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**US - A - 3 352 411**
**US - A - 4 085 822**

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# Thermoplastic bags

In the past, bags often had separate carrying handles. The carrying handles, distinct from the bag structure itself, were fed into a machine for attachment adjacent to the open mouth portion of the bag. The manufacturing operation to produce bags of this kind, with its separate process step of supplying the handling element and applying them to the bag was cumbersome and uneconomical. More recently, however, bag structures have been developed in which the carrying handles are formed as an integral part of the bag structure itself see, for example, U.S. Patents Nos. 4085822; 3352411 and 3180557.

One example of such a bag structure is one that is constructed from a flattened tube or a flattened side edge gusseted tube. A flattened portion of such a tube is cut off and sealed along its top and bottom edges. Conversely, such a bag may be formed by folding a piece of the thermoplastic material on itself, the bottom fold line constituting the bottom part of the bag and heat sealing the upper edge and side wall parts of the bag together. Next, a U-shaped cutout is make in the upper portion of the bag to provide an opening or entrance for the introduction of goods into the bag. The opposite edges of the upper portion of the bag structure immediately adjacent to the cutout ara form loops which may be used to carry the bag when they are loaded. In the case of a gusseted tube, the handle loops are reinforced, i.e., are of double thickness, by virtue of the re-entrant or gusset folds in the loop handles.

Bags of this type have exhibited structural failures in the areas which are most susceptible to stress concentration when the handle loops of the bag are separated and temporarily suspended on a loading fixture for bag filling operations, as described in U.S. Patent No. 4,085,822.

The areas of stress concentration are usually located at areas adjacent to the lower portion of the bag handles. Additionally, it has been found when the bag structure is fabricated from high density polyethylene film there is a pronounced tendency for tears to be initiated along the edge of cutout portions. These tears are usually in the machine direction of the film, i.e., in the direction in which the film is originally extruded. This direction usually corresponds to the lengthwise direction of the bag, that is, from the bag top to the bag bottom. Such tears, once initiated, quickly propagate in the machine direction, resulting in a bag failure. These problems are particularly troublesome with polymers which exhibit a high modulus or stiffness and low machine direction tear strength, e.g., high density polyethylene and polypropylene. The problem is also aggravated by the small tears or nicks which are created by the cutting dies used to cut the bags while they are arranged in a stack.

We have now devised a bag structure which eliminates or substantially reduces severity of the structural deficiencies of the bags described above. The present bag structures are provided with an increased surface area in the area of the lower handle region which is most susceptible to tearing, i.e., in an area immediately adjacent the open mouth portion of the bag and adjacent the individual bottom portions of the carrying handles. A particularly suitable technique for increasing the surface area of the bags in this region comprises impressing the film material in that area between matched forming dies to produce pleats in that area of the bag mouth. Such an arrangement of pleats causes the stresses which are encountered during bag loading operations to be redistributed to an area immediately below the mouth edge of the bag. This redistribution is obtained by reason of the increased path length along the edge of the bag relative to the film immediately below the pleated region.

Accordingly, the present invention provides a means for reducing the stress concentrations at the mouth portion of the bag adjacent the cut edge of the mouth and lower handle portions. Tearing of the bag in the machine direction, a direction in which linear polymers are most apt to tear, is either eliminated or substantially reduced during bag loading operations. This is accomplished by permanently cold drawing the film locally in the lower cut out region of the bag in a transverse direction. The drawing is accomplished by impressing a pleated section in the same area of the bag by causing the film to be cold drawing into a pleated configuration. The pleated section of film along the bag mouth edge is stretched 10 to 400 percent and is therefore 1.1 to 4, preferably 1.5 to 2, times longer than the adjacent film in the interior of the bag just below the pleated area. The pleats run in a direction which is transverse to the direction of the applied stresses, i.e., in the direction of the bag length, so that they extend when the stress is applied, thereby relieving the stress. As the pleated bag is stretched over a loading fixture, the shortest path length for the applied stress to follow is along the interior section of the bag direction below the pleating. Since there is a complete absence of nicks or irregularities in this area, initiation of tears at the edges of the film in this area is unlikely when normal bag-loading stresses are applied.

