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(71) Applicant: ADOLPH COORS COMPANY [US/US]; 12th and East Streets, Golden, CO 80401 (US).

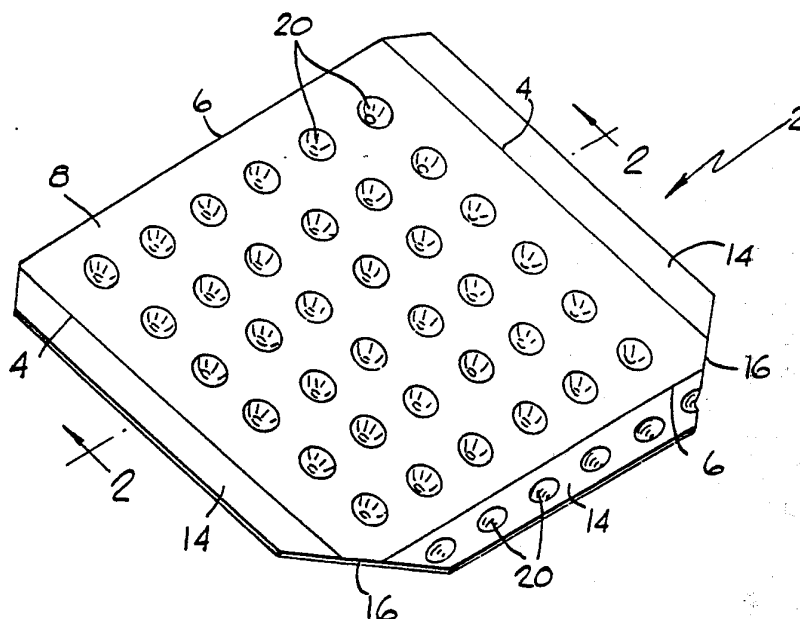
(72) Inventors: FRENKEL, Robert, L. ; 6177 South Locust Street, Englewood, CO 80111 (US). WEITS, Ferdinand ; 5155 West 68th Avenue, 3, Westminster, CO 80033 (US). TODOR, John, S., Jr. ; 6771 Beach Drive, Arvada, CO 80004 (US). MITCHELL, G., Robert ; 21900 Rinconada Road, Morrison, CO 80465 (US).

(74) Agents: KLAAS, Bruce, G. et al.; Klaas & Law, 738 Pearl Street, Denver, CO 80203 (US).

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Published*With international search report.
With amended claims.*

(54) Title: SLIP PALLET WITH A CUSHIONING EFFECT



(57) Abstract

A slip pallet (2) formed as a square or rectangular sheet of a plastic material having a central body portion (81) on which a load, such as an array of loaded cardboard boxes, is supported and a plurality of lip portions (14) extending outwardly and upwardly from the central body portion (81) wherein at least the central body portion (81) is provided with a plurality of spaced apart dimples (20) formed in the top surface of the central body portions so that a plurality of spaced apart projections (22) extend downwardly from the bottom surface of the central body portion to provide a cushioning support for the load and wherein at least a portion of each projection (22) is a segment of a sphere.

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- 1 -

SLIP PALLET WITH A CUSHIONING EFFECT

Field of the Invention

05 This invention relates generally to pallets for
use in supporting loads during shipment or storage of
materials and more specifically to a slip pallet with a
cushioning effect for a load supported thereon, such as
an array of cardboard boxes holding beverage
containers.

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Background of the Invention

Plastic slip pallets, such as those described in
U.S. Patent Nos. 3,776,145; 3,850,116 and 4,042,127,
have been used for ease of storage and handling of a
15 load of boxes supported thereon in a warehouse, a
manufacturing facility and during shipment by rail or
by truck. A plastic slip pallet has a lip means
adapted to be gripped by a lift truck and held in
tension while slipping a platen, or spatula-like
20 member, of the lift truck under the plastic slip
pallet. The platen then lifts the plastic slip pallet
and the boxes supported thereon and transports them to
a desired location where the slip pallet and the boxes
are pushed off the platen. A recent development in
25 plastic slip pallets is disclosed in U.S. Patent No.
4,507,348 to Nagata et al. The slip pallet in Nagata
et al. comprises a support member comprising an

- 2 -

interlining core sandwiched between and secured to two liners and has a flap portion continuous to the support member through a bending portion in which the interlining core and the two liners are compressed together and fused into one continuous layer to provide a hinge effect. While the corrugated slip pallet of Nagata et al. does provide a cushioning effect, it is expensive to manufacture.

