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Johnson

[11] **3,910,008**

[45] **Oct. 7, 1975**

[54] **VACUUM PACKAGING**

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[73] Assignee: **Svenska Manufacturing Corporation,** Santa Rosa, Calif.

[22] Filed: **Aug. 20, 1974**

[21] Appl. No.: **499,051**

[52] **U.S. Cl.** ..... **53/112 A;** 53/141

[51] **Int. Cl.²** **B65B 31/02**

[58] **Field of Search** ..... 53/22 A, 112 A, 141

[56] **References Cited**

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3,449,886	6/1969	Connelly et al.	53/22 A X
3,830,365	8/1974	Krueger et al.	53/22 A X

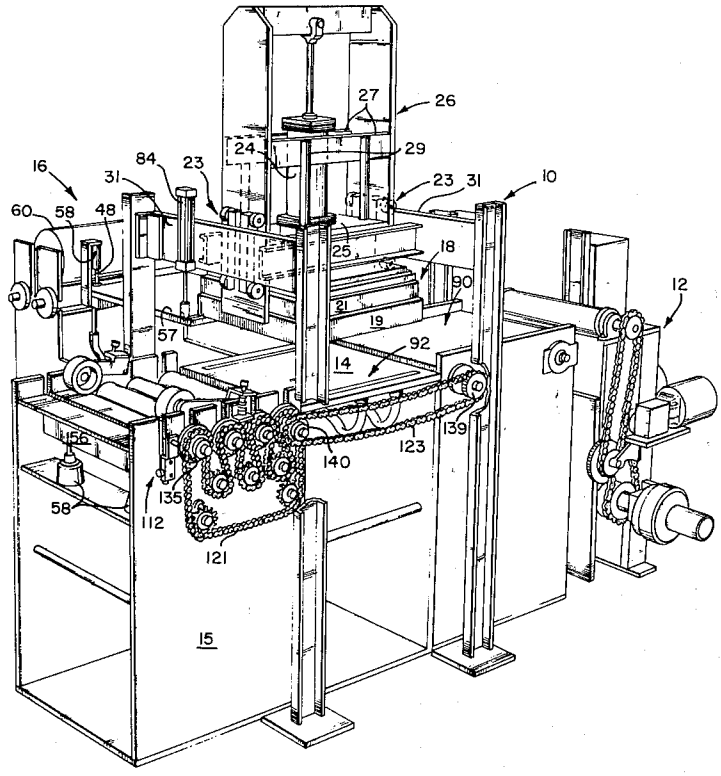
Primary Examiner—Travis S. McGehee

Attorney, Agent, or Firm—Kenneth J. Hovet

[57] **ABSTRACT**

A vacuum packaging system whereby upper and lower films are vacuum sealed about an article. The article to be packaged is placed on a lower film having upwardly extending projections. A vacuum is drawn about the edges of the film and an upper sealing film is positioned above the article and pulled tightly thereabout by the vacuum. The projections allow substantially complete evacuation of air from the enclosed article before the films become completely sealed together to form an airtight package.

