be vertically dis-

The gripper wedge **708**. intermediately disposed between the gripper fingers **702**, is connected to an air cylinder rod **712** which is driven by compressed air cylinder **714** so that the wedge **708** can be vertically displaced relative to the gripper fingers **702** to firmly secure the ends of extended bag blank between the gripper clamps **704** and the opposing faces of the gripper wedge **708**.

The angle formed at the apex of the gripper wedge **708** should be small enough to enter the angle formed in the bottom closure of the suspended bag blank yet sufficiently large enough to ensure firm contact with the gripper clamps **704** when the wedge is raised into position. An angle of between about 50° and 60° and, preferably about 55° is suitable for this purpose. For optimum operational results, the angular disposition of the gripper fingers **702** should be the same as that of the gripper wedge **708**. The gripper clamps **704** are positioned on the gripper fingers such that they will contact the blanked bag through the notches **116** in the leaves **114** of the internal mandrel. The apex of the gripper wedge **708** can be rounded and the wedge padded to prevent damage to the closure in the blanked bag.

After the ends of the extended bag blank have been firmly secured between the gripper wedge **708** and the gripper clamps **704**, cylinder rod **718** is activated through air cylinder **716** to draw the bag blank downward one bag length. This downward movement of cylinder rod **718**, and, consequently, the bag blank, can be decelerated by means, for example, of hydraulic shock absorbers mounted to cooperate with the downward movement of cylinder rod **718**. Through this or similar means, the distance through which the gripper wedge **708**, gripper clamps **704** and the bottom of the bag blank travel can be controlled and adjusted to accommodate varying bag lengths.

It should be understood that, during the time the end of the bag blank is engaged by the gripper assembly and then drawn downwardly, the lower clamping plate assembly **180** mounted on the indexing table **60** is opened to a degree sufficient to permit the gripper wedge **708** and gripper fingers **702** to pass therebetween.

Referring again to FIGURES 4–13, and 35 a blanking knife assembly **170** is mounted such that it is positioned below the upper clamping platen foldover roll assembly **160**. The blanking knife assembly comprises a female member **172** positioned on the inboard side of the indexing table **60**; that is nearer the drive mechanism in the center of the indexing table, and a male cutting member **174** positioned on the outboard side of the indexing table **60**; that is, farther away from the drive mechanism in the center of the indexing table, both of which can be mounted on a single carriage which, in turn, can be further movably mounted on horizontal tracks such that the female knife member **172** and the male cutting member **174** can be moved transversely toward each other in a direction perpendicular to the plane of the flattened tubular film **10**.

The face of the male cutting member **174** is illustrated in FIGURE 35. Protruding from the face of the male cutting member **174** is a transverse knife edge **175** which cuts completely across the flat width of the flattened tubular film **10** severing an individual bag blank **900** (FIG. 9) below the knife from the continuous length of flattened tubing above the knife, a bottom closure having been previously formed in the flattened tubular film. As the protruding transverse knife edge **175** severs one bag blank **900**, vertical and diagonal knives **173**, which also protrude from the face of the male cutting member **174**, form longitudinal slits in the flattened tubular film **10** above the point where the transverse knife edge **175** severs the bag blank **900**. These longitudinal slits form opposing end tabs and side flaps for both the top closure of the bag blank just severed and the bottom closure in the next succeeding bag blank to be cut from the continuous flattened tubular film **10** above the transverse knife **175**.

The face of the female knife member **172** is provided with slots and recesses to accommodate the knives on the face of the male cutting member **174** when the two members are brought together.

Rotatably mounted to the underside of the female knife member **172** is a wiper arm **177** having air jets in its leading edge, and which is activated by an air cylinder to rotate toward the face of the female knife member **172**

after the male cutting member **174** has been retracted. When at rest, the wiper arm **177** is positioned at an angle of about 45° with respect to the underside of the female knife member **172**. When activated, wiper arm **177** moves transversely across the flat width of the blanked tubular film and causes that portion of the individual bag blank **900** which protrudes above the planar surface of the lower clamping platen assembly **180** to lie down flat upon the upper planar surface of the lower clamping platen assembly **180** as shown in FIGURE 8.

The lower clamping platen assembly **180** is comprised of a pair of clamping platens **182** and **184** which are rotatably mounted to the indexing table **60** below the blanking knife assembly **170** and above the gripper assembly **700**. Lower clamping platen **182** is positioned inboard with respect to the indexing table **60** while lower clamping platen **184** is positioned outboard with respect to the indexing table **60**.

Since the four lower clamping platen assemblies **180** are identically mounted one on each of the corners within the indexing table **60**, the assembly **180** will be the same regardless of which one is positioned at the operating stations. The driving members for the lower clamping platen assemblies **180** are horizontally mounted in order to facilitate their rotation.

As shown in FIGURES 29 and 30, the platen members **182** and **184** are each equipped with foldover rolls **186** mounted beneath the platen members **182** and **184** which are driven upwardly through said members onto the upper surfaces of the platen members **182** and **184**. A plurality of suction cups **188** are recessed in the upper surfaces of the platen members **182** and **184**. Inboard platen member **182** is further provided with an additional section **183** containing suction cups **188** in order to increase the suction area. The additional section **183** is provided with an opening **185** through which the foldover roll **186** can be moved onto the upper surface of the platen.

The lower clamping platens **182** and **184** have several functions. For example, they serve as the mounting for and guide the foldover rolls **186**; they act as back-up surfaces during the sealing operation of the top end closure; they are the means for transporting the bag blanks as the bag blanks are rotated from station to station.

The lower clamping platen members **182** and **184** are preferably mounted on parallel, polished slide rods **189** which extend through bushed openings in the ends of the platen members. A suitable driving mechanism, such as a pneumatic cylinder **190** and interconnected bell cranks **192**, is provided to move the platen members **182** and **184** together and apart. The mating surfaces of the platen members are also provided with rubber pads **193** in order to insure good clamping action when the platen members are advanced toward each other and, further, to compensate for machine tolerances and minor variations in the wall thickness of the clamped tubular film.

The foldover roll **186** in the clamping platen assembly **180** is spring mounted by means of independent brackets and torsion springs **194** to a conventional bell crank and pneumatic cylinders **196** or **198**. The outboard platen member **184** is provided with a longitudinal slot **187** so that the foldover roll **186** can be advanced and retracted therethrough when the platen clamping members are in a clamped (closed) position. The inboard clamping platen **182** is sufficiently narrow so that the foldover roll **186** can be advanced and retracted therethrough while it is in the clamped position. The spring mountings and support brackets **194** of the foldover rolls **186** first urge the rolls about the side edge of the longitudinal slot **187** and the side edge of platen member **182**, respectively, and thence downwardly toward the mating surfaces of the platen members **182** and **184**. Thus, as the platens move toward each other to close, the rolls **186** and their supporting brackets **194** are advanced above the upper surfaces of the platen members, and the rolls **186** are then forced downwardly against the upper surfaces of the platens, moving toward the mating clamping surfaces of the platen members. The rolls **186** are mounted such that they are locked and non-rotating when they are being advanced and are rotating and free-rolling when they are being retracted. Thus, the rolls have a wiping action as they are advanced and a rolling action as they are retracted.

The purpose of the rolls **186** is to infold the previously blanked and outfolded side flaps of the thermoplastic tube into overlapping relationship with each other and with infolded end tabs, as will be described in greater detail hereinafter under the heading, Operation-Stations I and II. Thus, one of the rolls **186** must lead the other roll by a short time interval, suitably 0.3 to 0.4 second, so that one side flap is infolded slightly ahead of the other flap.

A pair of wiper arms and a pair of air nozzles (not shown) are mounted just below the platen member with the leading foldover roll **186** to insure that one side flap is infolded ahead of the other. The wiper arms are swingably mounted on air-driven rods to wipe the side portions of the inboard side flap up against the surface of the platen **182** before the outboard side flap is infolded. The air nozzles are mounted to direct jets of air across the middle of the platen **182** forcing the midportion of the inboard side flap toward the platen surface.

The upper clamping platen assembly **160** is also comprised of a pair of upper clamping platen assemblies **162** and **164** mounted inboard and outboard with respect to the indexing table **60**, respectively. Each of the upper clamping platen members **162** and **164** is provided with a rotatably mounted magnetic clamp **166** which is recessed within the body of each of the upper clamping platen members.