10 Brief Description of the Invention

 This invention provides a slip pallet with a cushioning effect comprising a sheet of single ply plastic material having a plurality of spaced apart dimples formed therein to provide a cushioning effect while retaining its load supporting properties.

 In the preferred embodiment of the invention, the slip pallet is formed from a single ply of plastic material, such as polypropylene or high density polyethylene, having a thickness of between about 0.040 and 0.125 inch and a stiffness measurement in the range of 120,000 to 180,000 psi as determined by ASTM specification D 790B. The slip pallet has opposite pairs of generally parallel edges to define a central body portion for supporting a load, such as an array of cardboard boxes holding filled beverage containers. The central body portion originally has a generally planar top surface and a generally planar bottom surface. A plurality of spaced apart dimples are formed downwardly from the top surface so as to form a plurality of spaced apart projections extending downwardly from the bottom surface. The dimples are generally spherical segments having an outer radius of between about 0.1875 and 0.563 inch and a depth from the bottom surface to the crest of the dimple of between about 0.094 and 0.281 inch so that the

- 3 -

projections formed thereby have outer surfaces which are segments of a sphere. The projections have a density of between about 0.75 to 2.00 per square inch and a surface area of between about 60 to 95 per cent of the entire surface area of the top surface. At least one integral lip portion extends outwardly and upwardly from one of the edges. Suitable materials for forming the plastic slip pallet are set forth in U.S. Patent 3,776,145 from Column 8, Line 43, to Column 9, Line 15. The preferred embodiment of this invention uses a copolymer of polypropylene marketed by Hercules Powder Co. of Wilmington, Delaware, under the trade designation pro-fox^R 8623.

Brief Description of the Drawings

An illustrative and presently preferred embodiment of the invention is shown in the accompanying drawings in which:

Fig. 1 is a perspective view of the preferred embodiment of the invention;

Fig. 2 is a cross-sectional view taken on the line 2-2 of Fig. 1;

Fig. 3 is an enlarged cross-sectional view similar to a portion of Fig. 2 but with no load supported thereon;

Fig. 4 is an enlarged cross-sectional view similar to Fig. 3 but with a load supported thereon;

Fig. 5 is an enlarged cross-sectional view of another modification of the invention but with no load supported thereon; and

Figs. 6 and 7 are illustrations for use with the formula set forth in the specification.

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- 4 -

Detailed Description of the Invention

The preferred embodiment of the invention is illustrated in the drawing and comprises a slip pallet 2 formed from a single ply of plastic material such as polypropylene or a high density polyethylene or other materials having similar characteristics. The plastic material has a thickness between about 0.040 and 0.125 inch and a stiffness measurement in the range of 120,000 to 180,000 psi and preferably about 160,000 psi as determined by ASTM specification D 790B. The slip pallet 2 has opposite pairs of generally parallel edges 4 and 6 to define a central body portion 8 originally having a generally planar top surface 10 and a generally planar bottom surface 12. Integral lip portions 14 are formed in a conventional manner and extend outwardly and upwardly from the generally parallel edges 4 and one of the generally parallel edges 6. If desired, the slip pallet 2 may have diagonally cut corners 16 preventing edges 4 and 6 from intersecting.

A plurality of dimples 20 are formed in the top surface 10 so that a plurality of projections 22 extend downwardly from the bottom surface 12. The dimples 20 have an inner surface 24 that is a segment of a sphere and the projections 22 have an outer surface 26 which is a segment of a sphere. The radius of the outer surface 26 is between about 0.1875 and 0.563 inch and the projections 22 have a depth, measured from the bottom surface 12 to the crest of the projection 22, of between about 0.094 and 0.281 inch. The centers for the spheres of the outer surfaces 26 are located above the top surface 10 a distance equal to one-half of the radius minus the thickness between the planar portions of the top and bottom surfaces. In accordance with this invention, the depth of each projection 22 from the bottom surface 12 will be about one-half the radius

