A foot for molded plastic furniture has a pad portion made of a first plastic or thermoplastic rubber and an anchor portion made of a second harder plastic or metal. The anchor has a base with a substantially flat surface that is bonded to a substantially flat top surface of the pad. Preferably the anchor portion and pad portion are co-extruded. A projection having at least one rib extends from the base of the anchor and is inserted into a cavity in a furniture leg creating a reliable mechanical fit which resists removal of the foot from the leg.
FOOT FOR MOLDED PLASTIC FURNITURE

FIELD OF THE INVENTION

[0001] The present invention relates to injection molded plastic furniture having improved feet and methods of making such furniture.

BACKGROUND OF THE INVENTION

[0002] Injection molded plastic furniture includes chairs, tables, stools, plant stands, and many other useful forms of furniture. A major advantage of such furniture is its low manufacturing cost. Typically, such furniture is made of a thermoplastic such as polypropylene, polystyrene, polyethylene, acrylic, acrylonitrile butadiene styrene (ABS), or mixtures and combinations thereof. Fillers such as calcium or talc may also be added. The selection of which of the many commercially available plastics to use depends on a variety of design and production factors, principle among which are the strength, toughness, stiffness, and durability of the overall structure in view of the intended use of the furniture item. For economical reasons, often the furniture item is injected molded as a single piece or as a set of small number of pieces of the same plastic which are then assembled together. See for example, U.S. Pat. No. 7,401,854 B2 to Adams which discloses an injection molded stackable folding chair.

[0003] Sometimes it is useful or necessary to attach to the floor-contacting parts of the injected molded plastic furniture a separately manufactured foot. One benefit of using such a foot is to provide the article of furniture with improved friction in order to reduce the slippage of the article on smooth surfaces. Another is that, when feet are used on an article of furniture with legs such as a chair or table, the amount of internal stress the article must withstand when a load is applied is reduced. The internal stress reduction achieved by using feet can be very significant. The ASTM Test Results section later in this document illustrates differences in how long specific chairs hold a set weight before failing when feet are used and when they are not used. One chair held for 76 minutes with conventional feet, but only for about 1 minute with no feet. For that chair, and for many other articles of furniture, feet are a critical and integral component. Other reasons feet may be used are to cushion impacts on the furniture or to protect substrates from being scuffed by the more rigid material comprising the furniture.

[0004] Feet are usually attached to an article of furniture shortly after the injection molding of the furniture although they could also be attached sometime thereafter. The article of furniture is usually provided with a cavity or socket for receiving the anchor portion of the foot. With conventional feet, the cavity and the anchor portion are normally shaped and sized so that the foot is retained by friction. The anchor portion is designed to be slightly wider than the cavity and to be compressed into the cavity to create an interference fit (also known as a friction or press fit). In some cases, press fits create a satisfactory mechanical connection. However, they are not sufficient for connecting feet to furniture. The initial friction strength is on the low side. In addition, conventional feet are normally made of a semi-rigid material. Any semi-rigid material will take a compression set over time. So as time passes and the feet are compressed, the grip of the foot into the cavity lessens. Consequently, it is possible for frictionally retained feet to be jostled or knocked off (or to simply fall off) of the article of furniture to which they were attached.

Although this conventional foot retaining method has been standard practice in the resin furniture industry for many years if not decades, it does not result in a reliable grip of the foot onto the chair. The ASTM Test Results section shows how if just one foot falls off it can cause a chair to no longer meet industry standards for outdoor furniture.

[0005] Even though semi-rigid materials take a compression set, they do not take a set as quickly as fully flexible, softer, lower-durometer materials. That is why semi-rigid materials are used for furniture feet instead of a softer material. The trade-off of not using softer foot material is that some grip on surfaces is sacrificed. Softer feet would provide more frictional grip on substrates.

[0006] The last weakness of conventional feet is the difficulty of inserting them. Since the anchor portion of the foot must be made wider than the cavity to create a friction fit, assemblers must exert themselves to squeeze the foot into the cavity. Often feet are inserted only to the point where they are stable enough to stay in place until they can be hammered fully in. Still, getting the feet even partially inserted into the cavity is difficult with conventional feet.

[0007] Another type of foot commonly used for furniture consists of a rubber washer with a bolt that passes through the center of the washer. The washer may be seated in a cylindrical metal housing to which a bolt or threaded rod is attached. Usually the head of the bolt is recessed into the washer so that only the washer makes contact with the floor. An example of such a product is available from Custom Rubber Corp., and sold as a Non-Marking Molded Rubber Leveling Foot. The leg in which the foot is attached typically has a threaded cavity or nut into which the bolt is secured. While this type of foot is securely held, several minutes may be required to install these feet on the legs of three-legged or four-legged furniture. The feet themselves are also much more expensive than feet which are extruded and friction fitted into a leg cavity.

[0008] It is also known to provide rubber caps encompassing the head of a bolt; such as the Molded Rubber Bumper Bolts again made by Customer Rubber Corp. With this type of foot, there are multiple issues. First among them, the rubber must be made very hard so that it cannot slip away from the head of the bolt since soft, flexible plastic would not have adequate resistance to decoupling from the head of the bolt during use. Also, the assembly of such feet would be time consuming and/or require special receiving cavities in the furniture. Next, the cost of such feet, due to the need for a somewhat large metal bolt as a component and to the expensive nature of insert molding, is much higher than with conventional feet. Finally, such feet could come partially or fully unscrewed during use.

SUMMARY OF THE INVENTION

[0009] The present invention fills the need for a new type of foot for injection molded furniture:

[0010] a) which does not add greatly to the cost of the furniture

[0011] b) that fastens the soft pads placed at one or more locations on an article of furniture reliably enough that the pads should stay in place throughout the article’s useful life

[0012] c) that enables the use of a softer plastic pad than is currently possible in order to achieve a better frictional grip on substrates

[0013] d) that is easier for assemblers to insert
We provide a foot having an anchor portion which fits into a cavity in the leg of a chair (or to the legs or floor-contacting parts of other furniture). The anchor has a base with a substantially flat bottom surface to which a pad is attached. The pad is made of soft plastic such as flexible polyvinyl chloride and the anchor is made of a hard plastic such as rigid polyvinyl chloride. Preferably the anchor and pad are co-extruded to form a chemical bond between the hard and soft plastics. Ribs on the anchor engage and preferably deform the side wall of the cavity to create a mechanical interlock between anchor and cavity.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The criticality of the features and merits of the present invention will be better understood by reference to the attached drawings. It is to be understood, however, that the drawings are designed for the purpose of illustration only and not as definitions of the limits of the present invention.

**FIG. 1** is a perspective view of the chair and a table each having attached feet in accordance with an embodiment of the present invention.

**FIG. 2** is an inverted perspective view of the leg end of the chair of FIG. 1 showing a foot receiving cavity.

**FIG. 3** is an inverted perspective view of the end of a leg of an article of furniture having a foot attached thereto in accordance with an embodiment of the present invention.

**FIG. 4** is a perspective view of the foot that is depicted in FIG. 3.

**FIG. 5** is an end view of the foot shown in FIGS. 3 and 4.

**FIG. 6** is an end view of a foot according to another embodiment of the present invention.

**FIG. 7** is an end view of a foot according to yet another embodiment of the present invention where the foot is wider and has multiple anchor portions.

**FIG. 8** is an end view of a foot according to still another embodiment of the present invention.

**FIG. 9** is an end view of a foot according to another embodiment of the present invention with a section of the article of furniture shown in ghost lines.

**FIG. 10** is a side view of a foot having helical threads according to another embodiment of the present invention.

**FIG. 11** is a side view of a foot having annular threads according to another embodiment of the present invention.

**FIGS. 12A-12D** are a series of schematic side views illustrating the insertion of a foot into a cavity similar to the cavity shown in FIG. 2, wherein:

**FIG. 12A** depicts the foot about to be inserted into the cavity.

**FIG. 12B** depicts the foot after it has been partially introduced into the cavity.

**FIG. 12C** depicts the foot after it has been forcibly seated fully into the cavity.

**FIG. 12D** depicts the foot and cavity as shown in 12A, but from a different perspective and with the cavity cross-sectioned lengthwise.

**DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION**

In this section, some preferred embodiments of the present invention are described in detail sufficient for one skilled in the art to practice the present invention. It is to be understood, however, that the fact that a limited number of preferred embodiments are described herein does not in any way limit the scope of the present invention as set forth in the appended claims.

Referring to FIG. 1 there is shown a chair 2 and a table 10. Each of these articles of furniture has attached to it a set of feet, e.g., foot 12, to provide the article a supporting interface with the floor upon which it sits. Although foot 12 is attached to the end of leg 14 of chair 2 or table 10, it is to be understood that the present invention may be used with all kinds of articles of furniture, e.g., chairs, tables, benches, stands, cabinets, shelves, trays, etc., regardless of whether or not the article has supporting legs, so long as at least the cavity or recess of the article of furniture by which the foot is attached has at least one wall comprising a thermoplastic as is described in more detail below. Preferably, the entire article of furniture comprises an injection molded thermoplastic. Preferably, the thermoplastic is polypropylene. Polystyrene, polyvinyl chloride, polycarbonate, polyethylene, acryl, acrylonitrile butadiene styrene (ABS), and mixtures and combinations thereof could be used. When the thermoplastic includes polypropylene and/or polyethylene, it may include one or more fillers, e.g., calcium or talc.

Referring now to FIG. 2, there is shown the bottom of a leg 20 of an article of furniture. The leg 20 has a cavity 22 for receiving a foot. The cavity 22 is defined in part by the surfaces of the first and second walls 24, 26. The first wall 24 has two ribs 28, 30 which protrude into the cavity 22 and similarly the second wall 26 has ribs 32, 34. At least one, and preferably both, of the first and second walls 24, 26 is made of a thermoplastic.

