

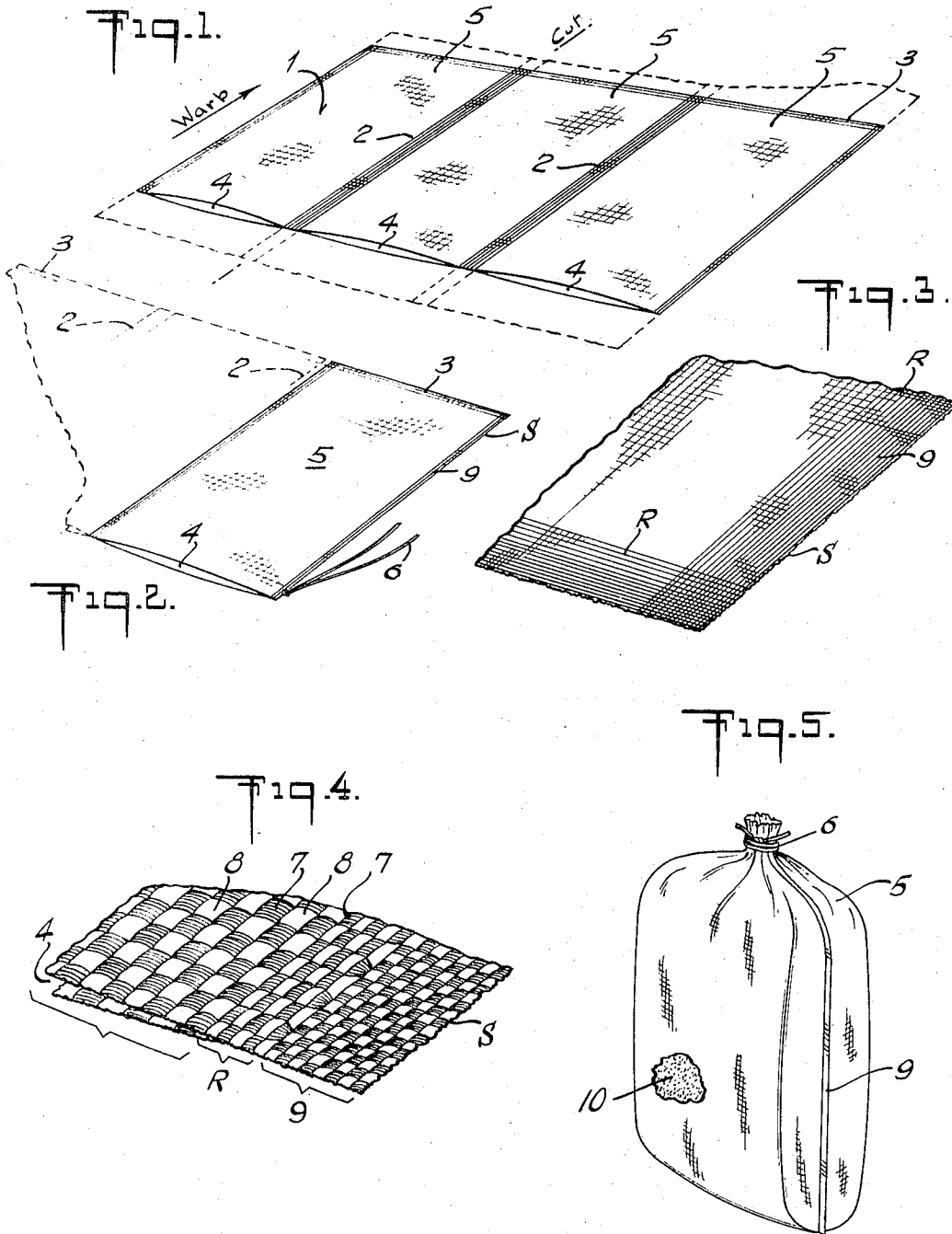
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3,340,919

BAG

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3,340,919  
BAG

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This invention is concerned with a bag having improved resistance to rupture, which is constructed of synthetic ribbon and texturized yarn and has a reinforced common selvage, with heat sealed edges to prevent raveling, closing two sides and one end of said bag.