The upper clamping platen assembly **160** is driven in the same manner as described hereinabove for the lower clamping platen assembly **180**. The function of the upper clamping platen assembly **160**, however, differs from that of the lower clamping platen assembly **180**. The upper clamping platen assembly **160** engages the flattened tubular film **10** and the internal mandrel **110** and aids in keeping them in place during the rotation and counter rotation of the flattened tubular film **10** and the internal mandrel **110**. Additionally, the upper clamping platen assembly **160** also acts to prevent the flattened tubular film **10** from advancing as the film is tensioned prior to being severed and blanked, as is set forth in greater detail hereinbelow under the heading Operation-Stations I and II.

Each of the upper clamping platens **162** and **164** is mounted in tracks within the trunnion mounting **150** such that they are each transversely movable in a direction perpendicular to the flat width of the flattened tubular film **10**. Essentially the same mechanism is employed with regard to the upper clamping platens **162** and **164** as has been described hereinabove for the operation of lower clamping platens **182** and **184**.

Internally mounted on tracks within the trunnion mounting **150** are also a pair of foldover rollers **154** which are separately driven by means of a pneumatic cylinder and interconnected bell cranks to produce a Geneva motion during rotation of the unit consisting of the upper ulamping platen assembly **160**, the flattened tubular film **10** and the internal clamping mandrel **110**. In this manner, one foldover roll **154** precedes the other in infolding the side flaps and end tabs onto the extended leaves **114** of the internal clamping mandrel **110** as described in greater detail hereinbelow.

Since the momentum generated during rotation, along with gravity, assists in laying down the side flaps and end tabs, no wiper arms or suction cups are required in the upper clamping platen **162** and **164**. Air nozzles, however, are provided and mounted on the trunnion mounting **150** to assist in the order of laying down the previously blanked infolded side flaps in proper sequence

such that the inboard side flap precedes the outboard side flap when they are infolded, by delaying the natural tendency of the outboard side flap to lie down under the influence of gravity and the rotational momentum.

After the bag bottom has been blanked from the flattened tubular film **10**, the film, together with the clamping roll carriage assembly **100** and the upper clamping platen assembly **160**, is rotated and positioned beneath a heat-sealer assembly **600** as shown in FIGURE 11. During rotation, the side flaps and end tabs of the blanked tubular film **10** are infolded over the trapezoidal leaves **114** of the internal clamping mandrel **110** which leaves have been extended into a flattened position substantially perpendicular to the body portion **112** of the internal clamping mandrel **110**. In this manner, a platen working surface is formed within the body of the flattened tubular film **10** upon which the heat-sealing operation for this end closure is performed. The heat-sealer assembly **600** is mounted in the upper portion of the trunnion mounting **150** such that the blanked tubular film is positioned directly below it after its rotation through 180°. It should be understood, however, that the heat-sealer assembly **600** can also be mounted such that the blanked tubular film can be rotated through an arc of only 90°, 60°, 30°, or through any arc desired, in order to accomplish the same function of heat-sealing the blanked end of the tubular film.

Referring now to FIGURES 33 and 34, the heat-sealer assembly **600** comprises two main elements; a clamping platen **602** and a heat-seal bar **604**. The heat-seal bar **604** is connected by shafts **606** and bell cranks **608** to pneumatic cylinders (not shown) that advance and retract the bar **604** in the vertical direction. The bar **604** is provided with a passage to receive an electrical resistance heater element **612**, and the lower face of the bar is provided with a plurality of protruding sealing surfaces **614**. The configuration of the sealing surfaces for the particular bag closure structure resulting from the blanking knife pattern shown in FIGURE 35 is shown in FIGURE 33, but the configuration of sealing surfaces can, obviously, be varied for different bag closure configurations and bag sizes, as described.

The aforedescribed heat-sealer **600** is described in more detail in a copending United States patent application bearing Ser. No. 198,014, entitled Plastic Film Welding Process and Apparatus, filed May 28, 1962, now U.S. Patent No. 3,272,674, issued Sept. 13, 1966. However, it is to be understood that this is only one example of the many different heat-sealers which can be used in the inventive apparatus.

The clamping platen **602** of the heat-sealer is supported above the bar **604** by means of shafts **616** and bell cranks connected to additional pneumatic cylinders (not shown) which advance and retract the platen **602** in the vertical direction. The platen **602** is provided with slots **620** to pass the corresponding sealing surfaces **614** on the bar **604** through the platen and into contact with the thermoplastic film to be sealed. The platen **602** also has grooves **622** equally spaced from the slots **620** to retain water-circulating tubing **624** for cooling the film around the sealing areas. A plurality of tapped holes is also provided in the platen **602** to receive adjustment screws **626** which limit the advance of the platen **602**, and thereby control melt penetration into the surface of the film to be sealed. The depth of sealing surface penetration in combination with the cooling of the walls of the slots **620** controls and limits the fused film zone in the film plies being sealed. In operation, the clamping platen **602** is first moved downwardly against the film to be sealed, and the bar **604** is then moved through the slots **620** to seal the film plies. The sealing bar **604** is then retracted from the weld surface while the platen **602** continues to clamp the plies of the film and chill the fused zones therein, thus permitting the stripping of the protruding sealing surfaces **614** cleanly from the film weld.

OPERATION-STATIONS I AND II

The operation of Stations I and II will be more readily understood when considered with FIGURES 1–15.

Referring to FIGURE 4, the flattened tubular film **10** is first extended downwardly from the tangentially mounted idler rollers **50** and **52** (FIGURE 1) over the internal mandrel **110** so that one ply of the tubular film is on each side of the mandrel. The film passes through the clamping roll carriage assembly **100** through the upper clamping platen assembly **160**, thence between the cutting members **172** and **174**, then through the lower clamping platen assembly **180**, and into the gripper assembly **700**.

The bottom closure in the lower end of the tube **10**, having been previously formed in the manner to be described hereinbelow, is spread over the gripper wedge **708** of the gripper assembly **700** and secured thereto by the gripper clamps **704** while the gripper assembly **700** is in its raised position; that is, at the extremity of its upstroke. At this point, Stations I and II appear as illustrated in FIGURE 4; that is, with the internal mandrel **110** held in position by the clamping roll carriage assembly **100**, both upper and lower clamping platen assemblies **160** and **180** open, and the cutting members **172** and **174** retracted.

Next, as shown in FIGURE 5, the film **10** is advanced one working bag length by retracting the gripper assembly **700**; that is, an amount of the flattened tubular film **10** necessary to form one completed bag, including end closures, is advanced. The amount of film to be advanced can be sensed by means of a limit switch or controlled by the electronic sensing mechanism **32** and its appropriate light source **34** as shown in FIGURE 1 and described hereinabove. During advancement of the film, all braking actions in the feed mechanism are released with the exception of that which controls the supply roll.

After the film has been advanced one working bag length, the upper clamping platen assembly **160** is closed by advancing upper clamping platens **162** and **164** toward each other until they firmly engage the flattened tubular film **10** and the internal mandrel **110**. The gripper assembly **700** is next lowered to tension the film, the distance which the gripper assembly **700** is lowered not being narrowly critical. Proper film tensioning can be achieved in most applications by lowering the gripper assembly **700** a distance of between about 1 and 5 inches. However, it should be understood that the distance the gripper assembly is lowered will depend, to a large extent, upon the extensible nature of the film employed. The greater the extensible property of the film, the greater the distance that the gripper assembly is lowered. After the gripper assembly **700** has properly tensioned the film **10**, the lower clamping platens **182** and **184** in the lower clamping platen assembly **180** are closed. At this point, Stations I and II appear as illustrated in FIGURE 6. The lower end of the tube **10** remains secured by the gripper assembly **700**, the internal mandrel **110** remains in its position, and the cutting members **172** and **174** are still retracted.

As shown in FIGURE 7, the cutting members **172** and **174** are next energized to cut the film **10** at a point between the upper clamping platen assembly **160** and the lower clamping platen assembly **180**. The female knife member **172** and the male cutting member **174** are simultaneously advanced toward each other and cut the tubular film **10** at their point of contact thereby severing an individual bag blank **900**. At this point, the tubular film is in the form illustrated as C in FIGURE 3. The transverse knife edge **175** cuts through all plies of the flattened tubular film **10** severing the individual bag blank **900** below the knife from the continuous length of tubular film **10** above the knife. At the same time, the vertical and diagonal knives **173** form a pair of opposed side flaps **901** and **903** and a pair of opposed end tabs **902** and **904** at the top end of the bag blank **900** and, similarly, a pair of opposed side flaps **905** and **907** and opposed end tabs

906 and 908 at the lower end of the tube 10 as shown in FIGURE 3.