- 5 -

of the outer surface 26. The dimples 20 have centers which are spaced apart a distance of between about 0.75 and 1.50 inches and have a density of between about 0.75 and 2.00 per square inch and a surface area of
05 between about 65 and 90 per cent of the top surface 10. As illustrated in Fig. 1, the dimples 20 preferably extend in spaced apart parallel rows which rows are parallel to the opposite parallel edges 4 and perpendicular to the opposite parallel edges 6. There
10 are no dimples 20 in the lip portions 14 integral with the opposite edge portions 4, but there are dimples in the lip portion 14 integral with the one edge 6.

In Fig. 3, there is illustrated one dimple 20 of a central body portion 8 wherein the thickness of the
15 plastic sheet between dimples 20 is about 0.051 inch. The outer surface 26 of each of the dimples 20 has a radius of about 0.250 inch and are on spaced apart centers of about 1.00 inch. The center for the radius is located about 0.074 inch above the top surface 10.
20 Each projection 22 has a depth of about 0.125 inch from the bottom surface 12 to the crest of the projection 22. In Fig. 4, there is illustrated the same dimple 20 when a load of about 6,000 pounds per square foot is being supported by the central body portion 8. The
25 depth of the projection 22 has been decreased by about 0.042 inch so that the dimple 20 still has a depth of about 0.083 inch and is fully capable of supporting greater loads. A slip pallet 2 having the dimples 20 as described above is capable of supporting loads up to
30 about 10,000 pounds per square foot and still providing a cushioning effect.

In some instances, the use of a slip pallet 2 as illustrated in Figs. 1 - 4 present some problems in that there is a tendency for the slip pallet 2 to slide
35 when being supported on a platen as illustrated in U.S.

- 6 -

Patent No. 3,776,145. In Fig. 5, there is illustrated a slip pallet 30 where a portion 32 of the outer surface 24 is relatively planar so that the portion 34 of the inner surface 26 is also relatively planar so as to provide a greater surface area for contact with the surface of the platen so as to provide greater frictional forces to prevent the sliding of the slip pallet 30 on the platen. The arcuate outer surface 36 is a frustum of a sphere having a radius of between about 0.185 and 0.563 inch and wherein the center of the sphere is located a distance above the top surface equal to one-half the radius minus the thickness between the planar portions of the top and bottom surfaces. The portion 32 has a depth of between about 0.061 and 0.248 inch and the planar surface 32 has a diameter of between about 0.1875 and 0.563 inch. In a preferred embodiment of the dimple of Fig. 5, the surface 32 has a diameter of about 0.25 inch and a depth of 0.092 inch. The arcuate outer surface 36 has a radius of about 0.25 wherein the center 38 of the sphere is located 0.074 inch above the bottom surface 12.

When the slip pallets of this invention are used in the shipment by truck or rail of filled beverage containers packed in boxes, the weight on each slip pallet is between about 2,100 and 2,600 pounds per square foot. In normal practice, one slip pallet is loaded on top of another slip pallet so that the load on the bottom slip pallet is between about 4,200 and 5,200 pounds per square foot. During shipment, the truck or rail car may periodically place additional loads on the slip pallets. During such additional loads, the projections will be depressed in an amount relative to the additional load, but after the additional load has been removed, the projections will

- 7 -

resile to their configuration prior to the additional load.

05 The above-described preferred embodiment is based on a load on the bottom slip pallet of between about 4,200 and 5,200 pounds per square foot. The specific construction of the slip pallet with dimples for any desired load may be calculated in the following manner. The conventional formula for the deflection of a sphere, illustrated in Fig. 6, wherein the dimple has been inverted for explanation purposes only, is:

$$\text{deflection } y = \frac{APR^2}{16TD}$$

$$\text{where } D = \frac{Et^3}{12(1-\nu)}$$

R = outer radius of the dimple

where ν = poissons ratio

A - is from the following table

α	0	1	2	3	4	5	6
A	1	.996	.935	.754	.406	.321	.210

$$\text{wherein } \alpha = 2 \sqrt[4]{3(1-\nu)} \times \sqrt{h/t}$$

E = Young's modulus of elasticity

t = final thickness

where final thickness $t = \text{initial thickness } (F) \times \left(\frac{l}{c}\right)^2$

