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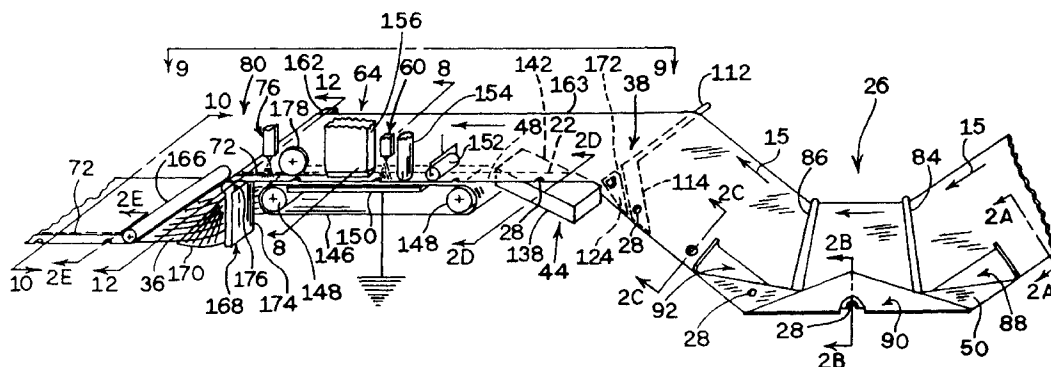
BE DE ES FR GB IT(30) Priority: **02.01.1996 US 582069****02.01.1996 US 582072**(71) Applicant: **CMD CORPORATION****Appleton, Wisconsin 54911 (US)**

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(57) Draw tape equipment (14), and methods for incorporating draw tapes (52, 54) into plastic and like bags. A continuous plastic web (10) is slit at a slitting station (16) to form layers (18, 20), and respective free edges (22, 24). The web (10) then passes to a hole forming station (26) where holes (28) are formed in the top and bottom layers adjacent the free edges. After the holes (28) are punched, edge regions (34, 36) of the top and bottom layers (18, 20) are separated from each other, followed by the forming of hems (40, 42) in the separated layers at hem forming stations (44, 46) arranged in parallel with each other. Concurrent with forming of the hems (40, 42), continuous draw tapes (52, 54) are

fed to the hem forming stations (44, 46) and the hems are formed about the draw tapes. The formed hems, (40, 42) with the draw tapes incorporated therein, optionally pass through transverse stretching apparatus (152) and/or through electrostatic pinning apparatus (154) and/or through first temperature control stations (60) where the temperature of the plastic web (10) is controlled to a desired temperature before hem sealing. The formed hems are then sealed to the main bodies of the respective top and bottom layers. The sealed hems (40, 42) optionally pass through second temperature control stations (76) to cool the web. The edge regions (34, 36) of the layers (18, 20) are then rejoined, in face-to-face relationship with each other.

FIG. 2

Description

This invention relates to plastic bags characterized by a draw tape which, when pulled, causes the bag mouth to constrict to a substantially closed condition.

Plastic bags of the type described here are typically comprised of a bag body folded to form top and bottom layers which are typically cut and sealed at the side edges. The front edges of the top and bottom layers, located opposite the fold, define the mouth of the bag. A near margin at the bag mouth is typically folded inside the bag to form a hem which is ordinarily sealed to the bag body to form a channel holding draw tapes. Pulling on accessible portions of the draw tapes causes the bag mouth to constrict thus closing the bag at its top.

Draw "string" bags have long been utilized, and have taken many forms. While drawstring bags made of plastic have been utilized to some extent, such bags have been used mostly in the lower volume boutique bag market because bags using draw "strings" tend to be more expensive. Much of the reason for this limitation in the market area is the cost of producing a draw "string" bag.

Manufacturing a plastic draw "string" bag typically requires special processing steps related to joining ends of the string being used. The string must be knotted, provided with a metal fastener, or otherwise fixed together at two ends in each such bag. Such processes cannot be carried out by the equipment usually associated with fabrication steps used to form seals and cuts in the plastic webbing from which the bag is derived. Accordingly, additional equipment must be used to so manipulate the draw "string," at related additional costs.

Subsequently, draw "tape" bags have been developed, first mostly in the boutique bag area, but now more generally for the higher volume markets. Draw tape bags represent a major advance in that a thermoplastic bag (e.g. low density polyethylene or linear low density polyethylene copolymer or the like) is provided with a thermoplastic tape (e.g. high density polyethylene), the tape being heat sealed into the bag during the process of manufacturing the bag. While draw "tape" bags in general represent a substantial improvement over draw "string" bags, there are still numerous difficulties in the production of the draw tape bags.

In making a draw tape bag in the conventional art, plastic film material is generally obtained in parent rolls. The roll is unwound and fed to a draw tape machine. The draw tape machine forms hems at edges of the web which ultimately form the top edges of the finished bag, and incorporates draw tape material into the hems, in addition to cutting holes at the edges which form the top edges of the finished bag. The hem is sealed, securing the tapes in the formed hems.

In the alternative, the plastic film material may be received in-line, from an ongoing film extrusion process.

In effecting the tape insertion, one or two strips of tape material are unwound from respective parent rolls

and fed to the formed hems of the respective top and bottom layers. Accordingly, a draw tape machine must handle at least the main web which is used to form the plastic bag, as well as the one or two tape webs being inserted into the hems. Normally two sets of sealing bars or the like are required for forming the heat seals at the respective two hems after the tapes are inserted.

Finally, after the draw tape insertion process is completed, the web is transferred from the draw tape machine to a bag-forming machine where transverse side seals, and corresponding cuts, are made across the width of the plastic web, forming side seals and cutting the continuous web into individual bags, using conventional heat sealing and cutting equipment and methods. The steps that form the side seals and cut the sides of succeeding bags from each other also seal the draw tapes, in the hems, to the bag material, itself, along the side edges of the bags, as well as cutting the tapes to a length corresponding to the full widths of the bags being fabricated.

This invention focuses on the draw tape equipment. Web material processed in this invention is subsequently transferred to bag making equipment for further processing as into the finished individual bags. The equipment of the invention could readily be incorporated into the bag making machine such that the draw tape apparatus and bag making apparatus might be incorporated into one common frame and driven by a single common controller, integrating the several steps of the overall process of both the draw tape operation and the bag making and cutting operation. While such is certainly feasible with the invention as disclosed herein, the description herein focuses on the novel aspects of such apparatus which is in general defined in the draw tape equipment.

Early bag-making equipment was designed on the basis of intermittent motion. Namely the bag-making equipment would stop the plastic web for performing bag-making steps, whether for making side seals in the bags, cutting the bags apart from the web, or for performing one or more of the earlier steps such as those associated with forming hems at the top edge of the bags, or inserting tapes into such hems. After the desired step(s) were performed, transport of the bag was again started and the bag advanced to subsequent steps. More recently, continuous motion processing equipment has been developed wherein bag-making steps are performed while the bag advances continuously along a processing line.

However, even the most modern bag-making equipment still includes a variety of problems. Of particular concern in this invention is the apparatus used to form hems and incorporate draw tapes into the hems. There is also the issue of controlling the temperature of the parent web both before and after the hem sealing step. There is also the issue of minimizing the amount of floor space occupied by the bag forming machinery while retaining the web being processed where workers can

reach it from floor level. Finally, there is the issue of improving handling of the parent web during its traverse through the bag forming operation.

It is an object of the invention to provide draw tape equipment and methods for forming hems around the draw tapes, rather than inserting the draw tapes into already-formed hems.

It is another object to provide draw tape draw tape equipment and methods wherein holes are formed adjacent the free edges of the plastic web before the free edges are folded for incorporation of draw tapes therein.

It is still another object to provide draw tape draw tape equipment and methods controlling the temperature of the parent web material both before and after applying sealing heat to formed hems.

It is yet another object to provide draw tape draw tape equipment and methods, separating edge regions of the top and bottom layers of the plastic and forming hem seals on both the top and bottom layers along parallel paths.

It is a further object of the invention to minimize the floor space occupied by the draw tape equipment while maintaining the web being processed at a level which can be reached by workmen standing on the floor of the work place.

Another object is to stretch the web adjacent the formed hems, with the draw tapes therein, prior to forming the seals at the formed hems.

A still further object is to electrostatically pin the formed hems to an underlying support, and to carry the thus pinned hems along the processing line on an intervening belt, thus controlling the transverse positioning of the hem with respect to hem sealing apparatus, for forming the hem seals.

A further object is to provide an angled turning member for assisting in returning the edge regions of the top and bottom layers into surface-to-surface contact with each other after the hem seals are formed along parallel paths.

SUMMARY OF THE INVENTION

This invention pertains generally to apparatus and methods for incorporating draw tapes into plastic and like bags. In general, a continuous length of a plastic tube is unwound from a parent roll, and slit at a slitting station to form upper and lower layers, and respective free edges. The web then passes to a hole forming station where holes are formed in the top and bottom layers adjacent the free edges. Prior to forming holes, edge portions of the respective top and bottom layers are folded against the main body portion of one of the layers, with one of the edge portions nested in the other of the edge regions.

After holes are formed, the edge regions of the top and bottom layers are separated from each other by a separating plow while the remainders of the layers are maintained in surface-to-surface contact with each other.

The edge regions traverse parallel paths while hems are formed in the respective edge regions, while tapes are incorporated into the hems, and while the respective hems are sealed to the main body members of the respective layers.

Continuous lengths of draw tapes are fed to the hem forming stations concurrent with forming of the hems. The hems are preferably formed about the draw tapes. The formed hems, with the draw tapes incorporated therein, optionally traverse stretching rollers which have working surfaces oriented at a small angle to the direction of movement of the web. The formed hems also optionally pass through electrostatic pinning apparatus and/or through temperature control stations where the temperature of the plastic web is controlled, such as with a mist of water or a stream of air, to a desired temperature before the hems are sealed.

The formed hems are then sealed to the main bodies of the respective top and bottom layers. Optional second temperature control stations can be employed downstream of the hem sealing apparatus, to cool the web after the seals are formed. After the hems have been sealed, the edge regions of the layers are then rejoined, in face-to-face relationship with each other. Preferred apparatus for rejoining the edge regions together is an upstanding cone, assisted by a horizontal turning bar downstream of the upstanding cone. Air lubrication may be used at one or more turning members, as beneficial for facilitating rejoining the edge regions with each other.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 shows a representative block diagram of primary work stations of equipment of the invention.

FIGURE 2 shows a representative pictorial view of the hole forming station.

FIGURES 2A-2E show cross-sections of the edges of the web at various stages in the process, and are taken at 2A-2A, 2B-2B, 2C-2C, 2D-2D, and 2E-2E of FIGURE 2.

FIGURE 3 shows a representative and fragmentary plan view of the hole forming station.

FIGURE 4 shows a representative and fragmentary elevation view of the hole forming station.

FIGURE 5 shows a side cross-section of a hole cutter used in the invention.

FIGURE 6 shows an enlarged fragmentary view of the separation station and the first hem forming station.

FIGURE 7 shows an enlarged fragmentary view as in FIGURE 6, with the web pulled back to illustrate the method of initiating separation of the edge regions.

FIGURE 8 is a cross-section taken at 8-8 of FIGURE 2, showing the separated edge regions at the hem sealing stations.

FIGURE 9 is a top view of equipment of the invention taken at 9-9 in FIGURE 2, including a showing of the hem forming area and the hem sealing area.

FIGURE 10 is a fragmentary end elevation taken at 10-10 of FIGURE 2.

FIGURE 11 is a partial section taken at 11-11 of FIGURE 10.

FIGURE 12 is a cross section taken at 12-12 of FIGURE 2.

The invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the terminology and phraseology employed herein is for purpose of description and illustration and should not be regarded as limiting. Like reference numerals are used to indicate like components.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring now by characters of reference to the drawings, FIGURE 1 is a block diagram illustrating processing equipment used in the invention. In general, a continuous plastic web 10, generally a collapsed tube with top and bottom layers in surface-to-surface contact with each other, is unwound at a web unwind station 12 and is fed into a draw tape machine 14. The web 10 is drawn through the draw tape machine 14 by nip rollers, not shown, which are driven by conventional drive means, not shown. The web 10 moves along a path having a general direction as shown by the arrows 15 in the several FIGURES. See FIGURE 2. The plastic web 10 is slit in draw tape machine 14 at a slitting station 16 to form top and bottom web layers 18, 20 having respective free edges 22, 24, such that the web at that stage takes the form of being folded longitudinally along its length, to form top and bottom layers. The web then passes to a hole forming station 26 where holes 28 are punched in the top and bottom layers adjacent the free edges 22, 24. Edge regions 34, 36 of the top and bottom layers 18, 20 are then separated from each other at a separation station 38, immediately followed by forming of the first and second hems 40, 42 in the separated layers 18, 20 at respective hem forming stations 44, 46 traversing generally parallel but spaced paths while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other. The separated edge regions generally lie in imaginary surfaces intersecting each other along an imaginary line having a component extending in the direction of travel of web 10. The hems are formed at edge portions 48, 50 of the layers 18, 20, including the free edges 22, 24.

Concurrent with the forming of the hems 40, 42, continuous draw tapes 52, 54 are fed from tape unwind stations 56, 58 to the hem forming stations 44, 46, and the hems are formed about the respective draw tapes 52, 54. The formed hems, with the draw tapes incorporated therein, then optionally pass through first temper-

ature control stations 60, 62, where the temperature of the plastic web is controlled to a desired temperature. The formed hems then pass to hem sealing stations 64, 66 where the edge portions 48, 50 are sealed, generally at free edges 22, 24, to the main bodies 68, 70 of the respective top and bottom layers 18, 20, forming hem seals 72, 74.

The forming of the hem seals traps the draw tapes 52, 54 in the hems 40, 42. A narrow pressure wheel, described hereinafter, applies pressure to the hot seal to improve the seal quality. The sealed hems then optionally pass through second temperature control stations 76, 78, where the temperature of the plastic web is again controlled to a desired temperature.

