

[54] **SHRINK-WRAPPING METHOD AND APPARATUS**

3,347,365 10/1967 Funkhouser 53/30 X
3,429,095 2/1969 Huson 53/24

[75] Inventors: **Michael P. Bitsura**, Pittsburgh;
Robert Brevko, Bridgeville; **Merle A. Palmer**, Pittsburgh, all of Pa.

Primary Examiner—Roy Lake
Assistant Examiner—E. F. Desmond
Attorney, Agent, or Firm—Parmelee, Miller, Welsh & Kratz

[73] Assignee: **Auburn Engineering, Inc.**, Clairton, Pa.

[22] Filed: **Aug. 6, 1968**

[21] Appl. No.: **750,497**

[52] **U.S. Cl.**..... **53/29, 53/30, 53/183,**
53/184, 53/386

[51] **Int. Cl.**..... **B65b 43/30, B65b 53/02**

[58] **Field of Search** 53/24, 29, 30, 183, 184,
53/186, 187, 373, 384, 386

[56] **References Cited**

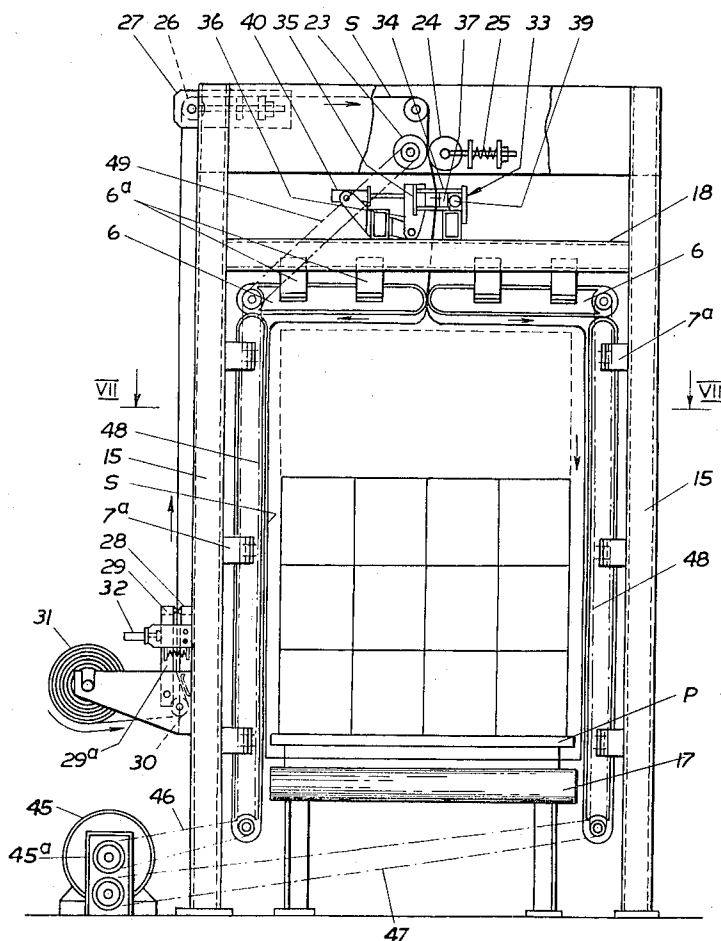
UNITED STATES PATENTS

2,759,648	8/1956	Piazz	53/29
3,112,586	12/1963	Luetzow	53/29
3,148,489	9/1964	Senior et al.	53/29 X

[57] **ABSTRACT**

There is disclosed a method of and apparatus for applying a tubular sheet of shrinkable polyethylene film to a load of articles or packages arranged on a pallet or other base by feeding a continuous flattened tubular sheet of film down around the load, and cutting it off. If the top of the package is closed, the sheet is transversely heat-sealed at a proper distance back of the leading edge of the strip, but if the package has an open top, the upper end of the tubular sheet is crimped in or gathered at the corners to keep the sheet from dropping down beyond the top of the load after it has been cut. The tubular sheet is opened out and pulled down around the load by suction belts.