$$t = \left[(F) \frac{(2) \sqrt{(R^2 - d^2)}}{D \cos^{-1} d/R} \right]^2$$

where

F = flat sheet thickness

R = outer radius of the dimple

d = distance R is spaced from centerline of F

l = diameter of the bottom portion s of the segment of the sphere

the c = circumference of the bottom portion s of segment of the sphere

- 8 -

for a semi-sphere $d = 0$ and $D = 2R$

$$t = (F) \left[\frac{2R}{D (\pi/2)} \right]^2$$

$$= \frac{4F R^2}{D^2 \left(\frac{\pi}{2} \right)^2} = \left(\frac{F}{\frac{\pi}{2}} \right)^2$$

The conventional formula for P which the load distribution, illustrated in Fig. 7, is:

$$P = \frac{\text{load lbs/ft}^2}{(12"/C)(12"/C)} = \frac{\text{load } (C^2)}{144} = \text{lbs./dimple}$$

where C is space between centers of the dimple.

While illustrative and presently preferred embodiments of the invention have been described in detail herein, it is to be understood that the inventive concepts may be otherwise variously embodied and employed and that the appended claims are intended to be construed to include such variations except insofar as limited by the prior art.

WHAT IS CLAIMED IS:

1. A shock absorbing pallet comprising:
 - a sheet of single ply plastic material having a thickness of between about 0.025 and 0.125 of an inch and a stiffness measurement in the range of between about 120,000 and 180,000 psi as determined by ASTM specification D 790B;
 - said sheet having opposite pairs of parallel edges defining a central body portion for supporting a load;
 - an integral lip portion extending outwardly and upwardly from at least one of said edges;
 - said central body portion having a top surface and a bottom surface;
 - a plurality of spaced apart dimples in said top surface forming a plurality of spaced apart projections on said bottom surface thereof so that said dimples will provide a cushioning effect whenever an additional force is placed on said load; and
 - said top and bottom surfaces being generally planar except for said dimples and projections.
2. A pallet as in claim 1 wherein:
 - said at least one lip portion has a top surface and a bottom surface; and
 - a plurality of spaced apart dimples in said top surface of said at least one lip portion forming a plurality of spaced apart projections on said bottom surface thereof.

- 10 -

3. A pallet as in claim 1 wherein:
said plurality of spaced apart dimples extend in spaced apart parallel rows having the same number of dimples and which rows are parallel to one pair of said opposite pairs of parallel edges and perpendicular to the other pair of said opposite pairs of parallel edges.
4. A pallet as in claim 3 wherein:
said at least one lip portion has a top surface and a bottom surface; and
a plurality of spaced apart dimples in said top surface of said at least one lip portion forming a plurality of spaced apart projections on said bottom surface thereof.
5. A pallet as in claim 4 wherein:
each of said dimples in said at least one lip portion is in alignment with one of said spaced apart parallel rows of dimples.
6. A pallet as in claim 5 wherein said at least one lip portion comprises:
at least three lip portions.
7. A pallet as in claim 1 wherein:
each of said dimples having a shape corresponding to a segment of a sphere having one portion thereof generally parallel to said top surface.
8. A pallet as in claim 7 wherein:
said plurality of dimples are located on spaced apart centers of between about 0.750 and 1.50 inches with each circular segment thereof

- 11 -

having a radius of between about 0.1875 and 0.563 inch;

each projection has a depth of between about 0.094 and 0.281 inch from said bottom surface to the crest of said projection; and

said dimples have a density of between about 0.75 and 2.00 per square inch.

9. A pallet as in claim 8 wherein:

the surface areas of the outer surfaces of said projections comprises between about 60 and 95 per cent of the surface area of said top surface of said central body portion.

10. A pallet as in claim 1 wherein:

each of said projections having a shape corresponding to a frustum of a sphere wherein the planes forming said frustum are parallel to said bottom surface.

