

Description

The present invention is related to movable insulation, and more specifically to expandable and contractable panel material formed of a unitary row of superimposed collapsible elongate hollow cells, of a flexible material, as for example a thin film plastic material.

With the advent of the energy shortages experienced over the last decade, there has been a renewed interest in energy conservation applications related to heat gains and losses through poorly insulated wall areas, such as windows and the like. One of the basic tenets of passive solar energy saving designs for building is that large generally south facing windows can be used to gain heat during sunny winter days. However, large windows are also responsible for heat loss during cold winter nights due to re-radiation of the heat from the interior of the house through the windows to the colder exterior. On the other hand, during hot summers, it is desirable to keep the heat from the sunlight during the day out of the interior of the house and to allow the heat in the house to radiate to the outside during the nights. Therefore, in order to take optimum advantage of the heating and cooling cycles of the sun or absence thereof during day and night periods, it is necessary to be able to move insulation in place over the windows or to retract it at appropriate times to allow or prohibit the transfer of heat through the windows, as desired. This need for movable insulation panels has resulted in a renewed interest in the use of honeycomb or stacked cell structured panels for movable insulation purposes since they contain numerous individual dead air space cells and are readily expandable and contractable. However, it is also necessary to have a material that reflects sunlight and is able to maintain its effectiveness, shape, structural rigidity and appearance through wide ranging temperature variations and over long periods of use. During hot summer days when the panel is in place over the window, temperatures can reach well over 100 degrees F (38°C). Alternatively, on cold winter nights, the temperatures can be quite low.

In other kinds of movable insulation structures, it has been found that a thin film polyester plastic material, commonly known by the trademark Mylar, has suitable characteristics for movable insulation applications. It can withstand the temperature variations required, reflective coatings can be applied to the surfaces thereof, it has the required longevity, and it is relatively inexpensive. However, past efforts to fabricate cellular movable insulation panels from thin flexible material, as for example polyester or Mylar material, have left much to be desired. For example, it has been found to be quite

difficult to fabricate on a mass production basis clean cut, uniform and neat panels with no wrinkles or warps to detract from the appearance thereof or to interfere with the insulating function of the panels. Further, mechanical folds and creases in the plastic film tend to lose their sharpness and sag or become rounded over time. The failures are particularly troublesome when the material is subject to high temperatures during hot summer applications, since the molecular bias of the plastic film material is toward the flat configuration of which it was manufactured. Prior attempts to set the folds or creases on the edges by pressure and heating have not been successful because these methods cause internal stresses that result in warps and wrinkles. Further, prior art attempts at stacking adjacent tubular layers of the thin film plastic material to form the panels have also been generally unsatisfactory in that they result in wrinkles and warps, and uneven lines. Some prior attempts have also included exceedingly cumbersome machinery having many strips of material running simultaneously.

A folding screen formed of cells having base and overlying portions is disclosed in FR-A-1568745. This screen is intended for use in a collapsible door construction and does not have pronounced folds. A prior proposal for an insulating panel is shown in US-A-4019554 and corresponding Reissue patent No. 30254. This panel comprises a row of complete tubes stuck together along their length and having folds to allow the panel to collapse. In this construction the folds are natural crease lines of a non-permanent nature; their presence is due only to the fact that the tube is originally supplied in flat lengths. In the completed panel or curtain the tubes have essentially parallel side surfaces, the folds having no significant influence on the shape of the panel. In FR-1 568 745 the fold lines are specifically said to be not significantly pronounced and their effect is to give an ogival shape to the cell cross-section.

It is an object of the present invention to provide an expandable and contractable panel that is long lasting, relatively inexpensive, and has a neat, clean cut appearance with no wrinkles or warps that detract from its appearance or interfere with its function.

It is also an object of the present invention to provide the expandable and contractable movable insulation panel material fabricated from a thin flexible material, e.g. polyester material, that is effective for insulation and heat reflection when expanded into position over a window or other opening.