18 Claims, 13 Drawing Figures



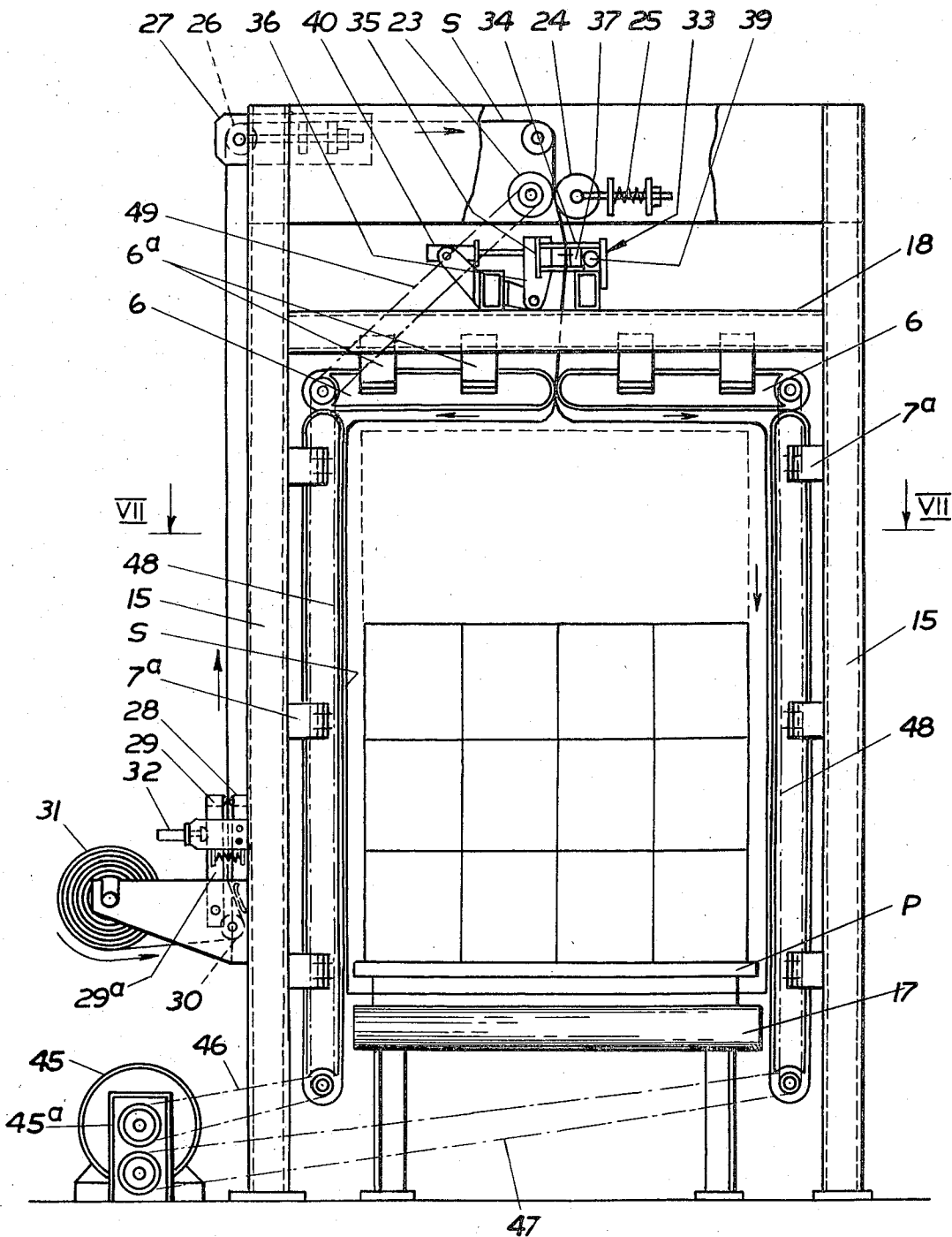


Fig. 1.

Inventors
Michael P. Bitsura.
Robert Brevko.
Merle A. Palmer.

By

Attorneys.

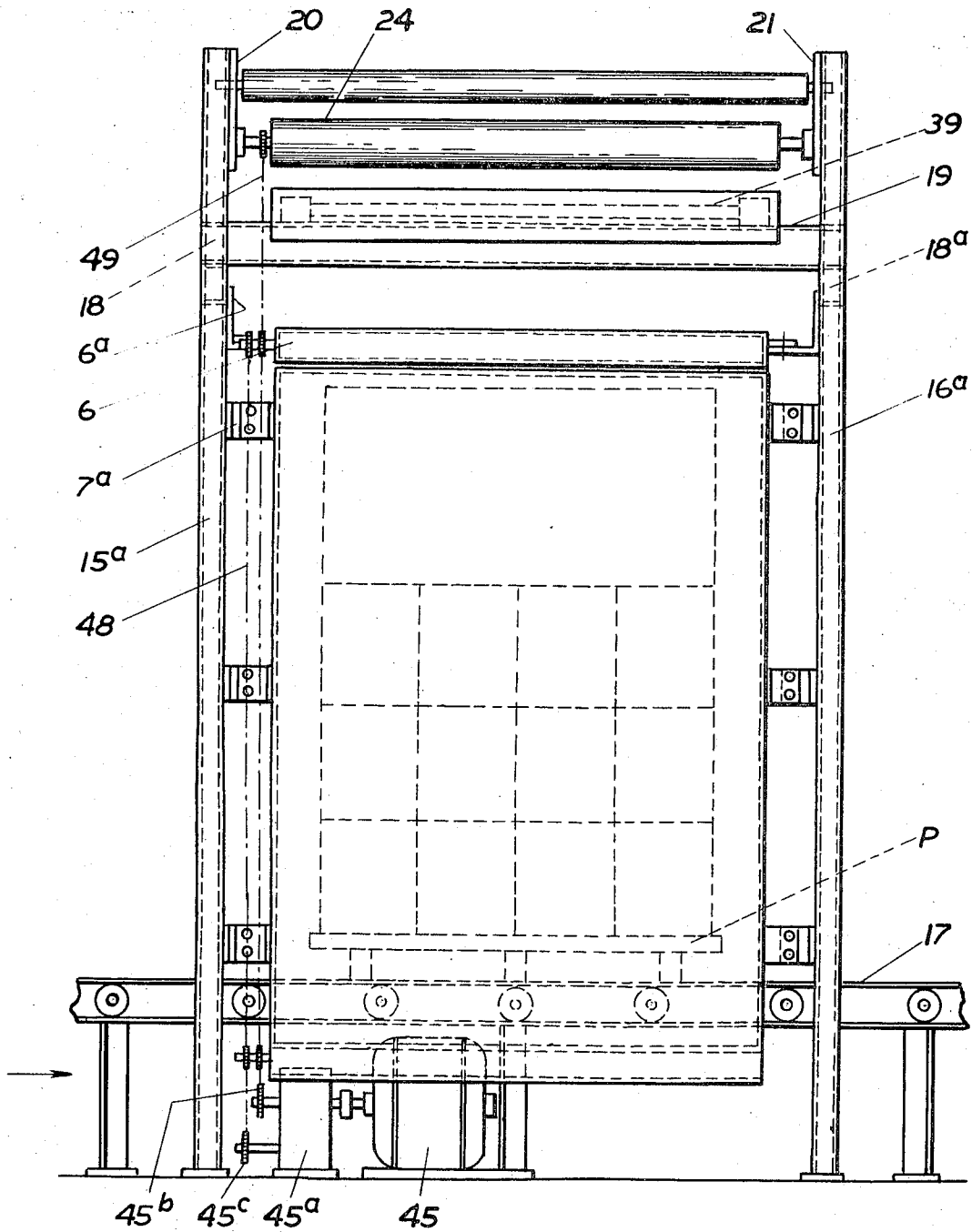


Fig. 2.

Inventors
Michael P. Bitsura.
Robert Brevko.
Merle A. Palmer.

By

Attorneys.

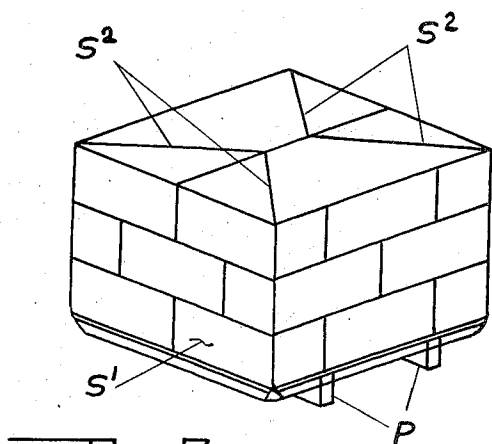


Fig. 3.

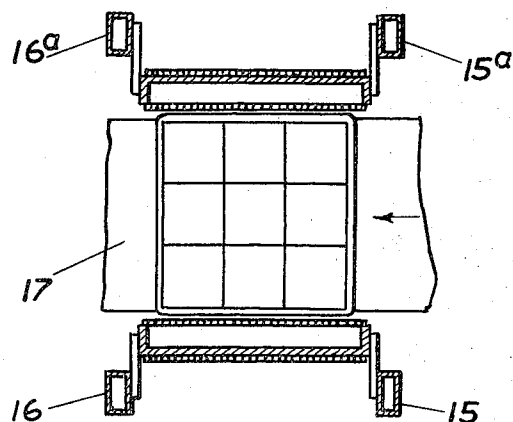


Fig. 7.