11. A pallet as in claim 1 and formed in accordance with the following formula:

$$\text{deflection } y = \frac{APR^2}{16TD}$$

$$\text{where } D = \frac{Et^3}{12(1-\nu)}$$

R = outer radius of the dimple

where ν = poissons ratio

A - is from the following table

α	0	1	2	3	4	5	6
A	1	.996	.935	.754	.406	.321	.210

$$\text{wherein } \alpha = 2 \sqrt[4]{3(1-\nu)} \times \sqrt{h/t}$$

E = Young's modulus of elasticity

t = final thickness

- 12 -

where final thickness t = initial thickness $(F) \times \left(\frac{l}{c}\right)^2$

$$t = \left[(F) \frac{(2) \sqrt{(R^2 - d^2)}}{D \cos^{-1} d/R} \right]^2$$

where

F = flat sheet thickness

R = outer radius of the dimple

d = distance R is spaced from centerline of F

l = diameter of the bottom portion of the segment of the sphere

the c = circumference of the bottom portion of the segment of the sphere

for a semi-sphere $d = 0$ and $D = 2R$

$$\begin{aligned} t &= (F) \left[\frac{2R}{D (\pi/2)} \right]^2 \\ &= \frac{4F R^2}{D^2 \left(\frac{\pi}{2}\right)^2} = \left(\frac{F}{\frac{\pi}{2}}\right)^2 \end{aligned}$$

The conventional formula for P which the load distribution, illustrated in Fig. 7, is:

$$P = \frac{\text{load lbs/ft}^2}{(12"/C)(12"/C)} = \frac{\text{load } (C^2)}{144} = \text{lbs./dimple}$$

where C is space between centers of the dimple.

AMENDED CLAIMS

[received by the International Bureau
on 28 May 1990 (28.05.90);
original claims 1, 3, 6, 7, 9 and 11 amended;
other claims unchanged (4 pages)]

1. A shock absorbing pallet comprising:
 - a sheet of single ply plastic material having a thickness of between about 0.025 and 0.125 of an inch and a stiffness measurement in the range of between about 120,000 and 180,000 psi as determined by ASTM specification D 790B;
 - said sheet having opposite pairs of parallel edges defining a central body portion for supporting a load;
 - at least one integral lip portion extending outwardly and upwardly from at least one of said edges;
 - said central body portion having a top surface and a bottom surface;
 - a plurality of spaced apart dimples in said top surface forming a plurality of spaced apart projections on said bottom surface thereof so that said dimples will provide a cushioning effect whenever an additional force is placed on said load; and
 - said top and bottom surfaces being generally planar except for said dimples and projections.
2. A pallet as in claim 1 wherein:
 - said at least one lip portion has a top surface and a bottom surface; and
 - a plurality of spaced apart dimples in said top surface of said at least one lip portion forming a plurality of spaced apart projections on said bottom surface thereof.

3. A pallet as in claim 1 wherein:
said plurality of spaced apart dimples extend in spaced apart parallel rows having the same number of dimples and which rows are parallel to one pair of said opposite pairs of parallel edges and perpendicular to the other pair of said opposite pairs of parallel edges.
4. A pallet as in claim 3 wherein:
said at least one lip portion has a top surface and a bottom surface; and
a plurality of spaced apart dimples in said top surface of said at least one lip portion forming a plurality of spaced apart projections on said bottom surface thereof.
5. A pallet as in claim 4 wherein:
each of said dimples in said at least one lip portion is in alignment with one of said spaced apart parallel rows of dimples.
6. A pallet as in claim 1 wherein said at least one lip portion comprises:
at least three lip portions.
7. A pallet as in claim 1 wherein:
each of said projections having an outer surface having a shape corresponding to a segment of a sphere having one portion thereof generally parallel to said top surface.
8. A pallet as in claim 7 wherein:
said plurality of dimples are located on spaced apart centers of between about 0.750 and 1.50 inches with each circular segment thereof

having a radius of between about 0.1875 and 0.563 inch;

each projection has a depth of between about 0.094 and 0.281 inch from said bottom surface to the crest of said projection; and

said dimples have a density of between about 0.75 and 2.00 per square inch.

9. A pallet as in claim 8 wherein:

the surface areas of the outer surfaces of said projections comprise between about 60 and 95 per cent of the surface area of said top surface of said central body portion.

