COMMONWEALTH of AUSTRALIA

74954/87

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

602902

AMENDED

We W. R. Grace & Co.-Conn., of
1114 Avenue of the Americas,
New York,
New York 10036,
United States of America,

hereby apply for the grant of a Standard Patent for an invention entitled:

"OXYGEN BARRIER FILM"

which is described in the accompanying ~~provisional~~ complete specification.

Details of basic application(s):—

Number	Convention Country	Date
880,259	United States of America	30 June, 1986

[illegible]

The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

Dated this 4th day of July, 19 89.

To: THE COMMISSIONER OF PATENTS

(a member of the firm of DAVIES & COLLISON for and on behalf of the Applicant).

Davies & Collison, Melbourne and Canberra.

Ref. No. 41323, USSN 880259

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952
DECLARATION IN SUPPORT OF CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT

In support of the Application made for a patent for an invention entitled:

OXYGEN BARRIER FILM

I, JULES H. STEINBERG, of W. R. GRACE & CO., of 1114 Avenue of the Americas, New York, New York, 10036, U.S.A., do solemnly and sincerely declare as follows:

1. (a) I am authorized by W. R. GRACE & CO., the applicant for the patent to make this declaration on its behalf.

(b) Gautam P. Shah, 603 Harness Trail, Simpsonville, South Carolina, 29681 USA

is/~~are~~ the actual inventor... of the invention and the facts upon which the applicant is entitled to make the application are as follows:

The said applicant is the assignee of the said actual inventor in respect of the invention.

2. The basic application....as defined by Section 141 of the Act was made in United States of America on the 30th of June 1986 by ~~W. R. Grace & Co.~~ Gautam P. Shah.

3. The aforesaid basic application was/~~were~~ the first application...made in a Convention country in respect of the invention the subject of the application.

Declared at New York, New York, this 6th day of April, 1987.

Jules H. Steinberg
Assistant Secretary

FORM 228/7/86

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(56) Prior Art Documents
US 4557780
US 4514465

(57) Claim

1. An oriented multilayer film comprising:

(a) a core layer comprising an ethylene vinyl alcohol copolymer;

(b) two interior layers each comprising an adhesive polymeric material; and

(c) two outer layers each comprising polymeric material selected from the group consisting of ethylene butyl acrylate copolymer, and blends consisting at least 10% of said ethylene butyl acrylate copolymer blended with ethylene alpha-olefin copolymer.

COMMONWEALTH OF AUSTRALIA

PATENT ACT 1952

COMPLETE SPECIFICATION 602902

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This document contains the amendments made under Section 49 and is correct for printing.

AUSTRALIAN PATENT OFFICE

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Complete Specification for the invention entitled:

"OXYGEN BARRIER FILM"

The following statement is a full description of this invention, including the best method of performing it known to us :-

OXYGEN BARRIER FILM

BACKGROUND OF THE INVENTION

This invention relates to oriented thermoplastic films for packaging; and more particularly, this invention relates to a coextruded, multilayer, oriented film having high oxygen barrier characteristics.

Thermoplastic film, and in particular polyolefin materials, have been used for some time in connection with packaging of various articles including food products which require protection from the environment, an attractive appearance, and resistance to abuse during the storage and distribution cycle. Suitable optical properties are also desirable in order to provide for inspection of the packaged product after packaging, in the distribution chain, and ultimately at point of sale. Optical properties such as high gloss, high clarity, and low haze characteristics contribute to an aesthetically attractive packaging material and packaged product to enhance the consumer appeal of the product. Various polymeric materials have been used to provide lower gas permeability in order to reduce the transmission of oxygen through the packaging film and thereby retard the spoilage and extend the shelf life of products such as food items which are sensitive to oxygen.