According to the present invention there is provided a panel made of expandable and contractable panel material formed of a unitary row of

superimposed collapsible elongate hollow cells secured together to form a unitary stack, each cell comprising a base strip portion continuous across its width between its front and back lateral edges, and integral overlying strip portions folded respectively along the length of the cell at the opposite lateral edges of the base strip portion over one side of the base strip portion in such a manner that the inside edges of the folded portions do not overlap each other, the outside surfaces of the folded overlying portions adjacent the inside edges thereof being bonded to the outside surface of the base strip portion of the next adjacent cell,

characterised in that the folds forming the integral lateral edges of the base portion and of the respective overlying portions are sharp, creased folds biasing the cells towards a flat configuration, the folds being permanently set by the orientation of the molecular structure of the material.

The panels of the present invention can be made in a continuous process by manipulating a continuous length of thin material to form uniform, clean cut, neat, and effective insulation panels. Such a process is disclosed in European application No. 84303455.4, (0162160) from which this application is divided.

The method may include the steps of continuously creasing and folding the thin material into an open-sided tubular structure, heat-setting the folds against a surface and under constant tension in an effective, uniform manner that eliminates internal stresses that could otherwise cause warps or wrinkles, applying adhesive material to the surface of the open-sided tubular structure, and continuously stacking the tubular material in layers on a flat surface or a plurality of flat surfaces to eliminate any curves that might cause wrinkles or warps in the finished product.

A suitable apparatus for fabricating expandable and contractable panel material in accordance with the invention is described and claimed in the parent application.

In particular, the apparatus may include an initial creaser assembly in which a pair of spaced-apart sharp wheels are pressed into the material to form uniform creases along which the material will be folded. It may also include as the folding means an assembly to fold the lateral edges at the crease over the mid-portion thereof and a press assembly to mechanically crimp the folds. The apparatus may also include a heat-setting assembly for heating the material, where, for example, it is a plastic film, to a sufficiently high temperature so that it loses its elasticity and becomes sufficiently plastic to permanently set the folds therein. The heat-setting assembly preferably provides a uniform surface around the periphery of a large diameter heated roller on which the folded film is pressed under

constant tension to eliminate internal stresses in the material.

The fact that the panel is composed of a plurality of elongated thin flexible tubes, stacked and adhered together with sharply creased edges tending to bias the tubes closed, tends to maintain its sharp crisp appearance and effective insulating qualities.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, advantages, and capabilities of the present invention will become more apparent as the description proceeds, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a plan view of an apparatus for fabricating insulation material in accordance with the present invention;

Figure 2 is a perspective view of the initial creasing assembly;

Figure 3 is a cross-sectional view of the initial creasing assembly taken along lines 3-3 of Figure 1;

Figure 4 is a cross-sectional view of the alignment block taken along lines 4-4 of Figure 1;

Figure 5 is a cross-sectional view of the first folding roller taken along lines 5-5 of Figure 1;

Figure 6 is a cross-sectional view of the second folding roller taken along lines 6-6 of Figure 1;

Figure 7 is a cross-sectional view of the folding track taken along lines 7-7 of Figure 1;

Figure 8 is a cross-sectional view of the final alignment block taken along lines 8-8 of Figure 1;

Figure 9 is a perspective view of the first crimper assembly;

Figure 10 is a perspective view of the film drive wheel and adhesive applicator assembly;

Figure 11 is a cross-sectional view of the stacking arm taken along lines 11-11 of Figure 1;

Figure 12 is an elevation view of an alternative stacking assembly;

Figure 13 is an elevation view of another form of stacking assembly;

Figure 14 is a perspective view of the finished insulation material, shown unfolded for use as an insulating panel material; and

Figure 15 is a perspective view of the insulation material shown in its collapsed state.

An apparatus for fabricating cellular insulation material in accordance with the present invention is shown in Figure 1. It comprises five major components designed for forming a continuous elongated strip of thin flexible material, as for example film polyester material, into movable insulation comprising a row of cells, as shown in Figure 14. The creaser assembly 60 forms an initial crease in the polyester film to facilitate folding by rollers 70, 72

and by folding channel 74. The crimper assembly 80 presses a permanent crimp in the material to form an open-faced tube. The heat roller assembly 90 heats the polyester film to a pre-selected temperature for heat-setting the crimp. The drive roller assembly 100 pulls the film through the preceding apparatus, and the glue applicator assembly 120 deposits metered beads of glue on the film for adhering adjacent lengths of the film to each other in laminated fashion on the stacking assembly 20. The tension and speed control assembly 140 maintains a constant tension on the film strip 40 as it is stacked on the stacking assembly 20, and it controls the speed at which the film is pulled through the preceding apparatus to conform to the film wrapping speed of the stacking assembly 20. The stacking assembly 20 is designed to continuously stack layer upon layer of the folded film 40 in equal lengths to form the panel insulating material shown in Figures 14 and 15.