Further features and advantages of the invention will become apparent from the following description of preferred embodiments, given with reference to the accompanying drawings in which:

Fig. 1 is an overhead planar view of a prior art bag structure.

Fig. 2 is a perspective view of the bag shown in Fig. 1 in a partly opened condition.

Fig. 3 is an overhead planar view of one embodiment of the bag structure of the present invention.

Fig. 4 is an overhead planar view of an alternative embodiment of the bag structure of the present invention.

Fig. 4A is a cross-sectional view, on an enlarged scale, taken on line 4A—4A of Fig. 4.

Fig. 5 is a schematic illustration of the bag structure of the present invention when opening forces are applied thereto.

Fig. 6 is a graphic representation illustrating the improved resistance to applied stress of the present bag structures.

Figures 1 and 2 show a typical prior art handle bag, generally designated at 10, both in a lay flat and partly open position. As shown in Figures 1 and 2, these bags include inwardly folded side edge gussets 12. After the bag is formed from a continuously running gusseted tube, seals are made to form the bag bottom and upper edge portion 14. After forming the sealed tube, a U-shaped cut out portion is cut away from the bag tube thereby forming an open mouth having handles 11 adjacent opposite edges of the mouth. In the area 13, located at the base of the opposite handles and inside the bag edge, severe stresses are encountered during bag loading operations when the bag is positioned as shown in Figure 5.

We have found that these stresses may be relieved by forming pleats 15 in the areas of maximum stress encountered during the loading operation. The pleats either eliminate or substantially reduce the tendency of the bag to tear along its length when placed under these stresses. As shown in Figure 3, pleats 15 may extend entirely across the bag mouth edge and slightly beyond or alternatively, as shown in Figure 4, the pleats 15 may be positioned in spaced apart locations which generally correspond to areas 13.

The individual bags, shown in Figures 3 and 4, vary in the configuration of the mouth cut out portion. It will be noted, for example, that the bag of Figure 4 is provided with tab 16 which may be fused to tags on similar bags in a stack so as to suspend the stack from a suitable support.

Pleats 15 may be formed utilizing a convenient method such as for example impressing a flattened bag between matched metal rollers or plates during the bag forming operation. The rollers or plates are provided with peaks, e.g., truncated pyramids, together with mating recesses in an opposing plate or roller. An enlarged cross-section of one form of pleat configuration is shown in Figure 4A. In specific examples discussed hereinafter it was found that an individual pleat length (the linear extent of the pleat from the bag mouth edge to its termination in the wall of the bag mouth) of about 20 to 25 mm. was effective.

When the bags are suspended from a loading fixture and are being loaded, the maximum stresses encountered now occur in an area below the cut edge of the bag mouth. As illustrated in Figure 5, these stressed areas are now positioned and are distributed generally as shown by vectors 17. If desired, any convenient and conventional technique for inspecting the stress areas in the bag may be employed, such as viewing the bag while under stress through a pair of crossed polarized plates. It will be seen from Figure 5 that the pleated configuration of the bag edges relocates the maximum stress forces. They are no longer located along the edge of the cut out mouth portion of the bag and, accordingly, are now removed from the most susceptible tear areas, 13.

Figure 6 represents a graphic illustration of the improved tear resistance of the bag structure of the invention. In one instance, as shown in Figure 6, the bags were fabricated from high density polyethylene having a thickness of about 25 microns. These bags were structurally similar to the bags shown in Figure 2, but no pleats were formed in the bags. To determine tear susceptibility in a controlled test, a 3 mm. notch was cut in the machine direction in the cutout regions of each bag, 3 mm. from the gusset fold, as indicated by the arrows in Figure 4. Subsequently the bag was opened and the opposite handle loops 11 were spread apart and draped over a pair of bag retaining fixtures which were positioned on the jaws of an Instron tensile tester ("Instron" is a trade mark). Next, the jaw carrying the load cell and one handle loop was gradually raised until the bag failed as a result of machine direction tear of the film.