FIG. 3 shows the same leg 20 having a foot 36 fixedly attached to it. The foot 36 is better seen in FIG. 4 and FIG. 5. The foot 36 has an anchoring portion 38 and a pad portion 40. The anchoring portion 38 is configured to be received by the leg cavity 22. The pad portion 40 is configured to be in contact with a floor or the ground so as to at least partially support the article of furniture on the floor.

The anchoring portion 38 and the pad portion 40 join along junction 42. The anchoring portion 38 comprises a set of two pairs of opposing self-centering surfaces 44, 48 which act to center the anchoring portion 38 as the foot 36 is being inserted into the leg cavity 22. The anchoring portion also has two pairs of opposing alignment surfaces 50, 52 which act to assist in the alignment of the anchoring portion 38 within the leg cavity 22. The alignment surfaces 50, 52 are designed to be only slightly wider than the leg cavity 22 so that the foot 36 can be easily inserted by hand until the opposing wedging surfaces 54 stop the penetration at which point the foot 36 is held steadily enough by friction in the cavity 22 in a partially-inserted position (see FIG. 12B) to be hammered into a fully-inserted position without the need for the assemblers to try to stabilize the foot 36 with their fingers while making the hammer blow. With conventional feet, the top of the anchor is much wider which makes partial insertion of the foot much more difficult. The anchor portion also has a pair of opposing groove-forming surfaces 56 and a pair of opposing retention surfaces 58 which, along with the wedging surfaces 54, interact to form an indentation in the first and second walls 24, 26 of leg cavity 22 (see reference numbers 168, 170 of FIG. 12C) in a manner which is described below. The anchoring portion 38 also has a pair of limiting surfaces 60 which act to limit the depth to which the anchoring portion 38 can be forced into the leg cavity 22. The anchoring portion 38 also has two opposing neck regions
[0037] The horizontal junction 42 between the anchor portion 38 and pad portion 40 should be flat or slightly curved or rippled such that the surface area of the pad which contacts the anchor portion is at least 75% and preferably over 90% of the area of the bottom surface of the pad. Because the pad is preferably made of a material that is softer than the anchor, tearing of the pad may occur if the contact surface of the pad portion with the anchor portion is less than 75% of the area of the bottom surface of the pad. This tearing can occur if the feet are on a chair or other article which is slido or “scooched” across the floor or on a chair or other article which must withstand lateral forces. To further improve the strength of the attachment between anchor and pad, the pad may extend up the edges of the anchor portion as shown in FIGS. 4 and 5 to create a vertical junction 43. The vertical junction 43 is intended to prevent separation of the anchor and pad from starting along the sides of or at the corners of the horizontal interface 73 of the anchor portion as shown in FIG. 6. The pad extension 45 in dotted lines in FIG. 5 shows how the pad could be further extended to wrap over the limiting surface 60 of the anchor.

[0038] It is to be understood that the foot 36 shown in FIGS. 4 and 5 is according to a particularly preferred embodiment of the present invention. Examples of some of the numerous additional embodiments of feet in accordance with the present invention are shown in FIGS. 6-8. Referring first to FIG. 6, there is shown a foot 70 which has anchor portion 72 and pad portion 74. The anchor portion 72 has a pair of opposing self-centering surfaces 76, a pair of opposing alignment surfaces 78, a pair of opposing wedgeing surfaces 80, a pair of opposing retention surfaces 84, and a pair of limiting surfaces 86. Surfaces 80 and 84 meet at groove-forming surface 82 to form ribs along the sides of the anchor (which could run around the ends of the anchor as well if the feet were co-injection molded rather than co-extruded).

[0039] Referring now to FIG. 7, there is shown a foot 90 having two anchor portions 92 and 93 and a pad portion 94. The foot 90 is similar to the foot 70 of FIG. 6, with the following exceptions. The foot is wider and longer. In the drawings, particularly FIG. 3, we have illustrated the foot to be smaller than the end of the leg to which the foot is attached. However, the foot can be larger such that there is more contact area between the foot and the floor. Greater contact area may increase skid resistance which may be desirable for larger chairs or tables, it also would distribute higher potential loads over more floor or ground area, and it can also create more foot stability or resistance to leg twisting. However, in these instances larger feet may have to withstand more stress such that the multiple anchor portions 92 and 93 may be needed to handle that increased stress without the foot cracking. The four retention surfaces 96 of foot 90 are disposed perpendicularly to the longitudinal midplane 98 of the anchor 92 and/or the second anchor 93 as the anchors are parallel) and the ribs are flattened. Also, the retention surfaces 96 are positioned higher on the anchor to form the mechanical interlock deeper in the foot cavity. This would result in more plastic in the ribs 28, 30, 32, 34 under the retention surfaces 96 which may increase the grip of the foot 90 into the cavity although further empirical testing of the revised design would be needed to confirm that is indeed the case.

[0040] Referring now to FIG. 8, there is shown a foot 100 having an anchor portion 102 and a pad portion 104. The foot 100 is similar to the foot 70 of FIG. 6, except that its groove-forming surface 106 has an irregular shape and it also has a neck 108. Thus, the edge of the ribs can have a knife edge shape shown in FIG. 6, be flattened as in FIG. 7 or have an irregular shape as in FIG. 8. Any shape that is useful for making the indentation in the manner described below can be used. Two other features of the foot 100 are noteworthy. The self-centering surfaces 105 are more pronounced for easier hand loading. This feature may (or may not) be necessary if the foot insertion process were automated depending on if an easier lead-in were required. The anchor stabilizer 109 could be used to prevent wobble or transverse rotation of the foot in the cavity.

[0041] Referring now to FIG. 9, there is shown a foot 110 in accordance with another embodiment of the present invention. The foot 110 is shown attached to the article of furniture 112 (which is shown in ghosted lines) within cavity 114 of the article of furniture 112. Note that the foot 110 has formed indentations, e.g., indentation 116, in what was a flat surface of the walls 118 of the article of furniture 112 prior to the forced insertion of foot 110 into cavity 114. Also note that in this embodiment of the present invention, the foot 110 has an inset 120 for receiving a protrusion 122 from an end wall of the cavity 114.

[0042] Two more embodiments of feet in accordance with the present invention are depicted schematically in FIGS. 10 and 11. Referring now to FIG. 10, there is shown in foot 130 having an anchor portion 132 and a pad portion 134. The anchor portion 132 can have a circular cross-section and has helical threads 136 which form a helical indentation into the wall of the receiving cavity of the article of furniture when it is forcibly inserted into the cavity while being rotated about its longitudinal axis 138. The foot 130 also has a recess 140 for receiving a tool for rotatably driving the foot 130 into the article of furniture cavity. Additionally, or alternatively, the outside edges of the pad portion 134 and/or the outside edges of the anchor portion 132 may be configured to be received within a tool for rotatably driving the foot 130 into the receiving cavity of the article of furniture. To prevent the threads from starting to unscrew, a vertical catch 137 could be added in one or more locations on the helical threads 136.

[0043] Referring now to FIG. 11, there is shown a foot 150 having an anchor portion 152 and a pad portion 154. The anchor portion 152 has annular threads 156 which form circular or arc-like indentations into the wall surface of the receiving cavity of the article of furniture when it is forcibly inserted into the cavity.

[0044] The anchor portion and pad portion of a foot according the present invention are most likely to be made of thermoplastics, although it would be possible to have the anchor portion be made of metal. When the anchor portion is made of a thermoplastic, it may be made of one that is the same as or different from the pad portion. In the context of this patent application, two thermoplastics are to be construed as being different if they have different chemical or physical properties. For example, an anchor portion that is made of a hard PVC that has a durometer hardness of 74 on the Shore D scale and a pad portion that is made of a soft PVC that has a durometer hardness of 60 on the Shore A scale are to be construed as being made of different thermoplastics. In embodiments wherein the anchor portion and the pad portion of a foot are made of different thermoplastics, these portions
may be joined together by any means known in the art which will provide a bond strong enough to keep the portions from separating during use. Co-injection molding, insert molding, or other bonding methods known in the art may be used. Most preferably, the portions are made from materials which are chemically compatible and chemically bond during co-extrusion.

[0045] The anchor portion is harder than the pad portion. The anchor portion thermoplastic is selected to have sufficient hardness and rigidity to enable the anchor portion to form the indentations in the manner described below. Preferably, the anchor portion is polyvinyl chloride having a durometer hardness of at least 70 on the Shore D scale. However, depending on the material used to make the furniture, the material used for the anchor portion may need to be made harder than 70 Shore D. This may require the use of ABS, nylon, filled polypropylene, polycarbonate, or another very hard thermoplastic, or possibly even metal. The pad portion thermoplastic is selected to have sufficient strength for at least partly supporting the article of furniture and operationally suitable abrasion resistance and friction properties with respect to its surface that is designed to contact the floor. Preferably, the pad portion material will be selected from one of the following types of thermoplastics: polyvinyl chloride (PVC), thermoplastic elastomer (TPE), polyurethane, real or thermoplastic rubber, silicone, and mixtures and combinations thereof. If using a metal anchor, a special metal-bonding plastic such as a TPV would be required. Preferably, the pad portion thermoplastic is PVC that has a durometer hardness of no more than about 65 on the Shore A scale.

[0046] The shape of the foot is to have can influence the process chosen to manufacture the foot. For example, feet having elongate shapes, such as the foot 36 shown in FIG. 4, are well suited to being made by an extrusion process. In contrast, feet wherein the anchor portion has a longitudinal axis and shape in a cross-sectional plane that is perpendicular to its longitudinal axis that is a circle, an oval, or a regular or irregular polygon, especially when the anchor portion also has annular or helical threads, are suited to being made by a co-injection molding process.