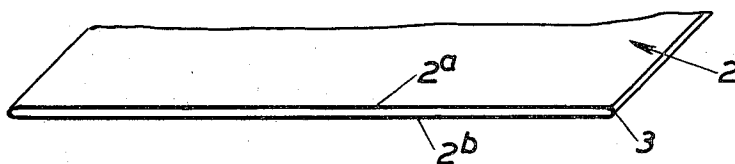


Fig. 4.

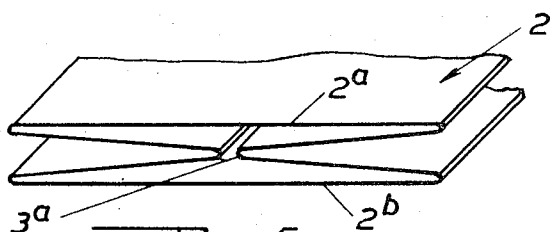


Fig. 5.

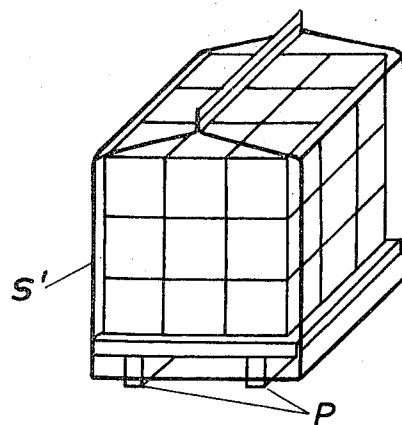


Fig. 8.

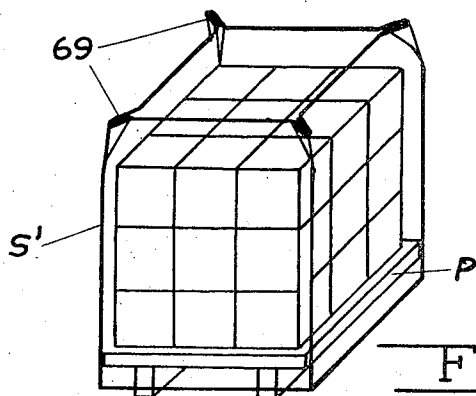


Fig. 9.

Inventors
Michael P. Bitsura.
Robert Brevko.
Merle A. Palmer.

By

Attorneys.

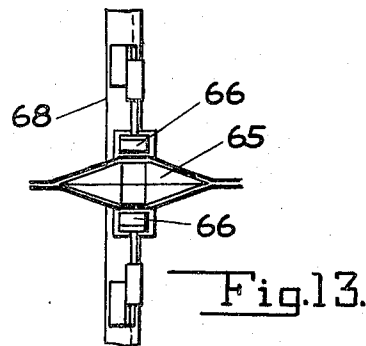
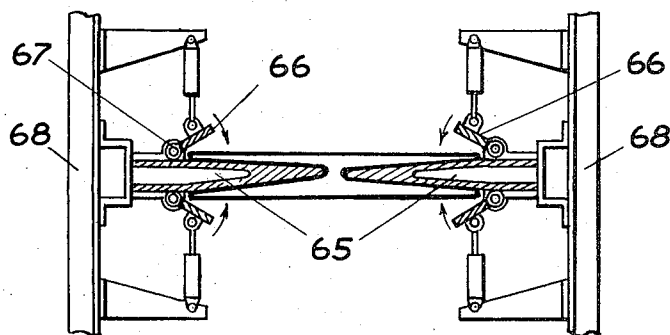
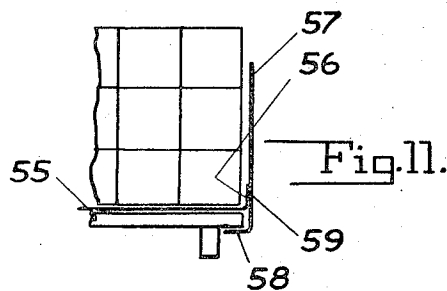
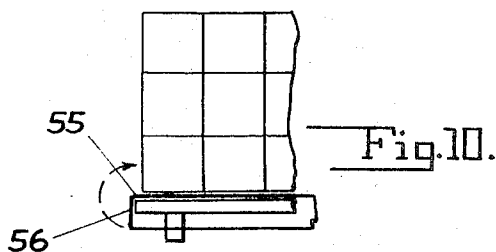
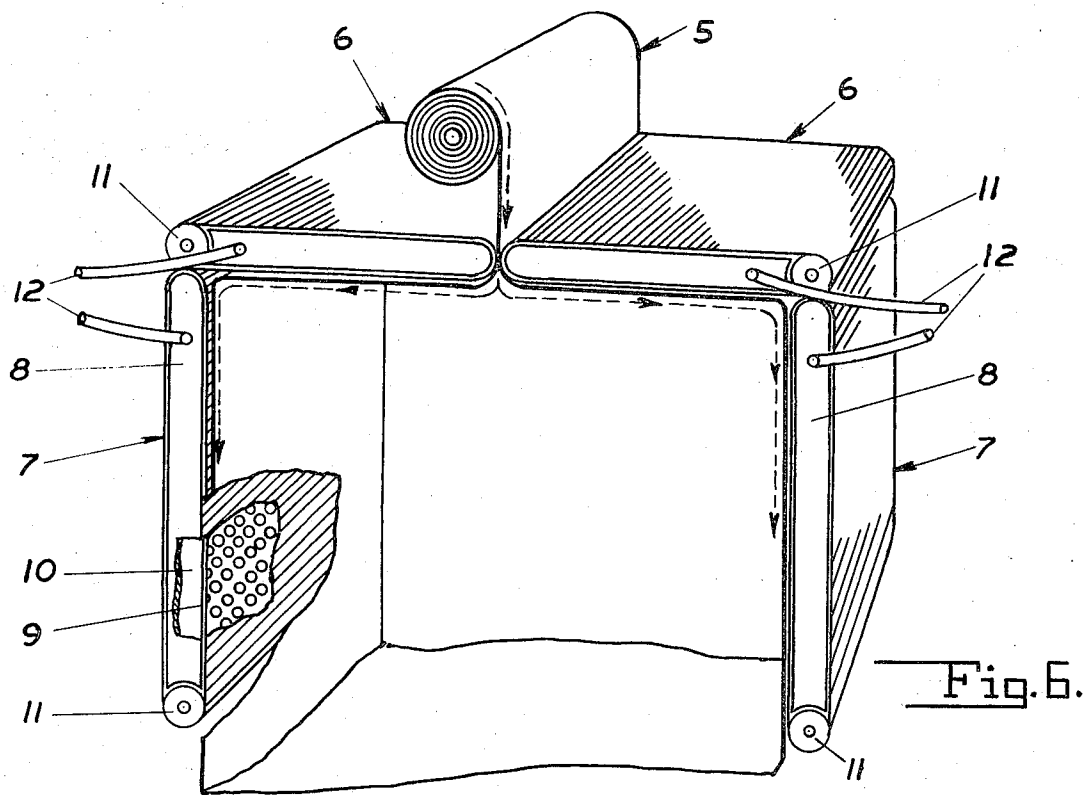


Fig. 12.