8 Claims, 16 Drawing Figures



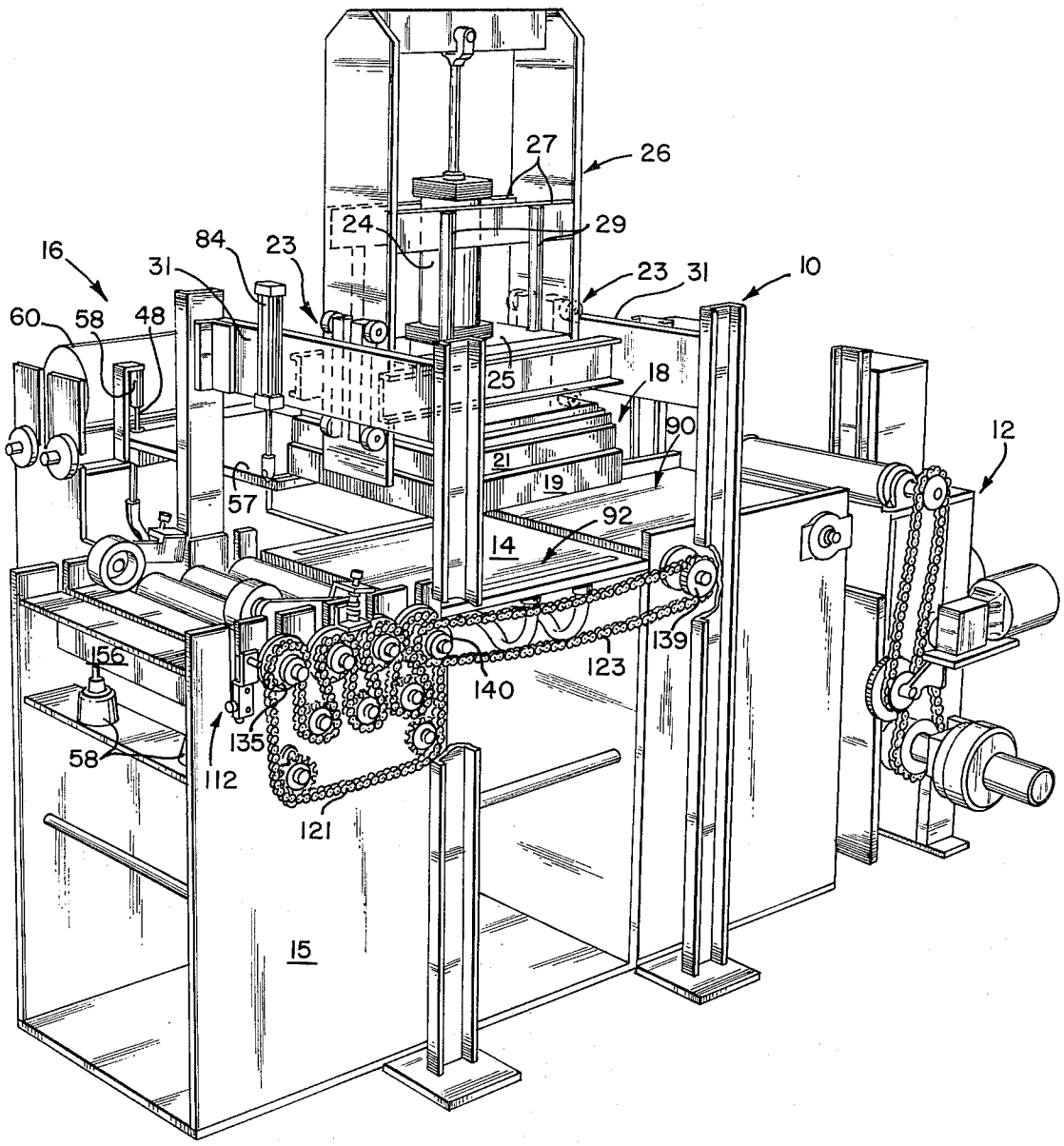

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FIG. 1

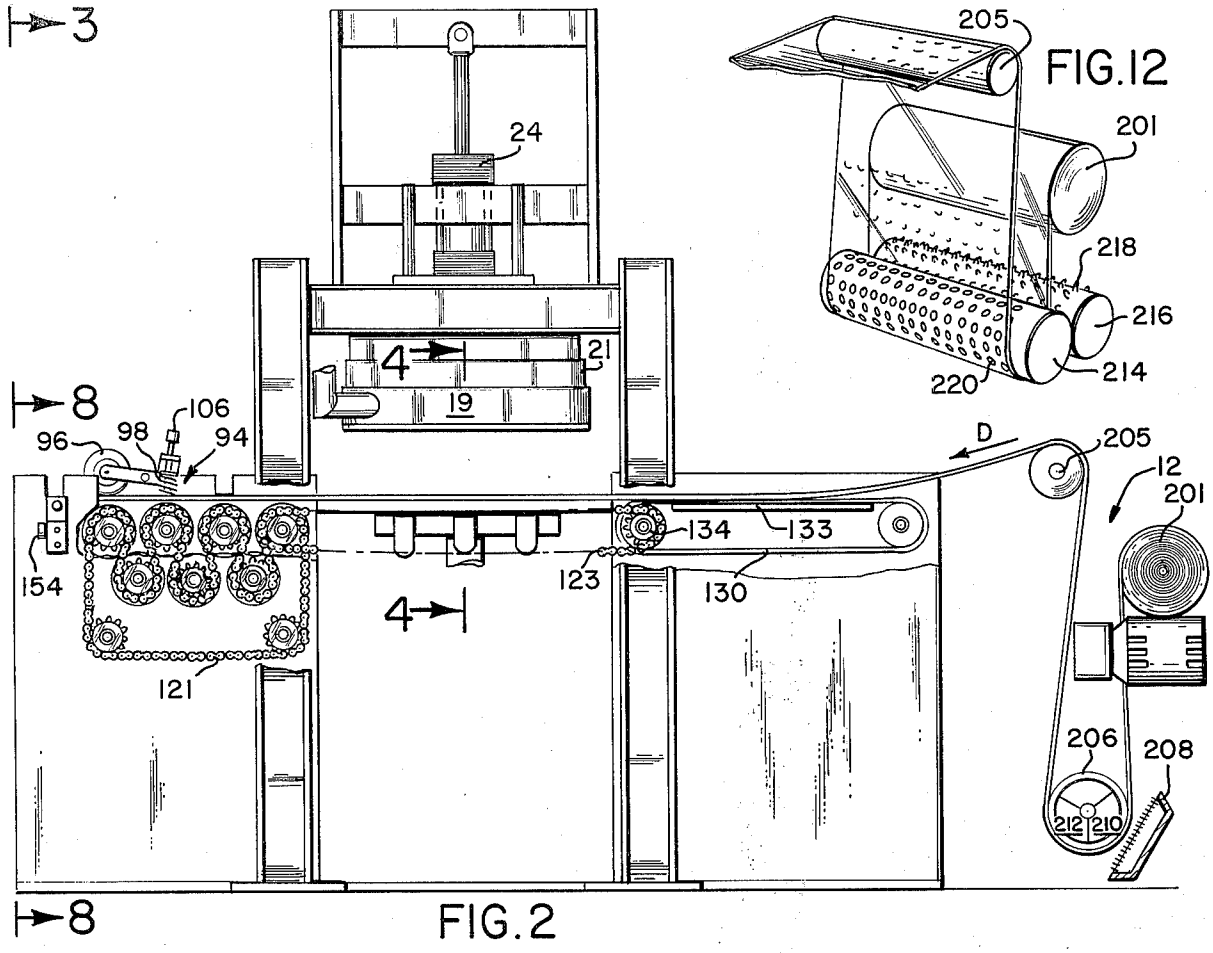


FIG.12

FIG.2

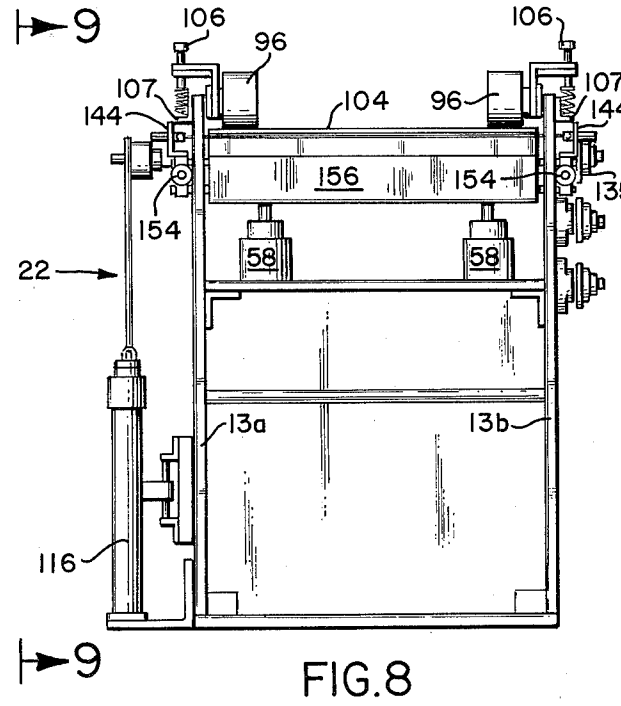


FIG.8

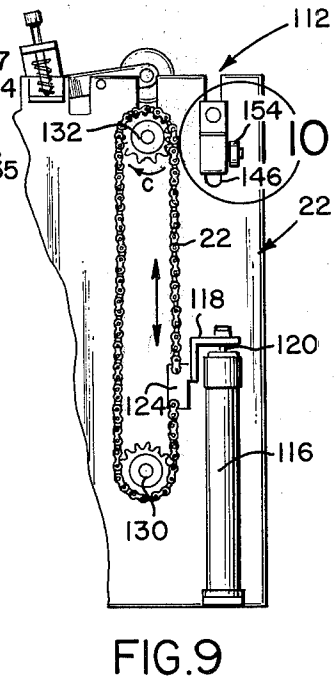