10. A pallet as in claim 1 wherein:

each of said projections having a shape corresponding to a frustum of a sphere wherein the planes forming said frustum are parallel to said bottom surface.

11. A pallet as in claim 1 and formed in accordance with the following formula:

$$\text{deflection } y = \frac{APR^2}{16\pi D}$$

$$\text{where } D = \frac{Et^3}{12(1-\nu)}$$

R = outer radius of the dimple

where ν = poissons ratio

A - is from the following table

α	0	1	2	3	4	5	6
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$$\text{wherein } \alpha = 2 \sqrt[4]{3(1-\nu)} \times \sqrt{h/t}$$

E = Young's modulus of elasticity

t = final thickness

where final thickness t = initial thickness $(F) \times \left(\frac{\ell}{c}\right)^2$

$$t = \left[(F) \frac{(2) \sqrt{(R^2 - d^2)}}{D \cos^{-1} d/R} \right]^2$$

where

F = flat sheet thickness

R = outer radius of the dimple

d = distance R is spaced from centerline of F

l = diameter of the bottom portion of the segment of the sphere

c = circumference of the bottom portion of the segment of the sphere

for a semi-sphere $d = 0$ and $D = 2R$

$$t = (F) \left[\frac{2R}{D (\pi/2)} \right]^2$$

$$= \frac{4FR^2}{D^2 \left(\frac{\pi}{2}\right)^2} = \left(\frac{F}{\frac{\pi}{2}}\right)^2 \quad ; \text{ and}$$

$$P = \frac{\text{load lbs/ft}^2}{(12"/C)(12"/C)} = \frac{\text{load } (C^2)}{144} = \text{lbs./dimple}$$

where C is space between centers of the dimple.

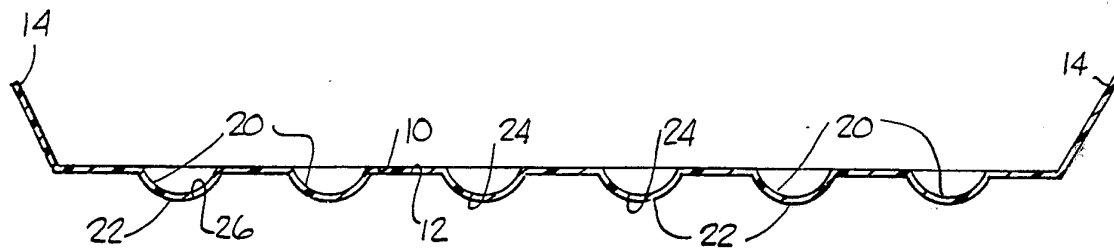
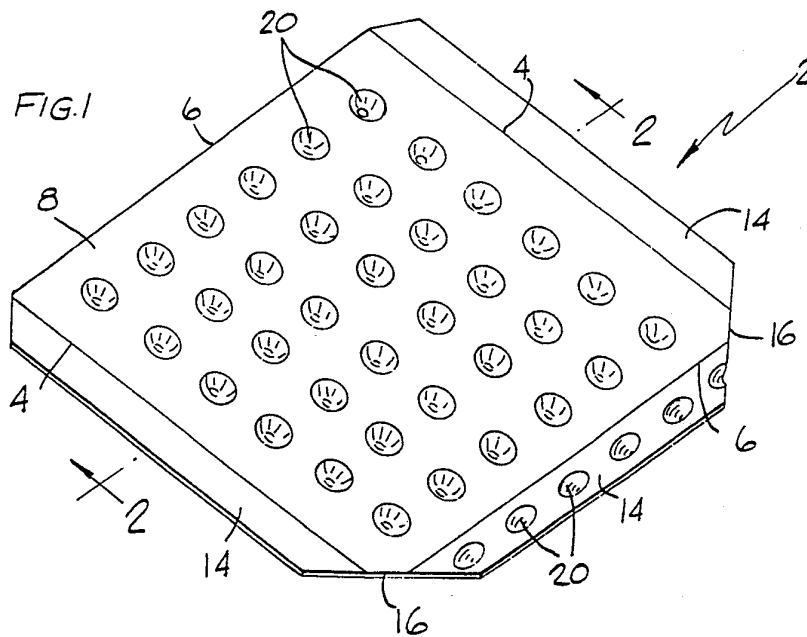