The formed and sealed hems, with the draw tapes therein, then pass to the edge region rejoinder station 80, where the first and second edge regions 34, 36 are rejoined, in face-to-face relationship with each other, with the effect that the top and bottom layers are again in surface-to-surface contact with each other over the entire transverse width of the web. The so processed web has draw tapes 52, 54 securely trapped in the hems 40, 42. The web then passes out of draw tape machine 14, and advances for further processing to e.g. a bag forming machine 82, where transverse heat seals and associated cuts are formed across the web, forming bag side seals which seal the draw tapes to the bags, and cutting individual bags from the continuous web 10.

Addressing a more detailed description of certain ones of the elements, attention is first turned to the hole forming station 26 and FIGURES 2-5. Hole forming station 26 includes first turning bar 84, generally arresting downwardly-sloped advance of web 10 and a second turning bar 86 generally turning the web back to an upwardly-sloped path of advance. In-turn plow 88, back-fold plow 90, and out-turning plow 92 operate on the edge portions 48, 50 of the web as the web traverses the hole forming station. In-turn plow 88 has a web contact surface 94 having a downwardly depending portion and a generally horizontal portion. Back-fold plow 90 has a generally horizontal web contact surface 96 comprising the bottom surface of the back-fold plow. Out-turning plow 92 has a web contact surface 98 having a generally horizontal portion and an upwardly depending portion. The downwardly depending portion of web contact surface 94 of the in-turn plow forms an obtuse angle "A1" with the web contact surface 96 of back-fold plow 90. The upwardly depending portion of web contact surface 98 of the out-turning plow forms a similar obtuse angle "A2" with the web contact surface 96 of back-fold plow 90. Angles "A1" and "A2" are generally equal, opposite, obtuse angles, measured from the bottom surface of the back-fold plow, generally taken in elevation view as in FIGURE 4.

In-turn plow 88 has an angled outer edge 100, adjacent the free edges 22, 24 of the web which outer edge 100 extends inwardly across the free edges of the web 10 along the direction of travel of the web at an angle

"A3" seen in plan view in FIGURE 3. Back-fold plow 90 has a first angled inner edge 102 defining approximately the same angle "A3" with respect to the free edges 22, 24 of the web 10. The angled inner edge 102 is generally aligned with the outer edge 100 of the in-turn plow 88, and comprises a continuation of the generally horizontal portion of the web contact surface 94.

Similarly, out-turning plow 92 has an angled outer edge 104, adjacent the free edges 22, 24 of the web which outer edge 104 extends outwardly across the free edges of the web 10 along the direction of travel of the web at an angle "A4" seen in plan view in FIGURE 3. Loci on outer edge 104 are generally aligned with respective loci on outer edge 100 along the length of web 10, and thus at a common transverse distance from free edges 22, 24. Back-fold plow 90 has a second angled inner edge 106 defining approximately the same angle "A4" with respect to the free edges 22, 24 of the web 10. The angled inner edge 106 intersects the inner edge 102 and is generally aligned with the outer edge 104 of the out-turning plow 92, and comprises an approximate continuation of the generally horizontal portion of the web contact surface 98.

Back-fold plow 90 receives the in-folded edge portions and folds the in-folded edges back onto a respective one of the main body portions. A cutting notch 108 in back-fold plow 90 intermittently receives a hole former, namely cutter 110, which cuts spaced holes 28, thus forming holes, in the edge portions of the web as the edge portions pass through the hole forming station 26.

FIGURES 2 and 6-8 illustrate detail of the separation station 38, and the close cooperation of the separation station 38 with the hem forming stations 44, 46. Turning first to FIGURES 2 and 6, as the web 10 leaves the hole forming station 26 the web travels along an upward path toward turning bar 112.

Separating plow 114 is mounted to turning bar 112 along the path of travel of the web 10, thus in part guiding the web in its upward travel. Separating plow 114 has a separating edge 116 angled inwardly along the direction of travel of the web. Separating edge 116 engages a progressively increasing portion of edge region 36 of the bottom layer as the web travels across the top surface 118 of the separating plow 114 toward turning bar 112, turning the edge region 36 in a downwardly directed path, relative to layer 18 and to the remainder of the bottom layer 20.

As the primary portion of the bottom layer 20 turns about turning bar 112, the edge region 36 of the bottom layer moves into a vertical orientation. The remainder 120 of the bottom layer (namely the above mentioned "primary portion") is in a horizontal orientation, disposed at more or less 90 degrees to the edge region 36. The relative vertical orientation of the edge region 36 and the respective horizontal orientation of the remainder 120 of the bottom layer are illustrated in FIGURE 8, where it is seen that the remainder 120 of the bottom layer 20

is in surface-to-surface contact with the remainder 122 of the top layer 18.

It is contemplated that the edge region 36 could readily adopt orientations other than vertical. Thus, the included angle "A5" (FIGURE 8) may be as small as about 30 degrees, or as large as 160 degrees, potentially up to nearly 180 degrees. Any and all angles in between are contemplated as possible, though angles closer to 90 degrees, such as between 75 and 105 degrees are contemplated as being most preferred.

Folding plow 124 is mounted along the path of travel of the web 10, beside separating plow 114. The top surface 126 of folding plow 124 forms a generally common surface with the top surface 118 of separating plow 114. Accordingly, the top layer 18 of web 10 is supported over a generally common top surface defined by the top surface of separating plow 114 and top surface 126 of folding plow 122, in combination, which top surfaces are aligned with the outer radius of turning bar 112. Folding plow 124 and separating plow 114 are separated by slot 128 which receives the edge region 36 of bottom layer 20 as the edge region 36 turns downwardly toward the vertical orientation seen in FIGURE 8.

Hem folding plow 124 has a folding edge 130 extending across and progressively inwardly of the free edge 22 of the top layer 18, up to the level of the top of turning bar 112. The folding edge progressively folds the edge portion 48 downwardly as the web progresses along folding edge 130, such that the free edge 22 is disposed generally downwardly as edge region 34 passes over the top edge 132 of the folding plow 124.

Hem folding plow 124 further has an aperture 134, and a small turning roll 136 journaled in the aperture 134. The turning roll 136 has an outer working surface generally aligned with the upwardly sloped top web-engaging surface 126.

Hem forming plow 138 has a generally horizontal surface 140 extending along the path of travel of the top layer 18, disposed at an angle obtuse to top surface 126 of plow 124, downstream of turning bar 112, separating plow 114 and folding plow 124, and generally level with the top of turning bar 112 and the top edge 132 of hem folding plow 124. The top surface 140 has an angled leading edge 142. An associated upstanding inner surface 144 extends inwardly across the free edge 22 of the top layer 18 when viewed along the direction of travel of the web 10, all as seen in FIGURES 2, 6 and 7. The edge portion 48 of top layer 18, which is down-turned at hem folding plow 124, engages the upstanding inner surface 144 and rides up and over leading edge 142. The oblique angle of leading edge 142 folds the already down-turned free edge 22 upwardly under the main body portion 68 of the layer 18, thus forming the hem 40.

As referred to herein, each layer 18, 20 has two main elements defined across the width of the respective layer, namely an edge region (34 or 36) and a remainder portion (120 or 122). Each edge region includes an edge portion and a main body portion. The edge por-

tion is that portion of the edge region which is folded under at e.g. hem forming plow 138. The main body portion is all the rest of the respective edge region. Each edge portion includes the respective free edge (22 or 24). Each hem (40 or 42) is formed from the respective edge portion and an adjoining part of the respective main body portion, with the hem seal typically being formed at or near the respective free edge 22 or 24 on the edge portion.

While the hem 40 is being formed as described above, draw tape 52 is being fed from unwind station 56 through aperture 134, over turning roll 136, and into contact with the underside of top layer 18 as it progresses onto the top surface 126 of folding plow 124. Thus, the draw tape 52 advances into the hem forming operation along a path generally parallel in place to the path of the plastic material of layer 18, and in parallel in time with the folding of the edge portion by the hem folding plow. The draw tape advances between the top surface 126 of the hem folding plow and the underside of the layer 18, thence advancing together with the edge portion 48 of layer 18 across the top edge 132, past leading edge 142, and across the top surface 140 of hem forming plow 138.

As draw tape 52 approaches the leading edge 142, it is drawn into close proximity with the edge portion 48 of the top layer 18. The draw tape, itself, is in a horizontal orientation, extending along the length of the free edge 22 of the layer 18. As the leading edge 142 of the hem forming plow 138 folds the edge portion 48 of top layer 18 upwardly against the main body portion 68 of the top layer in forming the hem 40, the edge portion 48 enfolds the draw tape 52 between the edge portion 48 and the main body portion 68. Thus, the edge portion is folded about the draw tape, whereby the hem is formed about draw tape 52 in the process of incorporating the draw tape into the hem. In the process, the edge region 34 is maintained as a generally straight line extension of the remainder of the width of the top layer 18.

The edge portion 48 is somewhat wider, measured across the width of the web 10, than the draw tape 52. Thus, when edge portion 48 is folded up against main body portion 68, the free edge 22 extends past the full width of the draw tape and is in surface-to-surface contact with the main body portion 68 away from the folded edge 158 of the edge portion 48. The relationship of the draw tape in the folded edge portion is shown in detail in FIGURE 8.

Endless support belt 146 is mounted for support and endless traverse under hem 40 downstream from hem forming plow 138 past electrostatic pinning device 154 and hem sealing device 156, to pressure wheel 178. Support belt 146 is mounted on a plurality of guide rolls 148 about an endless path. The guide rolls 148 are shown in FIGURE 2. The downstream one of the guide rolls 148 provides support against which pressure wheel 178 presses. Support belt 146 is driven by conventional drive, not shown, at a surface speed matching the speed

of advance of the web 10 at edge portion 48. Thus, the support belt moves with the hem thereon from approximately the hem forming plow to pressure wheel 178.

Support belt 146 is preferably rather flexible and can be made of, for example, reinforced polymer such as various natural and synthetic rubbers or other polymers or copolymers, or the like. Belt 146 may, of course, include conventional additives for controlling surface characteristics such as slip and the like. Examples of such additives are the silicones and fluorinated polyethylenes, such as polytetrafluoroethylene, also known as Teflon®.

Downstream of the hem forming plow, the edge portion 48 passes under stretching roll 152, thence electrostatic pinning device 154, subsequently first temperature control device 60, and heat seal device 156.

Support bar 150 underlies and supports support belt 146 along the portion of the path which passes under the electrostatic pinning device, and the heat seal device. Support bar 150 is stationary, and physically supports support belt 146 against physical downward forces.

Support bar 150 is electrically conductive, and is electrically grounded, whereby the support bar 150 presents an electrical ground cooperative with the electrostatic pinning device 154 for electrostatically pinning the non-conductive material of the plastic web 10 to moving support belt 146 after the edge portion 48 has been stretched by stretching roll 152. Support bar 150 is preferably metal or other suitably rigid conductive material.

Stretching roll 152 is mounted over the edge portion 48 at a slight angle to the direction in which the web 10 is moving, and presses downwardly against the edge portion 48, with the edge portion 48 being supported by resiliently flexible support belt 146. Thus, the primary working surface of stretching roll 152 is disposed at a slight angle (e.g. less than 20 degrees, for example about 5 degrees to about 10 degrees) to a perpendicular e.g. line 155 extending transversely across the web 10. Stretching roll 152 works against primary resistance of support belt 146, which can be pushed down slightly by roller 152, as the hem traverses from the hem forming element to the hem sealing element. Working against resilient underlying support belt 146, roll 152 controls transverse positioning of the formed hem with respect to sealing device 156, while the hem seal is being formed. Thus, the web moves freely transversely in removing wrinkles and the like until support belt 146 reaches support bar 150 in the vicinity of electrostatic pinning device 154.

Accordingly, the force exerted against the edge portion 48 urges the edge region 34 of layer 18 outwardly with respect to the web, stretching the web in the transverse direction and pulling wrinkles out of the film. At the same time, stretching roll 152 squeezes out air from between the edge portion 48 and main body portion 68 inside the formed hem 40.

Electrostatic pinning device 154 is mounted proximately downstream of the stretching roll 152 immediately after the stretching at stretching roll 152, over the edge portion 48. Pinning device 154 electrostatically pins the edge portion 48 against the moving support belt 146. The electrostatic pinning device thus effectively pins the edge portion 48 of stretched layer 18 to the moving belt 146 for the full length of the support bar 150, substantially from a point slightly downstream of the stretching roll 152 until after the hem seal 72 has been formed at sealing device 156 and pressure wheel 178 and set/cooled at the second temperature control device 76. Thus, the pinning device fixes the layer against transverse movement while the hem seals are being formed and set.

Heat seal device 156 is mounted downstream of electrostatic pinning device 154, over edge portion 48, and positioned approximately over the folded-under free edge 22 of the top layer. Heat seal device 156 can be any of the conventionally known heat seal devices which form heat seals on continuously moving plastic webs. As the edge portion 48 passes under the heat seal device, both the edge portion 48 and the main body portion 68, of edge region 34, are being supported by support belt 146. A stream of hot air from the heat seal device heats the main body portion 68 adjacent free edge 22, softening both the main body portion and the free edge, and forming bonds therebetween in creation of heat seal 72 along a line, extending along the length of the web, between the main body portion 68 and the edge portion 48 at or adjacent free edge 22. Other types of heat seal devices could be used, such as infrared heaters.

Pressure wheel 178 then exerts modest downward pressure on the softened materials to fuse, and thus bond the softener materials to each other.

First device 60 is mounted proximately downstream of the pinning device 154, over main body portion 68, which is over edge portion 48. The temperature control device 60 projects cooling (or heating) fluid such as cooling (or heated) air or a mist or stream of water onto the main body portion 68 immediately prior to the combination of the main body portion and the edge portion passing under the heat seal device 156. Thus, the temperature control device 60 imparts a predictable, controlled temperature at the edge portion 48 immediately upstream of hem seal forming at heat seal device 156.

Second temperature control device 76 is mounted proximately downstream of the heat seal device 156 and downstream of pressure wheel 178, over main body portion 68 at edge portion 48. The temperature control device 76 projects cooling fluid such as cooling air or a mist or stream of water onto the main body portion 68 shortly after the main body portion and the edge portion pass under the pressure wheel 178. Thus, the temperature control device 76 provides cooling to the seal 72 to set the seal and cool the seal thus to avoid residual heat inadvertently bonding portions of the web to each other downstream of the pressure wheel 178.