The raw material utilized in this process is a continuous strip of thin flexible material, such as a polyester plastic material or Mylar 40, though other materials may be used. A supply roll 41 of the film material 40 is mounted on a shaft 50. A slip clutch arrangement 51 allows the roll 41 to rotate for feeding out a continuous strip of film material, but only when a sufficient threshold of tension is applied. Therefore, this slip clutch 51 sets and maintains initial tension of the film strip 40 as it is unrolled and fed through the apparatus 10.

After unrolling from the roll 41, the film strip 40 passes around a guide roller 52 and into an alignment block 54, which is effective to keep the film strip 40 in proper alignment with the initial creasing assembly 60. The alignment block 54, as shown in Figure 4, includes a block body with a channel 55 recessed into the upper surface thereof. The channel 55 has a width approximately equal to the width of the film material 40 so that it is effective to guide the film strip 40 in proper alignment into the initial creasing assembly 60.

From the alignment block 54, the polyester film strip is positioned around the peripheral surface of a rubber surfaced backing roller 62 of the creaser assembly 60, as best shown in Figures 2 and 3. As the polyester film 40 moves around roller 62, a pair of creaser wheels 67, 69 press a pair of permanent creases 45, 46 in spaced-apart relation to each other in the polyester film 40.

The backing roller 62 is journaled on a shaft 61 that is mounted in the frame 14. The creaser wheels 67, 69 have sharp peripheral surfaces and are mounted in spaced-apart relation to each other on an axle 68 adjacent the peripheral surface of roller 62. The axle 68 is mounted in a pivotal arm assembly 63, which pivots about axis 66 attached to frame 14. A compression spring 65 positioned

between the frame assembly 63 and anchor block 64 biases the creaser wheels 67, 69 tightly against the peripheral surface of the backing roller 62. As the film 40 passes between the peripheral surface of roller 62 and the creaser wheels 67, 69, the force exerted by spring 65 causes the creaser wheels 67, 69 to press a pair of permanent creases 45, 46 in the film 40. These creaser wheels 67, 69 are spaced such that the creases 45, 46 are formed slightly less than one-fourth the width of the film 40 inward from the respective edges. Therefore, as the lateral edge portions 43, 44 are folded over the mid-portion 47 toward each other, as will be described below, they approach but do not overlap each other.

From the creaser assembly 60, the film 40 passes around two folding rollers 70, 72 mounted on the frame 14. As best seen in Figures 1, 5, and 6, these folding rollers are positioned offset from a straight line between the creaser roller 62 and a folding block 74. In this offset relation, the film 40 must pass through a slight curve of approximately fifteen degrees around the folding rollers 70, 72. The pressure of the rollers 70, 72 in combination with the curve through which the film 40 passes and the creases 45, 46 formed in the film 40, causes lateral edge portions 43, 44 to fold upwardly as shown in Figures 5 and 6 around the lateral sides of the rollers 70, 72. The first roller 70 causes the lateral edges 43, 44 to begin folding upwardly out of the straight line relationship mid-section 47. The roller 72 causes a further folding of the outer edge portions 43, 44 to nearly a right angle relation to the mid-portion 47. The curve mentioned above around rollers 70, 72 is necessary to make the distance which the center or mid-portion 47 travels equal to the distance travelled by the lateral edge portions 43, 44, which must fold up and back down again over the mid-portion 47.