FIG.9

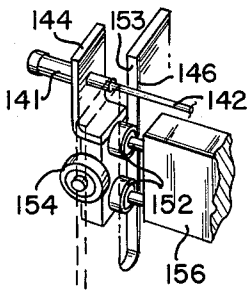
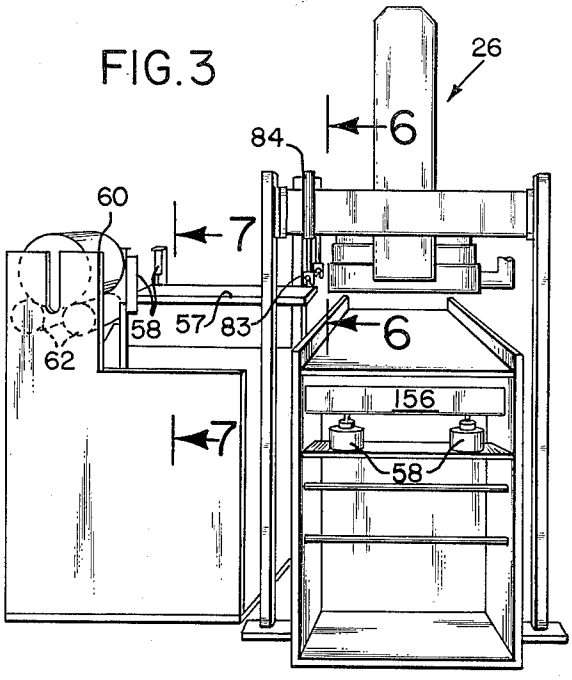


FIG.10

FIG.3



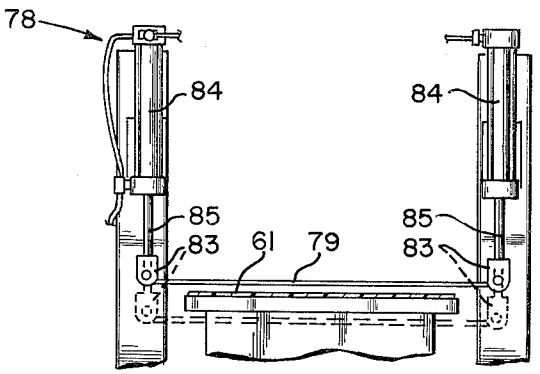


FIG.6

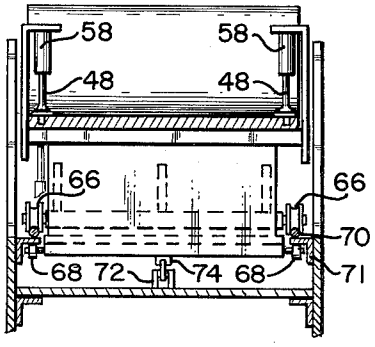


FIG.7

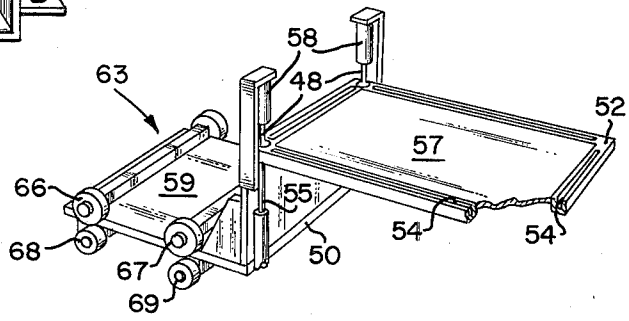
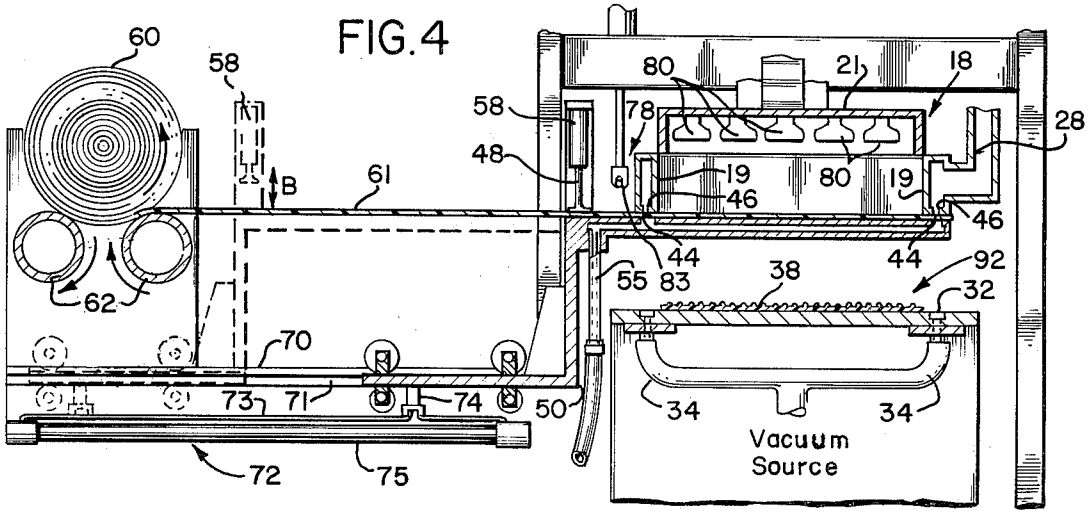