The remainders 120, 122 of the layers remain in surface-to-surface contact with each other over the entire path traversed by the web through the draw tape machine. Between turning bar 112 and turning bar 162 the remainders 120, 122 of the layers are supported by a support table illustrated generally by the element 159 (FIGURE 8). At the end of the support table, the remainders 120, 122 traverse a turn of about 45 degrees over turning bar 162. Turning bar 162 is hollow as illustrated in FIGURE 12, having an inner chamber 165 therein, and being closed at both ends. A row of air ports 167 extends from the inner chamber 165, through the outer wall of bar 162, to the outer surface of the turning bar, at about 22 degrees, trailing, from the top of turning bar 162. Low pressure compressed air is fed into the inner chamber 165 by an air line, and out the air ports 167 to provide a lubricating air cushion positioned generally mid-way along the path of turning contact between the bottom layer 20 and turning bar 162, to assist the turning of the remainders 120, 122 about the turning bar 162.

Turning bar 162 is mounted downstream of the second temperature control device 76. Turning bar 162 extends from generally the back edge 163 of the support table 159 to edge region 34, and thus stops well short of edge portion 48. Thus, edge portion 48 is not supported by turning bar 162.

Turning plate 168 has a rounded vertical edge 174, and a rounded horizontal turning edge 176. Turning edge 176 has a radius of curvature generally corresponding to the working surface of turning bar 162, and functionally comprises an extension of turning bar 162, along edge region 34. The turning bar 162 ends remote from edge portion 48. A gap 164 is disposed between the turning bar 162 and the turning edge 174 of turning plate 168. Rejoinder turning roll 166 is a second turning member, and is positioned downstream of, and is vertically downwardly displaced from, turning bar 162 and turning edge 176.

The entirety of top layer 18 passes over the functional combination of turning bar 162 and turning edge 176 and passes downwardly under rejoinder turning roll 166. The remainder 120 of bottom layer 20 passes over turning bar 162 while the vertically downwardly disposed edge region 36 passes through gap 164, about vertical turning edge 174, and over upstanding turning cone 170. Turning cone 170 engages the edge region 36 (FIGURES 2, 11, and 12) directly downstream of the turning edge 174 and turns the edge region 36 gradually over the conical surface of cone 170 from a vertical orientation toward a more horizontal orientation, such that the edge region 36 leaves the turning cone disposed at an angle of about 40-50 degrees (FIGURE 10), preferably 45 degrees, from the vertical. The edge region 36 continues the transition toward a horizontal orientation as it moves toward rejoinder turning roll 166. Edge region 36 finally reaches a horizontal orientation as it passes under turning roll 166, simultaneously rejoining edge region 34 of top layer 18.

FIGURES 10 and 11 show some detail of the process as the edge region 36 achieves a full 90 degree turn, which may be considered an edge rotation over a distance travelled, from vertical to horizontal as it passes over turning cone 170. Edge region 36 makes the rotation around turning cone 170 and joins edge region 34 of the top layer 18 at rejoinder turning roll 166.

At rejoinder turning roll 166, the web 10 comprises the full widths of top and bottom layers 18, 20, with draw tapes 52, 54 in the sealed hems 40, 42. The web 10 passes from turning roll 166 to a driven nip, not shown, and then out of the draw tape machine 14, to bag forming station 82 which forms e.g. transverse heat seals and cuts in the web to seal the bag sides and cut individual bags from the continuous web.

While not shown in the same detail as above, draw tape 54 is incorporated into the hem 42 in bottom layer 20 using like steps. Thus, the tape incorporation process at bottom layer 20 uses a folding plow 124 including aperture 134, a forming plow 138 including surfaces 140, 144, and angled leading edge 142, incorporating draw tape 54 into the hem 42, as well as a stretching roll 152, an electrostatic pinning device 154, first and second temperature control devices 60, 76, heat seal device 156, and pressure wheel 178.

While included in the preferred embodiment illustrated, temperature control devices 60, 76 are optional, and either such temperature control device may be used alone, or the control devices 60, 76 may be used together. The exact location of the temperature control devices can vary and still have the same effect.

Returning now to FIGURES 6 and 7, and looking downstream along the processing line, the top left corner of separating plow 114 and the top right corner of folding plow 124 define a separating notch 172 therebetween. Specifically, notch 172 is defined by upper facing edges of the respective plows which converge downwardly toward each other along the slot 128. In some embodiments, the slot 128 should be widened at the notch. Thus, an insert, not shown, is preferably added at the top edge e.g. at 132, where the top and bottom folding plows 124 meet. With the notch properly dimensioned, the notch causes automatic initiation of feeding of the edge region 36 of bottom layer 20 through slot 128 while feeding the edge region 34 transversely over hem folding plow 124. Thus, for use with e.g. low density polyethylene bag material having a thickness of about 0.001 inch each layer, one embodiment of the notch has an opening at its top of about 0.19 inch, an angle at the insert of about 60 degrees from horizontal, and a depth, from the widest to the narrowest opening represented by the notch 172, of about 0.33 inch.

FIGURE 7 illustrates the method of starting the bottom edge region 36 feeding downwardly through the slot 128. With the plastic web 10 being driven slowly along the processing line, under tension, such as at about 15 to about 600 feet per minute, the operator pushes the edge region 36 of bottom layer 20 across the separating

notch while keeping the edge region 34 extended across slot 128, and across folding plow 124. The edge region 36 is thus bunched up adjacent the notch as shown by the shaded area 173 of the web in FIGURE 7. It should be noted that, in FIGURE 7, part of the edge portion 34 of top layer 18 is shown in dashed outline, showing underlying layer 20 in full line drawing.

The operator then releases the edge region 36, preferably with the web still moving along the processing path, and allowing the bunched-up edge region 36 of bottom layer 20 to gradually move transversely back toward the notch as the web continues to advance under draw tension.

As the edge region 36 moves back toward the notch 172, the edge of the bottom layer begins feeding downwardly into the notch 172. As the web continues to advance, the edge region 36 becomes fully deployed through notch 172, resulting in subsequent smooth feeding of the edge region 36 downwardly through the notch in the continuous feed process characteristic of the equipment of the invention. This provides a fast, easy way to thread the hem forming station 46. The edge region 36 can, of course, be threaded through slot 128 by hand, with or without forward driving of the web 10.

FIGURES 2A, 2B, 2C, 2D, and 2E illustrate the configurations of the edges of the web at various stages of the process. Thus, FIGURE 2A shows the free edges 22, 24, and thus the edge portions 48, 50, after the slitting operation, overlying each other at the beginning of the process of forming the hems and incorporating the draw tapes thereinto.

FIGURE 2B shows the edge portions 48, 50 folded back onto the main body portion 68 of the top layer, with holes 28 having been simultaneously cut in both layers by the hole cutter 110. Folded-over edge portion 48 of top layer 18 is nested inside folded-over edge portion 50 of bottom layer 20.

FIGURE 2C shows the edge portions after being unfolded to the flat condition at out-turning plow 92.

FIGURE 2D shows the edge portions 48, 50 re-folded, inwardly against the main body portions 68, 70 and with the draw tapes 52, 54 received therein.

FIGURE 2E shows the edge portions 48, 50 after the edge regions have been rejoined at turning roll 166. The edge regions 34, 36 are again overlying each other, with the hems formed, sealed, and facing each other, and with the draw tapes secured therein by the seals 72.

It is contemplated that the operation and functions of the invention have become fully apparent from the foregoing description of elements, but for completeness of disclosure the usage of the invention will be briefly described.

A flattened tubular web 10 having opposing edges is unwound from web unwind station 12 and fed to the draw tape machine 14. As the flattened web 10 enters the draw tape machine 14, it is slit at one of the edges to form free edges 22, 24, which will be disposed at the

tops of the bags to be fabricated from the web 10.

The web, still in a generally flat disposition, then advances downwardly toward the hole forming station 26. As the web advances toward turning bar 84, the top layer is in overlying contact with the bottom layer. The slit free edges 22, 24 pass under in-turn plow 88 at web contact surface 94, and both free edges 22, 24 are folded upwardly about edge 100, as the main body of the web passes around turning bar 84 at an obtuse angle, to a horizontal disposition, and edge portions 48, 50 pass toward the back-fold plow 90. The edge portion 48 is nested inside edge portion 50. The upwardly folded edge portions 48, 50 are engaged by inner edge 102 of back-fold plow 90 and are folded back to a 180 degree orientation with respect to the main body portion 68 of the top layer.

With both edge portions 48, 50 folded back 180 degrees onto main body portion 68, the edge portions pass along the web contact surface 96 of back-fold plow 90, and through cutting notch 108. Cutter 110 cuts holes in the back-folded edge portions at spaced locations along the length of the web as the web advances through the cutting notch. Suitable cutter 110, and operation of such cutter, are taught in United States Patent 4,664,649 Johnson et al, herein incorporated by reference.

As the web advances past the cutting notch, the folded edge portions 48, 50 are unfolded by operation of inner edge 106 of back-fold plow 90 in combination with outer edge 104 of out-turning plow. The folded edge portions are turned generally into a vertical orientation as they leave inner edge 106 and as the main body of the web passes about turning bar 86 at an obtuse angle and begins advancing upwardly. As the edge portions are engaged by outer edge 104 the edge portions are fully unfolded such that the edge portions 48, 50 are restored to their generally flat condition as e.g. straight line extensions of the remainders 120, 122 of the respective layers 18, 20. FIGURE 2 illustrates the holes 28 in the web at the edge portions after traversing the hole forming station.

The advancing web next encounters the separating plow 114, and at about the same time hem folding plow 124. The edge region 36 of bottom layer 20 passes downwardly through the slot 128 between the folding plow 124 and the separating plow 114. The edge region 34 of the top layer advances over the top surface 126 of folding plow 124. The edge region 36 concurrently advances over a corresponding folding plow (not shown) below the level of support table 159.

The rest of the description here will describe the folding and sealing steps only with respect to the top layer 18. However, like steps also are performed with respect to the bottom layer 20.

As the edge portion 48 advances over the folding plow 124, the edge portion 48 is folded vertically downwardly by trailing folding edge 130. The downwardly depending edge portion 48 is engaged by the leading folding edge 142 of hem forming plow 138, and folded up-

wardly against and onto the main body portion 68 of the layer, thus completing formation of the hem 40.

As the hem 40 is being folded, draw tape 52 is fed around turning roll 136, out of the hem folding plow 124 at aperture 134, between the main body portion 68 of layer 18 and the top surface 126 of the folding plow. As the hem 40 is being formed, the draw tape 52 is fed over the leading edge 142 and across the top surface 140 of hem forming plow 138. Thus, as the downwardly depending edge portion 48 is folded upwardly against and onto the main body portion 68, the edge portion 48 is folded under the draw tape 52 which is advancing across the top surface 140. Thus, the upward folding of the edge portion 48 against the main body portion 68 engages the draw tape 52 between the edge portion and the main body portion 68, with free edge 22 extending beyond the draw tape 52 and engaging the main body portion 68 in surface-to-surface contact (FIGURE 8).

With the hem thus formed, the hem is passed under stretching roll 152 where any wrinkles or the like are stretched out of the edge region 34. With the edge region stretched, the edge portion is then electrostatically pinned to the support belt 146, with support bar 150 co-operating in providing the electrical pinning force. The support belt 146 moves at the same linear speed as the web 10, whereby the support belt moves along generally carrying the edge portion 48 through the rest of the hem fabrication steps.

The stretched, pinned edge region then passes under the first temperature control station 60 where a controlled temperature fluid is imposed against the edge portion, such as air, or atomized water e.g. a water mist, cooling or heating the edge region as appropriate to provide a predetermined temperature to the edge region in preparation for the step of forming heat seals at heat seal device 156 and pressure wheel 178, sealing the formed hems.

The temperature controlled edge region then passes to the hem seal station 64 at heat seal device 156. Concentrated heat such as hot air is applied to the main body portion of the web opposite the free edge 22, softening the main body portion and the adjacent elements of the edge portion, preferably at the free edge. The facing lines of softened material in main body portion 68 and edge portion 48 then pass under pressure wheel 178 which presses against the rear guide roller 148, as shown in FIGURES 2 and 9. The pressure urges the lines of heat softened material together in bonding contact, such that the continuous-line seal 72 is formed between the edge portion 48 and the main body portion 68. Thus is formed heat seal 72, joining the free edge and the main body portion, and thus closing and sealing the hem along the continuous line.

The sealed hem then passes under the second temperature control station 76 where a controlled temperature fluid, such as air, or atomized water e.g. water mist, is again imposed against the edge portion, cooling the edge region so that the plastic is not inadvertently bond-

ed to itself at unintended locations.

After cooling, the layer 18 passes over turning bar 162 and downwardly under turning roll 166. Meantime, the edge region 36 of the bottom layer, also hemmed, sealed, and cooled, passes about vertical turning edge 174, turning cone 170, and turning roll 166 in the process of rotating from its downwardly extending vertical orientation to a horizontal orientation. The edge regions 34, 36 are rejoined in surface-to-surface contact with each other at turning roll 166, and then proceed through the above-mentioned driven nip.

The web, having been hemmed, the draw tapes 52, 54 incorporated into the hems, the hems sealed, and the edge regions rejoined to each other, the web passes out of the draw tape machine for further processing steps which form no part of this invention.

Those skilled in the art will now see that certain modifications can be made to the apparatus and methods herein disclosed with respect to the illustrated embodiments, without departing from the spirit of the instant invention. And while the invention has been described above with respect to the preferred embodiments, it will be understood that the invention is adapted to numerous rearrangements, modifications, and alterations, and all such arrangements, modifications, and alterations are intended to be within the scope of the appended claims.

Claims

1. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

(a) hole forming apparatus forming holes at spaced locations in the edge portions of the web;

(b) tape feed apparatus feeding first and second draw tapes into proximity with the first and second edge portions;

(c) hem forming apparatus, preferably disposed downstream of the hole forming apparatus, receiving the first and second draw tapes and folding the first and second edge portions about respective ones of the first and second draw tapes and onto respective first and second ones of the main body portions of the respective layers, thus forming the first and sec-

ond hems about the draw tapes, with the draw tapes inside; and

(d) hem sealing apparatus sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and thereby securing the respective draw tapes therein;

and the equipment optionally including temperature control apparatus controlling the temperature of the web at the formed hems before the sealing of the edge portions to the respective main body portions.