As the film proceeds from the last folding roller 72, it enters the folding channel 74 to complete the fold as best shown in Figure 7. The folding channel 74 is comprised of two block portions 75, 76 positioned adjacent to each other. The block portion 75 has a channel 77 formed therein so that when it is placed adjacent block 76, it forms an enclosed slot of a width approximately equal to the width of the mid-portion 47 of film 40. The height of the slot is less than the width of the lateral edge portions 43, 44. Therefore, this channel or slot 77 causes the lateral end portions 43, 44 to fold over on top of the mid-portion 47 to form the open tube or cell structure of the insulation material according to this invention.

As the film 40 leaves the folding channel 74, it passes through the first crimper assembly 80. The first crimper assembly 80 is comprised of a large roller 81 journaled to rotate on a shaft 82. The film

40 passes around the peripheral surface of the roller 81 as best shown in Figure 9. A crimp roller 84 is positioned adjacent the peripheral surface of roller 81 and is journaled to roll on an axle 85 mounted in a frame 86. A compression spring 87 biases the roller 84 tightly onto the peripheral surface of roller 81. Therefore, as the film 40 passes between the crimp roller 84 and the peripheral surface of roller 81, it is tightly pressed and squeezed to form a fold in the film 40 along the crease lines 45, 46, so that the open tube form of the polyester film strip 40 as shown in Figure 9 is more or less permanently set.

Even though the crimper 80 sets the fold in the polyester film along the crease lines, the original bias of the molecular structure of the polyester material to a flat plane tends to cause the creases or bends to round out or sag over a long period of time. Such rounding out or sagging can be detrimental to the appearance of the insulation panel and can interfere with its functional operations. The only way to permanently set the fold in a sharp crimp or bend is to heat the polyester material to the point where it substantially loses its elasticity and becomes sufficiently plastic to re-orient the molecular structure along the bends to conform with the sharp crimps. Therefore, the polyester film is passed around the peripheral surface of a large diameter heated roller 90 where it is heated to approximately 350 degrees F (177° C). As the polyester film material is heated against the cylindrical peripheral surface of the roller 90 under the slight tension in the operating system, the molecular structure of the polyester material rearranges to permanently set the crease.

In order to avoid ripples and other undesirable effects that can result from internal stresses due to uneven heating, it is necessary to apply the heat evenly and uniformly across the entire width of the polyester film. Merely heating along the edges or along the creases will usually cause internal stresses that result in warps or wrinkles, which is avoided by the uniform heating of the film on a large radius surface under constant tension according to this invention.

While the polyester material is hot, press rollers 95 and 96 apply a rolling pressure across the entire width of the film to set the bend or crimp permanently at a sharp angle. These press rollers 95, 96 are similar to the crimp roller 84 shown in Figure 9. Also, the heated roller 90 has a biased mount which applies an upward pressure to press the peripheral surface of the wheel 90 against the peripheral surface of the roller 81 of the crimper assembly and against the peripheral surface of roller 101 of the drive assembly 100. As the film 40 passes between the respective peripheral surfaces of these rollers, the pressure thereon is also effective

to help set the permanent crease.

After the film leaves contact with the peripheral surface of the heated roller 90, it travels around the peripheral surface of drive roller 101. Drive roller 101 is cooled so that it is effective to lower the temperature of the film below its plastic point so that it again attains its elasticity with the bends or creases 43, 44 permanently set. Additional press rollers 105 and 106 presses the film 40 against the peripheral surface of drive roller 101 and help to maintain the sharp bend or crimp in the film as the film cools down.

As mentioned above, the drive roller 101 not only is effective to cool the film 40, but it is also used to pull the film 40 through the bending and heat setting apparatus. As best seen in Figures 1 and 10, A motor 112 has mounted thereon a belt pulley 113, and a drive belt 104 passes around the belt pulley 113 and around double pulley 103 which is connected to the drive roller 101. The drive roller 101 is journaled on a shaft 102 so that the motor 112 and drive belt 104 are effective to rotate the driver roller 101. The press rollers 105, 106, in addition to holding the crease as the film 40 cools as described above, also apply pressure to press the film 40 against the cylindrical peripheral surface of the drive roller 101 to provide the traction necessary for pulling the film 40 through the apparatus.