[0047] Some preferred methods of attaching feet to articles of furniture according to embodiments of the present invention will now be described with reference to FIGS. 12A to 12D. FIGS. 12A and 12D schematically show a foot 36 (similar to the one shown in FIGS. 3-5) positioned below a portion of an article of furniture 160 (shown in cross-section). The article of furniture 160 has a cavity 162 which is adapted for receiving the foot 36. We prefer to provide ribs 164 which extend into the cavity and are engaged by the anchor portion of the foot. In FIG. 12A we provided a range for the preferred distance between the ribs 164 as well as the preferred widths of the anchor portion at the alignment surfaces 50, 52 and opposing groove-forming surfaces 56.

[0048] FIG. 12B shows the foot 36 after it has been initially seated in the cavity 162. In the initial seating a part of the foot anchor portion 38 has been introduced into the cavity 162 to where the wedging surfaces 54 are resting against the ribs 164. The section of the anchor portion 38 of foot 36 that is within cavity 162 is sized so that the foot can be placed in the cavity manually with little effort. This is an improvement over prior art feet that required a substantial amount of force to be initially seated. Preferably, the foot anchor portion 38 is dimensioned so that it makes an interference fit with the cavity 162 up to its wedging surfaces 54 so that it initially seats with just a light push and is retained within the cavity 162 even if jostled.

[0049] When the foot is positioned as in FIG. 12B the foot is hit with a hammer or mallet for final insertion as shown in FIG. 12C. The application of a substantially greater force to foot 36 forces the anchor portion 38 down deeper into the cavity 162 until further progress is stopped by the contact of the limiting surfaces 60 of the anchor portion 38. As the downward movement occurred, the wedging surfaces 54 locally elastically forced apart the ribs 164 sufficiently to permit the downward movement of the anchor portion 38 into the cavity 162. After the movement substantially ended, the wedging surfaces 54, the grooving surfaces 56, and the retention surfaces 58 of foot 36 cooperate to form permanent indentations 168, 170 into the surfaces of the ribs 164. These indents are formed by plastic deformation of the ribs 164 as the cavity exerts sufficient compressive strength as it resists spreading to groove the ribs 164 around the anchor. Preferably the foot is inserted into the leg immediately after the furniture is molded. At that time the cavity ribs 164 will not have fully hardened, and as a result they will deform more easily around the ribs on the anchor. The deformation of the ribs 164 occurs over the course of a time period of up to an hour long. The indentations 168, 170 of the cavity 162 and at least the retention surfaces 58 of the foot 36 cooperate to form an interlocking joint which opposes the removal of the foot 36 from the article of furniture. Consequently, the foot disclosed herein, inserted in the manner here described will not fall out during normal handling and use of the furniture to which the foot is attached. We prefer to provide ribs that extend into the cavity and are engaged by the anchor. However, one could omit the ribs and size the cavity so that the anchor bites into the sidewalls that define the cavity. Alternatively, one could provide fins 166 on one or both ends of the cavity that may act as lead-ins for the foot so that the foot is centered or otherwise specifically located within the length of the cavity.

[0050] The walls 24, 26 of the cavity in FIG. 2 are distorted slightly outward during the foot insertion process described above. Thus the anchor stabilizer 109 of FIG. 8 would be made slightly wider than the original distance between the ribs 164 to more completely fill the larger gap that would exist at the bottom of the cavity. This would be for specific foot applications where there are more severe than normal loads in the transverse direction.

[0051] Most resin molded chairs which have foot pads rely on those pads to provide proper performance and stability. When one or more pads fall out of a chair the integrity and stability of the chair is compromised. The present invention essentially eliminates the risks involved with pads falling out.

[0052] When we prefer to use the insertion technique described in the discussion of FIGS. 12A-12D that technique need not be used where the anchor has a circular cross-section. In those embodiments, the foot is rotated around its longitudinal axis as it is forced into the receiving cavity in the article of furniture. This technique is especially useful when the foot has helical threads, e.g., like foot 130 shown in FIG. 10.

[0053] Molded plastic articles usually shrink to some extent immediately after the article is extruded or removed from a mold. The amount of shrinkage will depend upon the type and amount of plastic used. Inserting the foot immediately after the article is removed from the mold takes advantage of this shrinkage. The walls of the cavity will shrink.
around the anchor portion of the foot to tighten the grip of the cavity onto the foot, working in conjunction with the compressional force exerted by the cavity walls to create a reliable mechanical interlock.

[0054] The foot here disclosed has several advantages of other feet that have been used on furniture. First, the foot here disclosed can be made at a significantly lower cost than the non-marking molded rubber leveling feet that use a bolt and washer or similar structure. A foot configured as in FIGS. 4 and 6 can be made for around one cent ($0.01) while one can expect to pay at least a few cents for each non-marking molded rubber leveling foot.

[0055] Another advantage of the foot here disclosed is ease of installation. One can install a foot into a chair leg in a matter of seconds. No special equipment or tools, other than a hammer or mallet, is needed.

[0056] The foot disclosed can be used in any type of Mono-Block Resin Furniture, regardless of the line of draw on the ribs in the foot cavities. This fact is especially used for Adirondack chairs where the line of draw on the rear and/or front legs creates ribs with very pronounced angles from vertical. Unlike the screw/bolt of prior-art designs the foot here disclosed can be installed into cavities/ribs/sockets formed by any angle of mold draw.

[0057] The pad portion of the foot can be made from 60 durometer (Shore A) material, which improves the performance of molded plastic chairs. That improvement is described below in the context of the test results discussed herein. One cannot use 60 durometer material for a washer in a bolt and washer type foot because the bolt would tear the washer when the bolt is subjected to lateral forces, such as when a chair is slid across the floor. Tearing may expose the hard metal bolt which can scratch the floor. The hard metal bolt could also be exposed if the pad abraded away. Such a soft washer may also fold over itself during installation.

[0058] Although it is preferable that the entire article of furniture is made of a thermoplastic and be injection molded, the present invention is not limited to such furniture. Rather, the present invention encompasses all furniture, regardless of whether or not it has been injection molded in whole or in part, which have a receiving cavity for a foot in which the cavity is defined in part by a thermoplastic wall upon which the foot can act upon insertion to form an indentation in the manner described above.

[0059] Other advantages of the current invention are illustrated in the sections below.

Pull Force Test Results:

[0060] Injection molded chairs made of polypropylene were provided with cavities for receiving supporting feet. The cavities had walls with surfaces which were free of indentations. Feet having the design shown in FIG. 6 were made having an anchor portion comprising rigid PVC having a durometer Shore D hardness of 74 and a pad portion comprising flexible PVC having a durometer Shore A hardness of 60 by co-extrusion. The temperatures of the walls of the receiving cavities were adjusted to temperatures within the range of from about 175°F. to about 250°F. and the feet were forced into the cavities in the manner described above with reference to FIGS. 12A to 12D. The axially directed force required to remove the feet was measured using a testing rig that had a maximum pull force of 44 pounds force. The test was repeated in another rig applying 60 pounds of force. None of the feet were able to be removed by the testing rigs. The feet were subsequently removed by prying them out so that the cavity walls could be examined. The examination revealed indentations in the wall corresponding to the friction on the anchor portion of the feet.

[0061] For comparison, conventional feet made of a single material, a semi-flexible PVC having a durometer Shore A hardness of 88, were inserted into the receiving cavities of similar injection molded polypropylene chairs. The force required to remove these conventional feet was measured using the same testing method and rig to be less than 4 pounds force. The cavities were inspected after the feet had been removed and found to be free of indentations.

[0062] Although the pull force results shown above illustrate the dramatic increase in the grip strength of foot into cavity, other superior configurations potentially exist. Various features of the cavity, such as wall thicknesses, rib heights, and cavity length, width, and height, could be modified. Alternatively, the feet could also be adjusted to achieve the same relative dimensions as if adjusting the cavity. The end-result of such modifications might be even better pull force results. On the other hand, it may be determined that the grip strength of foot to cavity is greater than is necessary for a particular article of furniture. In which case, the anchor portion could for example be made narrower if that would allow for hand insertion of the feet here disclosed while still providing adequate foot grip and retention.

ASTM Test Results

[0063] Plastic chairs for outdoor use must meet certain performance requirements. ASTM F 1561-03 standard sets forth specific tests to be performed in order to determine if a plastic chair meets those requirements. One test involves placing the chair on a glass surface which simulates smooth surfaces such as linoleum and wet pool decks. Three hundred pounds is placed on the chair. The chair must then hold for at least 30 minutes without failing. Failure occurs when the chair collapses or when any visible evidence of structural damage develops such as a permanent indentation left up beyond 30 minutes to further evaluate performance even though that is not specified as necessary for the ASTM standard.

[0064] Testing was conducted on three types of plastic molded chairs sold by Adams Mfg. of Portersville, Pa.: an Adirondack chair sold under the ERGO ADIRONDACK® brand, a regular Adirondack chair, and a low back chair. All three chairs were tested under four conditions when placed on a glass surface having a 300 pound weight according to ASTM F 1561-03. First the chairs were equipped with feet configured as in FIGS. 12A-D. Second, the chairs were tested with all four molded plastic feet of the type that were used prior to the prior art. Those feet are T-shaped and made of 88 durometer Shore A polyvinyl chloride. Then the chairs were tested with three of those conventional feet, one foot having been removed. Finally the chairs were tested without any feet simulating a condition where all feet had fallen out of the chair. Since the feet here disclosed are very unlikely to come out of the legs no testing was done with three or fewer feet of the type here disclosed. Table 1 reports the minutes to failure for these chairs under those four conditions. Table 2 reports the percentage decrease in holding time versus the holding time achieved with the feet herein disclosed.
Table 1 shows the chairs with the new feet performed better than those with conventional feet. We attribute the improvement to the use of softer durometer material for the surface of the foot which contacts the floor. The softer material has better frictional properties. Prior to the present invention such soft materials could not be used because of tearing or inability to insure the soft material into a cavity in a chair leg without folding or distorting the materials. As Table 2 shows, the use of conventional feet results in hold time decreases of 10% and 13% for the two types of Adirondack chairs. Using conventional feet with the Low Back chair only resulted in a decrease of about 3% in hold time, but the chairs with conventional feet had inferior performance.