2. Equipment as in Claim 1, said hem forming apparatus including first and second hem folding plows having first and second hem folding edges extending at first and second transverse angles to the direction of travel of the web and folding the first and second edge portions of the web, and first and second hem forming plows having hem forming edges extending at third and fourth transverse angles to the direction of travel of the web and receiving the first and second folded edge portions from said hem folding edges, and folding the folded edge portions back onto the respective first and second main body portions, thus forming the first and second hems; and for example

(i) each said hem folding plow having an aperture therein, the respective draw tape advancing e.g. between said hem folding plows and the respective layers, through the respective aperture in the respective said hem folding plow for forming of the respective hem about the respective draw tape;

(ii) said first and second hem folding edges comprising trailing edges of said hem folding plows, said first and second hem forming edges comprising leading edges of said hem forming plows; or

(iii) each said draw tape advances over the respective said hem folding plow in contact with the respective layer of web material in parallel with the folding of the edge portion of the respective layer by the respective said hem folding plow.

3. Equipment as in Claim 1, the top and bottom layers comprising first and second edge regions respectively, said hem forming apparatus including a separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer.

4. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the

plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:

- (a) forming holes at spaced locations in the edge portions of the web, preferably before the hems are formed;
- (b) feeding first and second draw tapes into proximity with the first and second edge portions;
- (c) receiving the draw tapes and folding the first and second edge portions about respective ones of the first and second draw tapes and onto respective first and second ones of the main body portions of the respective layers, thus forming the first and second hems about the draw tapes, with the draw tapes inside the hems; and
- (d) sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions to thereby form the first and second sealed hems, and thus sealing the hems and securing the respective draw tapes therein; the method optionally including the step of forming holes including folding the first and second edge portions back onto at least one main body portion and, after forming the holes, unfolding the first and second edge portions prior to forming the hems, and optionally the forming of the first and second hems including folding the unfolded first and second edge portions onto respective first and second ones of the main body portions of the respective layers; the method further optionally including, prior to folding the first and second edge portions, separating first and second edge regions, including the respective first and second edge portions, of the top and bottom layers from each other, while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other, and if desired the method including returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions after sealing the first and second hems.

5. A method as in Claim 4, the folding comprising folding each respective edge portion about a trailing edge of a hem folding plow and receiving the respective folded edge portion and forming the hem

therefrom by passing the respective folded edge over a leading edge of a hem forming plow, or the folding comprising folding the first and second edge portions at respective first and second hem folding plows and advancing the respective draw tapes over the respective hem folding plows in contact with the respective layers of web material in parallel with the folding of the respective edge portions by the respective hem folding plows.

6. A method as in Claim 5, the or each hem folding plow having an aperture therein, the method including advancing the draw tapes through the apertures in the respective hem folding plows; for example into contact with the respective top and bottom layers, with the draw tapes disposed between the hem folding plows and the respective layers of the web material, and/or the method including advancing the respective layer and draw tape together across a leading edge of a hem forming plow and thus folding a free edge of the respective layer under the respective draw tape to form the respective hem, with the draw tape contained therein.

7. A method as in Claim 4, 5 or 6, including re-folding the first and second edge portions about first and second hem folding plows and separating first and second edge regions of the top and bottom layers, including the respective edge portions, at a separating plow for traverse along parallel but spaced first and second paths, the first hem folding plow and the separating plow, in combination, comprising a separating notch formed by cooperating elements thereof, the method including traversing the second edge portion of the bottom layer transversely across the separating notch and thereby initiating separation of the second edge region from the first edge region; the method for example including traversing the second edge portion across the separating notch either while the bottom layer is under tension, or while the first edge portion is disposed across the notch, and thereby initiating separation of the first and second edge regions; the method optionally further including returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions, over an up-standing turning cone, after sealing the first and second hems.

8. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective

main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

- (a) hole forming apparatus for forming holes, at spaced locations in the edge portions of the web, said hole forming apparatus including (i) an in-turn plow receiving the first and second edge portions of the web in a generally flat disposition and folding the first and second edge portions inwardly toward the main body portions of the web, (ii) a back-fold plow, receiving the in-folded edge portions and further folding the edge portions back onto one of the first and second main body portions of the web, (iii) a hole former forming holes in the web while the edge portions are folded back onto one of the first and second main body portions, and (iv) an out-turning plow, receiving the back-folded first and second edge portions from the back-fold plow and restoring the first and second edge portions to a generally flat condition;
- (b) tape feed apparatus feeding draw tape material into proximity with the first and second edge portions;
- (c) hem forming apparatus receiving the draw tape material, forming the first and second edge portions into respective first and second hems and incorporating the draw tape material into the hems; and
- (d) hem sealing apparatus sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein;.

and optionally:

- (i) said hem forming apparatus being disposed downstream in the processing sequence from said hole forming apparatus, the edge portions leaving said hole forming apparatus in an out-folded generally flat condition, and being re-folded to form the hems at said hem forming apparatus; or
- (ii) said in-turn plow receiving the web with the top layer in overlying contact with the bottom layer, and folding the first and second edge portions with one of the first and second edge portions nested inside the other of the first and second edge portions; or
- (iii) said hem forming apparatus forming the first and second hems about the first and second draw tapes;

and for example the equipment including temperature control apparatus controlling the temperature

of the web at the formed hems before the sealing of the edge portions to the respective main body portions.

9. Equipment as in Claim 8, said hem forming apparatus including first and second hem folding plows having first and second hem folding edges extending at first and second transverse angles to the direction of travel of the web and folding the first and second edge portions of the web, and first and second hem forming plows having hem forming edges extending at third and fourth transverse angles to the direction of travel of the web and receiving the first and second folded edge portions from said hem folding edges, and folding the folded edge portions back onto the respective first and second main body portions, thus forming the first and second hems; and optionally

- (i) each said hem folding plow having an aperture therein, the respective draw tape advancing, e.g. between said hem folding plows and the respective layers, through the respective aperture in the respective said hem folding plow for forming of the respective hem about the respective draw tape; or

- (ii) said first and second hem folding edges comprising trailing edges of said hem folding plows, said first and second hem forming edges comprising leading edges of said hem forming plows; for example said hem folding plows and said hem forming plows each having web contact surfaces contacting respective edge regions of the respective top and bottom layers, said web contact surfaces on said first hem forming plow and said first hem folding plow being disposed at a first obtuse angle to each other, said web contact surface on said second hem forming plow and said second hem folding plow being disposed at a second obtuse angle to each other; or

- (iii) each said draw tape advances over the respective said hem folding plow in contact with the respective layer of web material in parallel with the folding of the edge portion of the respective layer by the respective said hem folding plow.

10. Equipment as in Claim 8, said in-turn plow having a first outer edge disposed at a first angle from a free edge of the web, advancing inwardly across the web along the direction of travel of the web, and aligned with a second inner edge of said back-fold plow, said second inner edge being disposed at approximately the first angle, said back-fold plow having a third inner edge, intersecting said second inner edge and being disposed at a second angle from the free edge of the web, corresponding gen-

erally to the first angle but advancing outwardly across the web along the direction of advance of the web, said out-turning plow having a fourth outer edge disposed at approximately the second angle and aligned with said third inner edge of said back-fold plow, respective loci on said first and fourth outer edges being aligned with each other along a length of the web; and for example said back-fold plow having a fifth outer edge, and a notch at said fifth outer edge, the folded combined edge portions of the top and bottom layers traversing said notch at said fifth outer edge, said hole cutter cutting spaced holes in the edge portions of the web as the edge portions traverse the notch.

11. Equipment as in Claim 8, said in-turn plow, said back-fold plow, and said out-turning plow having respective first, second, and third web guiding surfaces guiding the web adjacent said edge portions, said first and third web guiding surfaces being disposed at obtuse angles with respect to said second web guiding surface, and optionally said first and third web guiding surfaces defining substantially equal and opposite angles from said second web guiding surface.

12. Equipment as in Claim 8, the top and bottom layers comprising first and second edge regions respectively, said hem forming apparatus including a separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer, and optionally including a turning member downstream of said hem forming apparatus, assisting in returning the edge regions into face-to-face relationship with each other, said turning member e.g. comprising an upstanding turning cone; and optionally the equipment including an upstanding turning cone downstream of said hem forming apparatus, assisting in returning the second edge region into face-to-face relationship with the first edge region, and a second turning member downstream of said turning cone, returning the second edge region into face-to-face relationship with the first edge region.

13. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

(a) tape feed apparatus feeding draw tape material into proximity with the first and second edge portions;

(b) hem forming apparatus receiving the draw tape material, forming the first and second edge portions into respective first and second hems and incorporating the draw tape material into the hems, for example said hem forming apparatus forming the first and second hems about the first and second draw tapes;

(c) hem sealing apparatus sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions of the respective layers, thus sealing the hems and securing the respective draw tapes therein; and

(d) hole forming apparatus disposed up-stream in said equipment from said hem forming apparatus, forming holes, at spaced locations in the edge portions of the web before said hem forming apparatus forms the first and second hems, and the apparatus desirably including temperature control apparatus controlling the temperature of the web at the formed hems before the sealing of the edge portions to the respective main body portions.

14. Equipment as in Claim 13, said hem forming apparatus including first and second hem folding plows having first and second hem folding edges extending at first and second transverse angles to the direction of travel of the web and folding the first and second edge portions of the web, and first and second hem forming plows having hem forming edges extending at third and fourth transverse angles to the direction of travel of the web and receiving the first and second folded edge portions from said hem folding edges, and folding the folded edge portions back onto the respective first and second main body portions, thus forming the first and second hems; and optionally

(i) each said hem folding plow having an aperture therein, the respective draw tape advancing through the respective aperture in the respective said hem folding plow for forming of the respective hem about the respective draw tape, the draw tapes e.g. advancing between said hem folding plows and the respective layers;

(ii) said first and second hem folding edges comprising trailing edges of said hem folding plows, said first and second hem forming edges comprising leading edges of said hem forming plows; or

(iii) each said draw tape advances over the respective said hem folding plow in contact with the respective layer of web material in parallel

with the folding of the edge portion of the respective layer by the respective said hem folding plow.

15. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

(a) hole forming apparatus folding the first and second edge portions and forming holes therein, at spaced locations in the edge portions, then unfolding the first and second edge portions;

(b) tape feed apparatus feeding draw tape material into proximity with the first and second edge portions;

(c) hem forming apparatus receiving the draw tape material, receiving the unfolded edge portions of the web with holes therein, re-folding the first and second edge portions onto respective first and second ones of the main body portions of the respective layers, and incorporating the draw tape material into the hems, e.g. by said hem forming apparatus forming the first and second hems about the first and second draw tapes, thus forming the first and second hems and incorporating draw tapes inside; and
(d) hem sealing apparatus sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein;

and optionally the equipment including a turning member downstream of said hem forming apparatus, assisting in returning the edge regions into face-to-face relationship with each other, and further optionally the equipment including temperature control apparatus controlling the temperature of the web at the formed hems before the sealing of the edge portions to the respective main body portions.

16. Equipment as in Claim 15, said hole forming apparatus receiving the web with the top layer in overlying contact with the bottom layer, and folding the first and second edge portions with one of the first and second edge portions nested inside the other of the first and second edge portions.

17. Equipment as in Claim 15, said hem forming apparatus including first and second hem folding plows having first and second hem folding edges extending at first and second transverse angles to the direction of travel of the web and folding the first and second edge portions of the web, and first and second hem forming plows having hem forming edges extending at third and fourth transverse angles to the direction of travel of the web and receiving the first and second folded edge portions from said hem folding edges, and folding the folded edge portions back onto the respective first and second main body portions, thus forming the first and second hems; and optionally

(i) each said hem folding plow having an aperture therein, the respective draw tape advancing through the respective aperture in the respective said hem folding plow for forming of the respective hem about the respective draw tape, and for example the draw tapes advancing between said hem folding plows and the respective layers;

(ii) said first and second hem folding edges comprising trailing edges of said hem folding plows, said first and second hem forming edges comprising leading edges of said hem forming plows;

(iii) each said draw tape advances over the respective said hem folding plow in contact with the respective layer of web material in parallel with the folding of the edge portion of the respective layer by the respective said hem folding plow.

18. Equipment as in Claim 15, the top and bottom layers comprising first and second edge regions respectively, said hem forming apparatus including a separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer.

19. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

(a) hole forming apparatus forming holes at spaced locations in the edge portions of the web;

(b) tape feed apparatus feeding draw tape material into proximity with the first and second edge portions; and

(c) hem forming and sealing apparatus receiving the draw tape material, forming the first and second edge portions into respective first and second hems and incorporating the draw tape material in the hems, and sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein,

said hem forming and sealing apparatus including temperature control apparatus controlling the temperature of the web at the formed hems before sealing the edge portions to the respective main body portions; and optionally

(i) said hem forming and sealing apparatus comprising a hem forming element, and a hem sealing element downstream of said hem forming element, said temperature control apparatus being disposed between said hem forming element and said hem sealing element, temperature control being applied after the hem is formed and adjacent said hem sealing element, and/or

(ii) said temperature control apparatus comprising a first temperature control apparatus, and including a second temperature control apparatus adjacent, and downstream of, said hem sealing element, controlling the temperature of the web after formation of the hem seals, and/or

(iii) said hem forming and sealing apparatus comprising a hem forming element and a hem sealing element, said equipment including an electrostatic pinning device between said hem forming element and said hem sealing element.

20. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

(a) hole forming apparatus forming holes at spaced locations in the edge portions of the web;

(b) tape feed apparatus feeding first and sec-

ond draw tapes into proximity with the first and second edge portions;

(c) hem forming apparatus separating first and second edge regions of the top and bottom layers from each other, for traverse along parallel but spaced first and second paths while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other, the first and second edge regions including the respective first and second edge portions and the respective first and second free edges, said hem forming apparatus receiving the first and second draw tapes, and forming the first and second edge portions into respective first and second hems and incorporating the draw tapes therein, and for example said hem forming apparatus forming the first and second hems about the first and second draw tapes;

(d) hem sealing apparatus sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein.