FIG. 2

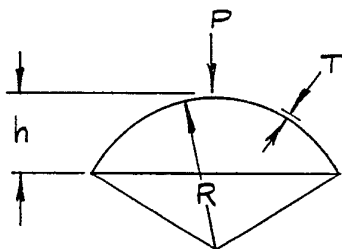


FIG. 6

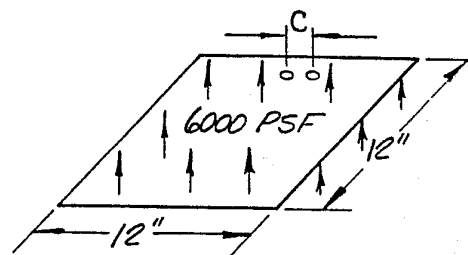


FIG. 7

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FIG. 3

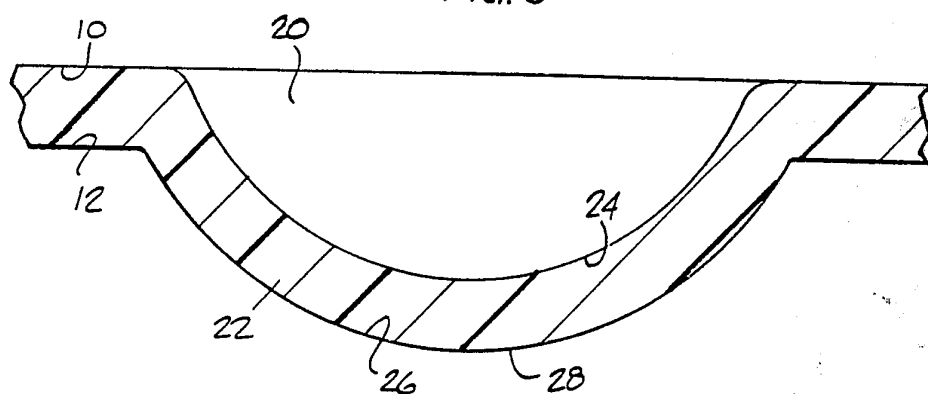


FIG. 4

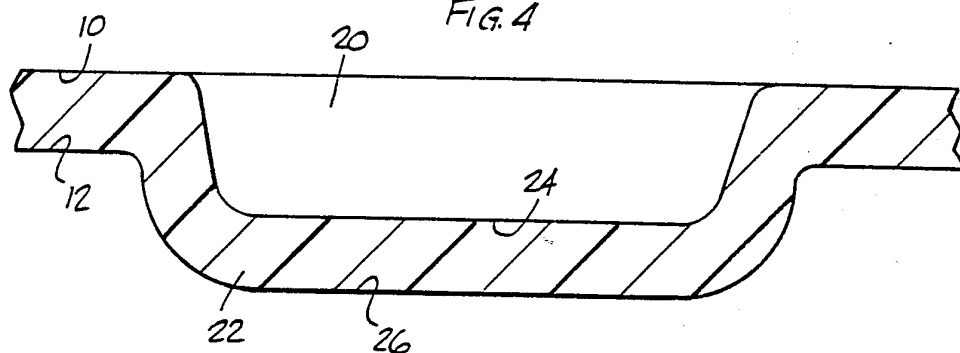
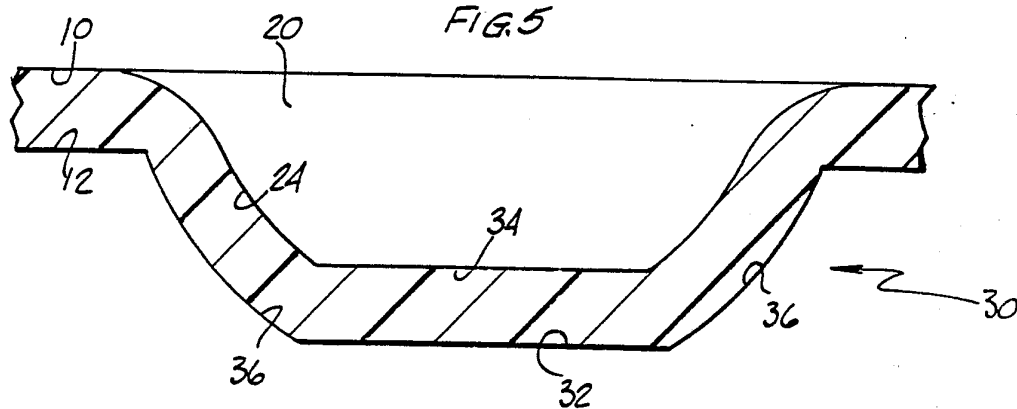