Fig. 13.

Inventors
Michael P. Bitsura.
Robert Brevko.
Merle A. Palmer.

By

Attorneys.

SHRINK-WRAPPING METHOD AND APPARATUS

This invention relates to the art of wrapping or packaging products by the use of polyethylene films that shrink upon heating, and which may also be sealed upon the application of heat, this procedure being generally known as shrink-wrapping or shrinkfilm wrapping. More especially this invention is for a method of and apparatus for shrink-wrapping loads of merchandise or other objects arranged on a pallet or base.

It is of course well-known that certain polyethylene films contract upon being heated, and this phenomenon has been extensively used in merchandizing small packages of fruits, vegetables and other items for retail trade. It has heretofore been proposed to shrink-wrap bulk loads of many similar items arranged on a pallet or other supporting base for shipment and storage by the purchaser. According to one procedure, the palletized load is moved horizontally between opposed rolls of polyethylene film having their leading ends joined by heat bonding. As the load moves forward, the sheet material covers the front of the load, and then folds back along the sides of the load. At the rear of the load the two ends are folded in, brought together, fused and cut off, forming a surrounding curtain about the load. The joined ends of the two sheets are fused together for application to the next load in a similar manner. The wrapped load is moved into an oven where, at the proper temperature, the surrounding curtain of wrapping shrinks about the load. A difficulty with this procedure is that this does not permit forming a weather-tight seal at the top of the bale or large package so wrapped. Another difficulty arises from the fact that the curtain of polyethylene film surrounding the load may slide down out of position before the wrapping has been heat-shrunk about the load which it surrounds.

A second procedure involves forming a folded sheet of polyethylene film into a large envelope-like bag, quite similar to the familiar snap-off plastic sandwich and food storage bags for household use. Such an envelope is placed over the load with the fold line over the center of the top of the load, and the two heat-sealed seams at the ends of the load. While making a good package, it is necessary for two men to handle each envelope and apply it to the load before it enters the heat chamber where the wrapping is heat-shrunk, and is therefore not adapted to automatic wrapping of the load.

It should be explained in connection with the present invention that polyethylene sheet is generally formed by extrusion as a thin wall hollow tube of indefinite length, and this tube is flattened down into a double sheet and one longitudinal edge is then slit or opened so that it becomes a folded sheet that may be opened out flat.

The present invention utilizes the tubular polyethylene extrusion without slitting the one edge. According to a preferred method, tubular extruded sheet flattened and wound into rolls without slitting is heat-sealed across its width the required distance back from the leading edge. It is then moved forward, opened out into a tubular shape that will fit around the load to be wrapped, and pulled down over the load. At the proper time the strip is cut off from the next-succeeding length just above the transverse heat seal first made. The leading edge of the severed section eventually projects below the deck of the pallet or other support, and the transverse heat-sealed seam then extends across the top

of the load. The package then is ready to be moved into the heating chamber to shrink the wrapping about the load, and the edge which originally hung down below the deck of the pallet will shrink in under the deck of the pallet in the usual manner.

Alternatively, the transverse heat sealing may be omitted and the tubular blank simply opened out and pulled down around the load, and the tube then cut off well above the top of the load, while the leading edge of the severed tube section extends down below the deck of the pallet. When this is heated to shrink the plastic film, the excess film above the top of the load will flatten down around the top marginal surface of the load.

With this second method the plastic tube, very loosely surrounding the package, would be free to slip down, and to avoid this, the top corners of the tube may be "gathered in" for a suitable length, so that, like wearing apparel gathered in at the waist, it cannot fall down.

While the regular flat tubular extruded plastic sheet, uncut down the one edge may be used, it is well-known to fold in opposite edges of the tube as it is flattened to make an infolded pleat or gusset along each edge similar to that commonly formed in familiar paper bags, so that when the tube is opened out, it will readily assume the required square or oblong shape to fit around the load without the flat tubular strip being excessively wide. Such folded tubular sheet is known as "gusseted tube," and our invention preferably uses this gusseted tube, although it may be adapted to sheet tubular material that is fattened but not gusseted.

A principal object of the invention is to provide an improved method of and apparatus for enclosing a large object or group of individual items in a polyethylene film and shrink-wrapping it.

A further object is to utilize tubular sheeted polyethylene as the film for this purpose.

These and other objects and advantages are secured by the invention which may be more fully understood by reference to the accompanying drawings illustrating certain preferred embodiments of our invention. In the drawings:

FIG. 1 is a front elevation of the wrapping machine as viewed from the entering end of the machine, with part of the top broken away to show mechanism with it;

FIG. 2 is a side elevation of the machine shown in FIG. 1;

FIG. 3 is a perspective view of a wrapped loaded pallet;

FIG. 4 is a representative of a section of one form of tubular extruded film;

FIG. 5 is a similar view through another form;

FIG. 6 is a schematic perspective view of the wrapping apparatus removed from the remainder of the structure;

FIG. 7 is a diagrammatic horizontal section in the plane of line VII—VII of FIG. 1;

FIG. 8 is a diagrammatic view showing the package as the envelope is applied, and before sealing;

FIG. 9 is a view similar to FIG. 7 showing the alternate method in which the sealing is incomplete;

FIGS. 10 and 11 show steps in the method of making a completely waterproof enclosure, the views being fragmentary elevations of two bottom corners of the

package, FIG. 10 showing the initial arrangement, and FIG. 11 showing the complete corner;

FIG. 12 is a transverse section showing an attachment that may be used for crimping or gathering the corners as illustrated in FIG. 9; and

FIG. 13 is a side view of the attachment shown in FIG. 12.

In the drawings, structures are largely indicated diagrammatically, and because of the polyethylene film being very thin, only heavy lines are used to indicate sections through it.