21. Equipment as in Claim 20, said hem forming apparatus including first and second hem folding plows having hem folding edges, and a separating plow adjacent said first hem folding plow, said separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer, the separated first and second edge regions, at corresponding points along the first and second parallel paths, lying in imaginary surfaces intersecting each other along an imaginary line having a component extending in the direction of travel of the web, the equipment optionally further including a separating notch formed by cooperating elements of said first hem folding plow and said separating plow, automatically initiating separation of the edge region of the bottom layer from the edge region of the top layer when the first and second edge regions traverse transversely across said separating notch; and further optionally said hem folding plows having hem folding edges extending at angles transverse to the direction of travel of the web, and for example said hem forming apparatus including first and second hem forming plows receiving folded edge portions of the web from said hem folding edges, and folding the folded edge portions back onto the respective main body portions and thereby forming the respective hems.

22. Equipment as in Claim 20, said hem forming apparatus being disposed downstream in the processing sequence from said hole forming apparatus, the edge regions being separated after holes are

formed therein, or said hem forming apparatus including first and second hem folding plows having first and second hem folding edges extending at first and second transverse angles to the direction of travel of the web and folding the first and second edge portions of the web, and first and second hem forming plows having hem forming edges extending at third and fourth transverse angles to the direction of travel of the web and receiving the first and second folded edge portions from said hem folding edges, and folding the folded edge portions back onto the main body portions, thus forming the first and second hems, and optionally

(i) each said hem folding plow having an aperture therein, the respective draw tape advancing through the respective aperture in the respective said hem folding plow for forming of the respective hem about the respective draw tape, and for example the draw tapes advancing between said hem folding plows and the respective layers, or

(ii) said first and second hem folding edges comprising trailing edges of said hem folding plows, said first and second hem forming edges comprising leading edges of said hem forming plows, or

(iii) wherein each said draw tape advances over the respective said hem folding plow in contact with the respective layer of web material in parallel with the folding of the edge portion of the respective layer by the respective said hem folding plow.

23. Equipment as in Claim 20, the top and bottom layers comprising first and second edge regions respectively, said hem forming apparatus including a separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer.

24. Equipment as in Claim 20, either including at least one turning member, e.g. comprising an upstanding turning cone, downstream of said hem forming apparatus, assisting in returning the edge regions into face-to-face relationship with each other, or including a turning member downstream of said hem forming apparatus, turning portions of the top and bottom layers, and air lubrication between said turning member and the bottom layer.

25. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and

second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

(a) hole forming apparatus forming holes, at spaced locations in the edge portions of the web;

(b) tape feed apparatus feeding draw tape material into proximity with the first and second edge portions; and

(c) hem forming and sealing apparatus receiving the draw tape material, forming the first and second edge portions into respective first and second hems, e.g. about the first and second draw tapes incorporating the draw tape material in the hems, and sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, using at least one sealing element, thus sealing the hems and securing the respective draw tapes therein, said hem forming apparatus for example being disposed downstream in the processing sequence from said hole forming apparatus,

said hem forming and sealing apparatus including first and second stretching rollers, e.g. for applying force on the web and directing the force against a flexible support belt, for applying transverse stretching forces to the respective layers at the first and second hems, with the draw tapes therein, upstream of the respective first and second hem sealing elements;

and optionally said stretching rollers having primary working surfaces generally urging the respective layers transversely at slight angles with respect to the general direction of the paths being traversed by the respective hems.

26. Equipment as in Claim 25, said hem forming apparatus including first and second hem folding plows having first and second hem folding edges extending at first and second transverse angles to the direction of travel of the web and folding the first and second edge portions of the web, and first and second hem forming plows having hem forming edges extending at third and fourth transverse angles to the direction of travel of the web and receiving the first and second folded edge portions from said hem folding edges, and folding the folded edge portions back onto the respective first and second main body portions, thus forming the first and second hems; and optionally each said hem folding plow having an aperture therein, the respective draw tape advancing through the respective aperture in the respective said hem folding plow for forming of the

respective hem about the respective draw tape, and for example each said draw tape advances over the respective said hem folding plow in contact with the respective layer of web material in parallel with the folding of the edge portion of the respective layer by the respective said hem folding plow, and optionally the top and bottom layers comprising first and second edge regions respectively, said hem forming apparatus including a separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer.

27. Equipment as in Claim 25 or claim 26, including an electrostatic pinning device downstream and adjacent each said stretching roller, pinning the first and second formed hems to respective first and second underlying supports, and thereby controlling transverse positioning of the respective layers to said equipment downstream of said electrostatic pinning devices and upstream of and adjacent the respective said hem sealing elements, and for example said first and second underlying supports extending under the respective said hem sealing elements, and supporting the hems while the hems are being sealed.

28. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

- (a) hole forming apparatus forming holes at spaced locations in the edge portions of the web;
- (b) tape feed apparatus feeding first and second draw tapes into proximity with the first and second edge portions; and
- (c) hem forming and sealing apparatus comprising hem forming elements receiving the draw tapes, forming the first and second edge portions into respective first and second hems, e.g. about the first and second draw tapes, incorporating the draw tapes in the hems, and sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, using respective first and second hem sealing elements, thus sealing the first and second hems and securing the respective draw tapes therein,

said hem forming and sealing apparatus including an electrostatic pinning device pinning a formed hem, with draw tape therein, to an underlying support, and thereby controlling transverse positioning of the formed hem with respect to said equipment as the hem traverses from the respective hem forming element to the respective hem sealing element;

the equipment optionally including temperature control apparatus controlling the temperature of the web at the formed hems before the sealing of the edge portions to the respective main body portions, and for example the top and bottom layers comprising first and second edge regions respectively, said hem forming apparatus including a separating plow separating the second edge region of the bottom layer from the corresponding first edge region of the top layer.

29. Equipment as in Claim 28, wherein optionally (i) said hem forming and sealing apparatus including first and second stretching rollers applying transverse stretching forces to the respective layers at the first and second hems upstream of the respective first and second hem sealing elements, and first and second underlying supports underlying the respective first and second hems, each said underlying support extending at least from the respective said electrostatic pinning device to the respective said hem sealing element thereby to support the hem from the locus where the layer is stretched until the layer is sealed; (ii) said underlying support comprising first and second underlying supports underlying the respective first and second hems, said first and second underlying supports extending from respective said electrostatic pinning apparatus to the respective said hem sealing element, and supporting the hems while the hems are being sealed, or (iii) said underlying support comprising a support bar, and a driven belt between said support bar and the respective hem, moving with the respective hem thereon from said electrostatic pinning device to the respective said hem sealing element.

30. Equipment for providing a draw tape in a plastic web, the plastic web having top and bottom layers, said equipment folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes into the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems, with the first and second draw tapes in the sealed hems, said equipment comprising:

- (a) hole forming apparatus forming holes at

spaced locations in the edge portions of the web;

(b) tape feed apparatus feeding draw tape material into proximity with the first and second edge portions;

(c) hem forming and sealing apparatus separating one of first and second edge regions of the top and bottom layers from the other of the first and second edge regions at an included angle of at least 30 degrees, e.g. 30 to 160 degrees, while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other, receiving the draw tape material as first and second draw tapes at the respective edge regions, and forming the first and second edge portions into respective first and second hems and incorporating the draw tape material into the hems, said hem sealing apparatus sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the draw tapes in the respective sealed hems while the first and second edge regions are so separated;

(d) a turning member comprising an upstanding turning cone disposed downstream of said hem forming apparatus, assisting in returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions; the equipment optionally including

(e) second turning member downstream of said turning cone, the assist of said turning cone in returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions being effected before primary effect of said second turning member, and optionally said hem forming and sealing apparatus maintaining the other of the first and second edge regions as a generally straight line extension of the remainder of the width of the respective layer.

- 31.** A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:

(a) forming holes at spaced locations in the

edge portions of the web by (i) receiving the first and second edge portions of the web in a generally flat disposition and folding the first and second edge portions inwardly toward the main body portions of the web, with one of the first and second edge portions nested in the other of the first and second edge portions, (ii) folding the edge portions back onto the main body portion of the layer representing the nested one of the first and second edge portions, and (iii) forming holes in the web at spaced locations in the edge portions, while the edge portions are so folded;

(b) feeding draw tape material into proximity with the first and second edge portions;

(c) receiving the draw tape material and forming the first and second edge portions into respective first and second hems, preferably downstream of forming the holes, and incorporating the draw tape material into the hems; and

(d) sealing the first and second edge portions to the respective first and second main body portions to thereby form the first and second sealed hems, and thus sealing the hems and securing the respective draw tapes therein;

and the method preferably including a step of controlling the temperature of the web at the formed hems before sealing the edge portions to the respective main body portions.

- 32.** A method as in Claim 31, including unfolding the edge portions with the holes therein and restoring the first and second edge portions to a generally flat condition; the method for example involving (i) forming of the first and second hems including folding the unfolded first and second edge portions onto respective first and second ones of the main body portions of the respective layers; (ii) including re-folding the first and second edge portions onto the first and second ones of the main body portions of the respective layers, and thereby forming the first and second hems, with the first and second draw tapes therein, and sealing the first and second edge portions to the main bodies of the top and bottom layers respectively, with the draw tapes therein; the re-folding for example comprising folding respective edge portions about the respective first and second draw tapes.

- 33.** A method as in Claim 32, including, prior to re-folding the first and second edge portions, separating first and second edge regions, including the respective first and second edge portions, of the top and bottom layers from each other, while holding the remainders of the top and bottom layers in surface-to-surface contact with each other.

34. A method as in Claim 32 or claim 33, wherein the re-folding comprising folding each respective edge portion about a trailing edge of a hem folding plow and receiving the respective folded edge portion and forming the hem therefrom by passing the respective folded edge over a leading edge of a hem forming plow; or the method including re-folding the first and second edge portions at respective first and second hem folding plows and advancing the respective draw tapes over the respective hem folding plows in contact with the respective layers of web material in parallel with the folding of the respective edge portions by the respective hem folding plows; and for example each hem folding plow having an aperture therein, the method including advancing the draw tapes through the apertures in the respective hem folding plows, e.g. into contact with the respective top and bottom layers, with the draw tapes disposed between the hem folding plows and the respective layers of the web; and the method preferably including advancing the respective layer and draw tape together across a leading edge of a hem forming plow and thus folding a free edge of the respective layer under the respective draw tape to form the respective hem, with the draw tape contained therein.
35. A method as in any of claims 31 to 34, including re-folding the first and second edge portions about first and second hem folding plows and separating first and second edge regions of the top and bottom layers, including the respective edge portions, at a separating plow, for traverse along parallel but spaced first and second paths, the first hem folding plow and the separating plow, in combination, comprising a separating notch formed by cooperating elements thereof, the method including traversing the second edge portion of the bottom layer transversely across the separating notch and thereby initiating separation of the second edge region from the first edge region; the method optionally including traversing the second edge portion across the separating notch either while the bottom layer is under tension, or while the first edge portion is disposed across the notch, and thereby initiating separation of the first and second edge regions.
36. A method as in claim 33 or claim 35, including returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions, e.g. over an upstanding turning cone, after sealing the first and second hems.
37. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:
- (a) feeding draw tape material into proximity with the first and second edge portions;
 - (b) receiving the draw tape material and forming the first and second edge portions into respective first and second hems, e.g. about the first and second draw tapes, and incorporating the draw tape material into the hems;
 - (c) sealing the first and second edge portions to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein; and
 - (d) prior to forming the hems and receiving the draw tapes, the step of forming holes at spaced locations in the edge portions of the web, and optionally
 - (e) including controlling the temperature of the web at the formed hems before sealing the edge portions to the respective main body portions.
38. A method as in Claim 37, the step of forming holes including (i) receiving the first and second edge portions of the web in a generally flat disposition and folding the first and second edge portions toward the main body portions of the web, (ii) folding the edge portions back onto at least one of the main body portions, (iii) while the edge portions are folded back onto the at least one of the main body portions, forming holes in the web at the first and second edge portions, spaced from free edges of the web, and (iv) unfolding the edge portions with the holes therein and restoring the first and second edge portions to a generally flat disposition.
39. A method as in Claim 37 or Claim 38, the step of forming the holes including folding the first and second edge portions back onto at least one main body portion and, after forming the holes, unfolding the first and second edge portions prior to forming the hems, and for example forming of the first and second hems including folding the unfolded first and second edge portions onto respective first and second ones of the main body portions of the respective layers.
40. A method as in Claim 39, including re-folding the first and second edge portions onto the first and second ones of the main body portions of the respective layers, and thereby forming the first and

second hems, with first and second draw tapes therein, and sealing the first and second edge portions to the main bodies of the top and bottom layers respectively, with the draw tapes therein; (i) the re-folding for instance comprising folding respective edge portions about the respective first and second draw tapes, (ii) folding each respective edge portion about a trailing edge of a hem folding plow and receiving the respective folded edge portion and forming the hem therefrom by passing the respective folded edge over a leading edge of a hem forming plow; or (iii) including re-folding the first and second edge portions at respective first and second hem folding plows and advancing the respective draw tapes over the respective said hem folding plows in contact with the respective layers of web material in parallel with the folding of the respective edge portions by the respective hem folding plows; and optionally each hem folding plow having an aperture therein, the method including advancing the draw tapes through the apertures in the respective hem folding plows.

41. A method as in Claim 40, including, prior to re-folding the first and second edge portions, separating first and second edge regions, including the respective first and second edge portions, of the top and bottom layers from each other, while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other.
42. A method as in Claim 41, each hem folding plow having an aperture therein, the method including either advancing the draw tapes through the apertures in the respective hem folding plows and into contact with the respective top and bottom layers, with the draw tapes disposed between the hem folding plows and the respective layers of the web, advancing the respective layer and draw tape together across a leading edge of a hem forming plow and thus folding a free edge of the respective layer under the respective draw tape to form the respective hem, with the draw tape contained therein.
43. A method as in Claim 39, including re-folding the first and second edge portions about first and second hem folding plows and separating first and second edge regions of the top and bottom layers, including the respective edge portions, at a separating plow for traverse along parallel but spaced first and second paths, the first hem folding plow and the separating plow, in combination, comprising a separating notch formed by cooperating elements thereof, the method including traversing the second edge portion of the bottom layer transversely across the separating notch, e.g. while the first edge portion is disposed across the notch, and thereby initiating separation of the second edge region from the

first edge region.