Present-day heavy duty bags and particularly bags intended for use as sand bags are constructed of jute, cotton or burlap and consequently they are highly susceptible to rot and mildew which seriously limits the usefulness of such bags when exposed to dampness or weather is contemplated. Additionally, the copper naphthenate and similar fungicide treatments normally applied to sand bag fabric render the bag sensitive in infrared; therefore, they become excellent landmarks for strategic gun emplacements, air strips, bunkers, etc.

With respect to the mode of commercial construction adopted in bag manufacture when jute, cotton or burlap are utilized, industry is forced to utilize seams of thread with the expected resultant high incidents in bag failure due to breakage or rotting of the thread, the seam, or of the bag fabric at the seam.

These and other disadvantages have been eliminated by the instant invention which provides a seamless bag of polyolefin construction having two face sheets of interwoven polyolefin yarn, said faces being joined by interweaving along two sides and one end, the remaining end being open to permit ingress, said bag having reinforced areas adjacent and in juxtaposed relationship to said joined edges, the edges of said bag being heat sealed and thus characterized by a substantially continuous ribbon-like connection adapted to preclude raveling and fraying.

The term "polyolefins" as used herein is meant generally to include only polyethylene and the poly- $\alpha$ -olefins including polypropylene, poly-1-butene and higher homologs and copolymers of these with ethylene; however, polypropylene is by far the preferred polymer for use as the yarns constituting the construction of the bag of this invention because of its low density, good tensile strength and great elongation to break together with intermediate stiffness as compared to other plastics. It also possesses a high heat distortion point which is an asset for use in this invention. While the polyolefins, and specifically polypropylene, offer the most desirable combination of tensile strength and elongation necessary to effect the impact strength needed in the particular bag construction of this invention, other synthetic polymers could be used in the yarns of this invention provided they offered the necessary combination of tensile strength and elongation in magnitudes sufficient to allow a bag constructed in accordance with this invention and utilizing such yarns in the warp or fill or both to exhibit the impact strength necessary to allow that bag to pass the "drop test" defined herein. The economics involved must be considered also since a bag of this nature must be inexpensively produced.

The term "yarn" as used herein is meant to define both ribbon-like monofilament yarn and textured multifilament yarn.

"Textured" or "texturized" yarns are formed of a plurality of permanently crimped continuous filaments. These yarns are made in one instance by taking a number of continuous filaments, twisting them, heat-setting the filaments to set this twist and then untwisting the filaments to form the final yarn. Other methods of manufacture

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are known to the art and examples of such yarns are "Agilon," "Fluflon," "Helanca," "Softex," "Superloft," etc.

The flat ribbon yarn is used in the warp yarn and provides a cover factor to the bag. Having width, the ribbon aids in retaining the contents of the bag. The multifilament yarn is used in the filling yarns and adds substantial strength to the bag as a whole. Utilizing yarn constructed of a synthetic polymer having the requisite tensile strength and elongation, and being made up of many individual thin filaments of texturized yarn, the multifilament yarn is flexible and provides elasticity in the bag, but it also acts to seal off the areas of the interstices of the woven fabric since it is far more flexible than the ribbon-like yarn and does conform to the area, within the weave, bounded by the ribbon yarn. Thus it acts to insure that leakage of any fine grained contents within the bag is prevented. Of course, the ribbon fiber could be used in the fill, in which case the multifilament textured yarn would be used in the warp. This is not to relate that only the texturized yarn must exhibit the tensile strength and elongation necessary herein because while the use of ribbon yarn in both the warp and filling yarn would not provide the bag of this invention, the use of ribbon yarn (in the warp or in the filling) which exhibited less than the required elongation and tensile strength would also result in "drop test" bag failure.

For use as a sand bag by the military, the yarns are delustered to reduce gloss and reflectivity. This is accomplished either mechanically during extrusion of the yarn or chemically by addition of a delustering agent to the melt during extrusion or to the mix prior to extrusion. The delustering agent must be one which is compatible with the polyolefin used. Additionally, for military use, the yarns must be solution dyed to no lighter than color 34096 or darker than color 34079 as specified under Federal Standard No. 595 "Colors."