It is also desirable to include in a packaging film a shrink feature, i.e., the propensity of the film upon exposure to heat to shrink or, if restrained, create shrink tension within the packaging film. This property is imparted to the film by orientation of the film during its manufacture. Typically, the manufactured film is stretched in either a longitudinal (machine) direction, a transverse direction, or both, in varying degrees to impart a certain degree of shrinkability in the film upon subsequent heating. After being so stretched, the film is rapidly cooled to provide this latent shrinkability to the resulting film. One advantage of shrinkable film is the tight, smooth appearance of the wrapped product that results, providing an aesthetic package as well as protecting the packaged product from environmental abuse. Various food and non-food items may be and have been packaged in shrinkable films.

It is sometimes also desirable to orient the packaging film and thereafter heat set the film by bringing the film to a temperature near its orientation temperature. This produces a film with substantially less shrinkability, while retaining much of the advantages of orientation, including improved modulus and optical properties.

Of interest is U. S. Patent No. 4,424,243 issued to Nishimoto et al disclosing a heat shrinkable laminate film having outer surface layers of an ethylene/alpha-olefin copolymer or a mixture of the ethylene/alpha-olefin copolymer with an alpha-olefin polymer. Ethylene alkyl acrylates having 1 to 6 carbon atoms may comprise such alpha-olefin polymers.

Also of interest is U.S. Patent No. 4,464,443 issued to Farrell et al showing the use of EVOH in a multilayer polymer structure, and including drying agents or desiccants such as sodium phosphate-di-basic and calcium chloride. EVOH, although a good barrier material, is moisture sensitive, and loses a great deal of its barrier properties at higher levels of relative humidity.

Also of interest is U.S. Patent No. 4,457,960 issued to Newsome which discloses the use of EVOH and EVOH blends in a multiple layer film. The film may be made as shrinkable film, and may be melt extruded. The outside layer of the multiple layer film may be a blend of linear low density polyethylene (LLDPE) and EVA.

Also of interest is U.S. Patent No. 4,495,249 issued to Ohya et al and disclosing a multilayer laminate film with a core layer of a saponified copolymer of ethylene and vinyl acetate, and including two outer layers of a mixture of EVA and LLDPE. The multilayer laminate film of this reference can be made heat shrinkable and has gas barrier properties.

U.S. Patent No. 4,501,797 issued to Super et al discloses an unbalanced oriented multiple layer film including an intermediate layer of anhydride modified polypropylene and a barrier layer of a blend of ethylene vinyl alcohol and nylon.

U.S. Patent No. 4,501,798 issued to Koschak et al also discloses the use of a blend of EVOH and nylon and an unbalanced multiple layer polymer film also including LLDPE or EVA in a sealant layer. Adhesive layers of materials having carboxy moieties and preferably anhydride derivatives are present. The film of the reference is characterized by having high barrier to gaseous transmission, high glass, transparency and stiffness.

U.S. Patent No. 4,347,332 issued to Odorzynski et al discloses a film having a blend of nylon and ethylene vinyl alcohol copolymer.

In accordance with a first aspect of the invention there is provided an oriented multilayer film comprising:

(a) a core layer comprising an ethylene vinyl alcohol copolymer;

(b) two interior layers each comprising an adhesive polymeric material; and

(c) two outer layers each comprising polymeric material selected from the group consisting of ethylene butyl acrylate copolymer, and blends consisting at least

10% of said ethylene butyl acrylate copolymer blended with ethylene alpha-olefin copolymer.

Preferably the film is irradiated to cross-link the respective layers.

A second aspect of the invention provides a method of making an oriented multilayer film comprising:

(a) coextruding a core layer comprising an ethylene vinyl alcohol copolymer, two intermediate layers of an adhesive material, and two outer layers each comprising polymeric material selected from the group consisting of ethylene butyl acrylate copolymer, and blends comprising at least 10% of said ethylene butyl acrylate copolymer blended with ethylene alpha-olefin copolymer;

(b) rapidly cooling the coextruded film;

(c) collapsing the cooled film;

(d) heating the collapsed film; and

(e) stretching the orienting the heated film.