FIG.5

FIG.4



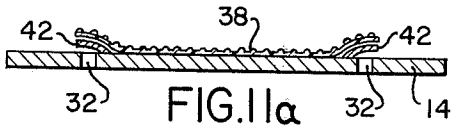


FIG.11a

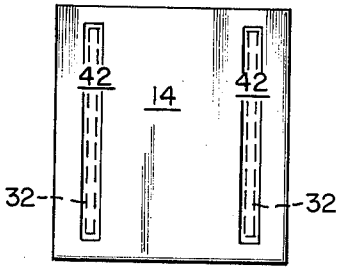


FIG.11b

FIG.13

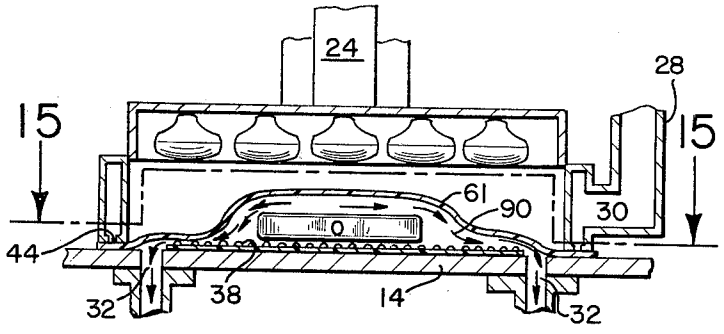


FIG.14

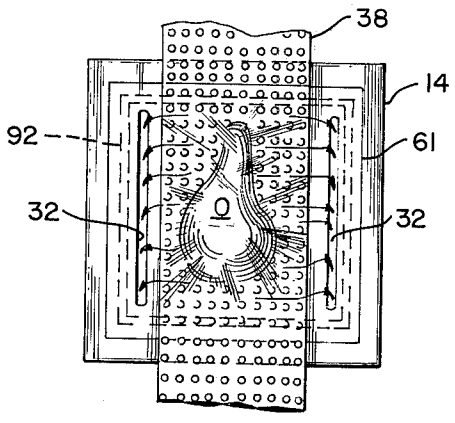


FIG.15

VACUUM PACKAGING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a packaging system and, more particularly, to the vacuum sealing of an article between packaging materials.

2. Description of the Prior Art

Numerous techniques have evolved over the years for packaging products between films, or against a cardboard backing or within a pre-shaped container. For example, U.S. Pat. No. 3,377,770 discloses a skin packaging apparatus whereby a porous base pad is placed over a vacuum platen and a product is placed thereon. Plastic sheet material is heated and stretched tightly over the product by drawing a vacuum through the porous base pad. This process requires numerous manual manipulations and is not suitable for high volume packaging. Additionally, it is not suited for products which are desirably maintained in an airtight condition inasmuch as the porous base pad will allow air to pass back into the package.

U.S. Pat. No. 3,634,993 to Pasco et al. provides a technique for sealing a product between a pair of films by placing the product on a bottom film which is on a heated reciprocable platen. A vacuum is pulled about the periphery of the platen while it is moved into sealing engagement with an upper chamber having an upper film stretched thereacross. when the films contact each other, the vacuum is released and air is injected above and below the films to push out any air lingering about the product. The two films become heat sealed together to form an airtight package.

The above sequence of steps is substantially similar to that shown in U.S. Pat. No. 3,491,504 wherein movable platens and dome-like chambers operate in conjunction with sequential vacuum and air injections to pull and push, respectively, the films tightly against a product.

An inherent disadvantage with the prior art systems is the fact that when a vacuum is drawn from between upper and lower films, ambient air adjacent the edges of the films is removed first. As a result, the films have a tendency to become sealed together at their periphery before the interior of the package can be evacuated of air. Residual air, of course, can be highly deleterious to various types of food products. To compensate for this, packagers have used the aforementioned air injections, or they have injected nitrogen into the package to displace the harmful air or they have used preformed films to minimize the interstitial space about the product. The air injection technique requires the films to be sealingly enclosed between a chamber and platen means so that the pressurized air will operate to push against the films and expel any air trapped about the product. Unquestionably, such techniques require an unnecessary number of process steps, they require high capital costs in equipment, they are inefficient, time consuming, and are generally unsuitable for assembly line operation.

SUMMARY OF THE INVENTION

In accordance with the present invention, an improved packaging system is provided whereby a substantially complete excavation of air from a package can be obtained with a simplified highly efficient apparatus. This is accomplished by providing a multiplicity of projections extending toward the interior of a package on at least one of the wrapping films.

In general, the invention contemplates the placement of a bottom film on a vacuum plate having vacuum ducts adjacent the film periphery. An article is placed on the film and a transfer housing moves an upper film over the article. Air is drawn through the vacuum ducts from the periphery of the bottom film to remove air from about the article. The evacuation of air continues during the downward movement of the upper film and after the upper and lower films contact each other. This is possible because of the passageways formed between the inwardly extending projections and the upper film. The removal of air continues until substantially all air is removed from about the article and the films become tightly drawn against each other.

A permanent airtight package results when the portions of the films that overlap the periphery of the article become sealed to each other. A suitable seal may be effected by heat, in which case the films comprise a heat sealable composition and the transfer housing and/or vacuum plate is provided with means for heating the films. Alternatively, a seal may be effected by coating at least one of the films with an adhesive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a packaging apparatus constructed in accordance with the present invention;

FIG. **2** is a side elevation view of the apparatus of FIG. **1**;

FIG. **3** is an end elevation view taken along the line **3—3** of FIG. **2**;

FIG. **4** is an elevation sectional view taken along the line **4—4** of FIG. **2**;

FIG. **5** is a perspective view partially broken-away of the upper sheet transportation assembly of the apparatus of FIG. **1**;

FIG. **6** is an elevation sectional view taken along the line **6—6** of FIG. **3**;

FIG. **7** is an elevation sectional view taken along the line **7—7** of FIG. **3**;

FIG. **8** is an end elevation view taken along the line **8—8** of FIG. **2**;

FIG. **9** is a side elevation view partially broken-away taken along line **9—9** of FIG. **8**;

FIG. **10** is a broken-away perspective view taken along line **10—10** of FIG. **9**;

FIG. **11***a* is a vertical sectional view of a modification of the vacuum plate of the apparatus of FIG. **1** showing vacuum duct shields operating in conjunction with a bottom film;

FIG. **11***b* is a top plan view of the vacuum plate of FIG. **11**a without a bottom film;

FIG. **12** is a modification of the bottom sheet-forming assembly shown in FIG. **1**;

FIG. **13** is an enlarged scale broken-away partial sectional side elevation view showing the apparatus of FIG. **1** in operation;

FIG. **14** is a sectional view taken along line **14—14** of FIG. **13**; and,

FIG. **15** is a plan view taken along line **15—15** of FIG. **14**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and, more particu-

larly to FIG. 1 thereof, a perspective view of the overall packaging apparatus is shown. This view includes an adjunct embossing assembly **12** for impressing projections onto a plain surfaced material for use as a bottom wrapping film. The assembly is readily detachable and may be operated as a separate unit for producing a packaging film in large quantities and stored in rolls for later use.

In general, the primary elements comprising the packaging apparatus of the present invention include support means shown generally as **90** and **94** in FIG. **1**, vacuum plate means **14**, a movable housing **18**, and a film transfer means **22**. An upper sheet transportation assembly is a desirable element of the invention, but its use is optional depending on how the apparatus is operated.