In the embodiment just illustrated, three of the knives 173 in the male cutting member 174 are shaped to form diagonal cuts which terminate at both ends in vertical cut portions while the fourth knife 173 forms a straight vertical cut.

Although the particular die cuts described herein are preferred to obtain a strong bag while employing a minimum amount of film, it should be understood that many other blanking patterns can also be utilized; the selection of such patterns being within the scope of those skilled in the art. It should also be understood that the die cuts can be made either in combination; that is, simultaneously, or can be made independently and at different times and in varying sequence.

Once the tubular film 10 has been cut, the male cutting member 174 is retracted while the female knife member 172 remains in place. As the male cutting member 174 is retracted, the wiper arm 177, equipped with air jets in its leading edge, is rotated across the cut film 10 laying down both plies of the cut film 10 upon the upper surfaces of the closed lower clamping platen assembly 180. At this point, the apparatus at Stations I and II appears as illustrated in FIGURE 8.

After the cut film 10 has been laid down on the lower clamping platen assembly 180, the wiper arm 177 is rotated back to its rest position and the female knife member 172 is retracted. Simultaneously with this action, the magnetic clamps 166 positioned in the upper clamping platen assembly 160 and in contact with the trapezoidal leaves 114 of the internal mandrel 110 through the film 10 are retracted extending the trapezoidal leaves 114 within the body of the film 10 causing the blanked bottom flaps of the tube 10 to open. The extended trapezoidal leaves 114 are now in a position to serve as an internal former for subsequent heat-sealing of the bottom closure of the bag. The apparatus is now in the position illustrated by FIGURE 9. As the trapezoidal leaves 114 are extended the pair of air nozzles in the upper clamping platen assembly 160 are activated to keep the bottom flaps, 905, 906, 907, and 908 (FIG. 3) apart and prevent them from being tucked underneath each other.

The apparatus of Stations I and II; that is, the tubular film 10, the internal mandrel assembly 110, and the closed upper clamping platen assembly 160, are now rotated through an arc of 180°.

Rotation is accomplished by means of the rotating assembly 130 illustrated in FIGURE 15. Rotating the apparatus of Stations I and II begins when the drive cylinder 138 is energized retracting drive cylinder rod 136 which causes the three bar linkage 140 to rotate. The tie link rod 142 which is rotatably connected to the three bar linkage 140 and to the pivot link 44, is thus activated so that it follows the rotation of the three bar linkage 140 in a clockwise direction. The clockwise rotation of the apparatus of Stations I and II through an arc of 180° is controlled by retracting the drive cylinder rod 136 of drive cylinder 138 a predetermined distance. During rotation and subsequent counter-rotation, movement of the other end of the three bar linkage 140 is controlled by movement of a stub shaft 146 which rides in a bearing sleeve 148, which sleeve is pivotally tied to the three bar linkage 140.

During the first 90° of rotation, one of a pair of foldover rollers 154, which are internally mounted in tracks within the trunnion mounting 150, is energized to wipe one side flap 905 (FIG. 3) down upon the extended trapezoidal leaves 114 of the internal mandrel 110, the end tab 906 having been laid down by the force of gravity. At this point, the apparatus of Stations I and II appears as illustrated in FIGURE 10. During the remaining 90° of rotation, the other foldover roll 154 is energized to wipe the opposed side flap 907 and opposed end tab 908 (FIG. 3) flat upon the surface of the extended trapezoidal leaves 114. The pair of foldover rolls 154 are separately activated by means of a Geneva motion so that one foldover roll will lead the other by about 0.3 to 0.4 of a second infolding the side flaps such that the inboard side flap 905 lies beneath the outboard side flap 907. At the completion of the 180° rotation, the infolded end tabs 906 and 908 and the infolded side flaps, 905 and 907 (FIG. 3), are positioned beneath the heat-sealing assembly 600 as illustrated in FIGURE 11.

As the tubular film 10 is being rotated through the 180° arc, all braking actions in the feed mechanisms are released permittiing the continuous length of the tubular film 10 to advance unimpaired. Proper tensioning of the continuous web of tubular film 10 during rotation and subsequent heat-sealing is maintained by floatably mounted idler transport roll 22 and rotatably mounted idler transport roll 44, as shown in FIGURE 1, acting through gravity upon the film 10.

As the apparatus of Stations I and II complete their rotation through 180°, the heat-sealing assembly 600 is advanced upon the overlapped and infolded end tabs and side flaps of the bag bottom as illustrated in FIGURE 12.

Closure of the thusly positioned bag bottom is accomplished by moving the clamping platen 602 of the heat-sealing assembly 600 downwardly. The heat-seal bar 604 seals the infolded end tabs in the areas where they are commonly overlapped forming a bottom bag closure as illustrated by E in FIGURE 3. The shape of the protruding sealing surfaces on the heat seal bar 604 will depend upon the configuration formed by the infolded and overlapped side flaps and end tabs in the bottom closure. Hence, it should be understood that the present invention can be readily adapted to accommodate a wide variety of different shapes and sealing configurations. While not narrowly critical, a heat-seal width of about ⅛ inch is usually adequate to provide a good bond between the overlapped plies of film in the bottom closure. Since the seals in the bottom closure are made through overlapped plies of film against an internal work piece formed by the trapezoidal leaves, the closure exhibits excellent strength.

Upon completion of the heat-seal forming the bottom closure, the heat-sealing assembly 600 is retracted, first retracting the heat-seal bar 604 and then the clamping platen 602. Cooling air is then directed onto the surface of the heat-sealed bottom closure by means of air nozzles mounted within the trunnion mounting 150. The air nozzles are activated upon completion of retracting the heat-sealing assembly 600 and are automatically shut off upon completion of the subsequent counter-rotation. Obviously, other cooling means within the knowledge of those skilled in the art can also be employed.

The apparatus of Stations I and II are then counter-rotated in a counter-clockwise direction through the same 180° arc by activating drive cylinder 138 to extend the drive cylinder rod 136, causing the rotating assembly to operate in reverse. As the apparatus is counter-rotated, the foldover rolls 154 are retracted and, upon completion of the counter-rotation, the apparatus of Stations I and II appears as illustrated in FIGURE 13. The upper clamping platen assembly 160 is closed and the magnetic clamps 166 are still in their retracted position so that the newly formed bottom bag closure lies flat against the extended trapezoidal leaves 114.

In order to advance the continuous tubular film 10 another working bag length, the gripper assembly 700 is advanced upwardly, its components appear as shown in FIGURE 13. While the gripper assembly 700 advances upwardly, the magnetic clamps 166 in the upper clamping platen assembly 160 are rotated toward each other partially collapsing the bag bottom by forcing the trapezoidal leaves 114 to close. The trapezoidal leaves 114 cannot be completely closed during this operation since part of the bag bottom is wedged between them leaving a sufficient, triangularly-shaped opening into which the gripper wedge 708 is inserted. The gripper assembly 700 is advanced un-

til the gripper wedge **708** is positioned in the opening of the parially collapsed bag bottom with the gripper fingers **702** positioned outside the partially collapsed bag bottom. At this time, the magnetic clamps **166** in the upper clamping platen assembly **160** are retracted. As the magnetic clamps **166** retract, the bag bottom contact the gripper clamps **704** of the gripper assembly **700** through the notches **116** in the trapezoidal leaves **114**. The bag bottom remains in this position while the magnetic clamps **166** are completely retracted into their recessed housing in the upper clamping platen assembly **160**. As the magnetic clamps **166** are retracted into their recessed housing, the gripper wedge **708** is advanced still further until the gripper clamps **704** firmly secure the bag bottom to the gripper wedge **708**. Next, the upper clamping platen assembly **160** is opened. Now, the tubular film **10** is ready to be advanced one working bag length as shown in FIGURE 4.

In order to maintain proper tension upon the tubular film **10** after counter-rotation, rubber clamp **28** in the feed mechanism shown in FIGURE 1 is electrically synchronized to engage idler transport roll **24** when the upper clamping platen assembly **160** opens. By engaging idler transport roll **24**, rubber clamp **28** momentarily brakes any further advancement of the tubular film **10**. Once rubber clamp **28** has engaged transport idler roller **24**, reset cylinder **26** is activated extending its pusher rod downwardly against floatably mounted idler transport roll **22**. In this manner, the slack in the continuous film **10** is taken up and proper film tension is restored. When the pusher rod of reset cylinder **26**, is returned to its starting position, rubber clamp **28** is disengaged from idler transport roll **24** releasing the braking action and the continuous tubular film **10** is free to advance and begin again the cycle of forming another bottom bag closure.