44. A method as in Claim 41 or 43, including returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions, e.g. over an upstanding turning cone, after sealing the first and second hems.
45. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:
 - (a) forming holes, at spaced locations in the edge portions of the web, including folding the edge portions back onto the main body portion of at least one of the layers, and subsequently unfolding the edge portions;
 - (b) feeding draw tape material into proximity with the first and second edge portions;
 - (c) receiving the draw tape material and the unfolded edge portions of the web with holes therein, at a hem forming station, re-folding the first and second edge portions onto respective first and second ones of the main body portions of the respective layers, and incorporating the draw tape material into the hems, e.g. by folding respective edge portions about the respective first and second draw tapes, thus forming the first and second hems and incorporating draw tapes inside; and
 - (d) sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein; the method optionally including, prior to re-folding the first and second edge portions, separating first and second edge regions, including the respective first and second edge portions, of the top and bottom layers from each other, while holding the remainders of the top and bottom layers in surface-to-surface contact with each other; and if desired returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions after sealing the first and second hems, the method preferably including controlling the temperature of the web at the formed hems before sealing the edge

portions to the respective main body portions.

46. A method as in Claim 45, the re-folding comprising folding each respective edge portion about a trailing edge of a hem folding plow and receiving the respective folded edge portion and forming the hem therefrom by passing the respective folded edge over a leading edge of a hem forming plow, or re-folding the first and second edge portions at respective first and second hem folding plows and advancing the respective draw tapes over the respective hem folding plows in contact with the respective layers of web material in parallel with the folding of the respective edge portions by the respective hem folding plows, and optionally the or each hem folding plow having an aperture therein, the method either including advancing the draw tapes through the apertures in the respective hem folding plows, e.g. into contact with the respective top and bottom layers, with the draw tapes disposed between the hem folding plows and the respective layers of the web; or including advancing the respective layer and draw tape together across a leading edge of a hem forming plow and thus folding a free edge of the respective layer under the respective draw tape to form the respective hem, with the draw tape contained therein.
47. A method as in Claim 45 or Claim 46, including re-folding the first and second edge portions about first and second hem folding plows and separating first and second edge regions of the top and bottom layers, including the respective edge portions, at a separating plow for traverse along parallel but spaced first and second paths, the first hem folding plow and the separating plow, in combination, comprising a separating notch formed by cooperating elements thereof, the method including traversing the second edge portion transversely across the separating notch, e.g. while the first edge portion is disposed across the notch, and thereby initiating separation of the second edge region from the first edge region.
48. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:

- (a) forming holes, at spaced locations in the edge portions of the web;
- (b) feeding draw tape material into proximity with the first and second edge portions;
- (c) receiving the draw tape material, and forming the first and second edge portions into respective first and second hems and incorporating the draw tape material into the hems; and
- (d) sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein, and controlling the temperature of the web at the formed hems before sealing the edge portions to the respective main body portions;

the method optionally including controlling the temperature of the web downstream of, and adjacent, the sealing of the first and second edge portions to the main body portions of the respective layers.

49. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:
- (a) forming holes at spaced locations in the edge portions of the web;
 - (b) feeding first and second draw tapes into proximity with the first and second edge portions;
 - (c) separating, e.g. after forming said holes, first and second edge regions of the top and bottom layers from each other for traverse along parallel but spaced first and second paths while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other, the first and second edge regions including the respective first and second edge portions and the respective first and second free edges;
 - (d) folding the first and second edge portions onto respective first and second ones of the main body portions in the edge regions of the respective layers and thus forming the first and second hems and incorporating the draw tapes into the hems; and
 - (e) sealing the first and second edge portions,

of the respective first and second hems, to the respective first and second main body portions, thus sealing the hems and securing the respective draw tapes therein, the folding for instance comprising folding each respective edge portion about a trailing edge of a hem folding plow and receiving the respective folded edge portion and forming the hem therefrom by passing the respective folded edge portion over a leading edge of a hem forming plow.

50. A method as in Claim 49, including folding the first and second edge portions at respective first and second hem folding plows and advancing the respective draw tapes over the respective hem folding plows in contact with the respective layers of web material in parallel with the folding of the respective edge portions by the respective hem folding plows, and for example each hem folding plow having an aperture therein, the method including advancing the draw tapes through the apertures in the respective hem folding plows, such as into contact with the respective top and bottom layers, with the draw tapes disposed between the hem folding plows and the respective layers of the web; and optionally the method involves advancing the respective layer and draw tape together across a leading edge of a hem forming plow and thus folding a free edge of the respective layer under the respective draw tape to form the respective hem, with the draw tape contained therein.

51. A method as in Claim 49 or Claim 50, including folding the first and second edge portions about first and second hem folding plows and separating first and second edge regions of the top and bottom layers, including the respective edge portions, at a separating plow, for traverse along parallel but spaced first and second paths, the first hem folding plow and the separating plow, in combination, comprising a separating notch formed by cooperating elements thereof, the method including traversing the second edge portion of the bottom layer transversely across the separating notch and thereby initiating separation of the second edge region from the first edge region; the method optionally including traversing the second edge portion across the separating notch either while the bottom layer is under tension, or while the second edge portion is disposed across the notch, and thereby initiating separation of the first and second edge regions.

52. A method as in any of Claims 49 to 51 including returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions, e.g. over an upstanding turning cone, after sealing the first and second hems.

53. A method as in any of Claims 49 to 52, including turning portions of the top and bottom layers about a turning member downstream of the hem forming apparatus, including providing air lubrication between the turning member and the respective portion of the bottom layer.

54. A method as in any of Claims 49 to 53, the separating of the first and second edge regions comprising separating one of first and second edge regions from the other of the first and second edge regions at an included angle of about 30 degrees to about 160 degrees.

55. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, e.g. by folding the edge portions about the respective tapes, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:

- (a) forming holes at spaced locations in edge portions of the web;
- (b) feeding draw tape material into proximity with the first and second edge portions; and
- (c) forming and sealing hems (downstream of forming the holes) in the web by receiving the draw tape material as first and second draw tapes, folding the first and second edge portions onto respective first and second ones of the main body portions of the respective layers, thus forming the first and second hems with the draw tapes in the hems, and sealing the first and second edge portions to the respective first and second main body portions using at least one hem sealing element, thus sealing the hems and securing the respective draw tapes therein, and

applying transverse stretching forces to the web at the first and second hems, with the draw tapes therein, upstream of the at least one sealing element; optionally applying force on the web directed against an underlying support having a surface generally parallel to the surface of the web; and the method optionally including, prior to folding the first and second edge portions, separating first and second edge regions, including the respective first and second edge portions, of the top and bottom

layers from each other, while holding the remainders of the top and bottom layers in surface-to-surface contact with each other.

56. A method as in Claim 55, including electrostatic pinning the first and second formed hems to respective first and second underlying supports using electrostatic pinning apparatus, and thereby controlling transverse positioning of the respective layers with respect to equipment downstream of the electrostatic pinning apparatus and upstream of and adjacent the at least one hem sealing element, and preferably the at least one hem sealing element comprising first and second hem sealing elements, the first and second underlying supports extending under the respective hem sealing elements, and supporting the hems while the hems are being sealed.

57. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, e.g. by folding the edge portions about the tapes, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:

- (a) forming holes at spaced locations in the edge portions of the web;
- (b) feeding first and second draw tapes into proximity with the first and second edge portions; and
- (c) forming and sealing hems in the web by receiving the draw tapes, folding the first and second edge portions onto respective first and second ones of the main body portions of the respective layers, thus forming the first and second hems, with the draw tapes in the hems, and sealing the first and second edge portions to the respective first and second main body portions using at least one hem sealing element, thus sealing the first and second hems and securing the respective draw tapes therein,

including electrostatic pinning the formed hems, with draw tapes therein, to underlying supports, with electrostatic pinning apparatus, and thereby controlling transverse positioning of the hems with respect to web handling equipment while the hem seals are being formed.

58. A method as in Claim 57 including (a) separating

first and second edge regions, including the respective first and second edge portions, of the top and bottom layers from each other, prior to folding the first and second edge portions, while holding the remainders of the top and bottom layers in surface-to-surface contact with each other; or (b) folding the first and second edge portions at respective first and second hem folding plows and advancing the respective draw tapes over the respective said hem folding plows in contact with the respective layers of web material in parallel with the folding of the respective edge portions by the respective hem folding plows.

59. A method as in Claim 57, the at least one hem sealing element comprising first and second hem sealing elements, the method including applying transverse stretching forces to the layers with stretching devices at the first and second hems, with the draw tapes therein, prior to forming the hem seals, the underlying supports extending from the respective stretching devices to the respective hem sealing elements, thereby supporting the hems from the time the layers are stretched until the hems are sealed, and for example the method includes supporting the hems with underlying supports at the seal loci while the hems are being sealed.

60. A method as in Claims 57 or Claim 59, each underlying support comprising a support bar, and a driven belt between the support bar and the respective hem, supporting the respective hem, and moving with the hem thereon, from the electrostatic pinning device to the respective hem sealing element.

61. A method of providing a draw tape in a plastic web, the plastic web being folded longitudinally along the length thereof to form top and bottom layers of the plastic web, the method including folding first and second edge portions of the top and bottom layers respectively onto respective first and second main body portions of the top and bottom layers, to form respective first and second hems, incorporating respective first and second draw tapes in the hems, and sealing the first and second edge portions to the respective main body portions to form first and second sealed hems with the first and second draw tapes therein, the method comprising the steps of:

- (a) forming holes at spaced locations in the edge portions of the web;
- (b) separating one of first and second edge regions of the top and bottom layers from the other of the first and second edge regions at an angle of at least 30 degrees, e.g. 30 to 160 degrees, while holding the remainders of the widths of the top and bottom layers in surface-to-surface contact with each other and main-

taining the other of the first and second edge regions as a generally straight line extension of the remainder of the width of the respective layer;

(c) feeding draw tape material into proximity with the first and second edge portions;

(d) forming and sealing hems in the web at the separated first and second edge regions, by receiving the draw tape material at the respective edge portions, folding the first and second edge portions onto respective first and second ones of the main body portions of the respective layers, thus forming the first and second hems, and incorporating the draw tape material in the hems, and sealing the first and second edge portions, of the respective first and second hems, to the respective first and second main body portions using hem sealing apparatus, thus sealing the hems and securing the respective draw tapes in the respective sealed hems while the first and second edge regions are so separated; and

(e) returning the separated one of the edge regions into face-to-face relationship with the other of the edge regions over an upstanding turning cone disposed downstream of the hem sealing apparatus, and optionally under a second turning member, downstream of the turning cone; the method for example including a step of maintaining the other of the first and second edge regions as a generally straight line extension of the remainder of the width of the respective layer.

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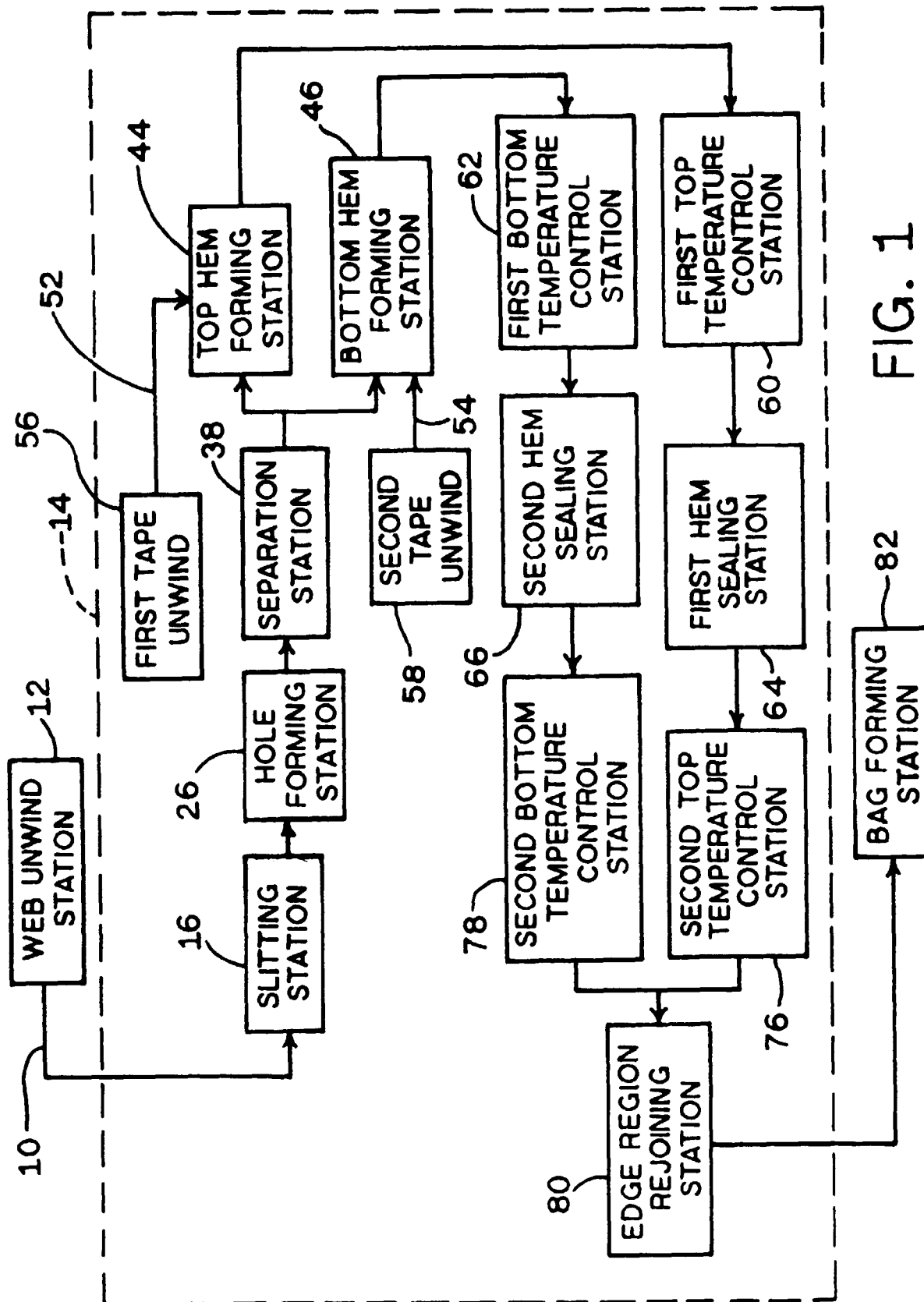
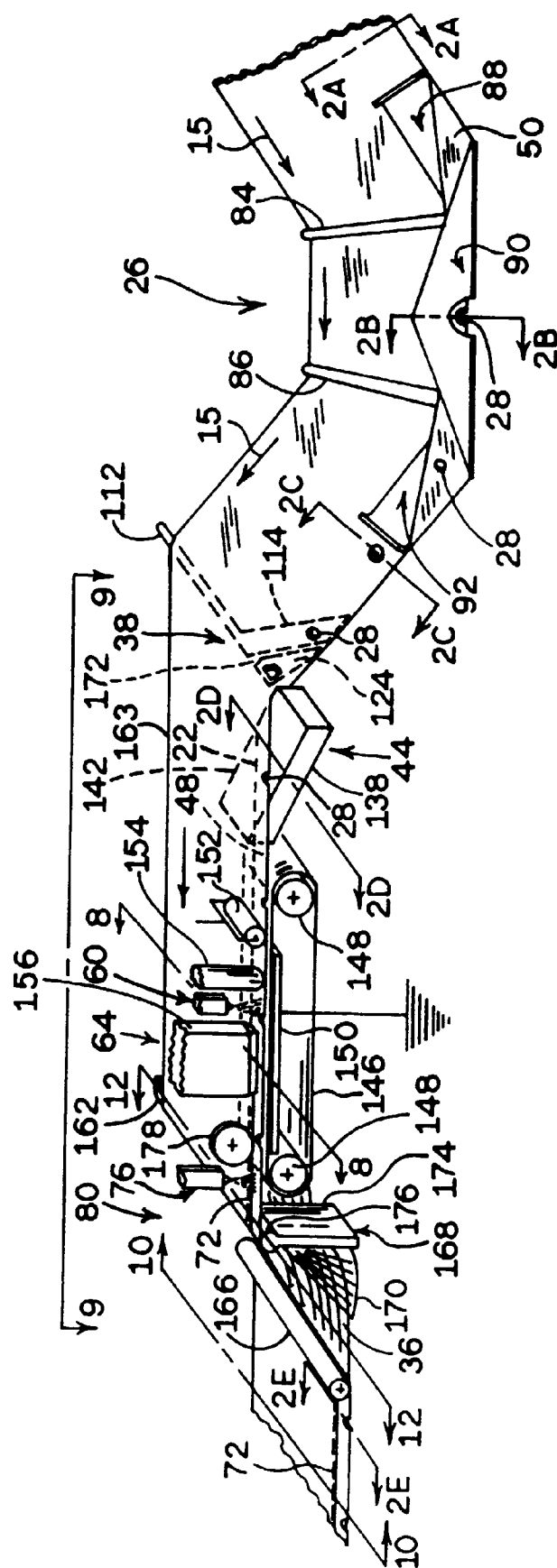