Figure 6 plots the extension or the amount of jaw separation of the Instron tensile tester against the stress to bag failure. Figure 6 shows that the bags without the pleat structure exhibit failure at a stress value of less than 26,48 N. Conversely, when the pleated bag structure are tested, failure does not occur until the applied stress is almost 53,94 N.

The pleats may be impressed by any suitable means, for example, by suitably shaped pressing dies or by toothed rolls. A preferred method employs toothed roll which engage the bag in the appropriate areas, to draw the plastic material and impress the pleats in it. The teeth in the rolls may be continuous or interrupted: in the former case the rolls will be oscillated so as to form a nip which engages the bags at the appropriate moment so that only the desired portion of the bag is impressed with the pleats; the rolls are then withdrawn from close engagement so that the pleated bag may be withdrawn and the next bag fed into the gap between the rolls before they move together again to form a nip for impressing the pleats. If the rolls have interrupted teeth, i.e., only a part or parts of the rolls are indented, the bags can be fed continuously to the roll nip so that they are impressed as the toothed portions of the rolls come together. In both cases, of course, suitable feed mechanisms are necessary to ensure that the bags are fed to the rolls at the correct time so that the proper part of the bag is impressed with the pleats.

The use of toothed impressing rolls is particularly desirable because it lends itself to a continuous production process. Thus, the bags can be made by forming a pleated tube and cutting off and sealing the ends of individual bag lengths from the tube. The cutting and sealing may be done simultaneously on a twin-pleated tube by means of a suitable heated cutting and sealing device, e.g., a hot wire cutter/sealer. The mouth portion of the bag may then be cut out to form a structure similar to that shown in Figure 1. The mouth is cut so that the inner portions of the pleats are removed, forming the handle openings. The pleats may then be formed in the manner described above, using either a pressing die or indented rolls, preferably the latter. If desired, the bags can then be stacked on top of one another and, if the bag is of the configuration shown in Figure 4, the tabs between the handles can be fused together to keep the bags in a stack. If this is to be done, the tabs may include a perforated tear line to permit easy removal of the bags from the fused tabs. This type of bag is particularly useful where many bags are to be rapidly dispensed because the fused tabs can be held in a holder and the bags then torn off when they are needed. The perforations in the tabs can be made when the mouth cutout is made.

The pleats may have different configurations: all that is necessary is that they be capable of extending under applied stress so as to provide stress relief in the mouth area of the bag. Thus, for example, the pleats may be sinusoidal, saw-toothed, square-toothed (rectangular) or of any other configuration which will perform the desired purpose. Two particularly preferred configurations are the saw-toothed (V-shaped) and truncated saw-toothed (approximately U-shaped) configurations. Pleats of these configurations may be conveniently made by means of impressing dies or rolls with grooves of the appropriate shape. The saw-toothed pleats are best made by means of rolls which have flat-topped teeth and V-bottomed grooves: the use of flat-topped teeth helps to prevent the plastic film being cut as it is drawn out by the teeth entering the V-bottomed grooves of the opposing, mating die or roll. Other pleat configurations can, of course, be made by the use of suitably contoured dies or rolls.

## Claim

A thermoplastic bag structure having front and rear walls, a mouth, and a pair of handles (11) formed integrally with the front and rear walls and located at opposite end of the mouth, characterized by a plurality of impressed pleats (15) being located along the edges of the bag mouth and/or in an area (13) of the bag walls adjacent the lower portions of the handles (11).

## Revendication

Une structure de sac thermoplastique ayant des parois avant et arrière, une bouche et une paire de poignées (11) formées d'une seule pièce avec les parois avant et arrière et placées à des extrémitès opposées de la bouche, caractérisée par le fait qu'un certain nombre de plis imprimés (15) sont situés le long des bords de la bouche du sac et/ou dans une zone (13) des parois du sac adjadente aux portions intérieures des poignées (11).