The polyolefin, i.e., preferably polypropylene, shall be fully stabilized for maximum resistance to heat and ultraviolet light. Copending application Ser. No. 341,614 filed Jan. 31, 1964, discloses and claims polyolefin compositions which possess greatly improved resistance to degradation on exposure to sunlight and weathering. In keeping with that invention, a system of certain selected stabilizers in amounts between about 0.1% and about 9% by weight, based on the weight of the total polymer composition, may be added to the mix which will be extruded to the yarns used in the instant invention. The stabilizers of the system are ultraviolet light absorbers, antioxidants and heat stabilizers.

In considering the ultraviolet absorbers, concern is manifested in the portion of the sunlight spectrum, i.e., the ultraviolet energy, which is sufficiently powerful to rupture chemical bonds, or, in other words, sufficiently powerful to cause photochemical degradation of the polyolefinic yarn; however, the ultraviolet absorbers used must be those which are compatible with the particular polyolefins defined herein. These are represented by p-octylphenyl salicylate; 2-hydroxy-4-n-octoxybenzophenol, sold by American Cyanamid and designated UV-531; AT-539, a substituted acrylonitrile manufactured by the Antra Chemical Company; a nickel organic complex AM-101 manufactured by Ferro Chemical; and Dow Chemical Company's tert-butyl salicylate. The ultraviolet absorber may be present in an amount from 0.0% to about 5% by weight in the finished product. The preferred limits are from about 0.25% to about 5% by weight.

The antioxidants contemplated in the system which fosters the yarns utilized in this invention must also be compatible with the polyolefin at extrusion temperatures and at service temperatures, i.e., they must be non-exuding, but they must also have sufficient heat stability at

extrusion temperature to permit the extrusion of the polyolefin yarns. They must also possess color stability such that there is little or no color change during, or after, extrusion or during the reasonable life of the polymer. They must also possess excellent water resistance so that moisture will not leach it from the yarn and thereby destroy the tensile strength and oxidation resistance which are both desired. Representative of antioxidants which fall within this definition are 2,6-di-tertiarybutyl-p-cresol; RA-1093, "Irganox 565," 858, 1076 and 1093, all manufactured and sold by Geigy Chemical Company; "Santanol," a dialkylphenol sulfide manufactured and sold by Monsanto Chemical; "Topanol C. A.," a 3:1 condensate of 3-methyl-6-tertiary butyl phenol with crotonaldehyde, a "Nonox WSP" and "Nonox CL" manufactured by Arnold Hoffman and Company; American Cyanamid Company's two phenolic antioxidants 2246 and 425; 703 sold by Ethyl Corporation; 2,4,5-tri-hydroxybutyropnone; and Shell Chemical Company's butylated hydroxytoluene.

To perform their function, one or more of these antioxidants must be present in an amount sufficient to insure a content of from about 0.05% to about 2% by weight in the final polymer; however, within the more commercial aspects of the present invention, the use of from about 0.25% to about 0.5% by weight is contemplated.

The third additive is represented by di-lauryl-thiodipropionate, bi-stearyl-thiodipropionate or "Steroban 20," a modified polymeric thioester manufactured by Halby Products Company, in an amount sufficient to provide from about 0.05% to about 2% by weight in the final product, with from about 0.1% to about 0.5% by weight being preferred. This particular additive is necessary since it is synergistically reactive with the antioxidant and since it imparts heat stability in the final polyolefin yarn.

Heat stabilizers compatible with the polyolefin and which exhibit good resistance to heat during extrusion, may also be added to the mix provided they are non-migrating.

Consistent with the invention disclosed and claimed in copending application Ser. No. 448,857, filed April 16, 1965 flame retardancy, a factor which is much needed with respect to polypropylene, may be made a factor in the bags of the instant invention by incorporating a certain system of additives to the premix prior to fiber extrusion. This is accomplished by adding an organic bromine compound and a dispersant for said bromine compound into the polypropylene mixture prior to melt spinning. This may be accomplished along with the aforementioned additives for heat and ultraviolet light degradation without harmful effects to the polypropylene yarns.