FIG. 1

FIG. 2



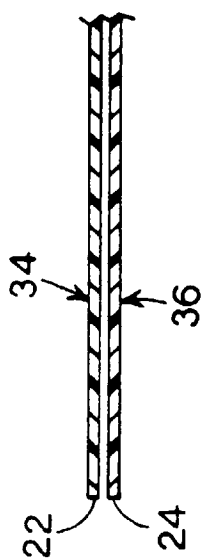


FIG. 2A

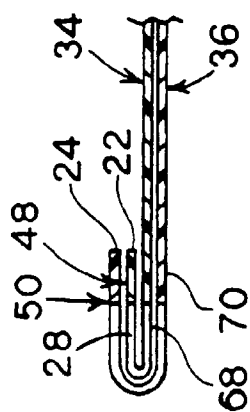


FIG. 2B

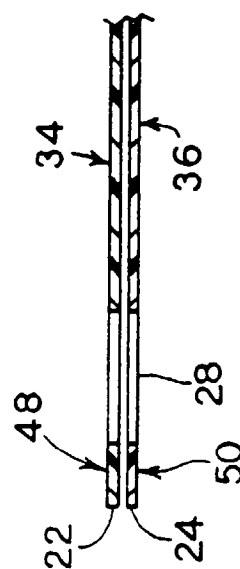


FIG. 2C

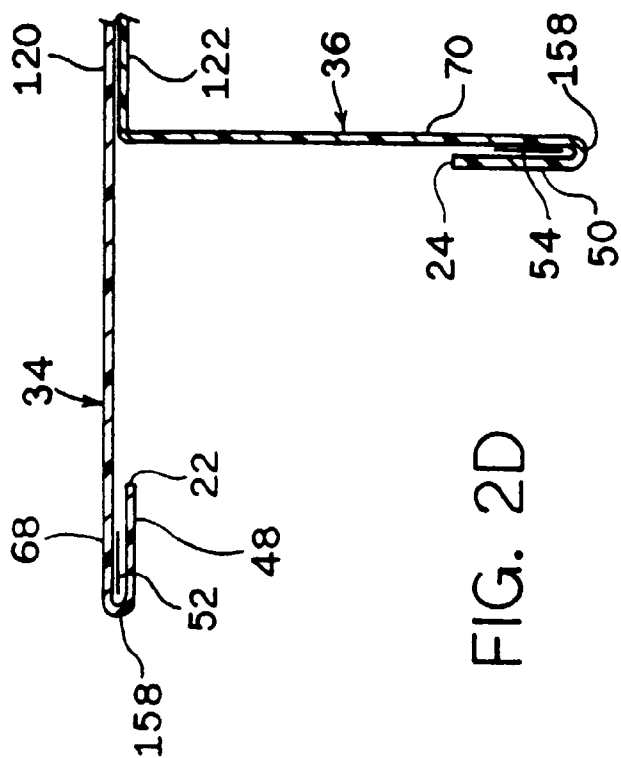


FIG. 2D

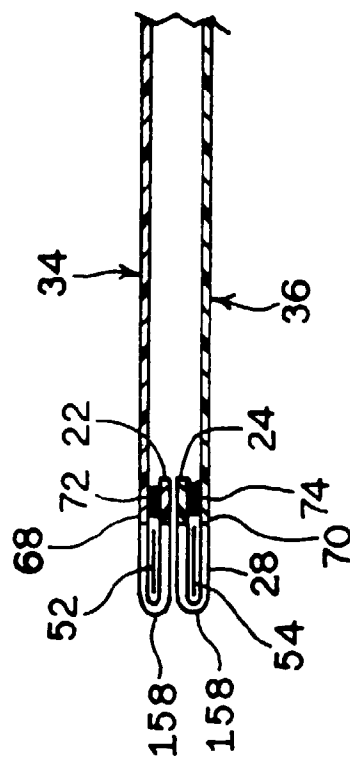


FIG. 2E

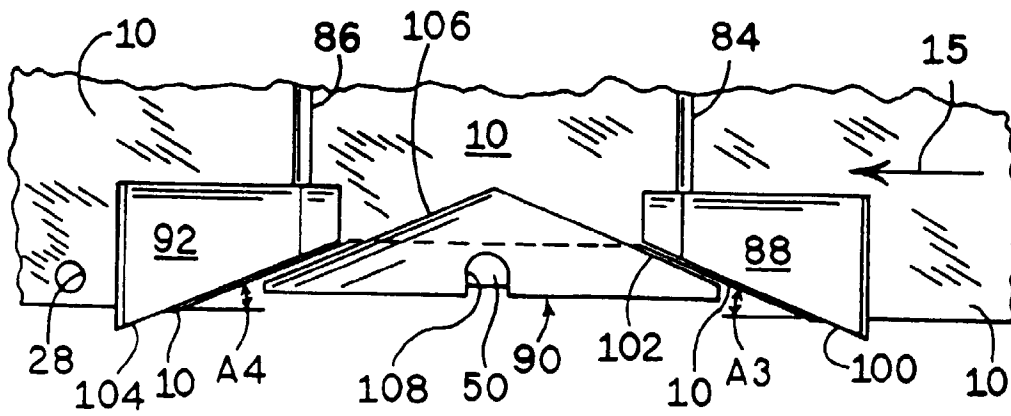


FIG. 3

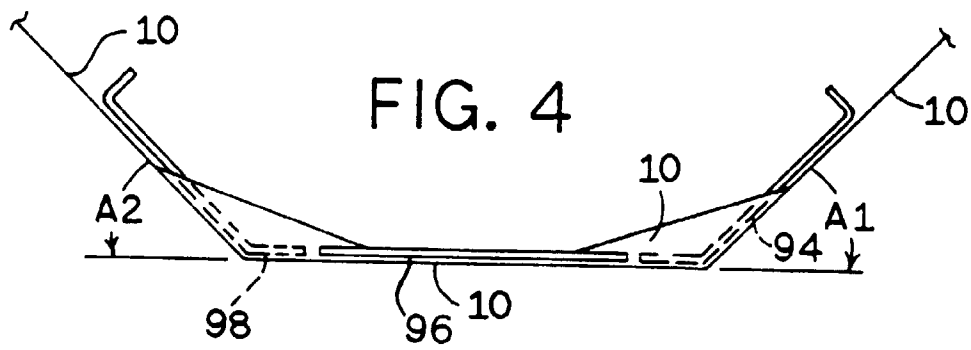


FIG. 4