The manner of forming the bottom end closure by infolding and overlapping the side flaps and end tabs described hereinabove is a preferred embodiment of the present invention since a strong end closure is obtained while a minimum of film is employed. However, it should be understood that the apparatus of Stations I and II is equally applicable to form other types of end closure constructions and can even be used to form a rectangular end closure without any cuts in the continuous tubular film. For example, the cutting members **173** could be eliminated, the spreading of the trapezoidal leaves **114** would then form a pair of opposed similar infolded end portions and a pair of opposed similar outfolded side portions in the end of the tube. The foldover rolls **154** would then infold the side portions over the infolded end portions, and the heat-sealer **600** would heat-seal the overlapping portions together against the spread leaves.

Furthermore, the resilient, internal work surface provided by the hinged trapezoidal leaves **114** can be spread and collapsed by the magnetic clamps, collapsing rolls, or by any other convenient means. The work surface provided by the leaves **114** is geometrically shaped to infold the end tabs, **906** and **908**, and side flaps, **905** and **907** (FIG. 3) snugly thereabout and can be altered to accommodate other geometric forms of end closure structures. However, the trapezoidal leaves can also be hinged such that only one leaf is rotatable while the other is fixedly mounted and the internal work surface obtained by rotating the rotatably mounted hinged leaf.

STRUCTURE-STATION III

As illustrated in FIGURES 36 and 37, Station III comprises, generally, the lower clamping platen assembly **180** mounted on the indexing table **60**, a suction means **302** for slightly raising only the upper ply of the two plies of that portion of the flattened tubular film **10** that was folded onto the upper surfaces of the lower clamping platen assembly **180** at Stations I and II, a shuttle assembly **330** for outfolding the raised ply of film onto the inboard lower platen member **182** automatically infolding the end tabs of the bag blank while simultaneously inserting a valve sheet **310** across the top surface of both out-folded side flaps of the bag blank and under the bottom surface of one end tab, a clamping means **312** for holding the forward end of the valve sheet **310** against the inboard lower platen member **182** (FIG. 2) as the shuttle assembly **330** is withdrawn, a heat-sealer **320** for sealing the valve sheet to the overlying end tab, and cutting means **314** for severing the valve sheet at the outer edge of the side flap outfolded on the outboard lower platen member **184**.

With reference to FIGURES 36 and 37, the suction means **302** comprises a bar **304** having a row of suction cup **306** mounted thereon, the suction cups **306** being connected to suitable vacuum lines (not shown). The bar **304** is mounted on the ends of arms **308** which extend from a rotatable sleeve **301** on rod **303**. The sleeve **301** is also connected to a pneumatic cylinder **305** so that the suction cups **306** can be lowered onto the film on the outboard lower platen member **184**, raising the film slightly to separate the two plies of film while the shuttle assembly **330** is inserted therebetween. The suction cups **306** are then retracted to their original position. In other words, the bar **304** can be moved to three different positions: a completely retracted position, a completely advanced position where the suction cups **306** are in contact with the film on the outboard lower platen member **184**, and an intermediate position where the suction cups **306** hold the upper ply of film above the lower film ply while the shuttle assembly **330** is inserted therebetween. The control mechanism for moving the bar **304** to these three positions is described in greater detail hereinbelow.

The shuttle assembly **330** comprises a shuttle plate **332** resting on a supporting table **334** and connected to a rigid shuttle carriage **336**. The carriage **336** is pivotably connected to an arm **338** and pneumatic cylinder **340** so that the shuttle plate **332** can be advanced and retracted across the surface of the lower clamping platen assembly **180**. The width of the shuttle plate **332** is about equal to the smallest width of the side flaps of the bag blank **900** so that insertion of the shuttle plate **332** between the film plies outfolds the upper side flaps and causes the end tab to infold. The outboard end of the shuttle plate **332** is preferably slightly elevated above the table **334** so that the shuttle is progressively lowered slightly as it is advanced across the surface of the lower clamping platen assembly **180**. One side of the platen **332** is provided with a clamping plate **342** on the upper surface thereof so that the valve sheet **310** can be held in place between the two plates **332** and **342** as the shuttle is inserted between the plies of the bag blank. The clamping platen **342** is required to push the thin flexible valve sheet **310** between the side flaps and end tab of the bag blank on the lower clamping platen assembly **180**. The inboard edges of both plates **332** and **342** are provided with notches **344** so that the inserted valve sheet can be clamped to the inboard lower clamping platen member **182** while the shuttle is withdrawn. The plate **342** is provided with an additional notch **346** to permit engagement of the heat-sealer **320** with the valve sheet.

A supply roll **350** of flat film **352** for forming the valve sheet is mounted above the shuttle plate **332** in line with the clamping plate **342**. The width of the valve film on roll **350** should be smaller than the width of the side flaps on the bag blank, and is, preferably, about half the width of the side flaps. The valve film **352** is passed downwardly from the roll **350** over idler rolls **354** and **356** and in between the plates **332** and **342**. The film is unwound from the roll **350** by the action of the shuttle as it is advanced over the lower clamping platen assembly **180**. Mounted on the outboard portion of the shuttle carriage **336** is an angular snubbing clamp **348** connected

to a pneumatic cylinder **341** so that it can be moved horizontally. In its advanced position, the snubbing clamp **348** engages the film **352** and presses it against the roll **356**, thus locking the llm and also slightly rotating the roll **356** in the reverse direction so as to tension the film **352** for subsequent cutting at the outboard edge of the lower clamping platen assembly **180**. The lower surface of the horizontal portion of the snubbing clamp **348** is preferably lined with rubber so that the clamp does not scratch or tear the film **352**. The snubbing clamp is always in its advanced position except when the shuttle is being retracted, i.e., when the film **352** is being fed between the plates **332** and **342**.

The cutting means **314** is mounted adjacent to the suction means **302** (see FIG. 37) and comprises an electrically heated cutoff wire **316** held taut between two arms **318**. The arms **318** are swingably mounted on the rotatable rod **303** which is driven by a pneumatic cylinder **137**, thus moving the wire **316** in an arc around the rod **303**. The cutoff wire **316** is located so that it strikes the valve sheet just off the outboard edge of the outboard platen member **184** as it is lowered. The wire **316** extends over the outboard platen member when the arms **318** are horizontal so that the wire is moving outwardly over the platen member as it strikes the valve film, thereby subjecting the film to a slight degree of tension as it is cut. As the film is cut, the tension is released and the cut edge of the valve sheet springs back to the edge of the platen so that it is coextensive with the end of the outfolded side flap of the bag blank.

The clamping member **312** is movably mounted in a vertical track **313** above the inboard edge of the inboard lower clamping platen member **182** so that the clamping member **312** can be vertically advanced and retracted with respect to the platen surface. The clamping member **312** comprises a rigid bar **315** from which are suspended two gripper clamps **311** positioned to mate with the notches **344** in the inboard edges of the plates **332** and **342**.

The heat-sealer **320** is mounted on the outboard side of the clamping member **312** over the ends of the two lower platen members **182** and **184**. The heat-sealer **320** is identical to the heat-sealer **600** described hereinabove except that the face of the heat seal bar in the sealer **320** is provided with only a single protruding sealing surface. This sealing surface extends perpendicularly to the mating surfaces of the lower clamping platen members **182** and **184** and is adapted to seal the valve sheet to the overlying end tab along a line parallel to the internal end of the end tab, as hereinafter described.

OPERATION-STATION III

As the lower clamping platen assembly **180** and the bag blank **900** clamped therein are moved into position at Station III, both plies of the upper portion of the bag blank are folded over onto the outboard platen member **184** and held there by the suction cups **188**. The form of the bag blank **900** at this point is shown as item F in FIG. 3. After the bag blank has been registered at Station III, the suction means **302** is lowered into engagement with the upper ply of the folded film and then raised to its intermediate position. This separates the two plies of film so that the shuttle assembly **330** can be inserted therebetween. The shuttle assembly **330** is advanced across the upper surface of the lower clamping platens **182** and **184**, outfolding the upper side flap of the bag blank onto the inboard platen member **182** concomittantly causing the end tabs to be infolded. At the same time, the shuttle assembly **330** feeds the valve sheet **310** across the outfolded side flaps and in overlapping relationship with one of the infolded end tabs. The suction means **302** is retracted as the shutle begins to advance. When the shuttle **330** is in its most advanced position, Station III appears as shown in FIG. 16, and the bag blank **900** appears as item G in FIG. 3. Although the valve sheet **310** is shown as being inserted under the overlapping end tab, it can similarly be inserted over the end tab, provided a backup means is employed beneath the end tab so that the valve sheet and end tab can be heat-sealed together without being sealed to the underlying portions of the bag blank.