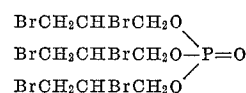
The dispersant is of extreme importance in the flame retardancy system since it must be highly compatible with the organic bromine compound used, i.e., sufficiently compatible at extrusion temperatures to prevent separating out of ingredients, yet of sufficient compatibility in the system at end-use temperatures to preclude exudation or migration.

The dispersant is added to the flame retardant system to rapidly and efficiently disperse the active ingredient, i.e., the organic bromine compound, substantially uniformly throughout the amorphous portion of the polymer without solvating the crystalline portion, or in any way inhibiting significant crystallization of the polymer. The dispersant used herein must accomplish these features, but must also be one which will permit the organic bromine compound to be absorbed by the amorphous portion of the polypropylene since the two are not known to be compatible or dispersible in one another. Thus, the dispersant must be compatible with both the polypropylene and the organic bromine compound used and it must readily disperse the organic bromine compound within the polypropylene. It must also have permanence which requires that it have a low vapor pressure and a low diffusion rate within the polyolefin.

Representative of the dispersants which are capable of satisfying all of these requirements are chlorinated polyphenyl compounds which define any of the biphenyl or triphenyl compounds containing from about 20% to about 70% by weight chlorine or blends of chlorinated biphenyls and triphenyls containing from about 20% to about 70% chlorine. Suitable examples of such chlorinated polyphenyl compounds are chlorinated biphenyl containing 60% by weight chlorine, chlorinated triphenyl containing 60% by weight chlorine and a blend of chlorinated triphenyl and chlorinated biphenyl containing 65% by weight chlorine, etc. Other acceptable dispersants that satisfy the demanding requirements recited herein are a chlorinated naphthalene sold under the trade-mark "Halowax" by Koppers Company, Inc., stearic acid, chloro-*rendic* anhydride, and selected waxes, etc.

The dispersant must be present in the flame retardant system in amounts from about 0.05% to about 20% by weight, based on the total weight of the resultant polypropylene composition, with 5% to 10% being preferred. The exact range will vary with the dispersant selected. For example, chlorinated biphenyl can be used in amounts of up to 20% without exudation, whereas with stearic acid exudation begins to occur at about 1% concentration and becomes prohibitive at greater than 4%. More than one dispersant may be added to the system but their combined amounts must fall within the limits given above. Below about 0.05% there is insufficient dispersant present to perform the functions required of it and exudation of the organic bromo compound occurs on aging of the resin and extrusion can become erratic. The economics involved do not warrant amounts above about 20%. The degree of fire retardancy obtained at that level is more than sufficient. Also, incorporating larger amounts of dispersant in the polymer mix causes a diminution of the properties of the polypropylene.

With specific reference to a definition for the active fire retardant additive, i.e., the organic bromine compound, it has been found that this fire retardant additive must (a) be resistant to water and weathering, (b) contain no water and be sufficiently low in vapor pressure so that it can be extruded without gasing, (c) have good thermal stability at the extrusion temperatures for polypropylene, (d) be capable of being made compatible with polypropylene at extrusion and end-use temperatures so as not to separate or exude from the polymer, (e) contain a high percentage of bromine so that a small amount of the additive will be effective, since the addition of any significant amount of additive would undoubtedly destroy or impair desirable polymer properties, and (f) be non-reactive with the base polypropylene polymer at extrusion temperatures yet be sufficiently reactive or unstable at ignition temperatures to extinguish a flame or impede combustion. This defines the organic bromine compounds which are the active ingredients and thus the essential elements in this invention. Representative examples of such compounds are "Phosgard" B52-RS, an organic bromine phosphate sold by Monsanto Chemical Company, and tris-2,3-dibromopropyl phosphate, i.e.



The organic bromine phosphates represent the preferred active fire retardant ingredients in this invention.

It is essential that the organic bromine compound impart fire resistance, but they must also have sufficient thermal stability and be low enough in vapor pressure at about 400° F. to be extruded without gasing or reacting with the polypropylene in the extruder. It appears that once the bromine of the compound reacts with the polypropylene resin, many desirable properties of polypropylene are lost.