Since conventional feet can and do fall out of a chair leg, the more important comparison is with failure times for chairs with 3 conventional feet and no feet. There are massive decreases in holding time when just one conventional foot has been removed. With one foot missing, the chairs tested lost anywhere from 47% to 70% of their holding strength.

Because failure time in this ASTM test is a predictor of failure of a chair during use, the feet disclosed here provide a much safer plastic chair.

Another thing this testing brings to light is that chairs that do not have the securely locked-in feet disclosed can only be said to be able to pass the 30-minute ASTM requirement with the caveat “as long as none of the feet have fallen out”. The Adams Mfg. regular Adirondack chair tested, which held over twice as long as the ASTM standard dictates when all four feet were intact, did not pass the test with one conventional foot missing. Chairs that were made by competitors of Adams Mfg. were purchased at various retail locations and were also tested. A foot was easily removed from one such chair and that chair only held for 11 minutes before failing.

ASTM standards for outdoor furniture could in the future be updated to include a “pull force test” such as described in the previous section. The test might require that feet be able to withstand a minimum axially directed force of such as 45 lbs. or 60 lbs. without releasing from the cavity. It could stipulate that if the feet are unable to withstand that force, then, for a chair to be deemed as acceptable, all the feet would need to be removed before the chair is tested. This would reduce the occurrence and risk of consumers getting chairs with one or more missing feet which, as a result, do not meet ASTM’s standard that chairs must hold 300 lbs. on glass for at least 30 minutes.

While we have disclosed certain present preferred embodiments of our feet for molded plastic furniture, furniture containing those feet and a method of installing those feet, it should be distinctly understood that our invention is not limited therefore but may be variously embodied within the scope of the following claims.

What is claimed is:

1. A foot for molded plastic furniture comprising:
   a pad portion having a substantially flat top surface and made of a plastic or thermoplastic rubber having a first hardness; and
   an anchor portion made of a second plastic or metal having a second hardness which is harder than the first hardness, the anchor portion comprising:
   a base having a substantially flat first surface bonded to the substantially flat surface of the pad portion, and a top opposite the first surface;
   a projection integral to the base and having an outer surface that defines a cross-sectional shape of the projection; and
   at least one rib on the outer surface of the projection.

2. The foot of claim 1 wherein the pad portion has a Shore A durometer of 60 and the anchor portion has a Shore D durometer of at least 74.

3. The foot of claim 1 wherein a cross-section of the projection is a polygon, a circle, or an oval.

4. The foot of claim 1 wherein the cross-sectional shape of the projection is rectangular and the at least one rib is comprised of a pair of ribs on opposite sides of the projection.

5. The foot of claims 1 wherein the pad portion and anchor portion were formed by co-extrusion of the pad portion and the anchor portion.

6. The foot of claim 1 wherein the base has sidewalls and the pad portion extends over the sidewalls.

7. The foot of claim 6 wherein the pad portion has a cross-sectional area parallel to the top surface and the top surface has an area greater than 75% of the cross-sectional area of the pad portion.

8. The foot of claim 1 wherein the projection is cylindrical and the at least one rib is at least one thread.

9. The foot of claim 8 also comprising a catch attached to the at least one thread.

10. The foot of claim 1 wherein the anchor portion also comprises of at least one additional projection integral to the base.

11. The foot of claim 1 wherein the plastic is a polyvinyl chloride, thermoplastic elastomer, polyurethane, mixture thereof or combination thereof.

12. The foot of claim 1 wherein the second plastic is a polyvinyl chloride, nylon, filled polypropylene, ABS, polycarbonate, mixture thereof or combination thereof.

13. The foot of claim 1 also comprising a leg having a cavity into which the projection of the anchor portion has been inserted.

14. The foot of claim 1 also comprising an article of furniture having a cavity into which the projection of the anchor portion has been inserted.

15. The foot of claim 1 wherein the anchor portion also comprises a stabilizer configured to prevent rotation of the foot when the anchor is placed in a cavity.

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### Table 3

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<tr>
<td>Adirondack</td>
</tr>
<tr>
<td>Low Back</td>
</tr>
</tbody>
</table>
16. A foot for an article of furniture, the foot comprising:
a) an anchor portion made of a first thermoplastic having a
selected hardness, the anchor portion having a self-cen-
tering surface, an alignment surface, a wedging surface,
a grooving surface, and a retention surface, wherein the
self-centering surface is configured to facilitate entry of
the anchor portion into a receiving cavity of the article of
furniture, the alignment surface is configured to align the
anchor portion within the receiving cavity, the grooving
surface is adjacent to the retention surface, and wherein
the wedging surface, the grooving surface, and the reten-
tion surface are configured to cooperate with each other
to form an indentation in a surface of a receiving cavity
when the anchor portion is forcibly advanced within the
receiving cavity, and the retention surface is configured
to cooperate with the indentation to form an interlocking
joint which opposes the removal of the foot from the
article of furniture; and
b) a pad portion comprising a second thermoplastic having
a hardness less than the hardness of the first thermoplas-
tic, the pad portion having a surface configured to con-
tact a floor;
wherein the pad portion and the anchor portion are bonded
to one another.
17. The foot of claim 16, wherein the first thermoplastic is
selected from the group consisting of polyvinyl chloride,
nylon, filled polypropylene, ABS, polycarbonate, and mix-
tures and combinations thereof.
18. The foot of claim 16, wherein the first thermoplastic is
polyvinyl chloride having a durometer hardness of at least 70
on the Shore D scale.
19. The foot of claim 16, wherein the second thermoplastic
is selected from the group consisting of polyvinyl chloride,
thermoplastic elastomer, polyurethane, thermoplastic rubber,
silicone, and mixtures and combinations thereof.
20. The foot of claim 16, wherein the second thermoplastic
is polyvinyl chloride having a durometer hardness of no more
than 65 on the Shore A scale.
21. The foot of claim 16, wherein the anchor portion and
the pad portion are bonded together by either a co-extrusion
bond or a co-injection molding bond.
22. The foot of claim 16, wherein the anchor portion has a
cavity adapted for receiving a protrusion from a wall of the
receiving cavity.
23. The foot of claim 16, wherein the anchor portion has a
neck region.
24. The foot of claim 16, wherein the first thermoplastic is
polyvinyl chloride having a durometer hardness of at least 70
on the Shore D scale and the second thermoplastic is polyvi-
nyl chloride having a durometer hardness of no more than 65
on the Shore A scale.
A stackable folding chair has a seat and a back pivotably attached to the rear edge of the seat. Front legs are pivotally attached at right and left edges of the seat. Rear legs are pivotally attached to the bottom of the seat. Armrests are pivotally attached to the seat back and adjustably attached to the front legs. The chair is preferably molded from plastic.
<table>
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<th>Patent Number</th>
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<th>Inventor(s)</th>
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STACKABLE FOLDING CHAIR

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of U.S. patent application Ser. No. 29/221,923 now U.S. Pat. No. D,509,970.

FIELD OF THE INVENTION

The invention relates generally to stacking chairs and stackable chairs.

BACKGROUND OF THE INVENTION

Folding chairs of various types are well known. Such chairs typically have a seat which is pivotably attached to legs such that the seat can be pivoted from an open position for sitting to a folded position for storage. Many such folding chairs have a seat back connected between the pair of legs. The advantage of these chairs is that they can be stored in a relatively small space when in a folded condition.

Another type of chair, popular for use as outdoor furniture, is a molded plastic chair. These chairs are a single molded structure and are usually configured so that one chair may be stacked on another chair.

Stackable chairs have an advantage in that they can be stacked upon one another and placed on a pallet for easy transport. A retailer may display the stacked chairs on the same pallet on which they have been shipped. Consumers may also store several stackable chairs stacked upon one another. While the stackability is an advantage for storage and display, larger stackable chairs are disliked by consumers because they will not fit into many automobiles. Consequently, there is a need for a chair which is both stackable and can be folded. Such a chair would fit into most family cars when folded.

Adirondack chairs are a larger type of chair and are very popular. These chairs tend to be either a single molded unit or a wooden chair in which the pieces of the chair are nailed together to form a single unit. Most wooden Adirondack chairs are not foldable, and are also very difficult to stack. Indeed, the only method of stacking such an Adirondack chair is to place one chair in an upright position and the invert the second chair and place it over the first chair. Consequently, there is a need for an Adirondack chair which is both stackable and foldable.

SUMMARY OF THE INVENTION

A stackable folding chair is provided having a seat and a seat back pivotably attached to the rear edge of the seat. A front pair of legs are attached to respective right and left edges of the seat, and a pair of rear legs are pivotably attached to the bottom of the seat at the rear edge of the seat, such that the rear legs can be pivoted from a position generally perpendicular, or at an obtuse angle, relative to the seat to a position at which the rear legs are folded substantially parallel to and beneath the seat. Preferably the front legs are also pivotably attached to the edges of the seat.

The chair also has a pair of armrests which are pivotably attached to the seat back and are adjustably attached to the upper end of the front legs. In one embodiment, adjustment of the armrests relative to the front legs allows the seat back to be set at different angles relative to the seat, and also enables the seat back and front legs to be folded substantially parallel to the seat. In another embodiment, the seat back has only two positions, folded for storage and open for sitting. Reinforcing bars can be attached to the bottom of the seat to enhance strength.

The stackable folding chair is preferably an injected molded plastic product. Preferably, the plastic is polypropylene, polyvinylchloride polycarbonate or ABS. If desired, the plastic may also be reinforced with fiberglass or filled with other materials commonly used in the industry.