While the shuttle assembly **330** is still in its most advanced position, the heat-sealer **320** is lowered (first the clamping platen, then the heat-seal bar) onto the end tab overlying the valve sheet **310** to seal that end tab and the valve sheet together along a line extending across the internal end of the tab. The shuttle plate **332** beneath the valve sheet **310** prevents the valve sheet from being sealed to the underlying side walls of the bag.

After the heat-seal has been made, the clamping member **312** is lowered to clamp the inboard edge of the valve sheet firmly to the lower inboard clamping platen **182**. At this point, Station III appears as shown in FIG. 17. The heater-sealer **320** and the shuttle **330** are then retracted to their original positions. As the shuttle is retracted, the snubbing clamp **348** is advanced to lock the valve film **352** against the roll **356** and to tension the valve film between the clamp **312** and the roll **365**. The cutting means **314** is then swung downwardly so that the hot cutoff wire **316** severs the valve sheet evenly with the edge of the outboard platen member. As the hot cutoff wire **316** is advanced, the valve film tensioning mechanism and shuttle are rotated upwardly away from the upper surface of the lower clamping platen assembly **180** to their intermediate "waiting" position in order to provide clearance between the top of the indexing table **60** and the top of the bag blank **900** when the valve film sheet is severed. The same cutting and tensioning mechanism can be employed regardless of whether the valve film sheet is of single or multiple plies. At this point, Station III appears as shown in FIG. 18. The cutting means **314** and the clamping member **312** are then retracted, thus completing the operations at Station III. Before the shuttle **330** advances the valve film **352**, the hot cutoff wire **316** is rotated and positioned above the shuttle **330** prior to severing the pretensioned valve film. Once the valve film is severed, the hot cutoff wire **316** is reset at its starting position beneath the shuttle **330**.

As shown in FIGS. 2 and 27, a forming platen **80** is pivotably mounted at each of the four sides of the indexing table **60**. One end of each forming platen **80** is pointed to mate with the apex in the hexagon formed in the film of the bag blank **900** when the end tabs are infolded. The pointed end of each forming platen **80** is preferably provided with an air nozzle **82** to blow the film off the platen after the side flaps and end tabs have been heat-sealed thereagainst. The forming platens **80** are mounted on arms **84** which are pivotably connected at the center of the indexing table **60**, the inner ends of the arms **84** are provided with cam followers **86** which follow a stationary cam groove **89** machined into the underside of a radial disc cam **62** as illustrated in FIGURE 26 and which is centrally mounted on the top of the indexing table **60**. The upper surfaces of the forming platens **80** are covered with silicone rubber which provides a resilient surface for the hereinafter described heat sealing operation.

Rollers **88** on the side edges of the platen **80** are mounted in horizontal tracks **87** so that the platen **80** can be moved horizontally. The tracks **87** slope downwardly slightly so that the forming platen **80** is lowered as it is advanced, thus facilitating entry of the forming platen **80** into the overlapped flaps and seating the forming plate **80** into the pocket formed by the distal end tab without dragging across the flaps. In order to maintain the forming platen **80** horizontal as it is lowered along the sloped track **87**, it is provided with two pairs of rollers **88** with the axis of the two rear rollers being slightly above the axis of the two front rollers. As the lower clamping platen **180** and the bag blank **900** are moved from Station III to Station IV, the cam grooves **89**

cause the arms 84 and the forming platen 80 to move parallel to the edge of the indexing table 60 in a direction counter to the direction of movement of the bag blank. The platen 80 passes over the middle of the valve sheet 310 and the end tab joined thereto and, since the forming platen 80 is also being progressively lowered, under the opposed end tab of the bag blank. The insertion of the platen 80 is illustrated in item H in FIG. 3. The platen 80 then forms the working surface for the operations carried out at Station IV.

STATION IV

As shown in FIGS. 38 and 39, Station IV comprises the lower clamping platen assembly 180 mounted on the indexing table 60 and a heat-sealer 400. The heat-sealer 400 is substantially identical to the heat-sealer 600 described above for Stations I and II except for the configuration of the protruding sealing surfaces on the heat-seal bar. The face of the heat-seal bar in the sealer 400 is shown in FIG. 40 and comprises a heat-seal bar 401, and clamping platen 403; two long parallel sealing surfaces 402, 404 to join the infolded side flaps together in the overlap; two short sealing surfaces 406, 408 parallel to the surfaces 402 and 404 to join the infolded ends of the valve sheet 310 to the infolded side flaps and two transverse surfaces 414, 416 to join the valve sheet 310 across the side flaps at the valve end of the bag closure; and two diagonal surfaces 410, 412 to join the infolded side flaps to the edges of the end tab at the other end of the closure.

As described above, the forming platen 80 is inserted over the infolded end tab 902 at the valve end of the bag closure and under the infolded end tab 904 at the other end of the bag closure as the bag blank is rotated between Stations III and IV. This forming platen 80 then forms the working surface for all operations performed at Station IV. These operations include infolding the side flaps 901, 903, and those portions of the valve sheet 310 which overlie the side flaps, and then heat-sealing the side flaps, the valve sheet, and the end tabs together in the overlaps. The side flaps 901, 903 are infolded in the same manner as the side flaps of the bottom closure were infolded at Stations I and II, i.e., the foldover rolls 186 are advanced through the openings in the lower clamping platens 182, 184 to fold the side flaps 901, 903 inwardly in overlapping relationship with each other and with the infolded end tabs 902, 904 and the valve sheet 310. The infolding of the side flaps also infolds those portions of the valve sheet which overlie the side flaps.

While the foldover rolls 186 are still in their advanced positions holding the side flaps 901, 903 and the ends of the valve sheet 310 in the infolded positions, the heat-sealer 400 is lowered as illustrated in FIGS. 19 and 20. The heat-sealer 400 operates in the same manner as the sealer 600 described for Stations I and II, the clamping platen being lowered first and then the heat-seal bar. The sealing surfaces 402, 404 join the side flaps to each other and to the infolded ends of the valve sheet; the sealing surfaces 414, 416 join the side flaps to the valve sheet transversely to the surfaces 402, 404, the surfaces 406, 408 join the valve sheet to the infolded portions of the side walls; and the surfaces 410, 412 join the edges of the side flaps to the edges of the end tab 904. The heat-sealer 400 and the foldover rolls 186 are then retracted. This completes the valved top closure, and the bag appears as item J in FIGURE 3.

The completed bag 910, held by the lower clamping platen assembly 180 is next rotated from Station IV toward Station I. During rotation, the forming platen 80 is withdrawn. As the completed bag approaches Station I, the completed bag 910 is engaged by the unloading and transfer device 800.

While the apparatus of Stations I and II, III and IV have been described above with specific reference to the forming of a valved end closure, it is obvious that this apparatus is equally applicable to the production of other end closures which do not require an internal forming mandrel. For example, the shuttle assembly 330 could be used to insert a membrane sheet which overlaps both infolded end tabs, the end tabs then being heat-sealed to the edges of the membrane sheet by using the shuttle plate as a back-up platen. The side flaps would then be infolded and heat-sealed together in the overlap by using the forming platen 80 and foldover rolls 186 as described above. The apparatus of Stations I and II, and III and IV can also be used to form end closures which do not require the flat forming platen 80. The apparatus can also be similarly employed to produce thermoplastic film bags having filling valves in both end closures.

STRUCTURE-UNLOADING AND TRANSFER DEVICE

As illustrated in FIGURES 41, 23 and 25, the unloading and transfer device 800 comprises a vacuum cup 802 pivotably mounted to a pair of rotating arms 801, 803 which are connected to a gear drive 805 through a pair of hinged drive legs 804, 806. The drive legs 804, 806 are hinged such that rotation of the vacuum cup 802 through an arc results in a knee-flexing action of the drive legs. One drive leg 806 is pivotably connected to the gear drive 805 and is powered by the movement of the gear. The gear drive 805 can consist of a pair of meshed circular gears having equal diameters or reduction gears one of which powers the drive leg 806 while the other transfers power to the first gear.