Since the known organic bromine compounds which effect fire retardancy are not compatible with polypropylene, the incorporation of the specific dispersant(s) defined earlier, within the ranges set forth, is also essential. Without the use of this dispersant the possible concentrations of the fire retardant organic bromine compounds in the polypropylene are far below those necessary to impart the requisite flame retardancy to the resin, and the required uniform distribution is not insured.

With the polypropylene yarns of this invention, the fire retardant organic bromine compound must be present in amounts within the range of from about 3.0% to about 12% by weight, based on the total weight of the polypropylene resin composition and preferably within the range of 4% to 8% with about 5% to 6% elemental bromine concentrations present. At these levels a 12 mil oriented monofilament extinguishes in less than one second after a three second ignition period. Below 3.0% there is insufficient present to provide the required fireproofing, and above about 12% problems regarding degrees of lack of compatibility begin to appear and polymeric breakdown will begin to be evidenced. If flammable pigments are present the lower limit must be raised, and in that event a minimum of about 3.5% is acceptable.

The invention will be more readily understood from a reading of the following description taken together with the accompanying drawings wherein:

FIG. 1 is a schematic plan view of a portion of a strip of bag fabric woven in accordance with this invention, FIG. 2 depicts a bag cut from the fabric of FIG. 1,

FIG. 3 is an enlarged fragmentary view of one corner of the bag of FIG. 2,

FIG. 4 is an enlarged fragmentary view of one edge of the bag of FIG. 2, and

FIG. 5 depicts the bag of FIG. 2 filled with sand and closed.

With specific reference to FIG. 1, there is shown a fabric 1 woven in continuous sheet form and in multiples of individual bag widths. The fabric is woven of ribbon-like polypropylene monofilaments in the warp and multifilament texturized yarn in the filling.

The warp yarn is 1000 denier unfolded polypropylene ribbon of about 100 mils in width. It has 10 pounds minimum tensile per single end and 15% to 30% ultimate elongation. The filling yarn is 2500/120-140 denier bulked, continuous filament polypropylene equivalent to Hercules type 36-B. Both yarns are solution dyed to be no lighter than color 34096 or darker than color 34079, as specified under Federal Standard No. 595 "Colors" and both are fully stabilized for maximum resistance to heat and ultraviolet light. Both are also delustered.

The body of the bag is of two-ply construction with single ply cutting bands 2 constructed transversely in the fabric and positioned about 14" apart. A single ply selvage-like strip 3 is woven along the widthwise edge, or in the filling direction, of fabric 1. With such construction pocket-like cavities 4 are formed and constitute a series of multiple bags 5 across the width connected along the common cutting edges 2, in the filling direction, and a plurality of bags connected bottom to bag mouth in the warp direction. By cutting along or near the midpoint of each of these cutting bands 2 and along each of the selvage-like band strips 3, a plurality of single bags 5 result (see FIG. 2).

As woven, the body of each bag 5 is of a construction having ten picks and ten ends per square inch in a 1/1 plain weave. The cutting bands 2 forming the woven side seams 9 of the individual bags 5, and the single ply cutting strip 3, forming the woven bottom seam, are constructed having twenty picks and twenty ends per square inch in a 1/1 plain weave. Adjacent each woven seam, there is an area (see FIG. 3) of reinforcement R extending in juxtaposed relationship the length of each such seam. In this bag each area of reinforcement is about 1/2 inch wide and has a yarn count of 20 x 10 with a 1/1 plain weave con-

struction. This reinforcement is constructed in each bag 5 to provide strength along each seam where maximum stress is developed during use.

A strip of twine-like material 6 of synthetic construction is attached along one edge of the bag 5 to provide a closure means when the cavity 4 of the bag 5 is filled with sand (see FIG. 5), or some other substance.