Other objects and advantages of the present invention will become apparent from a description of certain presently preferred embodiments shown in the figures.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a front perspective view of a stackable folding chair according to the invention;
FIG. 2 is a left side view of the chair in FIG. 1 with the front cross brace in a lower position, the right side view being a mirror image;
FIG. 3 is a back view of the embodiment shown in FIG. 2;
FIG. 4 is a bottom view of the embodiment shown in FIG. 2;
FIG. 5 is a left side view, with the backrest and rear legs folded against the seat;
FIG. 6 is a left side view of the embodiment of FIG. 2, with the only rear legs folded against the seat; and
FIG. 7 is a front perspective view of five chairs of the embodiment shown in FIG. 1 stacked together.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing figures, wherein like reference numbers designate like elements, a present preferred embodiment of a stackable folding Adirondack style chair 10 is illustrated. The chair 10 has a seat 13, a seat back 15 pivotably attached to a rear edge 17 of the seat 13, and a pair of armrests 20, 21. The seat 13 is supported at or near the front edge by a pair of front legs 23, 25. One leg is attached at right edge 18 and the other leg is attached at left edge 19 of the seat 13. The front legs 23, 25 can be pivotally attached to the edges of the seat 13. The front legs 23, 25 can be pivotally attached to a folded position substantially parallel to and adjacent the right and left edges of the seat 13 as shown in FIG. 5. A pair of rear legs 27, 29 support the seat 13 at or near the rear edge 17, and are pivotably attached to the bottom 44 of the seat 13, such that the rear legs 27, 29 can be pivotally attached to a folded position substantially parallel to and underneath the seat 13 as shown in FIGS. 5 and 6.

The pivotal attachment of the seat back 15 to the lower edge 17 of the seat 13 permits the seat back 15 to be folded toward the top surface of the seat 13, in a position substantially parallel to the seat 13. In particular, the lower edge 31 of the seat back 15 can be hinged to the rear edge 17 of the seat 13 in a known manner. For example, as illustrated in FIGS. 3 and 4, a pair of hinge portions 33, 35 project from the lower edge 31 of the seat back 15, at spaced apart locations thereon. These hinge portions 33, 35 are pivotally captured in respective, correspondingly spaced apart notches 38, 39 provided in the rear edge 17 of the seat 13.

I prefer to provide a cross member or brace 11 between the front legs 23, 25. The cross member may be positioned as in FIGS. 1 and 7 so the seat rests on the cross member. Alternately, the cross member can be lower on the legs as shown in FIG. 2. The cross member prevents the legs from splaying outward. A similar cross member 9 can be provided between the rear legs.
The stackable folding chair 10 is preferably an injected molded plastic product. Preferably, the plastic is polypropylene, polyvinyl chloride, polycarbonate or ABS. If desired, the plastic may also be reinforced with fiberglass or other materials commonly used in the industry. As can be seen in FIG. 4, reinforcing bars 40, 42 can be attached to the bottom 44 of the seat 13 to provide increased strength.

The armrests 20, 21 can be pivotally connected to both the seat back 15 and the front legs 23, 25. The front end of the armrest 20 is attached to the upper end 46 of the front leg 23 by a pin and slot arrangement commonly used in folding chairs. The opposite end of the armrest 20 is pivotally attached to the side of the seat back 15 above the hinged attachment of the seat back 15 to the rear edge 17 of the seat 13. The armrest 20 preferably has an upper support surface 50 and a flange 54, which projects downwardly from, and generally perpendicular to, the upper surface 50 of the armrest 20 and has a slot 61 provided therein which extends substantially the length of the flange 54. In general, the length of the slot 62 is determined with regard to the length required to enable the seat back 15 to fold substantially flat against the top of the seat 13, in a manner which will be described in more detail hereinafter.

A plurality of notches 64 are provided in the flange 54, in the upper edge of the slot 62, and are generally located toward the front of the flange 54, i.e., toward the front edge 66 of the seat 13. The notches 64 define different positions at which the armrest 20 may be set relative to the front leg 23. The upper end 46 of the front leg 23 is pivotally attached to the flange by a pin 70 which extends perpendicularly from the upper portion 46 of the front leg 23. A distal end of the pin 70 is slidably captured in the slot 62 in the flange 54. This manner of attachment of the armrest 20 between the seat back 15 and the front leg 23 allows the angle of the seat back 15 can be adjusted by manipulating the armrests 20, 21.

As can be understood from FIG. 2, lifting upwardly on the armrest 20 moves the pin 70 out of one of the notches 64 in which it is captured. At this point, the pin will slide freely in the slot 62, forward or backward, either to another of the notches 64, or to all the way to a rear boundary 74 of the slot 62. When the desired angle of the seat back 15 is obtained, the armrest 20 is then moved downwardly to capture the pin 70 in an adjacent one of the notches 64. At that point the armrest 20, and the seat back 15 are locked, at the selected location. Movement of both armrests 20, 21 forward and backward in this manner rotates the seat back 15 about the hinged connected between the seat 13 and the seat back 15, changing the angle of the seat back 15 relative to the seat 13. Thus, the angle of the seat back 15 can be conveniently changed and locked in the desired position simply by manipulating the armrests 20, 21 in the manner described.

In another embodiment of the chair only one flange is provided in the armrest. Consequently, the seat back in this chair can only be in one position for sitting.

Referring to FIG. 4, in a preferred embodiment of the armrests each flange 54, 56, is a pair of parallel, spaced apart walls. In particular, flange 54 is formed by a pair of walls 74, 75 on the underside of the support surface 50 of the left armrest 20, and flange 56 is formed by a pair of walls 76, 77 on the underside of the support surface 52 of the left armrest 21. The upper end 46, 48 of each front leg 23, 25, fits between the walls 74, 75 and 76, 77, respectively. A pin 70 connects the upper ends 46, 48 of each front leg 23, 25 between each of the pairs of walls 74, 75 and 76, 77. Each of the pair of spaced apart parallel flanges 74, 75 and 76, 77 has the slot 62 with notches 64 shown in FIG. 2. The pins 70 have a length sufficient such that opposite, distal ends of each pin extend through each side of the upper ends 46, 48 of the front legs 23, 25. The distal ends of each pin are then slidably captured in the slots in the respective pair of walls 74, 75 and 76, 77, such as in the same manner described above in regard to FIG. 2. If desired, one could use a single wall for each flange. However, the double wall arrangement shown in FIG. 4 provides greater strength and stability.

FIG. 5 illustrates the chair 10 in a fully folded position, with the seat back 15 and front legs 23, 25 folded substantially parallel to the seat 13. This position of the seat back 15 and front legs 23, 25 is obtained by manipulating the armrests 20, 21 to move the pins fully to the rear boundaries of the slots in the flanges.

Referring back to FIGS. 2 and 3, in addition to the adjustably slidable attachment of the front legs 23, 25 to the armrests 20, 21, each front leg 23, 25 is also pivotally attached to right 18 and left 19 edges, respectively, of the seat 13. The front legs 23, 25 are attached to respective edges 18, 19 of the seat 13 at a location intermediate the base of each leg 20, 21 and the pivot attachment of each leg 23, 25 to the armrests 20, 21, and somewhat closer to the upper end 46, 48 of each leg 23, 25. The specific location of attachment is a function of the style of the chair, i.e., an Adirondack chair, and also takes into account the folding characteristics of the chair 10 which enable the seat back 15 and front legs 23, 25 to be folded substantially parallel to the seat 13.

The pivot connection of the front legs 23, 25 to the left 18 and right 19 edges of the seat 13 facilitate the folding of the front legs 23, 25, along with the seat back 15, when the armrests 20, 21 are manipulated to fold the chair 10. Since the armrests 20, 21 pivotally connect the upper ends 46, 48 of the front legs 23, 25 to the seat back 15, moving the armrests 20, 21 fully forward causes both the seat back 15 and the front legs 23, 25 to fold substantially parallel to the seat 13. In this position, the seat back 15 is adjacent the top of the seat 13 and the front legs 23, 25 are adjacent the right 18 and left 19 edges of the seat 13.

To provide stackability, and to further improve compactness when the chair 10 is folded, the rear legs 27, 29 are pivotally attached to the bottom 44 of the seat 13, near the rear edge 17 and at opposite sides thereof. This permits the rear legs 27, 29 to be folded from an extended position generally perpendicular to, or at an obtuse angle to, the seat 13, as shown best in FIG. 2, to a folded position where the rear legs 27, 29 are substantially parallel to and beneath the bottom 44 of the seat 13, as shown in FIG. 6. Moreover, the rear legs 27, 29 may pivot independently of the seat back 15 and front legs 23, 25. Folding of the rear legs 27, 29 increases the compactness of the chair 10 when the seat back 15, armrests 20, 21, front legs 23, 25 are also folded.

The separately folding rear legs 27, 29 also facilitate the stacking of the chair 10 in an unfolded configuration shown in FIG. 6. The rear legs 27, 29 can be folded independently, permitting the seat back 15, armrests 20, 21 and front legs 23, 25 to each remain in the unfolded position. With only the rear legs 27, 29 folded, the chairs 10 can be stacked upon the other, as illustrated in FIG. 7. In the stacking configuration, the seat back 15 remains in the upturned position, with the front legs 23, 25 extended. The rear legs can be folded to the fully folded position shown in FIG. 6 or to an intermediate position shown in FIG. 7. Locking tabs, not shown, can be provided on the rear legs to retain the rear legs in that intermediate position. With the rear legs so positioned the chairs can be stacked such that the bottoms of the rear legs of one chair stand on the seat of the chair immediately below that chair as shown in FIG. 7. If the rear legs are fully folded as in FIG. 6, then one...
side of the rear legs would rest on the seat of the chair immediately below those legs and the chairs would be nested more closely together than they are shown in FIG. 7.