The support means preferably comprises two sections **90** and **94** located at opposite ends of the vacuum plate means **14**. Both sections are elevated to a position about level with the top surface of vacuum plate **14**. The first section **90** comprises a belt **130** mounted between end roller **132** and secondary drive roller **134**. An intermediate plate **133** is used to provide support for the belt between the rollers **132,134**, however, idler rollers could be utilized equally as well. It is desirable to provide an underlying support for the belt at this location since such area is convenient for the placement of articles to be packaged. An article to be packaged will preferably be placed on the bottom film **38** as it is drawn in the direction shown by arrow A in FIG. **2**. Of course, it is desirable to rotate the belt **130** at the same speed the film is drawn through the apparatus.

The second support section **94** includes pressure roller **104** and a multiplicy of rollers **97***a,b,c*, mounted across the top of opposing sidewalls **13***a,b* of frame housing **15**. The second section will be described in detail hereinafter, however, it is to be understood that an endless belt conveyor, paddle or flight conveyor, chain mounted clamping means, hook means or the like would work equally as well. It is contemplated that this section will support the sealed package prior to its removal for packing or, in the case where the bottom film is continuous, its conveyance to the cutting station **112**. As such, the specific support means used will be dictated by the type of article being packaged, its size, weight and structure.

Located between the first and second support sections is the vacuum sealing station shown generally as reference numeral **92**. At this location an article is vacuum sealed between an upper and lower film. Such occurs when housing **18** moves a film over a product located on an embossed film situated between fluid passageways **32** on a vacuum plate **14**. In the preferred embodiment, the housing comprises a continuous conduit formed into an openwork such as the rectangular-shaped housing frame **19** shown in FIGS. **1, 2, 4** and **14**. The frame **19** has a bottom edge **44** which is constructed to sealingly impinge an upper film against the vacuum plate radially outside the vacuum plate passageways **32**.

Also included with the housing assembly **18** is heating means **80** and heat shield **21** (see FIG. **4**), The heat shield surrounds the heating means and operates to reflect and/or contain heat emanating from the heating means. The heating means may comprise one or more banks of conduction, radiant and/or convection type heaters such as for example, hot air units, infra-red lamps or electrical resistant units.

The housing assembly is connected for movement to reciprocation means **24**. This reciprocation means includes a pneumatic or hydraulic cylinder and piston arrangement which is secured to stationary frame plate **23** which, in turn, is affixed to the basic apparatus frame structure shown as reference numeral **10**. The reciprocation means **24** is located between cross plates **27** which are secured to a movable overhead support frame shown generally as **26**. The support frame reciprocates within the basic frame structure on roller devices **23**. The roller devices are affixed to cross beams **31** of the basic frame structure. Movement of the housing is guided and stabilized against rocking by four guide bars **29** which slide against the cross plates **27**. The guide bars are secured to plate **25** and extend vertically therethrough.

Communicating with the conduit interior of frame **19** is fluid conductor **28**. The conductor is connected to a valve and a means for supplying a vacuum to the interior of the conduit. The valve and vacuum means, being conventional, are not shown. The bottom edge portions **44** of frame **19** are provided with passageways **46**. These passageways may take the form of slots, orifices or the like and are arranged to contact and retain by vacuum an upper film placed adjacent thereto either manually or by an upper sheet transportation assembly such as that shown generally by reference numeral **16**.

The upper sheet transportation assembly **16** comprises a carriage frame **50** which is adapted for supporting a top film and moving it from a first position shown in phantom in FIG. **4** to a second position beneath housing **18**, also shown in FIG. **4**. To accomplish such movement the carriage frame includes a rectangular-shaped vacuum frame **52** formed from a continuous hollow conduit and a set of spaced apart matching rollers. The top surface of the conduit contains fluid ducts **54** in the same manner as frame **19** and may conveniently be a mirror image of the bottom portion **44** of housing frame **19**. The purpose of having the vacuum frame **52** correspond in shape to the housing frame **19** is to facilitate the transfer of a top film from the vacuum frame when its positioned beneath the housing frame. The interior of the conduit of vacuum frame **19** is in communication with fluid conductor **55** which, in turn, is connected to a vacuum source (not shown). A top film is held to the top surfaces of vacuum frame **52** by excavating air from ducts **54** through the vacuum frame conduit **52** and conductor **55**. The film is situated on the vacuum frame in a manner to overlap the ducts such that a pressure differential will be created and atmospheric pressure will push the film against the regions of lower pressure about the ducts beneath the film.

It is to be understood that single precut top films may be manually positioned adjacent the bottom **44** of frame housing **19** or manually placed upon the vacuum frame and transported into the vacuum sealing section or, as shown in FIG. **4**, predetermined lengths of film shown as **61** in FIG. **4** may be pulled into the sealing section from supply roll **60**. To accomplish the latter alternative, the supply roll rests by gravity on idler rollers **62** so that when the carriage frame moves into the vacuum sealing section, the roll will freely rotate and allow the requisite amount of film to be withdrawn. A vacuum of 15 inches of mercury or more at ducts **54**

creates sufficient pressure differential across the top film **61** to overcome any frictional resistance to the rotation of the supply roll and prevent the film from slipping off the vacuum frame. It is desirable to have the ducts, slots, orifices or the like located about a major portion of the top surface of the vacuum frame periphery so as to uniformly hold the top film and prevent creasing or wrinkles.

In some instances, such as when a full heavy supply roll is being used, it has been found desirable to use supplementary retention means **58.** This may take the form of a pair of pneumatic or hydraulic operated plungers **48** mounted on frame **50.** The plungers reciprocate up and down as shown by arrow B in FIG. **4.** In the down position the plungers contact the film **61** and press it against the top surface of the vacuum frame. Additionally, it may be desirable to provide the vacuum frame with a center plate, shown as **57** in FIG. **5.** This is to provide a flat support area for the film and prevent it from sagging at its midpoint. The plate will also facilitate the positioning of single precut films over the frame when such are used.

To provide for movement of the carriage frame, a lower offset portion **59** is utilized in conjunction with a roller assembly shown generally by reference numberal **63** in FIG. **5.** In the embodiment shown, the roller assembly includes two pairs of spaced-apart upper rollers **66,67** mounted for rotation above frame portion **59** and on opposite sides thereof. Two pairs of spaced-apart lower rollers **68,69** are mounted beneath frame portion **59.** Each of the lower rollers are positioned directly beneath a corresponding upper roller and are spaced therefrom a distance sufficient to engage a pair of opposing tracks **70** which are affixed to the top edge portion of support angles **71.** Preferably, tracks **70** are in the shape of a rod and the upper rollers **66,67** present a concave circumferential surface. In this manner, the frame will be effectively guided and maintained in position during its traverse to and from the aforementioned first and second positions. Note also that rollers **68,69** engage the underside of angles **71** thereby preventing forward tipping of the carriage frame.