Considering first FIGS. 4 and 5, these figures show the extruded tubular sections which are flat double thickness sheets of indefinite length wound into rolls, and which are representative of the forms of sheeting referred to as tubular. FIG. 4 shows a tubular flattened sheet 2 having two flat sheet areas 2a and 2b integrally connected along the side edges 3. It was originally extruded as a circular section. Normally one edge would have been opened to form a folded flat sheet, but with our invention the flat tube is left intact. In FIG. 5 the tube is the same, but as it is flattened and wound onto rolls, opposite sides are pressed in to form infolded edges or gussets 3a.

According to this invention, the flat tubular sheeting is unwound from a roll as it is needed, opened out to a tube having four sides, and drawn down over the load to be wrapped, much like one might draw a sweater down over one's body, except that in this process the tubular wrapper will initially be much looser than such a garment.

A method of opening out the flat tubular sheet and pulling it down is schematically illustrated in FIG. 6, which is for illustration only. The tubular flattened sheet is pulled from roll 5 into the bight between two endless suction belt units 6 having belts moving horizontally, or generally horizontally, in opposite directions with the lower reaches of the belts moving away from each other. They each terminate near a vertical belt unit 7, and the confronting reaches of these two vertical belts move downwardly. These units, all of which are of like construction, comprise an endless air-pervious web 6a, as for example canvas belts, each moving around a suction box. Each suction box has a closed side plate 8, a perforate lower or inner panel 9, and an imperforate upper or outer wall or panel 10. A driven roller 11 is located outside the suction box at the outer end of each of the horizontal belts, and the bottom of each of the vertical belts. The belts slide over the rounded ends of the suction boxes at the ends opposite the rollers 11. All belts are driven at the same lineal speeds. Tubular connections 12 lead from the interior of each box to an exhaust pump or fan (not shown). Using a gusseted tubular plastic sheet as shown in FIG. 5, the belts may be about as wide as the pleated plastic strip tubing, but using a sheet as shown in FIG. 4, the roll 5 would be twice the effective widths of the belts to form a square tube. In other words, the peripheral dimension of the flattened tube must be larger when opened out than the peripheral dimension of the load on the pallet.

As the sheet emerges from between the two top belts, one layer or surface area is pulled to the right by the moving suction belt, and one to the left. When the panels reach the end belt units 7, the plastic tube will have been opened to its limit so that the leading edge then drops down to be engaged by the vertical belts. The tu-

bular plastic sheet is now opened out to a dimension slightly larger than the pallet, and lead end is drawn down by these vertical belts to a level below the deck of the pallet, when the belts will be stopped and the top of the plastic wrapping cut from the parent strip as hereinafter more fully described. The tubular sheet is thus progressively opened out in a horizontally-extending direction in two opposed areas to a generally four-sided configuration. The dimension of the tubular sheet is such that the four sides have no contact, or very little contact, with the load as the sheet is pulled down around the load.

The apparatus itself is more fully shown in FIGS. 1, 2 and 7. It may be assumed that for purposes of this description the machine is operating on a cubical load about 48 inches on a side. Actually elements of the machine provide adjustments for adapting the machine to various size loads, but since this is not material to a basic disclosure of the invention, such adjustability has, for purposes of simplicity, not been shown.

The machine comprises a frame structure with two spaced corner posts 15 and 15a at the front, and two similarly-spaced corner posts 16 and 16a at the rear. A conveyor 17 extends from in front of this frame between the corner posts 15 and 15a and through the frame and between corner posts 16 and 16a and beyond the frame at the rear. A horizontal transverse structural member 18 connects the two front corner posts 15 and 15a near the top of the frame, and a similar structural member 18a connects the two corner posts 16 and 16a. There are also longitudinally-extending structural members 19 at each side of the frame, one connecting posts 15 and 16, and one connecting posts 15a and 16a. The portion of posts 15 and 15a above the structural members 18 are connected by a plate 20, and the upper ends of the two rear posts are connected by a similar plate 21.

The two horizontal suction belt units 6 shown in FIG. 6 are suspended from the structural members 18 by brackets 6a secured to the side plates 8 of the suction boxes and to the crossmembers 18. Similarly, the two vertical suction belt units 7 at opposite sides of the conveyor are supported on their respective corner posts 15 and 16 and 15a and 16a by brackets 7a attached to the side plates 8 of the suction boxes for these units.

There are two pinch rolls 23 and 24 mounted in bearings on the plates 20 and 21. Pinch roll 23 is power-driven, and 24 is a slave roll resiliently urged toward the roll 23 as indicated by compression springs 25. The bight between these two rolls is in vertical alignment with the confronting ends of the two horizontal belt units 6, but spaced well above these belt units. The tubular plastic sheet is fed by these pinch rolls vertically down to pass between the belts of these two belt units, in the manner diagrammed in FIG. 6. This sheet is indicated by the heavy vertical line S in FIG. 1, but in this figure, the sheet is shown in position to be cut, where it is then flexed from a vertical plane in the manner hereinafter described.

The flat tubular sheet is pulled by the pinch rolls over an idler roll 26 supported on adjustable brackets 27 on the corner post 15 and the one behind it (16). This sheet extends down from the idler 26, between fixed and movable sealing bars 28 and 29 respectively, and then around a lower guide roll 30, and thence to the roll 31 from which the sheet is pulled by the pinch rolls.

The heat-sealing bars are of a known construction. The fixed bar 28 is in a plane clear of the normal line of travel of the sheet material, but here, too, the drawing shows the sheet pinched between the sealing bars which are in their closed sealing position. Like the movable bar 29, which is also normally clear of the sheet material, bar 28 has a length slightly greater than the width of the tubular sheet. Both bars are heated along their lengths electrically. The movable bar 29 is carried on arms 29a pivoted to swing through a limited vertical arc to press the sheet out of its normal line of travel against the fixed bar for an instant sufficient to seal a fused seam across the tubular strip, bonding the layers together. A cylinder and piston unit 32, operated by air or liquid from a source of pressure (not shown) effects the required oscillation of the movable bar. When one roll of sheet material is used up, the trailing end of the sheet may be heat-fused by these sealing bars to the leading end of the next, so that once an operation is started, there is no down time for threading each succeeding roll manually through the machine.