In the event that a person should sit on the top chair in a stack of chairs the stack should not collapse and no chairs in the stack should be damaged. Since the upper ends of the front legs curve outwardly, one does not want that curved portion to force the arms of the chair below to splay outward should the top chair be pushed too far down. The construction of the rear legs should prevent the chair from being pushed so far down that the curved portions of the front legs will engage the arms of a chair below. However, if a force is applied only to the front edge of the seat of the upper chair, that chair could tilt within the chair in which it is nested. Therefore, I prefer to provide a wing 47 having a flat bottom 47a extending from the upper end of each front leg. These wings can be seen most clearly in FIGS. 3 and 7. When the front of the upper chair in a stack is pushed downward, the flat bottom 47a of each wing 47 will rest on the top surface of an arm of the chair below. Consequently, the downward force will not cause those arms to splay outward.

I may also provide a rib 51 shown in dotted line in FIG. 7 that extends from each wing 47. This rib 51 will fit within a groove or slot 53 when the chair is fully nested locking the two chairs together. The optional ribs 51 and slot 53 are illustrated in FIG. 7 as being much larger than they would be in the actual chair so that these features can be clearly seen in the drawing.

The folding Adirondack chair 10 according to the invention thus has the advantage that multiple chairs 10 can be stacked one upon another and placed on a pallet for easy transport. A retailer can also display the stacked chairs 10 on the same pallet on which they were shipped. The ability to stack the chairs 10 is also advantageous to consumers, because stacking multiple chairs 10 one upon the other enables a more efficient use of storage space.

Additionally, as shown in FIG. 5, with both the front 21, 25 and rear 27, 29 legs folded, the chair 10 folds to a relatively compact overall size. In fact, the stackable folding chair 10 when fully folded as in FIG. 5 is sufficiently compact to fit in most family cars.

Although certain embodiments of the invention have been described in detail, it will be appreciated by those skilled in the art that various modifications to those details could be developed in light of the overall teaching of this disclosure. Accordingly, the invention is not limited to these present preferred embodiments, but may be variously embodied within the scope of the following claims.

What is claimed is:
1. A stackable folding chair comprising:
   a seat having a rear edge, a right edge, a left edge and a bottom;
   a seat back pivotally attached to the rear edge of the seat such that the seat back is foldable to a position substantially parallel to and on top of the seat;
   a pair of front legs, one leg pivotally attached to the right edge of the seat and the other leg pivotally attached to the left edge of the seat; and
   a pair of rear legs pivotally attached to the bottom of the seat such that the rear legs are foldable from an extended position to a position substantially parallel to and beneath the seat;
   a first armrest pivotally attached to one front leg and pivotally attached to the seat back;
   a second armrest pivotally attached to the other front leg and pivotally attached to the seat back;
   each of said first and second armrests slidable relative to each of said pair of front legs such that sliding said armrests relative to said front legs pivots the front legs and the seat back relative to said seat.
2. The stackable folding chair of claim 1 wherein the armrests are configured so that the seat back is locked in only one unfolded position.
3. The stackable folding chair of claim 1 wherein the armrests are configured so that the seat back can be positioned in one of at least two unfolded positions.
4. The stackable folding chair of claim 1 also comprising a wing attached to each front leg, the wing positioned and configured so that when a first stackable folding chair is stacked on a second stackable folding chair, each wing on the first chair will rest upon an armrest of the second chair.
5. The stackable folding chair of claim 1 also comprising a rib attached to each front leg and wherein the armrests each have a slot, the ribs and slots sized and positioned so that when a first stackable folding chair is stacked on a second stackable folding chair each rib will fit within the slot of an armrest of the second chair.
6. The stackable folding chair of claim 1 also comprising reinforcing bars attached to the bottom of the seat.
7. The stackable folding chair of claim 1 wherein the seat, seat back, front legs and rear legs are plastic.
8. The stackable folding chair of claim 7 wherein the plastic is selected from the group consisting of polypropylene, polyvinyl chloride, polycarbonate and ABS.
9. The stackable folding chair of claim 7 wherein at least a portion of the plastic is reinforced plastic.
10. A stackable folding chair comprising:
   a seat having a left edge and a right edge, a rear edge and a bottom;
   a seat back pivotally attached to the rear edge of the seat;
   a pair of front legs, one leg attached to the left edge of the seat and the other attached to the right edge;
   a pair of rear legs pivotally attached to the bottom of the seat such that the rear legs are pivotable from an extended position to a folded position;
   the seat, seat back, front legs and rear legs positioned and configured to enable the chair to be stacked upon one another with the rear legs pivoted to the folded position such that each chair so stacked is nested within another chair;
   each of the front legs pivotally attached to respective right and left edges of the seat;
   a first armrest pivotally attached to one front leg and pivotally attached to the seat back;
   a second armrest pivotally attached to another front leg and pivotally attached to the seat back;
   each of said first and second armrests slidable relative to each of said pair of front legs such that sliding said armrests relative to said front legs pivots the front legs and the seat back relative to said seat; and
   each of said first and second armrests, the seat, seat back, front legs and rear legs positioned and configured to enable the chair to be stacked upon one another with the rear legs pivoted to the folded position such that each chair so stacked is nested within another chair.
11. A stackable folding chair comprising:
   a seat having a left edge and a right edge, a rear edge and a bottom;
   a seat back pivotally attached to the rear edge of the seat;
   a pair of front legs, one leg attached to the left edge of the seat, and the other attached to the right edge;
a pair of rear legs pivotably attached to the bottom of the seat such that the rear legs are pivotable from an extended position to a folded position;
the seat, seat back, front legs and rear legs positioned and configured to enable the chair to be stacked upon one another with the rear legs pivoted to the folded position such that each chair so stacked is nested within another chair; and
a wing attached to each front leg, the wing positioned and configured so that when a first stackable folding chair is stacked on a second stackable folding chair, each wing on the first chair will rest upon an armrest of the second chair.

12. A stackable folding chair comprising:
   a seat having a left edge and a right edge, a rear edge and a bottom;
   a seat back pivotably attached to the rear edge of the seat;
a pair of front legs, one leg attached to the left edge of the seat, and the other attached to the right edge;
a pair of rear legs pivotably attached to the bottom of the seat such that the rear legs are pivotable from an extended position to a folded position;
the seat, seat back, front legs and rear legs positioned and configured to enable the chair to be stacked upon one another with the rear legs pivoted to the folded position such that each chair so stacked is nested within another chair; and
a rib attached to each front leg and wherein the armrests each have a slot, the ribs and slots sized and positioned so that when a first stackable folding chair is stacked on a second stackable folding chair each rib will fit within the slot of an armrest of the second chair.

* * * * *
SEAT FOR MOLDED PLASTIC CHAIRS

A seat on a stool, chair or bench has a permanent depression in the surface of the seat that corresponds in shape to an end view of a human iliac bone. This shape has concave curved central channel which has a first end and a second end. There is a first concave boomerang shaped channel having a central portion connected to the first end of the concave curved central channel and a second concave boomerang shaped channel having a central portion connected to the second end of the concave curved central channel. A chair, stool or bench whose seat has such a permanent depression is more comfortable to the person sitting on that seat than hard seats on seating devices known in the art.
SEAT FOR MOLDED PLASTIC CHAIRS

FIELD OF THE INVENTION

The invention relates particularly to molded plastic furniture, particularly chairs and stools having a hard surface seat.

BACKGROUND OF THE INVENTION

Molded plastic chairs are popular for use as outdoor furniture because they are not damaged by rain or snow. Molded plastic furniture is also light weight. Many molded plastic chairs are configured to be stackable so that several chairs can be stacked one upon the other for storage.

The seat in most molded plastic chairs is a flat or curved surface that may be horizontal or inclined. Because the surface is hard, many people become uncomfortable after being seated for a period of time. Depending on the person, that period of time may be less than five or ten minutes or as long as an hour. Many people will place cushions on the seats of molded plastic chairs to make them more comfortable.

Wooden chairs and indeed any chair which has a hard surface on the seat can be quite uncomfortable, particularly when the person must sit there for an extended period of time. Manufacturers have tried to make hard seats more comfortable by providing a contour in the seat surface. The contour or depression has been round or oval roughly corresponding to the outer surface of the buttocks of an average person who may sit on the seat. Indeed, some wooden seats used in classroom chairs have been shaped to make them more comfortable. Such shaping has generally involved providing a pair of spaced apart concave areas extending from the edge of the seat inward or an oval or round concave depression in the center of the seat.

When a person sits on a hard surface, the gluteus maximus and other muscles and tissues in the posterior are compressed. At the same time, blood vessels are compressed, adding to the discomfort. The objective in providing curved surfaces in seats is to increase the contact area between the seated person and the seat to spread the forces over a greater area. Prior to the present invention, that art has shaped those surfaces to generally correspond to the shape and position of the thighs and buttocks of the average person who may sit on that seat. Although these contour surfaces often make a hard seat more comfortable than a flat seat, even hard surfaced seats that have been made with curved surfaces tend to become uncomfortable. Consequently, there is a need for a seat having a hard surface that is formed in such a manner as to be more comfortable to the person seated on that seat.

SUMMARY OF THE INVENTION

We provide a seat, as well as a chair, a bench, and a stool having a seat, which is preferably made of molded plastic, but could also be made of wood or concrete or a hard composite material. The seat has a permanent depression in the surface of the seat that corresponds generally in shape to the lower protuberances of a human iliac bone. This shape has concave curved central channel which has a first end and a second end. There is a first concave boomerang shaped channel having a central portion connected to the first end of the concave curved central channel and a second concave boomerang shaped channel having a central portion connected to the second end of the concave curved central channel. A chair, stool or bench whose seat has such a permanent depression is more comfortable to the person sitting on that seat than hard seats on seating devices known in the art.