Movement of the carriage frame along the track is accomplished by carriage drive means **72.** As shown in FIG. **4,** this includes a cylinder **75** which pneumatically or hydraulically moves an internal rod and piston assembly (not shown) which is connected to drive chain or wire **73.** Attached to the wire is connector **74** which is also secured to the bottom of the carriage frame. In this way hydraulic or pneumatic force from drive means **72** is transmitted through the wire **73** and connector **74** to frame **50** thereby causing the movement thereof along track **70.** Mechanical eccentric means, electric drive means or various combinations of each could also be used for the drive means of the present invention.

An advantage of the above-described system is that it is substantially trouble-free and can very easily be adjusted for different stroke lengths. For example, different sized products will require different lengths and/or widths of top film to be pulled into the sealing section **92.** As such, it is a simple matter to adjust either the distance the wire **73** and connector **74** move or the position of the connector on the wire.

When carriage frame **50** is in the second position, a film cutting mechanism shown generally as **78** in FIG. **6** is activated to sever the film. The severing occurs only after the film has been released from vacuum frame **52** and retained on the lower edge portions **44** of housing frame **19** and the vacuum frame retracted back to its first position. the cutting means **78** may be a hot cutting wire shown as **79** in the preferred embodiment or rotary cutters or conventional knife means known in the art.

When the carriage frame has been retracted to its first position, the cutting mechanism is actuated causing fluid to enter cylinders **84** and effect the downward movement of shafts **84.** Opposite ends of resistance wire **79** are secured to shafts **85** by ceramic connectors **83.** The lowermost position of the cutting wire **79** after it has passed through film **61** is shown in phantom in FIG. **6.**

After the film **61** has been severed, housing **18** will reciprocate to a lower position to sealingly engage the vacuum plate **14.** In a preferred embodiment of the present invention, the housing **18** is provided with the aforementioned heating means **80.** The heating devices are conveniently mounted on shield **21** so that the upper film will become more efficiently softened by both reflection and convection currents.

As illustrated in FIG. **15,** an essential feature of the present invention is the position of the top film **61** and housing frame **19** relative to fluid passageways **32** and the side edges of bottom film **38.** The passageways **32** are in communication with fluid conduits **34** which are connected to a vacuum source (not shown). It is important that the passageways **32** remain unobstructed during the sealing process so that the evacuation of air may be as complete as possible from the package. In part, this can be accomplished by locating the passageways proximate the side edges of the bottom film and preferably beyond the periphery thereof as shown in FIGS.s **14** and **15.** Alternatively, shields shown as **42** in FIGS. **11***a* and **11***b* may be used to maintain the passageways open when wide bottom films are used or to prevent inadvertent misplacement or misalignment of the bottom film from obstructing the passageways.

The passageways **32** are shown as slots in the drawings but could just as well be a series of orifices or other type of duct. The passageways should be located substantially parallel to the side edges of the bottom film to produce the most effective air evacuation from the region between the packaging media. It is essential that there should be at least one passageway on the vacuum plate, but preferably two should be used adjacent each opposite side edge of the bottom film to effect a balanced evacuation of air. This is advantageous because it provides a quicker and more thorough removal of air. It also facilitates a more balanced vacuum draw of the top film over the item to be packaged and it produces a more uniform wrinkle-free bond between the films at their interface about the periphery of the item.

It is to be understood that the vacuum plate **14** can be removed and exchanged for a plate having passageways and/or templates or the like located in different positions to accommodate various types and sizes of products. Of course, the configuration of housing frame **19** could likewise be changed to accommodate the different products and conform to the changed vacuum plate. It is important, however, that the bottom edges **44** encompass the fluid passageways **32** to form an effective seal against the vacuum plate in a manner to be hereinafter described.

As advantageous aspect of the present invention resides in the use of an integral continuous bottom film conveying system operable with a unitary drive means. In general, the system comprises a drive means, shown generally as **22** in FIG. **8,** the previously described first and second support sections, a drive roller **104,** and a pair of friction wheels **96.** The wheels operate to frictionally engage the flattened side portions of the completed package at the nip between the wheels and drive roller. Since the bottom film is continuous, fresh film will be drawn from a storage roll or from the embossing assembly through the apparatus is an amount equal to the distance each successive package is moved. The amount of rotation is predetermined so that the appropriate amount of film will be drawn into the sealing section to adequately cover the product being packaged. It is to be noted that due to the inherent resilience of the packaging films, a package will be pushed downstream from the friction rollers as it passes therethrough into the cutting and unloading zone.

To provide the necessary pressure adjustment on the wheels **96** for effectively frictionally engaging the package periphery, the friction wheels are mounted on pivot arms **98.** Downward pressure of the friction wheels against drive roller **104** is effected by adjustment of threaded bolts **106.** As the bolts are screwed down against housing plates **107,** their offset position on arms **98** causes the arms and wheels to rotate counterclockwise against the drive roller. It is to be understood that opposing clamp means reciprocating on a track would work equally as well as a means for moving the bottom film and packages through the system.

In the preferred embodiment the drive means **22** of the bottom film conveying system includes pneumatic cylinder **116** having a rod **120** pneumatically reciprocated therein. Attached to the top of the rod is bracket **118** which is secured to connector plate **124.** The plate links together the ends of primary drive chain **122.** The drive chain engages the teeth of idler sprocket **130** and drive roller socket **132.** The drive roller socket is equipped with a conventional ratchet mechanism such that the drive roll **104** will be power driven only in the direction shown by arrow C in FIG. **9.**

Located on the opposite end of drive roll **104,** sprocket **135** transmits the rotational force thereof, through chain **121** to the auxiliary rollers **97***a,b,c.* (See FIGS. **2** and **13**). Roller **97***c* is equipped with a double sprocket **140** so that the rotational force of roll **104** will be further transmitted by chain **123** to a sprocket **139** on the end of secondary drive roller **134.** As previously described, the secondary drive roller **134** functions to rotate belt **130** of the first support section.

It can be seen that the above drive system provides a highly advantageous unitary means for not only moving a bottom film and package through the packaging apparatus, but it also drives the cooperating supplemental conveying means embodied in the two support sections. The drive system also imparts a high degree of versatility to the conveying system of the present invention in that different sized sprockets may be used to effect variable ratios of rotation to slow down or speed-up the rollers and/or belt. Of course, the system can be operated intermittently without the conveying system to individually package items.