A full gear-to-power drive leg 806 can also be employed with a semicircular transfer power gear. The transfer power gear can be made to engage the power gear through a predetermined revolution and counter-revolution by means of a pivotably mounted cam and cam follower linkage. The various drive combinations which can be employed to rotate the vacuum cup 802 through a predetermined arc are well known to those skilled in the art.

The drive gear segment is conventionally powered by means of an air cylinder 808 which also provides the vacuum for the vacuum cup 802 through its pneumatic cylinder 810. The vacuum cup 802 is rotated through an arc of about 120°. However, since the drive gear segment is adjustable, it is obvious that the vacuum cup 802 can be rotated through any desired arc. At the extremity of the arc through which the vacuum cup 802 is rotated, there is positioned a take-away conveyor mechanism (not shown) to accept the released completed bag 910.

OPERATION-UNLOADING AND TRANSFER DEVICE

As the completed bag 900, held by the lower clamping platen assembly 180, is rotated in the indexing table 60, from Station IV to Station I, a cam switch activated by the index drive 510, causes air cylinder 803, to advance the suction cups 802. The suction cups meet the completed bag 900, as it moves into the Station I position. When the cups 802, engage the bag and a suction grip is developed, a vacuum switch simultaneously signals the lower clamping platens 182 and 184, to open, releasing the bag, and air cylinder 803 to retract. As soon as air cylinder 803 has retracted far enough to clear the machine an electrical signal activates all stations to begin the next operating cycle. Near the end of the retraction stroke of air cylinder 803, a limit switch activates air cylinder 808, to rotate air cylinder 803, through an arc of approximately 120°. At the end of the rotation, vacuum is broken by a time delay relay and the completed bag 900 drops onto, for example, a take-away conveyor and is transported away from the apparatus. After a time interval, provided by a time delay relay, air cylinder 808, is retracted to return air cylinder 803, to its initial position and complete the cycle.

DRIVE FOR INDEXING TABLE

Referring to FIGURE 28, the horizontally rotatable indexing table **60** is intermittently driven by power from a continuously driven motor **500** with a flywheel directly coupled thereto. This main drive motor **500** powers a clutch-brake assembly **502** energizing the input of a double shafted speed reducer **504**. Opposite the motor end of the speed reducer input is mounted an electrically operated brake **506**. A silent chain drive **508** connects the output of the speed reducer **504** to the input of an intermittent motion drive **510**. The intermittent motion drive **510** is preselected to couple an input rotation of 300° to an output rotation of 90° with the remaining 60° of input rotation providing an output dwell period during which the indexing table is stationary. The square, horizontally rotatable indexing table **60** is centrally mounted on the output shaft **512** of the intermittent motion drive **510** and rotates 90° per bag cycle.

INDEXING CONTROLS

Controls to sequence the transfer of the bag blanks between Stations I and II, III and IV and the operations of the bag blanks at the various stations are arranged as a combination of mechanical-pneumatic-electric controls interrelated on the "cascade" principle. Thus, input to a primary control triggers one or more units of a secondary control that trigger units of a tertiary control and so forth. The manner in which the mechanical-pneumatic-electric controls can be combined and interrelated to accomplish the various functions of the apparatus of the present invention fall well within the scope of those skilled in the art and require no further elaboration. A similar cascading principle of operation is set forth in detail in co-pending application, entitled Bag Making Machine, Ser. No. 290,665, filed June 26, 1963.

GENERAL MACHINE OPERATION

During the dwell period of the indexing table **60**, that is, when the indexing table is stationary and indexed at Stations I–IV, the tubular film is simultaneously advanced one working bag length at Stations I and II and the film is blanked to form the side flaps and end tabs for the top and bottom closures of successive bag blanks. Meanwhile, at Station III, the valve film **310** is inserted over the outfolded side flaps and one end tab and is heat-sealed beneath the opposite end tab. At the same time, at Station IV, the side flaps and non-valve supporting end tab are infolded in overlapping relationship and heat-sealed to form the top closure.

Next, the indexing table **60** is rotated 90° so that the bag blank located at Station I is positioned at Station II, that of Station II is positioned at Station III and, the bag blank of Station III is positioned at Station IV.

During the first 90° rotation of the indexing table **60**, the blanked tubular film **10** positioned over the internal mandrel **110** at Stations I and II is rotated through an arc of 180°, the side flaps and end tabs being overfolded during rotation.

Meanwhile, the side flaps and end tabs of the bag blank **900** being rotated between Stations II and III are outfolded and the forming platen **80** is inserted into the top closure of the bag blank being rotated between Stations III and IV. At the same time, a completed bag **910** engages the unloading and transfer device **800** as it is rotated from Station IV toward Station I and is unloaded onto a take-away conveyor or other convenient means.

During the next dwell period of the indexing table **60**, the bottom closure of the bag blanks at Stations I and II are heat-sealed and the bag blanks counter-rotated through 180° as Stations III and IV perform their dwell period operations.

The indexing table **60** is then rotated another 90° so that the bag blank at Station II, formerly at Station I, is positioned at Station III and the bag blank of Station III, formerly at Station II, is positioned at Station IV. The completed bag of Station IV is unloaded as described hereinabove.

During the next successive dwell period, the cycle of Stations I and II begin again while Stations III and IV continue their operations.

While various specific forms of the present invention have been illustrated and described herein in some detail, it will be apparent that the same are susceptible of numerous modifications within the scope of the invention. For example, although the invention has been described with particular reference to specific types of bottom and top closures for the thermoplastic film bag, the subject apparatus is equally applicable to other types of closure structures. As mentioned above, the internal mandrel and the elements associated therewith can even be used to form an end closure in a flattened tube with no flaps or die cuts whatever. Moreover, although the arrangement of the various operating stations has been described as circular and intermittent, these stations can be positioned in a linear arangement, either horizontally of vertically. In the same manner, the driving system can be either intermittent, continuous, or combinations of both. Similarly, one or more operating stations can be duplicated or multiples thereof provided to service a variety of production requirements or needs as desired. Also, while reference has been made to a mechanical-pneumatic-electric control system, the apparatus can also be controlled by an electrical system, a hydraulic system, or any other suitable control system. Similarly, it will be apparent that without substantial change, the apparatus of the present invention can be applied to any heat-sealable thermoplastic film of various thicknesses, and can produce sacks and bags of various sizes, either opened or closed, with or without valves, single-walled or multi-walled, and using either seamed or seamless tubing. If it is desired to produce a bag with valves at both ends, Stations I and II can be supplied with apparatus identical to that described at Station III. That is, Stations I and II along with Station III can be used alone as well as in combination with each other.

What is claimed is:

1. An apparatus for continuously making industrial shipping bags having lapped, heat-sealed end closures which comprises, in combination:

(a) a feed mechanism for supplying a continuous web of flattened, tubular thermoplastic film;

(b) means for disposing an internal mandrel workpiece within said flattened tubular film;

(c) means for fixedly securing the internal mandrel within the flattened tubular film;

(d) means for severing the tubular film simultaneously blanking a top closure and bottom closure;

(e) means for infolding a pair of opposed end tabs in the blanked end of the tubular film;

(f) means for rotating the blanked tubular film together with the internal mandrel through a predetermined arc;

(g) means for infolding a pair of opposed side flaps in the blanked end of the tubular film during its rotation;

(h) means for sealing a first rectangular closure in the blanked end of the tubular film at the extremity of the rotational arc;

(i) means for counter-rotating the tubular film together with the internal mandrel;

(j) means for displacing the thusly blanked tubular film relative to the internal mandrel along the longitudinal axis of said blanked tubular film;

(k) means for securing the displaced blanked tubular film in a conveying means;

(l) means for outfolding a pair of opposed side flaps and infolding a pair of opposed end tabs and temporarily retaining said flaps in this position in the conveying means;

(m) means for disposing a flat forming platen in the blanked end of the thusly secured tubular film;
(n) means for infolding a pair of opposed side flaps in the thusly blanked end of the tubular film;
(o) means for sealing a second rectangular closure in said thusly blanked end of the tubular film;
(p) means for withdrawing the flat forming platen from the second sealed rectangular closure; and
(q) means for removing the completed shipping bag from the conveying means.