FIG. 5



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US90/00515

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC (5) B65D 19/00 U.S. CL. 10%/53.3;248/346,633;206/593																													
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border: 1px solid black;">Classification System</th> <th style="border: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top;">U.S.</td> <td style="border: 1px solid black;">108/901,51.1,5.3.3,55.3,57.1;248/346,633;206/593,594,585,591</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	U.S.	108/901,51.1,5.3.3,55.3,57.1;248/346,633;206/593,594,585,591																							
Classification System	Classification Symbols																												
U.S.	108/901,51.1,5.3.3,55.3,57.1;248/346,633;206/593,594,585,591																												
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border: 1px solid black;">Category *</th> <th style="width: 60%; border: 1px solid black;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%; border: 1px solid black;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 3,776,145 (ANDERSON) 04 DECEMBER 1973 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 3,850,116 (MACKES) 26 NOVEMBER 1974 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 4,042,127 (BROSSIS) 16 AUGUST 1977 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 4,507,348 (NAGATA) 26 MARCH 1985 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 3,231,454 (WILLIAMS) 25 JANUARY 1966 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 3,892,902 (ILUKOWICZ) 01 JULY 1975 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">U.S., A, 3,199,468 (SULLIVAN) 10 AUGUST 1985 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">Y</td> <td style="border: 1px solid black;">D.E, A, 2,625,346 (STRANGELAND) 15 DECEMBER 1977 See entire document</td> <td style="border: 1px solid black; text-align: center;">1-12</td> </tr> </table>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	Y	U.S., A, 3,776,145 (ANDERSON) 04 DECEMBER 1973 See entire document	1-12	Y	U.S., A, 3,850,116 (MACKES) 26 NOVEMBER 1974 See entire document	1-12	Y	U.S., A, 4,042,127 (BROSSIS) 16 AUGUST 1977 See entire document	1-12	Y	U.S., A, 4,507,348 (NAGATA) 26 MARCH 1985 See entire document	1-12	Y	U.S., A, 3,231,454 (WILLIAMS) 25 JANUARY 1966 See entire document	1-12	Y	U.S., A, 3,892,902 (ILUKOWICZ) 01 JULY 1975 See entire document	1-12	Y	U.S., A, 3,199,468 (SULLIVAN) 10 AUGUST 1985 See entire document	1-12	Y	D.E, A, 2,625,346 (STRANGELAND) 15 DECEMBER 1977 See entire document	1-12
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>																													
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: 1px solid black; vertical-align: top;"> Date of the Actual Completion of the International Search <div style="text-align: center; font-weight: bold;">19 MARCH 1990</div> International Searching Authority <div style="text-align: center;">ISA/US</div> </td> <td style="width: 50%; border: 1px solid black; vertical-align: top;"> Date of Mailing of this International Search Report <div style="text-align: center; font-weight: bold; font-size: 1.2em;">04 MAY 1990</div> <div style="text-align: center;"> Signature of Authorized Officer PETER A. ASCHENBRENNER </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center; font-weight: bold;">19 MARCH 1990</div> International Searching Authority <div style="text-align: center;">ISA/US</div>	Date of Mailing of this International Search Report <div style="text-align: center; font-weight: bold; font-size: 1.2em;">04 MAY 1990</div> <div style="text-align: center;"> Signature of Authorized Officer PETER A. ASCHENBRENNER </div>																									
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	U.S., A, 3,545,249 (BROWN) 08 DECEMBER 1970 See entire document	1-12
A	U.S., A, 4,562,718 (DUNK) 07 JANUARY 1986 See entire document	1-12