Between the pinch rolls and the horizontal suction belt units there is a cut-off unit, designated generally as 33. This is of a known type in which a double-edged knife moves horizontally from one edge of the strip in one direction past the other strip edge to make one cut, and in the reverse direction for the next cut. There is a fixed channel-like structure 34 supported on the cross members 18 with its channel confronting the sheet material, but set back out of the normal plane of travel of the sheet material. Opposed to the channel 34 there is a movable channel 35 confronting the opposite face of the strip sheet. It is carried on levers 36 pivoted to the machine frame to swing in an arc so that the upper and lower flanges of the channel 35 will force the sheet S from its vertical plane of travel against the flanges of channel 34, holding the reach of the sheet taut between the upper and lower flanges of the opposed channel-like structure. When this has been accomplished, the knife 37 and carrier block are movably guided in the channel 34 and will move across the sheet, cutting it just above a previously-formed transverse seal made by the sealing bars 28 and 29. The slide is moved by a fluid pressure cylinder unit 39 fixed in channel structure 34. Operation of this unit transmits the required travel to the knife block through flexible cables in a manner well understood in the art. A fluid pressure cylinder and piston unit 40 is provided to move the clamping channel 35 toward and away from the fixed channel 34.

Assuming the load to be a 48 inch cube, and that there will be about 3 inches of clearance between the plastic sheet on the sides and ends of the load when the tubular sheet is pulled down around the load and before the plastic has been shrunk, the polyethylene tube will have a perimeter when opened out of 4×54 , or 216 inches. Formed in the manner shown in FIG. 5, the flattened tube will have an overall width of about 54 inches, and the infolds or gussets will be about half this, but not quite touching at the center. When the sheet is opened out and pulled down around the load, it will hang below the pallet about 3 inches. From the bottom end of the sheet to the cut-off will be approximately 76 inches to 80 inches, figuring the height of the load as 48 inches, the deck of the pallet as 1 inch, the distance of the bottom edge below the deck as 3 inches, and half the distance across the top as 24 inches, plus some looseness in the top.

In the operation of the machine to make an enclosure which is sealed across the top of the load as contemplated in the preceding calculation, the load may be assumed to be on a pallet, and the loaded pallet is placed on the conveyor and moved into a position where it is centered under the top of the frame of the machine. Assuming that the machine is being started up for the first time, the sheet material will be unrolled and pulled up through the sealing bars. Taking the example above given, when 76 to 80 inches of the sheet has passed between the sealing bars, the sealing bars will be pressed together to form a transverse seal across the tubular sheet, sealing all of the laminations together. The sheet, after being sealed, will then be pulled over the idler roll 26, and at this time the pinch rolls will be started and the edge of the sheet will be pulled by the pinch rolls down through the cut-off device which is then open, and the leading edge of the strip will pass between the confronting ends of the two horizontally-extending suction belt units 6. When another 76 or 80 inches has passed between the sealing bars 28 and 29, the machine will be stopped and a succeeding heat seal will be formed. As the leading end of the folded tubular sheet comes down between the ends of the suction belts, the sheets will be opened out by reason of the fact that the flat two plies of the tubular sheet will be held by suction against the suction belts which are moving oppositely toward the opposite sides of the machine frame. This will effect an opening out of the folds or pleats between the two flat plies of the sheeting. By the time that these folds are fully opened out, the sheet material that is held up and being moved by the horizontal belts will drop down and be engaged by the downwardly-moving suction belts of the units 7. As the first heat seal passes the level of the cut-off knife in the cut-off unit 33, the machine will be stopped and the sheet will be severed just above the heat seal. The idler roll 26 is so adjusted with respect to the frame of the machine that at the time the cut-off is made, just exactly the right length of sheeting will have passed up between the sealing bars 28 and 29 for another transverse heat seal to be made. In other words, the distance between the cut-off and the sealing bars must be at least one full length of wrapping, or an even multiple of this length.

When the cut-off is being made, the movement of the channel 35 of the cut-off mechanism moving toward the fixed clamping channel 34, pulling the sheet material out of vertical alignment, will pull the sheet material up very slightly against the tension exerted by the suction belts, so that after the sheet is cut off and the cutting mechanism is opened, a space will have been formed between the trailing edge of the severed length and the leading edge of the following length. After the cut is made, the machine will again be started, continuing to open the severed length of sheeting and pull it down around the load until the lower edge of the severed section will be about 3 inches below the deck of the pallet. At this time the seam across the top of the severed blank will be centered above the top of the load on the pallet, and further downward travel will stop, the machine being stopped at this time. As the final travel of the severed length is taking place, the open edge of the next section of the sheeting to be cut off will be feeding down between the horizontally-extending suction belt units and start to be opened out preparatory to the wrapping of the next load.

When the downward travel of the severed length of material has been stopped, the polyethylene sheet will be loose around the sides and over the top of the load. The pallet with the covering thus applied is then moved from under the frame of the machine onto a conveyor which will carry it onto a heat-shrinking tunnel (not shown) where, at the proper temperature, the polyethylene will shrink tight about the load and the lower edge of the wrapper that hangs below the deck of the pallet will be drawn by the shrinkage up under the pallet in accordance with the wellknown behavior of the polyethylene sheet in a heated environment that will effect shrinkage of it.

Using a gusseted tubular sheet as shown in FIG. 5, the sealing bars will fuse all four layers of the sheet together in making the transverse seal or seam. As a result of this the gussets cannot open out as the upper end of the severed section moves down, and the tension will draw them automatically inward to form tucks at each end of the top of the load, as indicated by the triangular configurations in the top of the package as shown in FIGS. 3 and 8. This eliminates any need for manual operation in folding in the ends of the peak which would form when using the tubular sheeting without gussets as shown in FIG. 4.

As one load is moved from under the frame, the load traveling in the direction of the arrow shown in FIG. 2, and another load may be brought into position to be wrapped and the next length of material, as explained above, will be partially folded out to be pulled down around the load. The dimensions of the machine are so proportioned that each time a length of sheeting is cut off above a seam, the sealing bars 29 will be operated to press a succeeding seam as above explained.

In order to co-relate the sealing and cut off operations or properly index the sealing, cut-off and wrapping operations, there is a single driving motor 45 with an associated gear box 45a that drives two sprocket wheels 45b and 45c in opposite directions. One drives a sprocket chain 47 indicated by dot-and-dash lines that passes around a sprocket wheel on the roller at the bottom of one vertical suction box unit, and the other a sprocket chain 47' passing around a sprocket wheel at the lower end of the other vertical suction belt unit so that the inner reaches of both vertical belt units travel down at the same speed. A second sprocket on the roller at the lower end of each vertical suction belt unit drives a chain 48 that engages the sprocket wheel on the roller at the outer end of that horizontal suction belt unit immediately above it. As viewed in FIG. 1, the left such roller in turn has a sprocket chain 49 thereabout that drives the pinch roll 23, since this roll must revolve in a clockwise direction in this figure. The pinch roll 23 is driven at a slightly slower peripheral speed than the speeds of the several suction belts so that there will be always a slight tension on the reach of sheeting S between the pinch rolls and the horizontally-extending suction belts. While this differential speed is not necessary, it is desired to keep the material as it descends through the cut-off unit taut and avoid unnecessary wrinkling as the sheet opens out in the manner described.