## Patentanspruch

Beutel aus hemoplastischem Material mit einer Vorder- und einer Rückwand, einer Öffnung und zwei Handgriffen (11), die einstückig mit der Vorder- und der Rückwand ausgebildet und an einander gegenüberliegenden Enden der Öffnung angeordnet sind, dadurch gekennzeichnet, daß mehrere eingepresste Falten (15) entlang der Kante de Beutelöffnung und/oder im Bereich (13) der Beutelwände, der dem unteren Abschnitt der Handgriffe (11) benachbart ist, angeordnet sind.

FIG.1 (PRIOR ART)

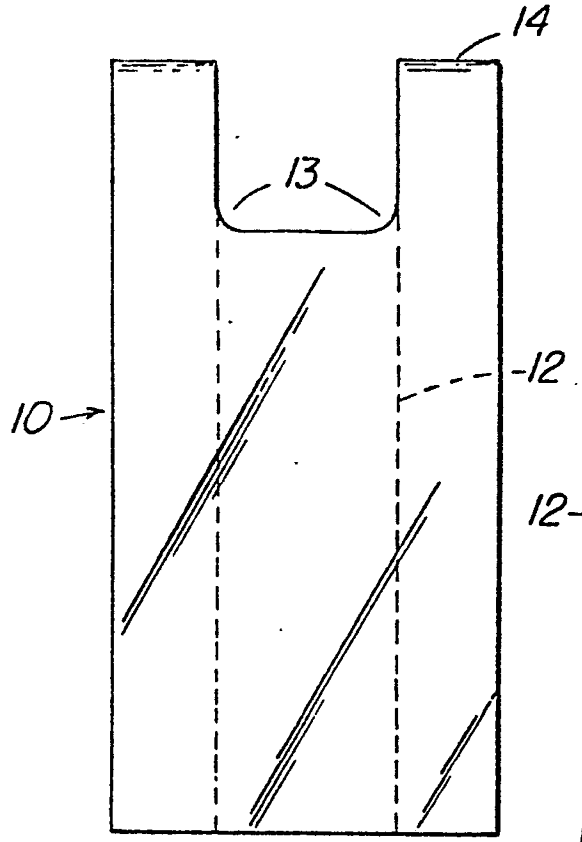



FIG. 2 (PRIOR ART)