The coextruded thermoplastic multilayer films tend to have good oxygen barrier properties over a wide range of moisture conditions and are substantially free of voids in the barrier material of the film. The thermoplastic multilayer films generally have an aesthetic appearance with good clarity, and other desirable optical properties such that a thin thermoplastic multilayer film may have superior toughness and abrasion resistance.

Conveniently the coextruded thermoplastic multilayer film may be totally coextruded, and oriented to provide a film with good shrink properties and good barrier properties over a wide range of moisture conditions. It is also possible to provide a coextruded thermoplastic film which is oriented yet substantially shrink free.

DEFINITIONS

The term "ethylene butyl acrylate copolymer" (EBA) is used herein to define a copolymer formed from ethylene and butyl acrylate monomers wherein the ethylene derived units in the copolymer are present in major amounts.

"Intermediate layer", "interior layer", and the like is used herein to define a layer in a multilayer film enclosed on both sides by other layers.

The term "oriented" and the like is used herein to define a polymeric material in which the molecules have been aligned by a process such as racking or blown bubble process.

The term "ethylene vinyl alcohol copolymer", "EVOH", and the like is used herein to include saponified or hydrolyzed ethylene vinyl acetate copolymers.

The term "racking" is used herein to define a well-known process for stretching coextruded and reheated multilayer film by means of tenter framing or blown bubble processes.

The term "ethylene alpha-olefin copolymer" is used herein to include linear copolymers of ethylene and alpha-olefins as for example those defined below.

The term "linear low density polyethylene", "LLDPE", and the like are used herein to refer to copolymers of ethylene with one or more comonomers selected from C_4 to C_{10} alpha olefins such as butene-1, octene, etc. in which the molecules of the copolymers comprise long chains with few side chain branches or cross-linked structures. This molecular structure is to be contrasted with conventional low or medium density polyethylenes which are more highly branched than their respective counterparts.

"LLDPE" as defined herein has a density usually in the range of from about 0.916 grams per cubic centimeter to about 0.925 grams per cubic centimeter.

The terms "linear medium density polyethylene", "LMDPE" and the like as used herein refers to copolymers as described above and having a density usually in a range of from about 0.926 grams per cubic centimeter to about 0.941 grams per cubic centimeter.

The term "oriented" is used herein to define a material which, when heated to an appropriate temperature above room temperature (for example 96°C), will have free shrink of 5% or greater in at least one linear direction.

The term "polyamide" refers to high molecular weight polymers having amide linkages along the molecular chain, and refers more specifically to synthetic polyamide such as various nylons.

All compositional percentages used herein are calculated on a "by weight" basis.

BRIEF DESCRIPTIONS OF THE DRAWINGS

Further details are given below with reference to the sole drawing figure where figure 1 is a schematic cross-section of a preferred embodiment of a multilayer film of the invention.

DESCRIPTIONS OF THE PREFERRED EMBODIMENTS

Referring specifically to the drawings, in figure 1, a schematic cross-section of the preferred embodiment of the coextruded multilayer oriented film of the invention is shown. Film structure is directed to a multilayer film having the generalized structure of A/B/C/B/A where A is an outer layer, B is an intermediate adhesive layer, and C is a core layer containing a barrier material. Preferably, the outer layers A each comprise about 35% of the total multilayer film thickness; the intermediate layers B each comprise about 10% of the film thickness; and the barrier layer C about 10% of the total film thickness. The total thickness of the multilayer film is preferably between about 0.5 and 2.0 mils, and more preferably between about .75 and 1.5 mils. Even more preferably, the multilayer film of the present invention is about 1 mil thick.

Preferably, core layer 10 is an ethylene vinyl alcohol copolymer. Core layer 10 is preferably between about .05 and 1 mil thick and more preferably about 0.1 mil thick. Thicknesses less than about .05 mils result in a very thin film with possible voids in the barrier material. Thicknesses greater than about 1 mil make the film difficult to stretch or rack, and also result in increased cost due to the expensive barrier component. A suitable EVOH is EVAL H commercially available from EVALCA.