Referring now to the package severing means **112** (see FIGS. **1, 9** and **10**) located immediately downstream from the friction wheels, the use of a movable hot wire system is shown. This system consists of a thin resistance wire **142** connected at opposite ends to a ceramic adaptor **141** which is mounted on bracket **144.** The bracket is provided with a roller assembly adapted to engage and roll against a side portion of support housing **15** adjacent slot **146.** A pair of guide rollers **152** are mounted on the lower inner face of the bracket and are positioned to slide along the inner edges **153** of slot **146.** A transverse support roller **154** slides along the outside sidewalls of housing **15** adjacent the slot **146.** Bracket **144** is secured to cross plate **156** which is reciprocated up and down by lift devices **158.** When a package formed from the continuous bottom film **38** reaches the unloading zone **160** (see package M in FIG. **13**), the lift devices are actuated to move the hot wire through the film.

Continuing on the optional bottom sheet-forming assembly shown generally by referene numeral **12** in FIGS. **1** and **2** and schematically in FIG. **12,** a supply roll **201** is shown having a plain flat film drawn therefrom over a portion of vacuum drum **206** and across tension roller **205** into the apparatus shown by arrow D. The drum surfaces are provided with a series of orifices **204** such that after the film has been heated, either by internal means within the drum or by auxilliary heating means **208,** the film becomes pliant and can be partially drawn into the orifices on the face of the drum. Upon cooling, the film will have a series of projections spaced throughout its surface. The optional heating section of the drum is shown by reference numeral **210** and the vacuum section is shown by numeral **212.**

Alternatively, it is within the purview of the present invention to utilize a mechanical device for creating a series of projections on the bottom film. This may be accomplished by passing a film through the nip of a pair of rollers **214, 216**—one of which has outwardly extending projections **218** that engage matching recesses **220** on the opposing roller. The film may be optionally heated by heated rollers or external means as it passes through the forming device.

The advantage of the mechanical device is that it is simpler and presents no problem of the film becoming overheated due to the sequential operation of the apparatus.

As previously mentioned, it may be convenient to have the projections formed in the bottom film in a separate operation and stored in rolls. In such case, the embossed film would simply be substituted for roll **201** and fed directly into the apparatus.

To obtain a better understanding of the method of the present invention reference should be made to FIGS. **13, 14** and **15.** In FIG. **13** products being packaged in a sequential manner on a continuous bottom film are shown schematically by letters M, N, O, and P. To begin operation, the bottom film with its projections directed upwardly is pulled through both the first and second support sections and the sealing section, and inserted between the nip of wheels **96** and drive roller **104.** Similarly, an upper film is placed over the vacuum frame **52.** The vacuum source is opened such that when the machine is activated, a predetermined sequence of events will occur.

With the vacuum source in communication with conduit **55** which is opened by conventional valve means (not shown), air will be removed from the vicinity of ducts **54.** The resultant pressure differential will func-

tion to retain the top plastic film about the perimeter of the vacuum frame. Additionally, the supplementary retention plungers **48** may be activated to press the film against the vacuum frame to further prevent the film from being twisted or slipping off the frame. An electronic control means activates carriage drive means **72** to move the carriage assembly from the first position shown in phantom in FIG. **4** to the second position beneath the housing **18.** At this point the hold-down plungers **48** are released and the vacuum to the frame **52** is shut-off. Simultaneously a vacuum source is placed in communication with fluid conduit **28** and housing frame **19.** Air is evacuated through orifices **46** and about the bottom edge portion **44** such that the top film will be released from the vacuum frame **52** and become pushed by pressure differential against the bottom edges **44** of the housing frame. Note that the second position of the carriage assembly facilitates this in that it extends to a location substantially directly beneath the housing and in close proximity to the lower edges **44.**

After the housing has received the top film **61,** the carriage drive means **72** operates to return the carriage frame to its first position. Immediately after this has occured, top film severing means **78** is activated to move a hot wire through the film and sever it completely. The housing is now ready to move to a lower position upon the vacuum-sealing plate **14.** Of course the above sequence could be eliminated by simply manually placing a precut sheet of film into place against the edges **44.** Such may be more convenient when packaging separate or unusual items rather than a large number of similar articles where speed and high volume are not the criteria.

About the time the severing means **78** is operated heaters **80** are activated so that the upper film is being warmed into a pliant or formable state. This occurs as a result of the heating action of the heating means located within the housing and beneath shield **21.** Depending upon the type of heaters being used, it may be preferable to leave them on continuously.

Before the housing descends to a lower position, a vacuum source is placed into communication with conduits **34** and passageways **32.** At this point it will be recalled that the dimpled film has been stretched across the vacuum sealing plate **14** and is located between the passageways **32** as shown in FIGS. **14** and **15.** Note that an article of manufacture, a meat product, a foodstuff, or some other type of product designated O has been placed upon the embossed bottom film. This preferably occurs at the first support means located which has now been sequenced into the vacuum sealing section.

As the housing **18** descends over the product, the top film being in a softened state and secured about its periphery by vacuum, stretches over the product while the housing continues its downward movement. Simultaneously, air is being evacuated from the edges of the embossed bottom film. As the top film continues to be lowered air is removed from the area shown as **90** in FIG. **14.** This is defined as the region below the upper film and within the perimeter of the area of sealing engagement between frame portion **44** and the vacuum plate. With the present invention, evacuation of air continues even after the top film has made initial contact with the top surfaces of the projections of the bottom film. This occurs through the interstices between the projections as shown by the arrows in FIGS. **14** and **15.**

After substantially all the air is removed, it is believed that the somewhat resilient projections become collapsed due to the pressure differential between the atmosphere and the reduced pressure between the films. At this point the top film commences to bond with the bottom film at the annular area of their overlap about the product periphery. Alternatively, depending on the type of product being packaged, it may be desirable to heat the bottom sealing plate to enhance the seal. However, this is entirely optional and not necessary or even desirable in some cases.

After the top film has been tightly stretched over the product and sealed about the product periphery, the vacuum source is shut-off to both the vacuum plate and housing **18.** The housing reciprocates back to its upper position and drive means **22** is actuated to transport the package from the vacuum sealing section to the second support section. It is contemplated that as the sealing process is taking place, an operator will be placing another product, shown as P in FIG. **15,** upon the bottom film at the first support section. Therefore, it can be seen that product P will be drawn into the sealing section as product O is pulled to the second support section.