2. The apparatus of claim **1** wherein the feed mechanism comprises, in combination:
(a) a plurality of spindle-mounted supply rolls each carrying a continuous web of flattened, tubular, thermoplastic film, each supply roll being provided with its own brake mechanism;
(b) multiple sets of a plurality of fixed, axially mounted idler transport rolls, each set of which is aligned to coact with at least one supply roll, about which idler transport rolls the continuous web of tubular film from the supply rolls is laced and threaded carrying and transporting the web of tubular film;
(c) a plurality of sensing nozzles within said sets mounted adjacent to the idler transport rolls to align the longitudinal edges of the flattened tubular film as said film passes said nozzles;
(d) at least one cylinder-operated snubbing clamp within said sets mounted adjacent to and cooperating with the face of at least one transport idler roll to impart a braking action thereto;
(e) at least one floatably mounted idler roll within said sets positioned between a pair of fixed, axially mounted transport idler rolls, the face of said floatable mounted idler roll cooperating with a cylinder rod which is powered by a pneumatically driven and independently mounted reset cylinder;
(f) an independently mounted electronic sensing device within said sets positioned to receive impulses from one flattened side of said tubular film;
(g) an independently mounted light source within said sets positioned to cooperate with said electronic sensing device;
(h) at least one rotatably mounted transport idler roll within said sets positioned between a pair of fixed, axially mounted transport idler rolls, said rotatably mounted idler roll being pivotably connected to and driven by an independently mounted air cylinder; and
(i) at least one pair of tangentially mounted idler rolls within said sets between which the web of flattened tubular film is passed and guided onto an internal mandrel.

3. The apparatus of claim **1** wherein the internal mandrel workpiece comprises, in combination:
(a) a relatively thin, flat mandrel capable of being positioned within a continuous web of flattened, tubular thermoplastic film, said internal mandrel having a pair of opposed leaves hingeably connected at one end;
(b) means for disposing said internal mandrel within the flattened tubular film positioning the ends of the hinged leaves of said internal mandrel in the same direction as the movement of the flattened tubular film;
(c) means for fixedly securing said internal mandrel within the walls of said flattened tubular film;
(d) means for extending the hinged leaves of said internal mandrel to a substantially transverse position relative to the longitudinal axis of said tubular film, the side edges of the leaves engaging the walls of the tubular film;
(e) means for rotating the fixedly secured internal mandrel together with said flattened tubular film through a predetermined arc;
(f) means for infolding, during rotation, a pair of opposed side flaps in overlapping relationship in a blanked end of the tubular film over the extended leaves of the internal mandrel;
(g) means for sealing said opposed infolded and overlapping side flaps to each other and to a pair of previously infolded opposed end tabs to form a first rectangular end closure at the end of the rotational arc;
(h) means for counter-rotating said fixedly secured internal mandrel together with said tubular film having said first rectangular end closure;
(i) means for collapsing the extending hinged leaves of the internal mandrel; and
(j) means for displacing the tubular film along its longitudinal axis relative to the internal mandrel.

4. The apparatus of claim **3** wherein the internal mandrel is equipped with a pair of spring-mounted ears which are centrally linked to each other and to the internal mandrel and which engage the edges of the tubular film assisting to center the internal mandrel within said film while holding the tubular film taut across the surface of the internal mandrel.

5. The apparatus of claim **3** wherein the hingeably mounted leaves of said internal mandrel form a hexagonally shaped surface when they are extended to a substantially transverse position relative to the longitudinal axis of said tubular film.

6. The apparatus of claim **3** wherein the opposed surfaces of the hingeably-mounted leaves are covered with a sheet of heat-resistant material.

7. The apparatus of claim **3** wherein the leaves are hingeably connected to one end of the internal mandrel by at least one pair of sheets of flexible material said sheets being bonded to the outer surfaces of said leaves and to an adjacent surface at the end of said mandrel.

8. The apparatus of claim **7** wherein a portion of the outer surfaces of said leaves is magnetic.

9. The apparatus of claim **7** wherein said leaves have mounted in each corner and adjacent to the side edges of said leaves a pivotably connected, spring activated leaf extension which extension engages the walls of said blanked tubular film when the normal surfaces of the extended hinged leaves fail to engage said walls of the blanked tubular film.

10. The apparatus of claim **8** wherein a portion of the outer edges of said leaves is notched to cooperate freely with the insertion of gripper clamps therebetween.

11. The apparatus of claim **3** wherein a plurality of discs are rotatably mounted at the end of the internal mandrel opposite the hinged leaves, the planar surfaces of said discs being substantially parallel to the planar surfaces of the internal mandrel and a portion of the circumferences of said discs protruding outwardly from the side edges of said internal mandrel engaging the tubular film and centering the internal mandrel in a transverse direction with respect to the longitudinal axis of said film.

12. The apparatus of claim **3** wherein a plurality of spaced rollers are rotatably mounted within the body of the internal mandrel, the surfaces of each pair of spaced rollers protruding outwardly from the planar surfaces of the internal mandrel, each pair of spaced rollers intimately engaging at least one clamping roll through the walls of the tubular film to fixedly secure the internal mandrel within the walls of the flattened tubular film.

13. The apparatus of claim **1** wherein the rotating means comprises, in combination:
(a) a frame;
(b) a plurality of clamping rolls rotatably mounted in the frame, said rolls intimately engaging a plurality of rotatably mounted, spaced rollers in the internal mandrel through the walls of the tubular film fixedly securing the internal mandrel within the tubular film while, simultaneously, permitting the tubular film

to be displaced relative to the internal mandrel along the longitudinal axis of said tubular film;

(c) a linkage bar pivotally connected to the frame at one end and pivotably connected to a drive cylinder at the other end, the rotational moment arm of the linkage bar lying between the two pivot connections; and

(d) a pair of foldover rolls rotatably mounted in the frame which wipe down the blanked opposed side flaps of the tubular film in an infolded, overlapping relationship.

14. An apparatus for continuously making industrial shipping bags having lapped, heat-sealed end closures which comprises, in combination:

(a) a relatively flat, thin internal mandrel fixedly secured within the walls of a web of flattened, tubular thermoplastic film, said internal mandrel having a pair of hingeably mounted leaves at one end capable of being extended to a substantially transverse position relative to the longitudinal axis of said tubular film providing an internal work surface within said tubular film;

(b) a first clamping assembly having at least two members, each of which are disposed opposite one another and on opposite sides of said tubular film which firmly and fixedly engage the tubular film and the internal mandrel within said tubular film therebetween when the two clamping members are moved together;

(c) a rotating mechanism having a plurality of clamping rolls capable of intimately engaging and fixedly securing the internal mandrel within the flattened tubular film during rotation while permitting the flattened tubular film to be displaced relative to said internal mandrel when the rotating mechanism is in its original position, said rotating mechanism being motivated by a linkage bar assembly which has at least two foldover rolls which act to complete an end closure in one blanked end of the tubular film by infolding a pair of blanked opposed side flaps and a pair of blanked opposed end tabs of the tubular film in overlapping relationship;

(d) a heat-seal means positioned to heat-seal said infolded flaps and tabs and form a first end closure while the said tubular film is in an inverted position at the completion of its rotational arc;

(e) a gripper assembly advanced to engage a first end closure upon completion of the tubular film through a counter-rotational arc and advance said tubular film one bag length, said gripper assembly having a gripper wedge disposed between and cooperating with a pair of gripper clamps, which gripper clamps directly engage the tubular film through notches provided therefor in the partially collapsed leaves of the internal mandrel and secure said first end closure to said gripper wedge;

(f) a second clamping assembly positioned below the first clamping assembly having at least two members, each of which are disposed opposite one another and on opposite sides of said tubular film which firmly and fixedly engage said tubular film after it has been advanced one bag length; and

(g) a knife assembly positioned between said first and second clamping assemblies, said knife assembly having a male cutting member and female knife member disposed opposite each other which coact to sever and blank the tubular film disposed therebetween when said members are brought together thereby simultaneously forming flaps for a bottom closure and flaps for a top closure in the severed tubular film.

15. The apparatus of claim **14** wherein the members of the first clamping assembly engage the internal mandrel at a point above the hinged leaves of said internal mandrel permitting the hinged leaves to be freely extended.

16. The apparatus of claim **14** wherein each of the members of the first clamping assembly have a magnetic clamp rotatably mounted to the underside of said members which acts to engage the hinged leaves of the internal mandrel through the tubular film and extend said hinged leaves to a substantially transverse position relative to the longitudinal axis of said tubular film.