Orienting EVOH to produce a heat shrinkable film has proven to be difficult. During the stretching or racking step for orienting such a film, the EVOH can sometimes develop voids. This phenomenon can result in some loss of oxygen barrier properties, which can affect, i.e. reduce the effective shelf life of food products packaged in EVOH film. The presence of voids in the EVOH layer can also result in discoloration of a food product, such as processed meat, and therefore reduce the appearance and market value of a packaged food item.

It is therefore desirable in certain applications to blend the EVOH of the core layer with between 1 and 20 percent of a polyamide resin. The polyamide may be a polymer or copolymer comprising polyamide comonomers. When such a blend is used, the EVOH preferably comprises between about 80% and 99% by weight of the blend, and the polyamide comprises between about 1% and 20% by weight of the blend. More preferably, the blend comprises about 90% by weight of an ethylene vinyl alcohol copolymer, and about 10% of a polyamide.

Intermediate layers 12 and 14 are preferably acid or acid anhydride-modified polymeric material which can bond the core layer 10 to the outer layers 16 and 18. This material preferably includes a graft copolymer of a polyolefin, such as polyethylene, or ethylene-ester copolymer substrate and an unsaturated carboxylic acid or acid anhydride, blended with a polyolefin, such as polyethylene, or ethylene-ester copolymer.

Outer layers 16 and 18 comprise a polymeric material which can be EBA, or a blend of EBA with ethylene alpha-olefin copolymers such as LLDPE and LMDPE. Preferred compositions of outer layers 16 and 18 are given below in table 1.

TABLE 1

	EBA (% By Weight)	LLDPE (% By Weight)	LMDPE (% By Weight)
Composition 1	100	-	-
Composition 2	50	25	25
Composition 3	25	50	25
Composition 4	10	50	40

It is preferred that EBA comprise at least about 10% of each of outer layers 16 and 18. In the blended compositions, the linear polymeric materials listed above may be used together or in the alternative, producing two and three component blends when combined with the EBA.

More preferably, outer layers 16 and 18 each comprise a three component blend of LLDPE, LMDPE, and EBA. These outer layers preferably include from about 40% to about 60% by weight of LLDPE, from about 20% to about 30% by weight of LMDPE, and from about 20% to about 30% by weight of EBA. Even more preferably, the outer layers 16 and 18 include about 50%, by weight, of a LLDPE, about 25%, by weight, of LMDPE, and about 25%, by weight, of EBA.

The EBA has a butyl acrylate (BA) content of preferably between about 0.5 and 19% by weight and more preferably about 2.5% by weight.

The film is preferably irradiated prior to orientation of the film. Orientation is done by racking or stretching the film at a racking ratio of from between about 3.0 and about 5.0 times the original dimensions of the film in the longitudinal (machine) and transverse directions.

EXAMPLE 1

A sample film was prepared by blending 50% of LLDPE (Escorene LL 3001.63), 25% LMDPE (Dowlex 2037) and 25% EBA having a butyl acrylate content of about 2.5%. About 1.5% (by weight of the blend) slip and anti-block agents were added to the blend. This outside blend layer was co-extruded with a core layer containing a blend of 90% EVOH (EVAL H) and 10% of a nylon 6/nylon 12 copolymer (Grillon CA-6), and an intermediate adhesive (Norchem Plexar 169).

The Escorene LL 3001.63 can be obtained from Exxon. This is an especially preferred LLDPE for use in this invention, and is a copolymer of ethylene and 1-hexene and has a density at 23°C of about 0.920 grams per cubic centimeter and a melt flow index of from about 0.7 to about 1.2 grams per ten minutes (as measured by ASTM-D-1238, E-28). LLDPE adds toughness to the film.