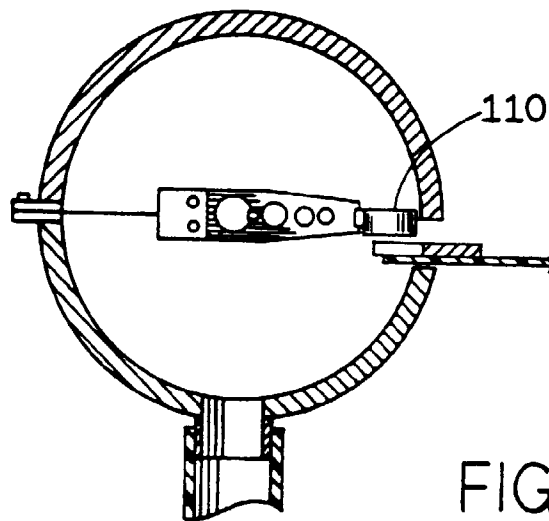


FIG. 5

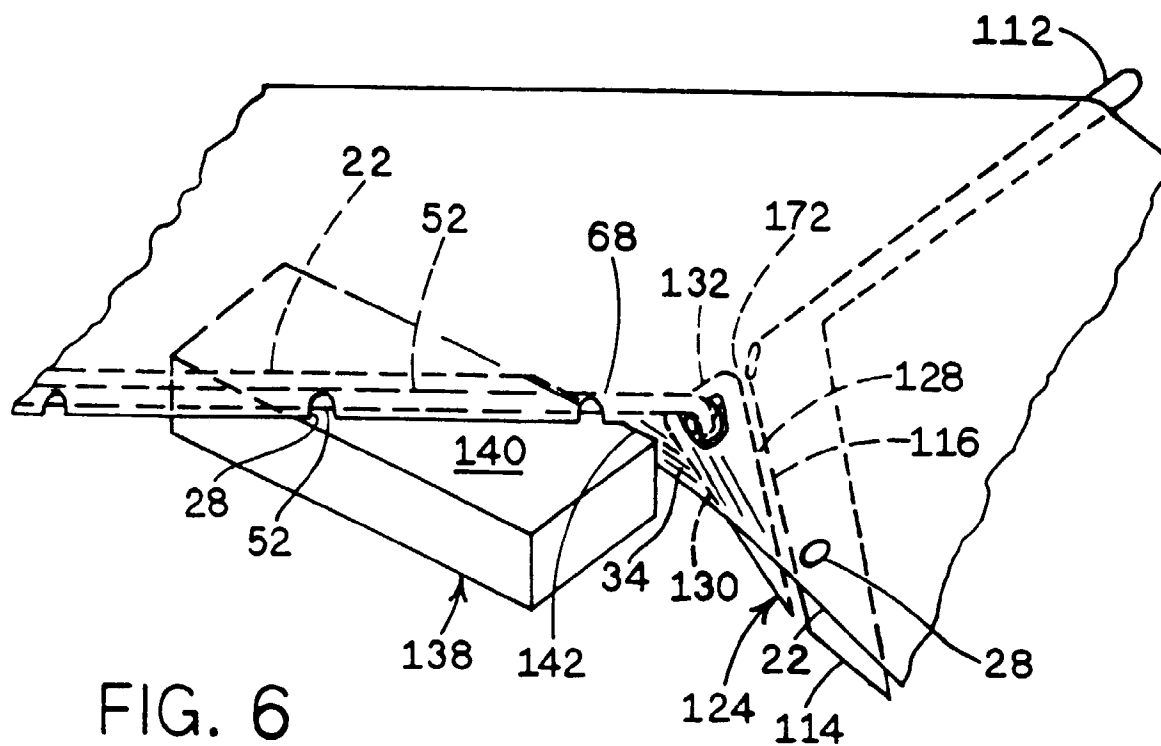


FIG. 6

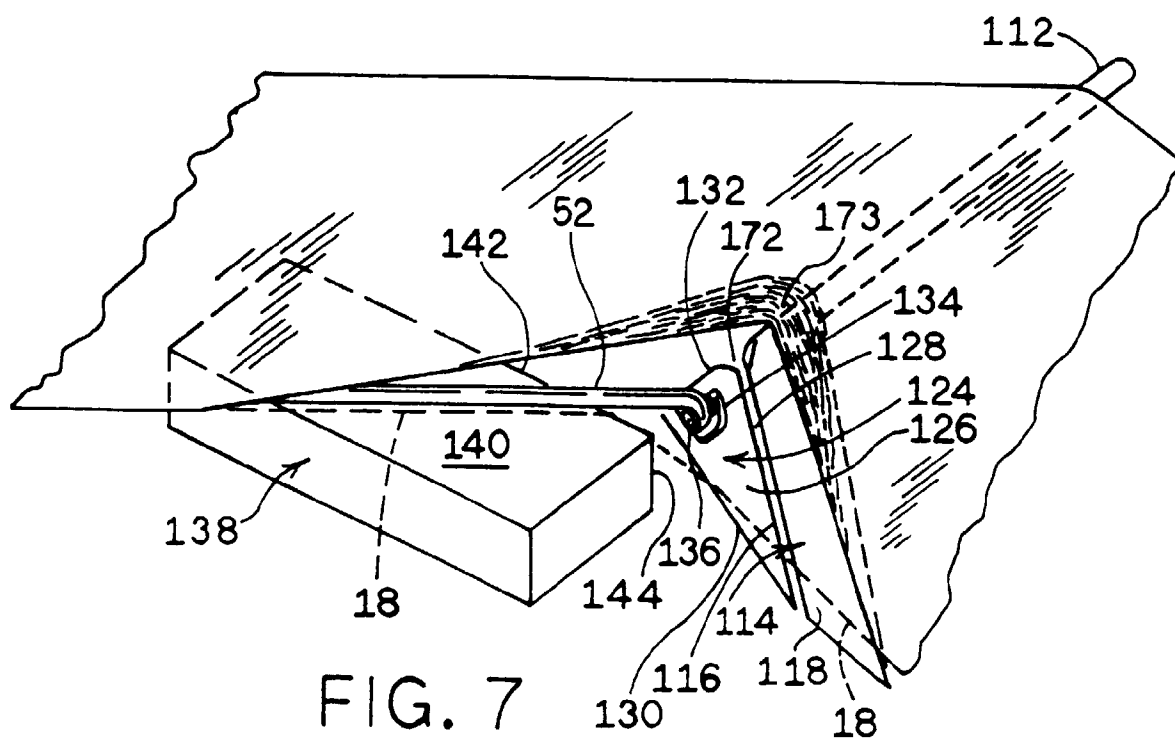


FIG. 7

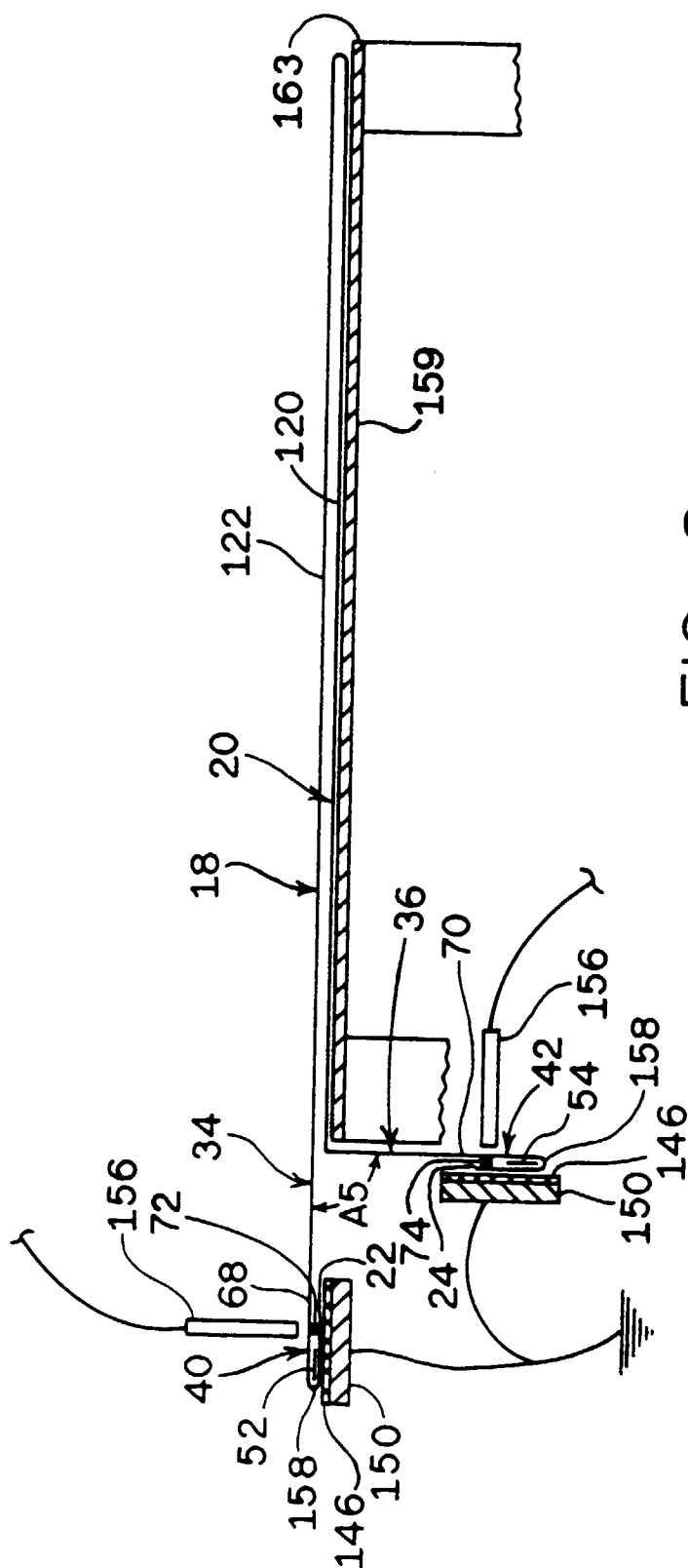


Fig. 8

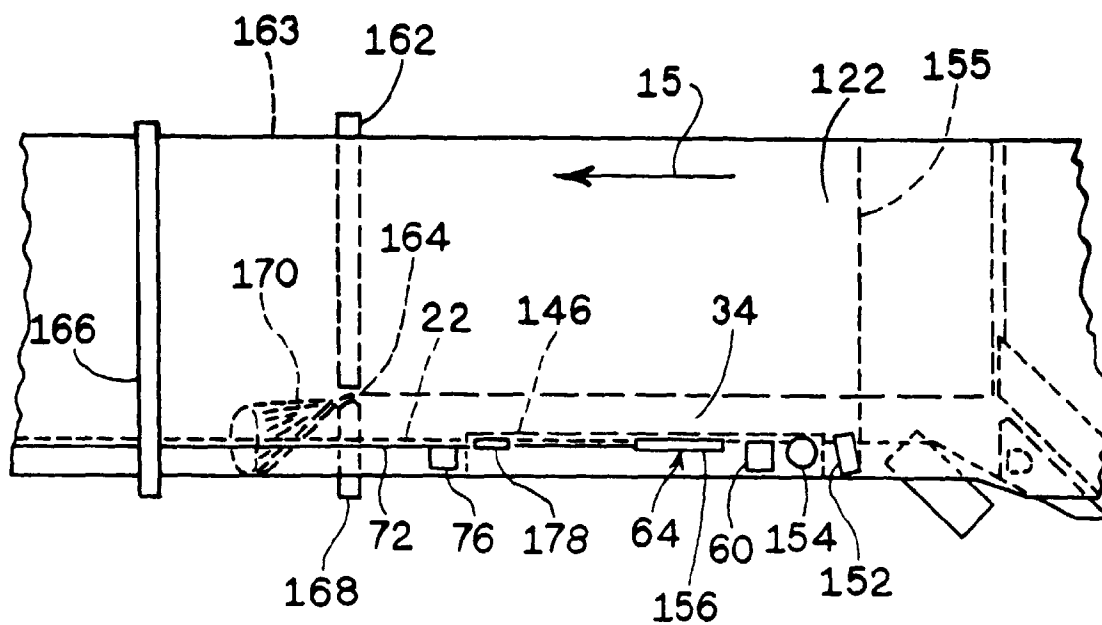


FIG. 9

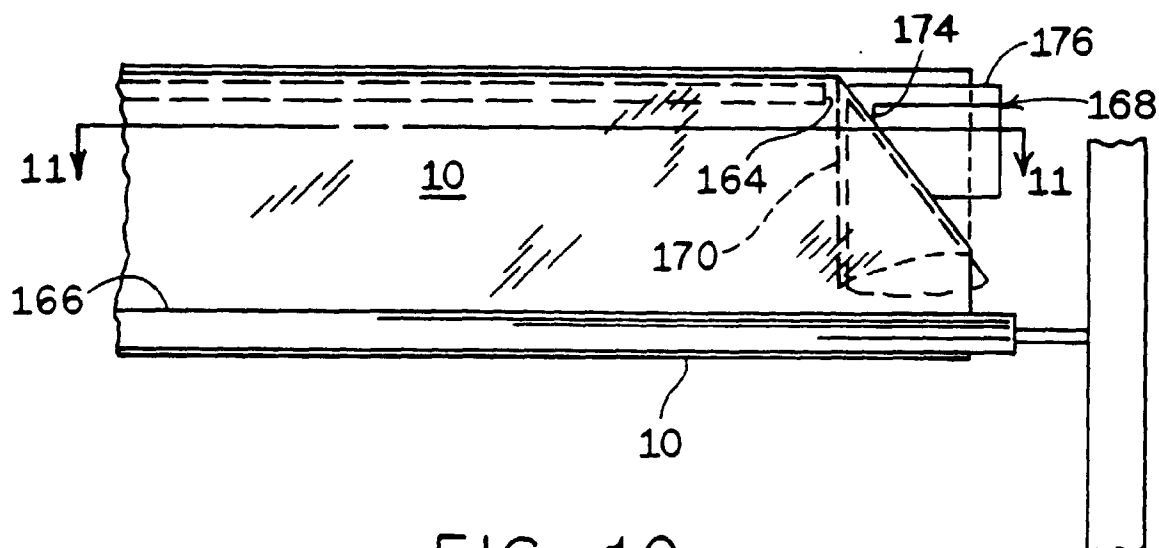


FIG. 10

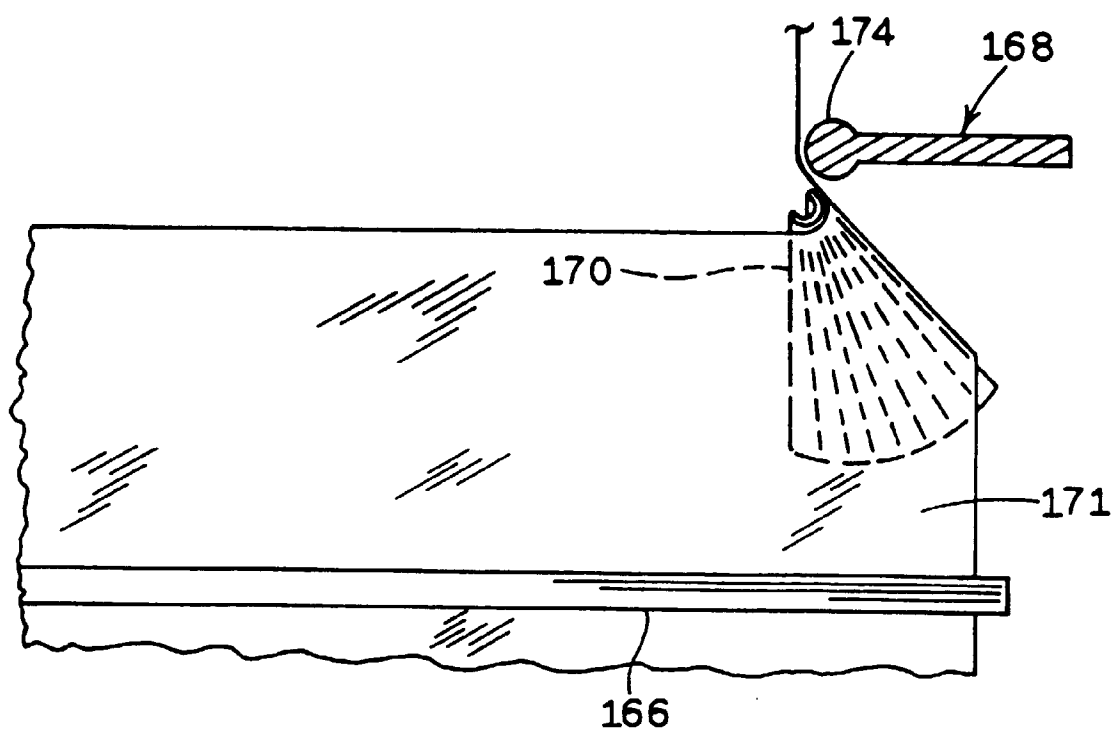


FIG. 11

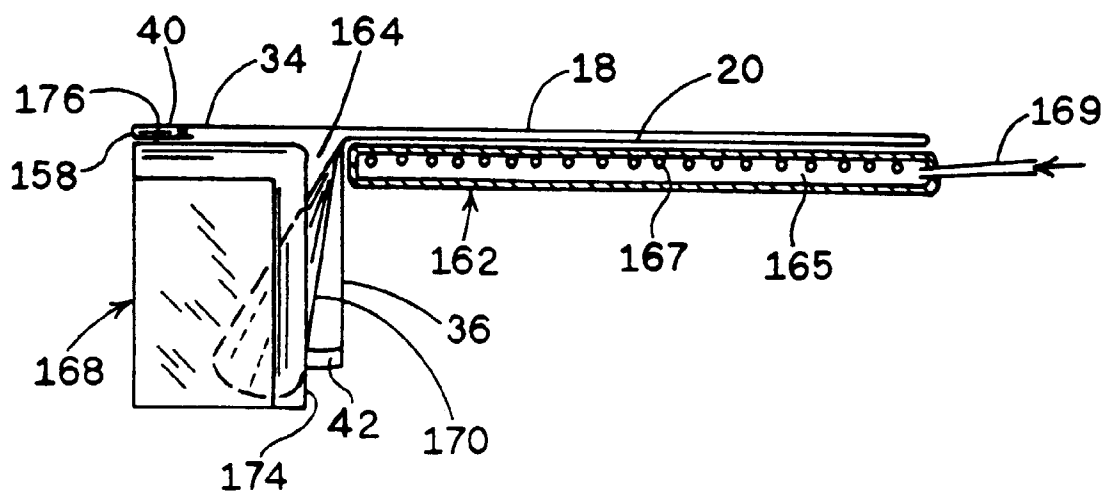


FIG. 12