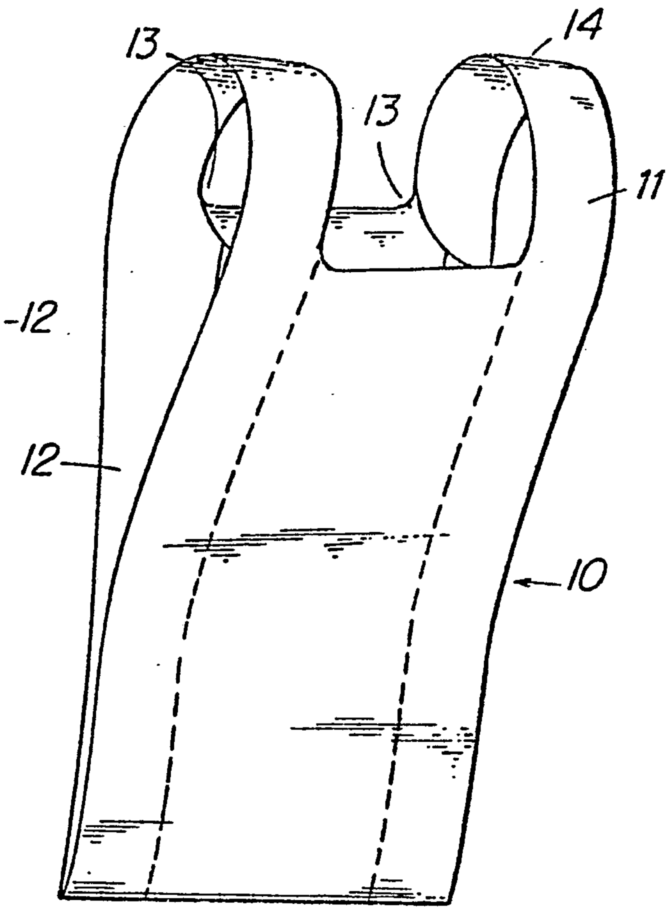



FIG.3

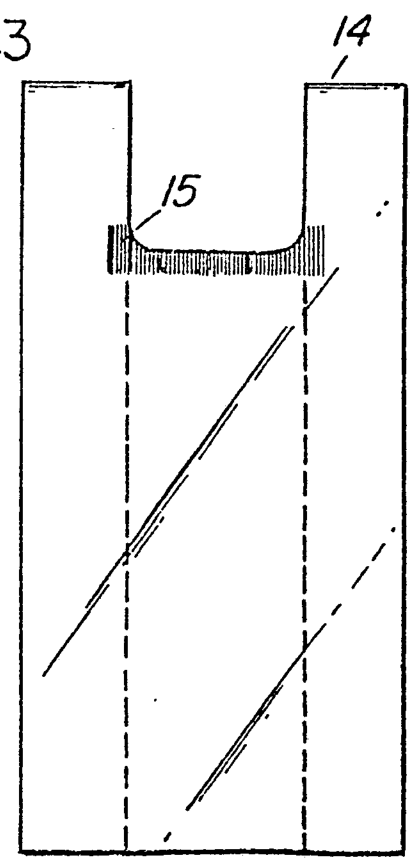



FIG.4

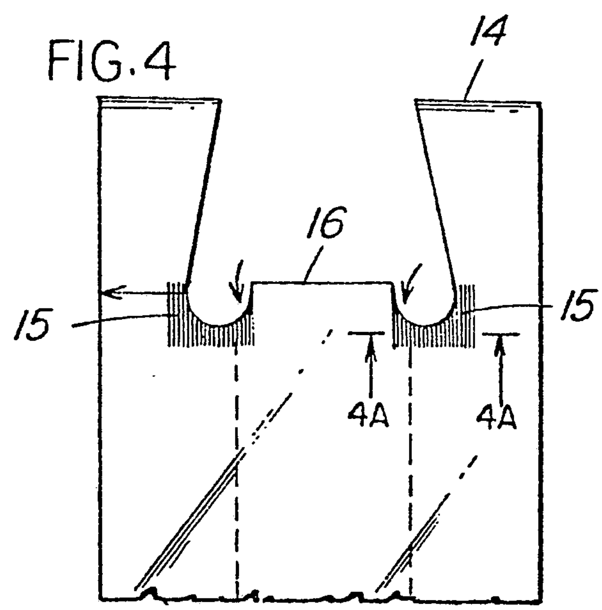




FIG.4A

FIG.5