A preferred LMDPE is Dowlex 2037, also obtainable from Dow Chemical Company. This resin is a copolymer of ethylene and octene and has a density at 23°C of about 0.935 grams per cubic centimeter and a melt flow index of about 2.55 grams per ten minutes (ASTM-D-1238, E-28). The LMDPE imparts stiffness, i.e. high modulus, to the film without significantly sacrificing toughness. The high modulus characteristic of the film is especially desirable in form-fill-seal applications where the film is fed as a lay-flat film and then formed on a forming shoe into a tube.

The EBA of the outside blend layer was Norchem DNBA 714. This material has a density at 23°C of about 0.921 grams per cubic centimeter (ASTM D 1505) and a melt index (ASTM-D-1238) of about 3.2 grams per ten (10) minutes. The butyl acrylate content of this EBA is about 2.5% by weight. The crystalline melting point is about 109°C as determined by differential scanning calorimeter.

The EVOH of the core blend layer was EVAL H, available from EVAL Company of America and having an ethylene content of about 38% by weight and a melt index of about 1.5 grams/10 minutes. Other suitable EVOH resins include EVAL E, EVAL F, and EVAL K, as well as blends of the above, and preferably such resins or blends having a melt index of between about 1 to 4 grams per ten minutes (ASTM 1238). Grillon CA-6, available from Emser Industries, was blended with the EVOH. The Grillon CA-6 is a nylon copolymer having about 60% nylon 6 and about 40% nylon 12 by weight.

Although nylon 12 would be effective alone as a blending material in the core layer, this is a relatively expensive material. Nylon 6 alone would be effective as a blending material, but with some difficulty in processing. The particular blend employed proved to be very advantageous in providing an economical yet effective means for providing a core blend having the good barrier properties associated with EVOH, but with the processing and elongation advantages of nylon. Another suitable nylon copolymer is Grillon CR-9, having 20-30% nylon 6 and 70-80% nylon 12 by weight.

The intermediate adhesive material, Norchem Plexar 169, is a low density polyethylene-based anhydride-modified resin produced by Norchem. Other anhydride-modified adhesives such as CXA-E162 (duPont) can also be used as the intermediate adhesive.

The polymer melt from the coextrusion die was then cooled and cast into a solid tape which was irradiated with about 3 megarads of irradiation. The tape was then heated to about 114°C in an oven and blown into a bubble. The bubble was expanded to about 3.5 times its original dimensions in both the machine (longitudinal) and transverse directions, and then deflated and ply separated into single wound film rolls. The final film had a thickness of about one mil, and in addition to the shrink properties imparted by orientation, exhibited excellent toughness, good optics, burn out resistance, resistance to tear propagation, and heat sealability. The film also exhibited good abuse resistance and the necessary stiffness and lower tack required for packaging applications and was substantially free of voids in the EVOH/polyamide blend layer.

Test results for the sample film are listed below in Table 2.

TABLE 2

	Tensile at Break and 73°F (PSI)[1]	
Avg.[2]	Longitudinal	109.5x100
	Std. Dev.	4.5x100
	95% C.L.[3]	7.2x100
Avg.	Transverse	87.2x100
	Std. Dev.	1.2x100
	95% C.L.	1.9x100
	Elongation at Break and 73°F (%)[4]	
Avg.	Longitudinal	71.
	Std. Dev.	4.
	95% C.L.	6.
Avg.	Transverse	83.
	Std. Dev.	2.
	95% C.L.	3.
	Modulus at 73°F (PSI)[5]	
Avg.	Longitudinal	106.8x1000
	Std. Dev.	7.7x1000
	95% C.L.	12.3x1000
Avg.	Transverse	97.5x1000
	Std. Dev.	3.2x1000
	95% C.L.	5.1x1000
	Tear Propagation at 73°F (grams)[6]	
Avg.	Longitudinal	12.75
	Std. Dev.	0.50
	95% C.L.	0.80
Avg.	Transverse	18.00
	Std. Dev.	2.48
	95% C.L.	3.95
	Free Shrink (%)[7] at 220°F	
Avg.	Longitudinal	26.
	Std. Dev.	1.
	95% C.L.	1.
Avg.	Transverse	28.
	Std. Dev.	1.
	95% C.L.	1.