FIG. 3 represents an enlarged fragmentary view of one of the corners of bag 5 (FIG. 2) showing one of the cutting edge bands 2, i.e., the woven side seam 9, and the single ply selvage-like strip 3, i.e., the woven end seam. The warp yarn is shown to be of ribbon construction, where the filling yarn 7 is seen to be of textured multifilament yarn (see FIG. 4). The ribbon character of the warp yarn 8 provides a cover factor since it is impermeable, while the textured multifilament yarn 7 provides strength and elasticity to the bag and, since each filling yarn 7 is composed of a plurality of thin textured filaments, the yarn can expand and contract to fill the area between adjacent warp yarns 8.

With reference to the outer perimeter of edges 2 and 9, and with specific reference to FIG. 4 which is an enlarged fragmentary view of an edge of the bag 5 shown in FIG. 2 or FIG. 3, note that the severed edges of the fabric are substantially unitary and continuous. This is the result of severing using heat which causes the polypropylene yarns immediately adjacent the line of severance to become thermoplastic and flow together to form a continuous substantially unitary edge S which acts to preclude fraying and raveling. This can be accomplished by using a heated wire or a heated knife blade and severing along the midpoint of cutting band 2 shown in FIG. 1, or by separately treating both the uncut and the cut edges with a heat source. In any event, all edges are heat treated to fuse the fibers along the edge to provide a continuous or unitary edge against raveling.

FIG. 5 depicts the bag 5 of this invention filled with sand 10 (shown in cutaway) and having the openings to the cavity 4 secured by the twine 6. The longitudinal edges 9 are secured and protected by the reinforced wear strip R.

The bags constructed in accordance with the teachings of this invention have sufficient strength to survive, without failure, the drop test defined hereinafter.

Bags to be tested shall be filled with clean, dry washed sand which passes a No. 10 sieve and is retained by a No. 60 sieve. The filled bag shall have a volume of not less than 760 cubic inches (in a space of 4 x 10 x 19 inches). Bags shall be dropped from a height of four feet directly on a solid surface of concrete, stone, or steel of sufficient mass to absorb substantially all shock without deflection. Each bag shall be dropped once on any one face, butt and side, which shall consist of three drops for the bag. Before each drop the contents of the bag shall be uniformly distributed throughout the bag and slippage of the tie string shall be corrected after each drop. A bag shall be considered as having failed if it bursts or tears so as to spill or expose the contents.

The instant invention provides not only a bag having inherent resistance to rot and mildew as well as one being chemically inert and more weather resistant, but it also provides a bag having increased strength and a bag with no sewn seams. The use of ribbon-like monofilaments and the textured multifilaments in the bag construction, together with the reinforced band adjacent three sides, increases the strength of the bag and provides a cover factor which enables the contents of the bag to be kept within the cavity. The lack of sewn seams due to the single-ply end construction utilized on three sides of the bag of the instant invention eliminates failure due to seam or fabric failure and workmanship.

While it will be apparent that many widely different embodiments of this invention may be made without departing from the spirit and scope thereof, the instant invention is not intended to be limited except as indicated in the appended claims.

What is claimed is:

1. A bag of two woven face fabrics commonly joined by a single ply selvage extending along two sides and one end of said bag, each of said face fabrics being constructed of two sets of interwoven synthetic yarn, one set consisting of ribbon monofilament yarn and the other set consisting of texturized yarn, a narrow band of tightly woven fabric in each face fabric extending along said selvage to provide reinforcement and the outer edge of said selvage being heat sealed to prevent raveling, said bag exhibiting such improved strength and resistance to rupture as to pass the "drop test."

2. The bag of claim 1 wherein said yarns comprise polyolefins.

3. The bag of claim 1 wherein said yarns are delustered to reduce gloss and reflectivity in the bag.

4. The bag of claim 1 wherein said yarns comprise polypropylene and are stabilized to heat and to ultraviolet light by containing, based on the total weight of the polymer, from 0.0% to about 5% by weight of an ultraviolet

light absorber, from about 0.05% to about 2% by weight of an antioxidant and from about 0.05% to about 2% by weight of a heat stabilizer.

5. The bag of claim 1 wherein said yarns comprise polypropylene and contain from about 3% to about 12% by weight of an organic bromine compound and from about 0.05% to about 20% by weight of a dispersant for said organic bromine compound and said yarns are flame retardant.

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