The creased film is subsequently glued by the application of two uniform beads of adhesive 130,131 on the edge portions 43,44 adjacent the gap between them. The glued strips are then stacked and subsequently cut to length, as shown in Figs. 1 and 10 to 13 and more completely described in the parent application EP 162160, to which reference should be made.

The finished panel is thus composed of a plurality of straight, unwrinkled tubular film structures laminated and adhering together one on another in a neat, clean-cut expandable panel 160, as shown in Figures 14 and 15. In order to give the panel structural rigidity, a top slat 161 can be adhered to the top tube, and a rigid bottom slat 162 can be adhered to the bottom tube. The preferred form is with the top and bottom slat 161, 162 being at least as wide as the panel, as shown in Figures 14 and 15, with the adjacent tubular film structures adhering to the slats across that entire width.

In this completed form, the panel or movable insulation assembly 160 can be expanded to cover a desired section of wall, window, opening or the like as shown in Figure 14, or it can be retracted as shown in Figure 15. The construction of the panel 160 is best seen in Figure 14. The tubular cells can be seen to comprise a flat strip folded over on itself lengthways until its edges 43, 44 nearly meet along the middle of the strip. The lateral edges 43,

44 adhere to the outside surface of the mid-portion of the adjacent tubular film. The sharply creased folds 45, 46 tend to bias the lateral edge portions 43, 44 toward the mid-portion or bottom portion 47. This bias tends to partially close the cells or at least not allow them to be stretched fully open under the normal weight of the panel. Therefore, the panel hangs naturally in approximately the configuration shown in Figure 14 in which it is effective to cover and insulate a wall, window, or the like while maintaining its neat, clean-cut, attractive appearance and functional utility.

Although in the example described the cells were stuck together using a liquid adhesive, double-sided contact tape has also been used successfully for this purpose.

It is significant to note that expandable and contractable insulation panels according to this invention are neat in appearance, clean-cut, and have virtually no visible warps or wrinkles, as a result of the sharp uniform creases and folds which may be heat set under a constant tension on a surface uniformly across the entire film width as disclosed herein. In order to eliminate internal stresses in the polyester plastic material, it is important that the entire width of the film be heated uniformly and cooled uniformly during the heat-setting process.

Claims

1. An expandable and contractable panel (160) for use as an insulating window-covering construction comprising flexible material formed of a unitary row of superimposed collapsible elongate hollow cells secured together to form a unitary stack (48), each cell comprising a base strip portion (47) continuous across its width between its front and back lateral edges, and integral overlying strip portions (43,44) folded respectively along the length of the cell at the opposite lateral edges of the base strip portion over one side of the base strip portion (47) in such a manner that the inside edges of the folded portions do not overlap each other, the outside surfaces of the folded overlying portions (43,44) adjacent the inside edges thereof being bonded to the outside surface of the base strip portion of the next adjacent cell,

characterised in that the folds forming the integral lateral edges of the base portion and of the respective overlying portions are sharp, creased folds (45,46) biasing the cells towards a flat configuration, the folds being permanently set by the orientation of the molecular structure of the material.

2. A panel as claimed in claim 1, wherein the overlying and base portions and the creased

folds (45,46) therebetween are of sufficient strength and resilience to maintain an acute angle between the portions at the creased folds when the panel is expanded.

3. A panel as claimed in claim 2, wherein the curvature of the overlying and base portions has a transition located approximately midway between the bond between the cells and the creased folds, so that, in the expanded state of the panel, the said curvature changes from being concave near the folds to being convex near the bonds.
4. A panel as claimed in any preceding claim, in which the areas defined by the said bonds between the outside surfaces of adjacent cells remain substantially flat and parallel to each other when the panel is in its expanded state.
5. A panel as claimed in any preceding claim, in which top and bottom rigid slats (161, 162) are provided to which top and bottom cells of the panel material are respectively secured, characterised in that when the panel hangs from the top slat (161) the cells open only to the extent that the depth of the cross-section of each cell is less than its width between the opposite folded lateral edges.
6. A panel as claimed in any one of claims 1 to 4, in which top and bottom rigid slats (161, 162) are provided to which top and bottom cells of the panel material are respectively secured, characterised in that when the panel hangs from the top slat (161) the cells are not stretched fully open under the normal weight of the panel.
7. A panel as claimed in any preceding claim, in which the cells are made of polyester material.
8. A panel as claimed in any preceding claim, in which the flexible material is a heat-settable material and in which the said orientation of the molecular structure of the material is brought about through heat-setting.