Free Shrink
at 240°F

Avg. Longitudinal	62.
Std. Dev.	1.
95% C.L.	2.
Avg. Transverse	58.
Std. Dev.	1.
95% C.L.	2.

Free Shrink
at 260°F

Avg. Longitudinal	69.
Std. Dev.	1.
95% C.L.	2.
Avg. Long.	63.
Std. Dev.	0.
95% C.L.	0.

Shrink Properties
at 220°F
Shrink Force (lbs)[8]

Avg. Longitudinal	0.353
Std. Dev.	0.009
95% C.L.	0.015
Avg. Transverse	0.489
Std. Dev.	0.021
95% C.L.	0.033

Shrink Tension (PSI)[9]

Avg. Longitudinal	332.66
Std. Dev.	11.88
95% C.L.	18.90
Avg. Transverse	436.32
Std. Dev.	27.32
95% C.L.	43.47

Shrink Properties
at 240°F
Shrink Force (lbs.)

Avg. Longitudinal	0.395
Std. Dev.	0.026
95% C.L.	0.041
Avg. Transverse	0.453
Std. Dev.	0.020
95% C.L.	0.032

Shrink Tension (PSI)

Avg.	Longitudinal	373.34
	Std. Dev.	23.56
	95% C.L.	37.49
Avg.	Transverse	393.86
	Std. Dev.	21.24
	95% C.L.	33.79

Shrink Properties at 260°F
Shrink Force (lbs)

Avg.	Longitudinal	0.385
	Std. Dev.	0.035
	95% C.L.	0.055
Avg.	Transverse	0.481
	Std. Dev.	0.008
	95% C.L.	0.012

Shrink Tension (PSI)

Avg.	Longitudinal	363.01
	Std. Dev.	31.58
	95% C.L.	50.24
Avg.	Transverse	450.48
	Std. Dev.	12.63
	95% C.L.	20.08

Optical Properties
at 73°F
Haze (%)[10]

Avg.		4.1
	Std. Dev.	0.5
	95% C.L.	0.9

Clarity (%)[11]

Avg.		45.5
	Std. Dev.	9.2
	95% C.L.	14.7

Gloss (45°)[12]

Avg.		85.
	Std. Dev.	2.
	95% C.L.	3.

Oxygen Transmission[13]
at 73°F, 0% RH

Sample 1	3.7
Sample 2	1.8
Sample 3	2.2

The following footnotes apply to Table 2.

1. ASTM D882-81.
2. All values in Table 2 are averages obtained from four (4) replicate measurements.
3. C.L. is Confidence Limit - e.g., if the reported average value was 10 and the 95% C.L. was 2, then if one hundred replicate readings were made, 95 of them would have a value between 8 and 12, inclusive.
4. ASTM D-882-81.
5. ASTM D-882-81.
6. ASTM D-1938-79.
7. ASTM D-2732-70 (reapproved 1976).
8. ASTM D-2838-81 (shrink free = shrink tension x film thickness in mils x 1000)
9. ASTM D-2838-81
10. ASTM D-1003-61 (reapproved 1977)
11. ASTM D-1746-70
12. ASTM D-2457-70 (reapproved 1977)

~~Obvious modifications to the invention as described may be made by one skilled in the art without departing from the spirit and scope of the claims as presented below.~~

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An oriented multilayer film comprising:

(a) a core layer comprising an ethylene vinyl alcohol copolymer;

(b) two interior layers each comprising an adhesive polymeric material; and

(c) two outer layers each comprising polymeric material selected from the group consisting of ethylene butyl acrylate copolymer, and blends consisting at least 10% of said ethylene butyl acrylate copolymer blended with ethylene alpha-olefin copolymer.