As successive products are placed onto the bottom film, a continuous chain will be formed until the bottom film is severed. Since the sealing process requires a certain period of time, newly formed packages will have a brief dwell period, corresponding to the sealing time, in which the films may cool. The package will then be alternately pulled and then pushed between wheels **96** and roller **104** to an unloading area denoted by reference numeral **160.** At this point the package shown as M will be severed from the continuous bottom film by severing means **112** and removed for final stacking, storage and/or shipment.

Note that with the present invention there is no airtight chamber required above the upper film **61.** A seal is formed about the periphery of the housing **18** at edges **44** as the housing engages the upper film and presses it against the surface of the vacuum sealing plate **14.** To enhance this seal a resilient gasket shown at **92** in FIG. **15** may be provided on the vacuum plate to engage frame portion **44.** When the housing engages the bottom film radially outward from passageways **32** and presses it against the vacuum plate or gasket (and transverse portions of the bottom film if such is continuous), all air contained within region **90** will be evacuated. When the pressure differential is great enough to overcome the inherent resilience of the upwardly extending projections and cause their collapse and/or cause the upper film to flatten against the bottom film, an airtight seal will be formed. Because of the seal delaying action caused by the projections, the interstitial air evacuation passageways formed thereby, and the fact that air is being removed from opposite sides of the package, it can be seen how the present invention produces a tightly sealed package with substantially all air removed.

Of course, the type of film, its resilience and ability to stretch are important. The films are preferably of a thermoplastic material such as Surlyn or various thermoplastic coated laminates such as polyethylene, cellulose acetate, polyethylene-regenerated cellulose, regenerated cellulose films, rubber hydrochloride films,

polyvinyl films or metallic laminated foil films having a thermoplastic coating. Plastic or adhesive-coated embossed members whether they are rigid or semi-rigid, could be substituted for the bottom film. Note that with the present invention substantially any configuration or arrangement of projections may be utilized on the bottom packaging material. Hemispherical protuberances are shown as uniformly spaced about the surface of the bottom film in the drawings of the preferred embodiment. However, the projections may take the shape of pyramidal protuberances, straight or zigzag ridges, or any other design providing a number of intersticies between which air may be drawn.

It should be noted that the closer together the projections, the less susceptible they are to flattening by the pressure differential during evacuation and sealing. Similarly, the more resilient and/or the closer together the projections, the more thorough will be the excavation of air about the product. However, the material or projections should not be too rigid to prevent a final seal to occur with the top film. Of course, due to the preferred softening of the upper film, this would be an uncommon occurrence. In this regard, reference is made to the disclosure of U.S. Pat. No. 2,778,171 which discloses the use of various types of film projections and packaging materials to facilitate the evacuation of air from a pouch. To the extent of utilizing various types of projections and packaging materials, this patent is hereby incorporated by reference.

The present invention is particularly suitable to the packaging of food products wherein packaging materials having a relatively low air or oxygen permeability should be utilized. In this regard, substantially impermeable films may be coated with heat activatable adhesives and utilized. Examples of such would be the use of a polyethylene film with a coating of ethylene vinyl acetate. Such a film when heated will allow the tight bonding and sealing of upper films to lower films. Of course, a film must be chosen that will stretch and draw down over the shape of the product being packaged without being disproportionately stretched, weakened or torn.

As mentioned previously, the present apparatus operates sequentially with the dwell period between movements being conveniently dictated by the time required to seal the product at the vacuum sealing section. This may be automatically controlled by timer means and electrical circuitry which coordinates the activation of the carriage frame movement and the housing means movement together with the vacuum conduit openings and closings.

Although pneumatic or hydraulic means have been shown to drive the carriage frame, housing and support means, electric motors, cam mechanisms or the like, operated by solenoid devices would work equally as well. Likewise, a central vacuum source may be utilized in conjunction with the sequential operation of valves in the various fluid conduits connecting the various outlets at the appropriate time.

While the invention has been described with respect to a specific embodiment, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrative embodiments, but only by the scope of the appended claims.

I claim:

1. In an apparatus for packaging articles between an upper and lower sheet comprising;

vacuum forming means;

a vacuum base member supported by a frame, said base member including passageways in communication with said vacuum forming means, said passageways being open at predetermined locations on said member proximate peripheral portions of a lower sheet placed thereon;

a lower sheet conveying system comprising drive means engagable with said lower sheet at a point downstream from said vacuum base member, and sheet support members located along the path of travel of said lower sheet adjacent said vacuum base member; and,

a movable housing mounted above said base member on said frame including means to reciprocate said housing between an upper position and lower position, and including heating means and upper sheet retaining means operating in response to the position of the housing, said housing being adapted to substantially sealingly engage said base member radially outward from said passageways.

2. The apparatus of claim **1** including sheet cutting means located downstream from said drive means to sever individual packages from said lower sheet.

3. The apparatus of claim **1** including an upper sheet transportation assembly adjacent said housing assembly including a carriage means for carrying the upper sheet of packaging material from a first position to a second position beneath said housing when said housing is in the upper position, retention means on said carriage means for releasably retaining said upper sheet on said carriage means, and means for moving said carriage means from said first position to said second position.

4. The apparatus of claim **3** wherein said upper sheet retaining means and the carriage retention means comprise vacuum ducts in communication with the vacuum forming means and located about the sheet-contacting portions of said housing and carriage means.

5. The apparatus of claim **3** wherein said upper sheet is initially in a continuous roll, including sheet cutting means located between said carriage means and said housing and activated to cut individual sheets from the continuous roll when said carriage means is in the second position.

6. the apparatus of claim **5** wherein said upper sheet transportation assembly includes secondary retention means mounted on said carriage means for securing said upper sheet against slippage during movement from said first position to said second position.

7. The apparatus of claim **1** including control means comprising:

means to activate said upper sheet retaining means for retaining the upper sheet on said housing;

means to activate the movement of said housing from said upper position to said lower position; and,

means for activating said heating means at least during the period said housing moves from said upper position to said lower position.

8. The apparatus of claim **3** including control means comprising:

means to cause said upper sheet retaining means to retain the upper sheet upon said housing;

means for activating said heating means at least during the period said housing moves from said upper position to said lower position;

means for activating the movement of said carriage means between said first and second positions;

means to activate the movement of said housing to said lower position after said carriage means has moved to said first position; and,

said control means further including means to control the time said housing is in said lower position and means to activate said drive means when said housing moves to said upper position.

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