Automatic controls (not shown) may be used to stop the motor 45 each time a length of material is to be cut off, and a heat seam is to be formed, and for thereafter starting it, or this can be effected by manual control.

Where the load is to be made entirely weatherproof, the method illustrated in FIGS. 10 and 11 is used. In this procedure a sheet of shrinkable polyethylene designated 55 is laid over the deck of the pallet before any load is put on it, and the sheet is larger than the pallet so that the edges 56 hang down all around the four sides of the pallet. The load is then put onto the pallet, after which the hanging free edges 56 of the sheet 55 are folded up as indicated by the dotted line in FIG. 10, and temporarily held in this position by a pressure-sensitive adhesive tape or similar temporary binding means, this tape being adhered to the load at intervals around the load. The wrapper with the heat-sealed top is then applied to the load in the manner previously described, and its lower edges will pass down below the up-folded edges 56 of the bottom sheet of plastic. Then when the load is moved into the heat-sealing furnace and the polyethylene shrinks, the polyethylene will shrink against the upwardly-extending edge portions 56, while the free edges of the main wrapper will shrink in under the deck of the pallet. In this manner the edges 56 of the bottom sheet will be joined through a watertight connection to the inner faces of the side walls of the principal wrapping. This is indicated in FIG. 10 where the principal wrapping is designated 57, and the turned-in bottom edges 58, while the fused joint between the upturned edge 56 of the bottom sheet and the side wall of the principal wrapper is indicated at 59. It will be understood that while one corner of the wrapping has been shown in FIGS. 9 and 10, this seal will extend entirely around the base of the package. Packages sealed in this way can be exposed indefinitely to the weather, and therefore be adapted to outside storage, or storage or shipment in open trucks or cars without damage to the contents.

In some cases the nature of the packaged goods may be such that a seal over the top of the package is not required. In this case the sealing bars 28 and 29 are used only when the leading edge of one roll is to be welded to the trailing edge of another roll at the time that one roll is exhausted and another roll must be used. In this method of wrapping, the folded sheet is opened out and pulled down around the load until its lower edge projects below the pallet in the manner previously described. The sheet material will be cut off at such a time that when the lower end reaches this level, the upper end will be approximately 8 or 9 inches above the top of the load. This may be accomplished by the use of apparatus indicated in FIGS. 12 and 13. In these figures the apparatus there shown is substituted for the sealing bar apparatus shown at 28 and 29 in FIG. 1. With this substitute apparatus the gusseted tubular sheet is drawn past a somewhat boat-shaped anvil member 65 that spreads the gussets open as best seen in FIG. 12. At the widest parts of these anvil members the folded corners of the sheet pass between the anvil and heated sealing elements 66 pivotally supported at 67 on the base of the anvil elements. These anvil elements in turn are fixed on supporting members 68. At the place where the corners are to be crimped, these sealing elements 66 are moved in the direction indicated by the dotted arrows to squeeze the folds together and heat-seal them. When the sheet moves clear of these anvil elements, it will again flatten down. However, when the sheet is opened out to the position shown in FIG. 9, the previously crimped corners 69 will appear as shown in this figure, constructing the plastic

wrapping so that it cannot drop down below the top of the load. When the load thus wrapped is carried into the heating chamber, the free portions of the polyethylene sheet extending above the load will fold down flat against the top of the load in the same manner that the lower edge of the wrapping shrinks in under the deck of the pallet. This forms in effect a confining wrapper about the load which, however, is open at the top.

In the foregoing description the load has been assumed to be a cube of 48 inches, but this is merely for purposes of illustration. The load may in some cases be larger or smaller, or may be higher, but of the same width, or it may be of an irregular shape, and the machine can be designed to meet the requirements of the particular goods to be shipped, or as previously indicated, provision may be made for adjusting the machine to different sizes of packages or loads by some adjustable connection between the brackets 22 for the side suction belt units, and the horizontally-extending belt suction units at the top may be adjusted to different angles through adjustment of their brackets 21 on the frame members to which they are secured. Adjustments may also be provided in other ways. The invention of course has application to goods and packages of various descriptions. In place of a pallet, the load in many cases may be supported on a base which is only temporarily held at a level where the edges of the plastic sheet can be curled under the base.

Various other modifications may be made within the contemplation of the invention and under the scope of the following claims.

We claim:

1. The steps in the method of shrink-wrapping a polyethylene film about a bulky load on a supporting base wherein the polyethylene is a roll of tubular film flattened down upon itself, which comprises:

- a. mechanically feeding the flattened tubular sheet from the supply roll downward toward and about a load to be wrapped positioned beneath it;
- b. engaging the two opposed surfaces of the leading end of the flattened tubular sheet at a level above the load to be wrapped and below the level at which the mechanical feeding of the film occurs and opening it horizontally into a four-sided configuration by oppositely moving sheet-gripping means, mechanically feeding the flattened tubular sheet from the supply roll downwardly toward the load while the open end of the tube is so engaged and guiding it downwardly around the load whereby the gripping means is required to apply only sufficient tension to hold the film open and guide it downwardly around the load,
- c. terminating the downward feed of the sheet when the leading edge of the sheet is below the supporting base of the load,
- d. severing the flattened tubular sheet after the leading edge has progressed downwardly a predetermined distance back from the leading edge determined by the height of the load and at such a place so that when the leading edge is below the supporting base the severed edge will be at a level above the top of the load, and
- e. thereafter moving the load about which the film has been so placed through a heated environment to shrink the film about the load.

2. The method defined in claim 1 in which the layers of flattened tubular sheet are sealed together across the

width of the sheet at a predetermined interval depending on the height of the load back of the leading edge and the severing of the strip is just above the transverse seal whereby the seam so formed will ultimately be positioned across the top of the load and the leading edge of the next length of the sheet may be opened out for a succeeding cycle of operation.

3. The method defined in claim 1 in which the periphery of the tubular sheet when opened is greater than the periphery of the load and the sides of the sheet are held substantially free of contact with the load as the sheet material is moved down around the load.

4. The method defined in claim 1 in which the two opposed areas of the tubular sheet that are first opened out horizontally are maintained in parallel planes spaced from the sides of the load as the sheet is moved downward while the areas of the sheet between said two areas are free of any supporting surface and are held in tension by the two supported areas.