2. The film of claim 1 wherein said ethylene butyl acrylate copolymer comprises from 0.5%, by weight, to 19%, by weight of butyl acrylate derived units.

3. The film of claim 2 wherein said ethylene butyl acrylate copolymer comprises about 2.5%, by weight, of butyl acrylate derived units.

4. The film of any preceding claim which has been irradiated to cross-link the respective layers.

5. The film of claim 4 which has been cross-linked with from three megarads to thirteen megarads of irradiation.

6. The film of claim 4 which has been cross-linked with about three megarads of irradiation.

7. The film of any preceding claim which has been oriented by racking at a racking ratio of from 3.0 to 5.0 in both the longitudinal and transverse directions.

8. The film of claim 7 which has been oriented by racking at a racking ratio of about 3.5 in both the longitudinal and transverse directions.

9. The film of any preceding claim wherein the two outer layers are cross-linked and each comprise between 10% and 100% of an ethylene butyl acrylate copolymer, blended with between 0% and 90% linear low density polyethylene.

10. The film of any one of claims 1 to 8 wherein the two outer layers are cross-linked and each comprise between 10% and 100% ethylene butyl acrylate copolymer blended with between 0% and 90% linear medium density polyethylene.

11. A method of making an oriented multilayer film comprising:

(a) coextruding a core layer comprising an ethylene vinyl alcohol copolymer, two intermediate layers of an adhesive material, and two outer layers each comprising polymeric material selected from the group consisting of ethylene butyl acrylate copolymer, and blends comprising at least 10% of said ethylene butyl acrylate copolymer blended with ethylene alpha-olefin copolymer;

(b) rapidly cooling the coextruded film;

(c) collapsing the cooled film;

(d) heating the collapsed film; and

(e) stretching the orienting the heated film.

12. The method according to claim 11 wherein, before heating the collapsed film, the film is cross-linked by irradiating the film with between 3 and 13 megarads of irradiation.

13. The method of claim 11 or 12 wherein the collapsed film is heated to a temperature between 105°C and 120°C.

14. The method of claim 13 wherein the coextruded film is cooled to about room temperature.

15. The method according to claim 13 or 14 wherein the heated film is oriented by racking at a racking ratio of from about 3.0 to about 5.0 in both the longitudinal and transverse directions.

16. The method according to claim 13 or 14 wherein the heated film is oriented by racking at a racking ratio of about 3.5 in both the longitudinal and transverse directions.

17. The method according to any one of claims 11 to 15 further comprising the step of reheating the oriented film to a temperature near its orientation temperature to provide a substantially non-shrinkable film.

18. An oriented multilayer film according to claim 1, or a method of making a said film according to claim 11, substantially as hereinbefore described with reference to the Examples.

DATED this 3rd day of August 1990.

W.R. GRACE & CO.-CONN.
By Its Patent Attorneys
DAVIES & COLLISON

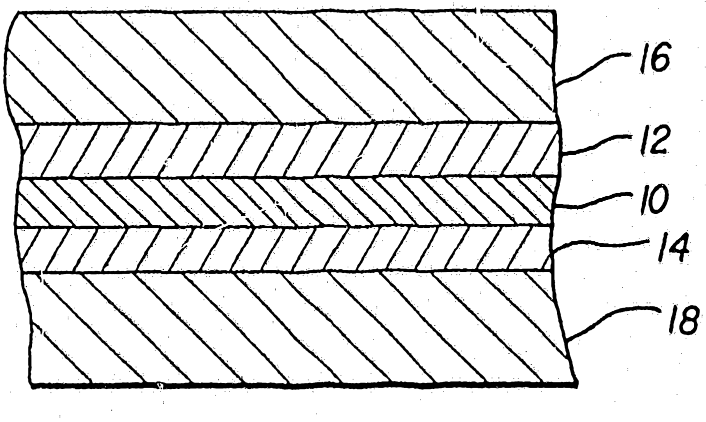

FIG. 1