We may also provide a pair of depressions that extend from the central channel to the front edge of the seat and which depressions correspond to the rear surface of a human thigh. Depending upon the type of chair on which the seat is used and whether the seat is inclined or horizontal, the central channel may be centered relative to the front edge and the rear edge of the seat or be closer to the front edge or closer to the rear edge of the seat.

Other details and advantages of the invention will become apparent from a description of certain preferred embodiments shown in the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a first present preferred embodiment in the form of a stool having a seat which has a permanent depression in the surface of the seat that corresponds in shape to an end view of a human iliac bone.

FIG. 2 is a top view of the stool shown in FIG. 1.

FIG. 3 is a sectional view taken along the line III-III in FIG. 2.

FIG. 4 is a sectional view taken along the line IV-IV in FIG. 2.

FIG. 5 is a sectional view taken along the line IV-V in FIG. 2.

FIG. 6 is a sectional view taken along the line VI-VI in FIG. 2.

FIG. 7 is a perspective view of a second present preferred embodiment in the form of a chair having a seat which has a permanent depression in the surface of the seat that corresponds in shape to an end view of a human iliac bone.

FIG. 8 is a perspective view of a third present preferred embodiment in the form of an Adirondack chair having a seat which has a permanent depression in the surface of the seat that corresponds in shape to an end view of a human iliac bone.

FIG. 9 is a perspective view of a fourth present preferred embodiment in the form of a bench having a seat which has a permanent depression in the surface of the seat that corresponds in shape to an end view of a human iliac bone.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring to FIGS. 1 through 6 we provide a stool 1 having a seat 2 and legs 4 that extend from the seat. In this embodiment the seat is generally square having rounded corners and a leg extends from each corner of the seat. However, the seat could be round, rectangular or oval and the stool may have three legs. This stool has a back 6 along the back edge 7 of the seat. The seat also has a front edge 8, a right edge 9 and a left edge 10. The stool is preferably made of a molded plastic such as polyvinyl chloride or polyethylene.

The seat 2 has a permanent depression 12 in the surface 13 of the seat that corresponds in shape to an end view of a human iliac bone. This shape has concave curved central channel 14, a first concave boomerang shaped channel 15 connected at its center to one end of the concave curved central channel and a second concave boomerang shaped channel 16 connected at its center to an opposite end of the concave curved central channel. The concave curved central
channel and the two boomerang shaped channels form a bent dog bone shape. The concave curved central channel has a length of between 5 and 8 inches (12.7 to 20.3 cm.). The two boomerang shaped channels extend that length to between 9 and 12 inches (22.9 to 30.5 cm.). The concave curved central channel has a maximum depth which preferably does not exceed ½ inch (1.6 cm.). The bottom of the concave curved central channel 15 may be flat or slightly concave. Side walls extend upward from the base of the concave curved central channel. As can be seen most clearly in FIG. 2 through 6 these sidewalls curve toward the front edge or toward the rear edge of the seat. They also curve toward the right side or toward the left side of the seat. We also prefer to provide a pair of concave cavities 21, 22 one concave cavity extending from each of the boomerang shaped channels 15, 16 to the front edge 8 of the seat 12. These cavities 21 and 22 are shaped to correspond to a rear surface of a human thigh. The cavities are spaced apart from one another so that when an average adult person sits on the seat that person’s thighs will be on the cavities. While we prefer to provide cavities 21 and 22, such cavities are not essential and may be omitted. [0020] We have discovered that when a person sits on a hard surface several muscles are compressed. When the buttocks are sandwiched between a hard seating area and the prominent lower curve of the iliac bone protuberances (the lower part is the ischium), discomfort ensues to the overly compressed gluteus maximus muscles, the blood vessels within, and the skin. Pressure comes from both the hard seat and the ischium bones, increasingly cutting off circulation and compressing nerves as the pressure on the sitter’s rear end continues to be maintained. By putting the right size and shape of depression in the chair seat, the maximum distance is maintained between the ischium and the seat surface. That configuration relieves pressure on the gluteus maximus muscles and the skin, making our new seat more comfortable. [0021] Variations in human sizes were carefully considered. We designed the cavity to fit people between 4’11” and 6’3” comfortably. We made sure that the present design made the seat as comfortable as possible for sitters weighing between 95 and 240 pounds. [0022] When a person sits on a chair, the two lowest protuberances of the iliac bone are pushed downward, toward the surface of the chair. The lower iliac protuberances press against the tissue between them and the actual seat. By providing a depression beneath each lower iliac protuberance, the compression of tissue between the lower iliac protuberance and the seating surface is minimized. [0023] The seat design disclosed herein was developed based upon feedback from people ranging in size from 5’ to over 6’ tall. Various sizes and shapes of depressions were made and compared. The sizes that we have used in this application work best. Some rounding is necessary, and when the chair seat is angled backwards, as in an Adirondack chair, the cavities are deeper in the rear portion than in the front. That configuration lets the bone push above the depression that is beneath it, which has shifted to the rear depending on the slant of the chair and angle of the back. [0024] The shape of the seat also takes into account the sensitive perineum area between the anus and the scrotum in males and between the anus and the vulva in females. When we provide the more comfortable cavity for the tissue beneath the iliac bone, the seat does not force the perineum area to absorb more pressure. The depressions in our seat minimize depression of the tissue below the lower iliac protuberances in a way that does not transfer more pressure to the perineum. Our seat has achieved maximum comfort to the sub-iliac area while relieving pressure to the perineum. In short, we eliminate pressure on the premium while reducing pressure to the maximum on the tissue below the lower iliac protuberances. [0025] Some chairs use leather, webbing, or plastic straps to make the seat. When a person “sinks into” such a surface, the buttocks are forced together, making seating less comfortable. Such discomfort increases over time as the lower iliac protuberances compress the tissue beneath them. To make even these flexible seats more comfortable, a depression similar in size to that disclosed in this invention may be formed into the surface of such a seat. And, these depressions are also helpful in cushions, keeping the sub-iliac tissue and the nerves and blood vessels between those bones and chair surface from being needlessly compressed. [0026] The depth and placement of the permanent depression should change from chair to chair, depending on the angle of the back. In the present embodiment of a stool shown in FIG. 1 through 6, the concave curved central channel 14 will be farther to the rear because the angle of the spine approximates 90 degrees. If such a permanent depression were to be put in an Adirondack chair, where the angle of the back to the thighs is greater than 90 degrees, the permanent depression may be shallower, and deeper in the back than in the front, as well as being moved slightly forward. Generally, the permanent depression should be centered relative to the right edge and the left edge of the seat. In any chair, the position of the permanent depression should be such that pressure from the ischium does not compress the gluteus maximus muscles, the skin, nerves, and blood vessels any more than absolutely necessary. [0027] In commercial embodiments of the seat, there may be some rounding and changing of the shapes that provide maximum comfort to the tissue between the iliac bone’s lower projections and the seating surface. While maximum comfort is important, the commercial embodiments may differ from the comfort ideal when it is thought more important to provide a cleaner, more attractive visual appearance. [0028] If desired, one could provide a higher back and arms on the stool shown in FIG. 1. One arm would be above and adjacent the right edge of the chair and the second arm would be above and adjacent the left edge of the chair. [0029] We may provide a hole 24 shown in dotted line in FIG. 2 in the top of the seat. This hole may be 1.5 inch (3.8 cm.) in diameter and allows water to drain from the permanent depression 12. The hole may enable a rotatable seat or a planter (not shown) to be held on the stool. [0030] Referring to FIG. 7 a second present preferred embodiment is in the form of a chair 30 having a seat 32 which has a permanent depression 33 in the surface of the seat 32 that corresponds in shape to an end view of a human iliac bone. This depression 33 is of the same size and shape as the permanent depression 12 in the embodiment of FIGS. 1 through 6. The chair has four legs 35 that extend from the seat and a back 36. An arm 37, 38 is provided above and adjacent the right edge and above and adjacent the left edge of the seat. [0031] A third present preferred embodiment shown in FIG. 8 is the form of an Adirondack chair 40 having a seat 41 which has a permanent depression 42 in the surface of the seat 43 that corresponds in shape to an end view of a human iliac bone. This depression 42 is of the same size and shape as the permanent depression 12 in the embodiment if FIG. 1 through 6.
[0032] Turning to FIG. 9 a fourth present preferred embodiment is in the form of a bench 50 that is sized for two people. The bench has a seat 51 which has a pair of permanent depressions 52 in the surface of the seat 51. These depressions 52 are of the same size and shape as the permanent depression 12 in the embodiment of FIG. 1 through 6. Longer benches can be made which have more than two permanent depressions 52, there being one permanent depression for each person for whom space is provided on the bench.

[0033] While we have shown and described certain present preferred embodiments of our seat for molded plastic furniture, it should be distinctly understood that the invention is not limited thereto but may be variously embodied in the scope of the following claims.

What is claimed is:

1. A seat for molded plastic furniture of the type having a surface on which a person sits, where the improvement comprises:
   the surface of the seat having a permanent depression that corresponds in size and shape to an iliac bone of a person.

2. A seating device of the type having a seat surface on which a person sits, the seat surface being plastic, wood, metal or concrete and the seat surface having a permanent depression whose shape corresponds to an end view of a human iliac bone.

3. The seating device of claim 2 wherein the surface has a pair of concave cavities that extend from the permanent depression, the cavities having a shape that corresponds to a rear surface of a human thigh.

4. The seating device of claim 2 wherein the seating device is a chair, a stool or a bench.

5. A seating device of the type having a seat surface on which a person sits, the seat surface having a permanent depression consisting of a concave curved central channel, the channel having a first end and a second end, a first concave boomerang shaped channel having a central portion connected to the first end of the concave curved central channel and a second concave boomerang shaped channel having a central portion connected to the second end of the concave curved central channel.