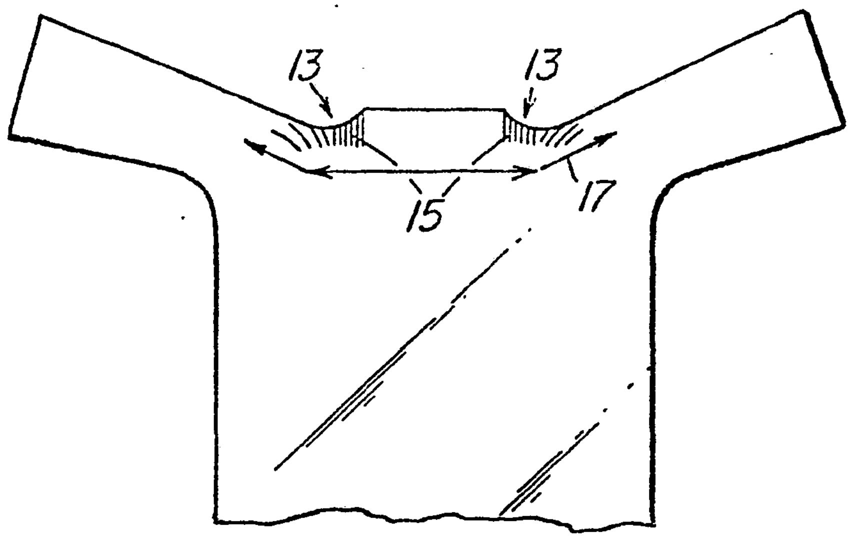
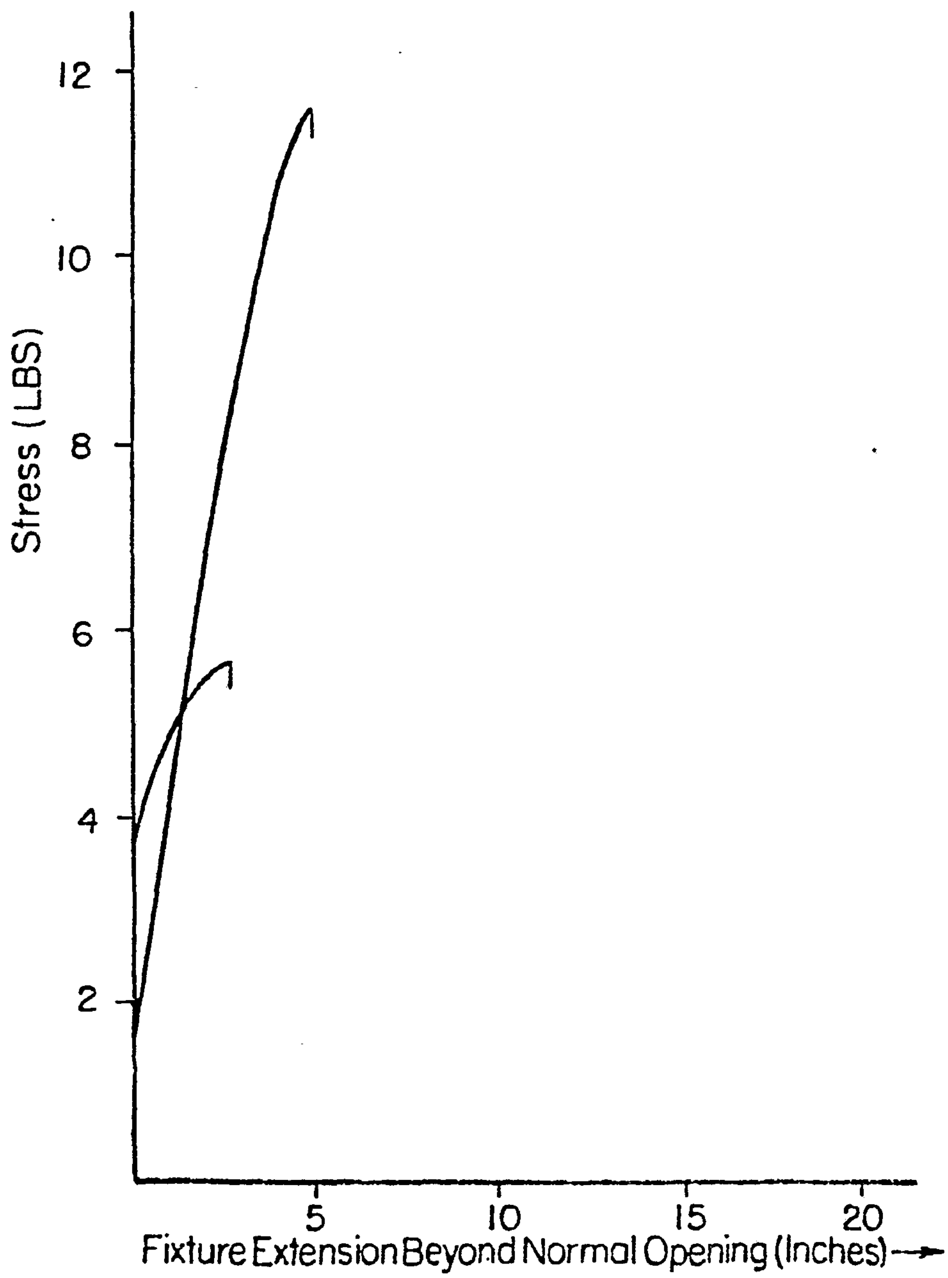

13
13
15
17

FIG.6


12
10
8
6
4
2
Stress (LBS)
5
10
15
20
Fixture Extension Beyond Normal Opening (Inches)