Revendications

1. Panneau extensible et contractable (160) pour utilisation comme construction de couverture et d'isolation de fenêtre comprenant un matériau souple formé d'une rangée unitaire d'alvéoles creuses allongées superposées repliables fixées ensemble pour former une pile unitaire (48), chaque alvéole comprenant une partie de bande de base (47) continue à tra-



44 adhere to the outside surface of the mid-portion of the adjacent tubular film. The sharply creased folds 45, 46 tend to bias the lateral edge portions 43, 44 toward the mid-portion or bottom portion 47. This bias tends to partially close the cells or at least not allow them to be stretched fully open under the normal weight of the panel. Therefore, the panel hangs naturally in approximately the configuration shown in Figure 14 in which it is effective to cover and insulate a wall, window, or the like while maintaining its neat, clean-cut, attractive appearance and functional utility.

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6. A panel as claimed in any one of claims 1 to 4, in which top and bottom rigid slats (161, 162) are provided to which top and bottom cells of the panel material are respectively secured, characterised in that when the panel hangs from the top slat (161) the cells are not stretched fully open under the normal weight of the panel.
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vers sa largeur entre ses bords latéraux avant et arrière et des parties de bande superposées solidaires (43, 44) pliées respectivement le long de la longueur de l'alvéole aux bords latéraux opposés de la portion de bande de base sur un côté de la portion de bande de base (47) d'une manière telle que les bords intérieurs des parties repliées ne se recouvrent pas l'un l'autre, les surfaces extérieures des parties superposées repliées (43, 44) adjacentes à ces bords intérieurs étant liées à la surface extérieure de la portion de bande de base de l'alvéole suivante adjacente,

caractérisé en ce que les plis formant les bords latéraux solidaires de la partie de base et des parties superposées respectives sont des plis francs nets (45, 46) sollicitant les alvéoles vers une configuration plate, les plis étant établis de manière permanente par l'orientation de la structure moléculaire du matériau.

2. Panneau selon la revendication 1, dans lequel les parties superposées et de base et les plis francs (45, 48) entre celles-ci sont d'une résistance et d'une élasticité suffisantes pour maintenir un angle aigu entre les parties au niveau des plis francs lorsque le panneau est étendu.
3. Panneau selon la revendication 2, dans lequel la courbure des portions superposées et de base présente une transition placée approximativement à mi-chemin entre le lien qui réunit les alvéoles et les plis francs, de sorte que dans l'état étendu du panneau, la courbure change de concave près des plis pour devenir convexe près des liaisons.
4. Panneau selon l'une quelconque des revendications précédentes, dans lequel les surfaces définies par lesdites liaisons entre les surfaces extérieures des alvéoles adjacentes demeurent pratiquement plates et parallèles l'une à l'autre lorsque le panneau est dans son état étendu.
5. Panneau selon l'une quelconque des revendications précédentes, dans lequel des lattes rigides supérieure et inférieure (161, 162) sont prévues auxquelles des alvéoles supérieure et inférieure du matériau de panneau sont respectivement fixées, caractérisé en ce que lorsque le panneau pend de la latte supérieure (161) les alvéoles s'ouvrent dans la mesure seulement où la profondeur de la section transversale de chaque alvéole est inférieure à sa largeur entre les bords latéraux repliés opposés.

6. Panneau selon l'une quelconque des revendications 1 à 4, dans lequel sont prévues les lattes rigides supérieure et inférieure (161, 162) auxquelles des alvéoles supérieure et inférieure du matériau de panneau sont respectivement fixées, caractérisé en ce que lorsque le panneau pend de la fente supérieure (161) les alvéoles ne sont pas tirées totalement ouvertes sous le poids normal du panneau.
7. Panneau selon l'une quelconque des revendications précédentes, dans lequel les cellules sont constituées d'un matériau de polyester.
8. Panneau selon l'une quelconque des revendications précédentes, dans lequel le matériau souple est un matériau thermofixable et dans lequel l'orientation de la structure moléculaire du matériau est déterminée par l'intermédiaire du thermofixage.