5. The method defined in claim 1 in which the flattened tubular sheet has infolded gussets along each edge between two sheet areas of equal width and only said two sheet areas are the areas which are engaged by the oppositely-moving sheet-gripping means and first opened out in a horizontal direction and then moved down vertically to form two opposed sides of the four-sided configuration and the infolded gussets are opened out to form the other two sides.

6. The method defined in claim 1 wherein the upper portion of the sheet that extends above the top of the load is gathered in at intervals around the sheet and the gathers sealed together to prevent them from reopening whereby the gathers constrict the perimeter of the sheet at the top of the load and hold the sheet which surrounds the load from dropping below a predetermined position relative to the load until the sheet has been heatshrunk about the load.

7. The method of shrink-wrapping as defined in claim 1 wherein a layer of polyethylene film is first placed over the supporting base with its edges extending beyond the base, then placing the load on the base over said layer of film, lifting the extending edges of said film layer up around the base of the load and confining them at least temporarily against the load, after which the tubular sheet is passed down over the load, whereby when the tubular sheet heat-shrinks, the lower portion of the sheet will contact and fuse to the upturned edges of said layer.

8. The method of shrink-wrapping as defined in claim 1 in which the sheeted tubular film is gusseted to provide two outer flat layers that form two sides of the four-sided configuration when the strip is folded out and two opposed inturned gussets that form the other two sides wherein all of the several layers of said film are fused together to form a transverse seam in advance of the line on which the sheet is severed, and the downward travel of the film is stopped with the severed top end of the tubular film terminating in said transverse seam, whereby the seam prevents the full opening of the film in its final downward movement whereby the sleeve at opposite ends of the transverse seam is pulled in toward the center of the load along diagonal lines.

9. The method of shrink-wrapping as defined in claim 1 in which the sheeted tubular film is gusseted to provide two outer flat layers that form two sides of the four-sided configuration when the strip is folded out and two opposed inturned gussets that form the other

two sides comprising the further steps of partially spreading the folds of the gussets in advance of the sheet being severed and heat-sealing the corners only of the sheet to form gathers at intervals along the length of the sheet to restrict the perimeter of the sheet where such gathers are formed, and severing the sheet just above the level of the gathers so formed.

10. Bulk shrink film packaging apparatus comprising:

- a. a frame having means therein for supporting a load to be wrapped,
- b. means on the frame for supporting a roll of flat tubular wrapping sheet,
- c. means arranged to feed wrapping material from said roll downwardly from the top of said frame toward a load positioned on the load-supporting means to be wrapped,
- d. tube-gripping and holding means movable in opposite directions from the plane of the descending flat tubular sheet and positioned at a level above the load to be wrapped and below the sheet feeding means, said tube-gripping means being arranged to engage opposite sides of the flat tubular sheet as it is fed downwardly and spread them apart to form the sheet into a four-sided configuration and then hold it in said configuration and guide it downwardly around the load as the sheet-feeding means continues to feed the sheet downwardly, and
- e. means positioned at a level below the sheet-feeding means and above the tube-gripping and holding means for severing the flattened tubular sheet.

11. Bulk shrinkfilm packaging apparatus as defined in claim 10 wherein said tube gripping and holding means comprises two upper vacuum belt units having inner ends closely spaced from each other with the under reaches of each endless belt being movable in opposite directions over a suction surface together with a vertical vacuum belt unit adjacent the outer end of each of said upper belt units, each vertical vacuum belt unit having a downwardly-moving flight confronting the other at opposite sides of the load, each such downwardly-moving flight moving over a suction surface.

12. Bulk shrinkage film packaging apparatus as defined in claim 11 wherein means is provided for holding a continuous roll of the flattened tubular sheet material and wherein a pair of pinch rolls is provided in the frame above the sheetsevering means for pulling the sheet material from the roll and feeding it vertically into the space between the confronting ends of the two upper vacuum belt units.

13. Bulk shrinkage film packaging apparatus as defined in claim 12 wherein means is provided for driving the pinch rolls at a peripheral speed slightly slower than the lineal speed of the belts whereby to tension the folded sheet between the pinch rolls and the upper suction belt units.

14. Bulk shrinkage film packaging apparatus as defined in claim 12 wherein means is provided in the path of travel of the tubular sheet between a roll of such sheet film on said roll-holding means and the pinch rolls for forming a transverse heat seal across the flattened tubular sheet at a distance back from the sheet-severing means such that the sheet being advanced by the pinch rolls will always be severed by the sheet-

severing means just above a previously-formed transverse seal so that the sheet is severed in uniform lengths and the trailing end of the severed sheet section is sealed and the leading edge of the succeeding section may be opened.

15. Bulk shrinkage film packaging apparatus as defined in claim 12 in which the continuous roll of tubular sheet film is a flat gusseted sheet wherein:

- a. opposed gusset spreader and anvil elements are arranged between the roll-holding means and the severing means at each side of the sheet to spread the gusseted sheet, one being positioned to separate and firmly support the two corners of the sheet along one edge thereof and the other arranged to separate and support the two corners of the sheet at the other edge thereof,
- b. a heat-sealing element at each corner movable toward and away from the anvil element and the film supported thereon for confining the film against the anvil element and heat-sealing the corners of the film, and
- c. means for moving said heat-sealing elements into and out of heat-sealing engagement with the film corners.

16. Bulk shrinkage film packaging apparatus as defined in claim 10 for use with flattened tubular gusseted film in which

- a. means is provided in advance of said severing means for separately squeezing together and heat-sealing each of the four corners of the flattened tubular sheet only at predetermined spaced intervals along its length.

17. A corner sealing apparatus for separately squeezing together and heat-sealing each of the four corners of a flattened tubular gusseted sheet of plastic film at intervals along its length comprising

- a. means for intermittently advancing the tubular sheet from a roll to a severing device,
- b. means in the path of travel of the sheets at each side edge thereof engaged in the gussets for partially opening them and supporting the separated four corners thereof,
- c. heated tube-sealing elements positioned adjacent said tube opening and corner supporting means movable toward and away from the film and arranged when moved toward the film to squeeze only tube corners against the corner supporting means and heat-seal the corners only of the tube together, and
- d. means for moving said elements into and out of engagement with the corners of the film whereby said corners may be sealed at spaced intervals along the length of the sheet.

18. A corner sealing apparatus as defined in claim 17 wherein said means at each side edge thereof comprises a wedgedshaped element at each side of the sheet engaged between the folds of the gussets with its narrow end directed toward the roll and with a flat surface at its widest end on each side thereof, said heating elements being positioned to squeeze the corner folds of film against said flat surfaces to seal the folds where they are supported on said flat surfaces.

* * * * *