17. The apparatus of claim **14** wherein the gripper wedge of the gripper assembly has an included angle of between about 50°–60°, and which gripper wedge is capable of being independently driven in a vertical position disposing said gripper wedge into a more intimate relationship between the partially collapsed hinged leaves of the internal mandrel.

18. The apparatus of claim **14** wherein the male cutting member is equipped with a plurality of cutting edges protruding outwardly from the face of said male cutting member in a direction normal to the plane of the tubular film and the female knife member has a plurality of notches in its face corresponding to and cooperating with the cutting edges of the male cutting member receiving said male cutting edges when the male and female cutting members are advanced toward each other and struck together in the plane of said tubular film, the cutting edges of the male cutting member piercing the plies of the tubular film as they pass into the notches of the female knife member.

19. The apparatus of claim **14** wherein one member of the knife assembly is equipped with a wiper arm rotatably mounted in its lower end, said wiper arm advancing to lay flat upon the upper surfaces of the second clamping assembly that portion of the blanked tubular film which protrudes above the upper surfaces of the second clamping assembly.

20. An apparatus for continuously making industrial shipping bags having lapped, heat-sealed end closures which comprises, in combination:

(a) means for disposing a flat, internal mandrel work piece within the walls of a continuous web of flattened, tubular thermoplastic film;

(b) means for fixedly securing said internal mandrel within said flattened tubular film;

(c) means for severing said flattened tubular film and blanking flaps to form an end closure in one end of said tubular film;

(d) means for rotating said blanked film together with said internal mandrel through a predetermined arc, infolding the blanked flaps in overlapping relationship during rotation and heat-sealing said infolded flaps at the end of the rotational arc to form a first end closure in said tubular film;

(e) means for counter-rotating said tubular film having the first end closure together with said internal mandrel;

(f) means for advancing said tubular film having a first end closure in one end;

(g) means for blanking flaps for forming a second end closure in the other end of said tubular film;

(h) means for outfolding a pair of opposed side flaps and infolding a pair of opposed end flaps in said other end of the tubular film;

(i) a shuttle means for inserting a valve sheet of thermoplastic film across the outfolded side flaps and in overlapping relationship with one of said infolded end flaps in said other end of the tubular film, said shuttle means comprising an upper and lower plate holding the valve sheet therebetween, said upper plate having a notch therein and said lower plate acting as a work surface;

(j) means for heat-sealing said valve sheet to the overlapped, infolded end flap;

(k) means for inserting a movable forming platen beneath the free, infolded end flap and over the heat-sealed valve sheet in said other end of the tubular film;

(l) means for infolding the opposed outfolded side flaps and the end portions of said valve sheet over the forming platen in overlapping relationship with each other and the infolded end flaps;

(m) means for heat-sealing said infolded and overlapping side flaps, end flaps and valve sheet to each other in their common areas of overlap to form a second end closure having a filling valve integral therewith in said other end of the tubular film;

(n) means for withdrawing said forming platen from said second end closure; and

(o) means for unloading a completed, valved, industrial shipping bag from the continuous bag making apparatus.

21. The apparatus of claim **20** wherein a clamping means is provided for securing the leading end of said valve sheet to the lower plate and to the outer end of one of said outfolded side flaps through the notch in the upper plate.

22. The apparatus of claim **20** which includes means for tensioning said valve sheet across the outfolded side flaps and overlapped, infolded end flap and means for severing the tensioned valve sheet at its trailing end along a line parallel to and substantially coextensive with the outer end of the other outfolded side flap.

23. The apparatus of claim **20** wherein the means for advancing said tubular film includes a clamping assembly having two members which are disposed opposite each other with the tubular film firmly and fixedly disposed therebetween, the blanked flaps in said other end of said tubular film being laid flat on the upper surface of one of said clamping members.

24. The apparatus of claim **20** wherein a lifter means outfolds one of the opposed side flaps while the other-side flap remains outfolded on the upper surface of the advancing means and the opposed end flaps are simultaneously infolded permitting the valve sheet to be inserted in overlapping relationship with the outfolded side flaps and one of the infolded end flaps.

25. An apparatus for continuously making industrial shipping bags having lapped, heat-sealed end closures which comprises, in combination:

(a) a feed mechanism for supplying a continuous web of flattened, tubular thermoplastic film to a plurality of fixed operating stations;

(b) a rotating indexing table having mounted thereon a plurality of movable forming platens;

(c) means for positioning said indexing table at the fixed operating stations, at least two of said operating stations performing substantially the same functions each of which has a relatively flat internal mandrel adapted to fit within said tubular film and which include means for fixedly securing said internal mandrel within said tubular film; means for severing and simultaneously blanking flaps for forming a top closure and bottom closure in said tubular film; means for rotating the blanked tubular film together with the internal mandrel through a predetermined arc; means for infolding a pair of opposed side flaps and a pair of opposed end flaps in overlapping relationship in the blanked end of the tubular film about extended, hinged leaves of the internal mandrel; means for heat-sealing said opposed, infolded end flaps and said opposed, infolded and overlapping side flaps at the extremity of the rotational arc to form a first end closure; means for counter-rotating the tubular film having the first end closure; means for advancing said tubular film one working bag length displacing said tubular film relative to the internal mandrel; means for tensioning the thusly advanced tubular film; means for clamping said tubular film above the first end closure; means for severing and simultaneously blanking flaps for forming a top closure and a bottom closure above said clamping means; and means for laying down flat upon the upper surfaces of said clamping means that portion of the blanked film which is above the clamping means;

(d) means for outfolding a pair of opposed side flaps and infolding a pair of opposed end flaps in that portion of the tubular film extending above the clamping means as said film is advanced to another fixed operating station, said operating station having shuttle means for inserting a valve sheet across said outfolded side flaps and in overlapping relationship with one of said infolded end flaps; mean for securing and tensioning said valve sheet in its inserted position; means for heat-sealing said valve sheet to said infolded end portions; and means for severing the trailing end of said valve sheet;

(e) means for inserting a forming platen over the heat-sealed valve sheet, under the opposed infolded end flap and between the opposed outfolded side flaps;

(f) means for infolding the opposed side flaps in overlapping relationship as the tubular film is advanced to a further fixed operating station which station has means for heat-sealing the opposed infolded side and end flaps in their common areas of overlap to form a second end closure having a filling valve integral therewith;

(g) means for withdrawing said forming platen from the second end closure as the film is further advanced; and

(h) means for unloading the completed industrial shipping bag from the continuous bag making apparatus.

26. The apparatus of claim **25** wherein the unloading means comprises a rotatably mounted vacuum cup which engages the flat wall of the completed bag as it is released from the clamping means in the indexing table and which vacuum cup conveys said completed bag to a take-away conveyor means.

27. A process for continuously making industrial shipping bags having lapped, heat-sealed end closures which comprises, in combination:

(a) uninterruptedly supplying a plurality of continuous webs of flattened, tubular thermoplastic film;

(b) severing said flattened tubular film in a plane normal to the flat width of said flattened, tubular film and simultaneously blanking flaps in said severed tubular film for forming a top closure and a bottom closure;

(c) rotating said blanked tubular film through a predetermined arc;

(d) infolding a pair of opposed end flaps and a pair of opposed side flaps in overlapping relationship in one blanked end of said tubular film as said tubular film is being rotated;

(e) heat-sealing the opposed, infolded end flaps and opposed, infolded side flaps to each other in their common areas of overlap at the end of the rotation of said tubular film to form a first end closure in said tubular film;

(f) counter-rotating the tubular film having said first end closure;

(g) advancing said tubular film having said first end closure substantially one working bag length;

(h) outfolding a pair of opposed side flaps and infolding a pair of opposed end flaps in the other blanked end of the tubular film;

(i) inserting a valve sheet across said outfolded side flaps and in overlapping relationship to one of said infolded end flaps in said other blanked end of the tubular film;

(j) securing said valve sheet in its overlapping relationship to said infolded end flap in said other blanked end;

(k) infolding the pair of opposed outfolded side flaps and the ends of said valve sheet in overlapping relationship in said other blanked end; and

(l) heat-sealing said opposed infolded side flaps, the infolded ends of said valve sheet and the opposed, infolded end flaps to each other in their common areas of overlap in said other blanked end to obtain a completed industrial shipping bag.

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