Patentansprüche

1. Ausziehbares und zusammenraffbares Paneel (160), das zur Isolierung und Abdeckung von Fenstern geeignet ist und aus einem biegsamen Material besteht, welches von einer Einzelreihe übereinandergelagerter, faltbarer, langgestreckter Hohlzellen gebildet wird, die so aneinandergesetzt sind, daß ein einheitlicher Stapel (48) entsteht, wobei jede Zelle einen Bodenstreifen (47) und damit einstückige, darüberliegende Streifen (43,44) umfaßt, wobei ersterer (47) sich zwischen seinen vorderen und hinteren Längskanten kontinuierlich über die ganze Zellbreite erstreckt, während letztere (43,44) an den gegenüberliegenden Kanten des Bodenstreifens (47) entlang der Zellenlänge über eine Seite dieses Bodenstreifens (47) eingefaltet werden, und zwar derart, daß die Innenkanten der eingefalteten Teile einander nicht überlappen, wobei die an die Innenkanten angrenzenden Außenflächen der eingefalteten Teile (43,44) an der Außenfläche des Bodenstreifens der benachbarten Zelle haften, **dadurch gekennzeichnet, daß** die Faltungen, welche die Längskanten des Bodenteils und der entsprechenden darüberliegenden Teile bilden, als scharfe Knicke (45, 46) ausgebildet sind, die eine flache Gestaltung der Zellen bewirken, wobei diese Knicke aufgrund der Ausrichtung der Molekülstruktur des Materials dauerhaft fixiert sind.
2. Paneel nach Anspruch 1, **dadurch gekennzeichnet, daß** die Bodenstreifen und darüberliegenden Streifen sowie die dazwischen befindlichen Knicke (45, 46) eine genü-



gend hohe Festigkeit bzw. Elastizität aufweisen, sodaß an den Faltungen zwischen den Teilen ein spitzer Winkel erhalten bleibt, wenn das Paneel auseinandergezogen wird.

3. Paneel nach Anspruch 2, **dadurch gekennzeichnet, daß** die Krümmung der Bodenstreifenteile und darüberliegenden Streifenteile einen Wendepunkt aufweist, der sich etwa auf halbem Weg zwischen der Verbindungsstelle zwischen den Zellen und den Knickfalten befindet, sodaß die Krümmung, die an den Falten konkav ist, in eine konvexe nahe den Verbindungsstellen übergeht, wenn das Paneel auseinandergezogen ist.

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4. Paneel nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die durch die Verbindungen zwischen den Außenflächen benachbarter Zellen gegebenen Bereiche im wesentlichen eben und zueinander parallel bleiben, wenn das Paneel auseinandergezogen ist.

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5. Paneel nach einem der vorhergehenden Ansprüche, bei dem steife Deck- bzw. Bodenlatten (161,162) vorgesehen sind, die mit den obersten bzw. untersten Zellen des Paneelmaterials verbunden sind, **dadurch gekennzeichnet, daß** sich die Zellen nur so weit öffnen, daß die Höhe des Querschnitts einer jeden Zelle kleiner als ihre Breite zwischen den gegenüberliegenden eingefalteten Kanten ist, wenn das Paneel von der Dechlatte (161) hängt.

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6. Paneel nach einem der Ansprüche 1 bis 4, bei dem steife Deck- bzw. Bodenlatten (161,162) vorgesehen sind, die mit den obersten bzw. untersten Zellen des Paneelmaterials verbunden sind, **dadurch gekennzeichnet, daß** sich die Zellen unter dem normalen Paneelgewicht nicht zur Gänze entfalten, wenn das Paneel von der Decklatte (161) hängt.

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7. Paneel nach einem der vorhergehenden Ansprüche, bei dem die Zellen aus Polyester bestehen.

8. Paneel nach einem der vorhergehenden Ansprüche, bei dem das flexible Material durch Hitze plastisch formbar wird und die Ausrichtung der Molekülstruktur des Materials unter Hitzeeinwirkung zustandekommt.

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