6. The seating device of claim 5 wherein the seat surface is molded plastic.

7. The seating device of claim 5 wherein the central channel has a depth which is not greater than ½ inches.

8. The seating device of claim 5 wherein the central channel is centered on the seat surface.

9. The seating device of claim 5 wherein the seat surface has a front edge and a back edge and the central channel is closer to the front edge than to the back edge.

10. The seating device of claim 5 wherein the seat surface has a front edge and a back edge and the central channel is closer to the back edge than to the front edge.

11. The seating device of claim 5 wherein the seat surface has a right edge and a left edge and the central channel is centered relative the right edge and to the left edge.

12. The seating device of claim 5 wherein the seat surface has a right edge and a left edge and further comprising a right arm positioned above and adjacent to the right edge and a left arm positioned above and adjacent to the left edge.

* * * * *
SUCTION CUP HAVING AN OFFSET-MOUNTED HOOK


Appl. No.: 493,806
Filed: Mar. 15, 1990

Int. Cl: F16B 47/00
U.S. Cl: 248/206.2; 248/309.3
Field of Search: 248/205.5, 205.6, 205.7, 248/205.8, 205.9, 206.1, 206.2, 206.3, 309.3, 362

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ABSTRACT

A device is disclosed which utilizes either an offset-mounted hook, or an offset-mounted hook combined with an oval shaped cup body. The suction cup has a cup neck located in a position which allows the vacuum chamber between the cup and the mounting surface to be equidistant from all points on the perimeter of the cup when the cup is under a load. The hook which is attached to the cup neck is mounted along the perimeter thereof to assure proper orientation of the asymmetrical device.

11 Claims, 2 Drawing Sheets
SUCTION CUP HAVING AN OFFSET-MOUNTED HOOK

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a device for suspending small articles from a vertical surface. More specifically, the invention relates to a suction cup and hook in which the hook is mounted on the cup offset from the geometric center of the cup, allowing for greater holding ability.

2. Description of the Prior Art

Suction cups with attached hooks for hanging objects have been available for many years. The prior art is characterized by a device having a cup portion and a hook portion. The cup portion is formed from a single piece of molded plastic or rubber and has a concave front face. The cup portion has a neck extending outwardly from the rear face, opposite the concave front face. The neck is located at the geometric center of the rear face of the cup portion. A hook, usually constructed of hard plastic or metal, is affixed to the neck of the cup portion, and may be permanently mounted or removable.

The suction cup is mounted on a smooth vertical surface by compressing the concave front face of the cup against the vertical surface, forcing the air out of the concave space formed by the front face and the vertical surface. The soft cup then creates a seal around this chamber and air is prevented from re-entering it. The cup is thus secured in place. Lightweight objects may then be suspended from the hook attached to the cup neck.

One problem with this prior art device is that over time, air tends to leak back into the vacuum chamber between the cup and the vertical surface when the device is under a load. One reason for this slow leakage is that the weight of an object suspended from the neck distorts the concave face of the cup, pulling part of the cup away from the vertical surface. As shown in FIG. 1, the neck 3 of cup 1 has been displaced downwardly, causing the chamber 2 beneath the cup to shift upwardly. The chamber 2 is displaced in such a fashion that the air outside the perimeter of the cup may be drawn into the chamber 2 by the vacuum created therein. The distance 5 between the chamber 2 and the perimeter of the cup 1 is markedly less than corresponding distance 6 at the opposite end of the cup 1. This disproportionate distance 5 permits increased air leakage in area 4 between the exterior environment and the chamber 2. This eventually causes the vacuum within the chamber 2 to dissipate, and the cup to fall.

What is lacking in the art, therefore, is a device which utilizes a suction cup designed to resist the flow of air from the environment outside the cup to the chamber between the cup and the mounting surface while the cup is under a load.

SUMMARY OF THE INVENTION

A device is disclosed which utilizes either an offset-mounted hook, or an offset-mounted hook combined with an oval shaped cup body. The cup is designed to be mounted on a vertical surface in the same manner as prior art suction cups. The cup neck of my device is located in a position which allows for a more uniform settlement of the chamber under the cup, when the cup is distorted by the weight of an object suspended therefrom. The cup neck is preferably mounted at a point which will allow the chamber to be equidistant from all points on the perimeter of the cup when the cup is under a load. A hook which is attached to the cup neck is permanently mounted therein to assure proper orientation of the asymmetrical device.

These and other advantages and features of the present invention will be more fully understood with reference to the presently preferred embodiments thereof and to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front plan view of a prior art device pressed against a flat surface.

FIG. 2 is a front plan view of a first present preferred embodiment of the suction cup device.

FIG. 3 is a side view of the device of FIG. 2 pressed against a flat surface.

FIG. 4 is a front plan view of the device of FIG. 2 which is under a load.

FIG. 5 is a side view of the device shown in FIG. 4.

FIG. 6 is a sectional view of the device of FIG. 4, taken along line VI—VI.

FIG. 7 is a front plan view of a second preferred embodiment of the suction cup device.

FIG. 8 is a side view of the device of FIG. 7.

FIG. 9 is a front plan view of the device of FIG. 7 which is under a load.

FIG. 10 is a sectional view of the device shown in FIG. 9, taken along line X—X.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Two present preferred embodiments of my suction cup having an offset hook are illustrated in the figures beginning with FIG. 2. The first embodiment of the device, shown in FIGS. 2 through 6, utilizes a cup body 10 having a neck 16 extending outwardly therefrom. The cup neck 16 is mounted offset from the geometric center of the cup body 10. The cup body 10 is thus divided by chord 19 which passes through cup neck 16. This creates two sections, large cup portion 14 and small cup portion 12. The cup body 30 is also divided into left and right hemispheres, as shown in FIG. 1, by major diameter 17. The cup neck 16 is located on the major diameter of the cup body 10. The preferred location of the cup neck 16 on major diameter 17 is such that the ratio of long cup radius 24 along major diameter 17 (see FIG. 3) of large cup portion 14 to short cup radius 22 of small cup portion 12 along major diameter 17 is between 1.5:1 to 2:1.

A hook 18 is mounted within the cup neck 16 and is axially rotatable therein. The hook 18 is, however, mounted within cup neck 16 such that it cannot be rotated with respect to the perimeter of cup neck 16. This insures that hook 18 is always properly registered with the offset cup neck 16. The device should therefore be mounted and utilized so that the hook and cup body are in the proper orientation.

A tab 20 is optionally placed on the perimeter of the cup body 10 to facilitate removal. If the tab is utilized, it may be located on the perimeter of the cup body 10 at a point opposite the hook from which objects will be hung.

Referring to FIG. 3, the vacuum chamber 26 is shown as being bounded by the cup body 10 and the mounting surface 21. The cup neck 16 divides the outer...
When the device is in use, an object is suspended from the hook 18. The weight of the suspended object causes the cup neck 16 to bend and distort the cup body 10 as shown in FIGS. 4 and 5. The cup neck 16 is bent forward in the direction of the arrow of FIG. 5. Both long and short cup radii 24 and 22, respectively, are bent into curved shapes, and the vacuum chamber 26 is displaced from its resting position. As shown in FIG. 4, however, the offset location of the cup neck 16 allows the vacuum chamber 26 to be evenly spaced from the outer perimeter of the cup body 10 while under the load. Distance 28 is therefore substantially constant about the entire perimeter of the cup body 10. This constant spacing helps to prevent air from leaking into the vacuum chamber 26 from the exterior environment. The variable spacing of distance 29 is more clearly shown in FIG. 6, in which the contact surface between the cup body 10 and the mounting surface is equal for both the long cup radius 24 and the short cup radius 22.

As previously stated, the cup body and hook are fixed with relation to each other to prevent rotation of the hook around the neck. Therefore, the hook 18 will always be aligned with a fixed direction corresponding to short cup radius 22 as shown in FIGS. 2 through 6. This insures that the large cup portion 14 will always be at the top of the cup body 10, as shown in FIGS. 2 through 6, and that the vacuum chamber 26 will always be displaced into the proper position when the device is under a load.

A second preferred embodiment of the device is illustrated in FIGS. 7 through 10. The second embodiment is quite similar to the first embodiment, save that the cup body 36 is oval or elliptical in shape, as compared to the circular cup body 10. A chord 19 passing through the cup head 16 separates the cup body 36 into a large cup portion 14 and a small cup portion 12, as shown in FIG. 8. The relationship between the small cup portion 12 and the large cup portion 14 is the same as that of the first embodiment. The cup body 36 is thus divided by chord 19 which passes through cup neck 16. This creates two sections, large cup portion 14 and small cup portion 12. The cup body 36 is also divided into left and right hemispheres, as shown in FIG. 1, by major diameter 17. The cup neck 16 is located on the major diameter of the cup body 36. The preferred location of the cup neck 16 on major diameter 17 is such that the ratio of the length of long cup radius 24 along major diameter 17 (see FIG. 3) of large cup portion 14 to the length of short cup radius 22 of small cup portion 12 along major diameter 17 is between 1.5:1 to 2:1.

A hook 18 is axially rotatably mounted within the cup neck 16, but is nonrotatably mounted with respect to its orientation about the perimeter of cup neck 16. This insures that the hook 18 is always properly oriented with relation to the offset cup neck 16. The device should therefore be mounted and utilized so that the hook and cup body are in the proper orientation. This insures that the large cup portion 14 will always be at the top of the cup body 36, and that the vacuum chamber 26 will always be displaced into the proper position when the device is under a load. A tab 20 is optionally placed on the perimeter of the cup body 36 to facilitate removal. If the tab is utilized, it is may be located on the perimeter of the cup body 36 at a point opposite the hook from which objects will be hung.

A vacuum chamber 26 is created by the cup body 36 and the mounting surface 21, as shown in FIG. 10. Similar to the first embodiment, when the device is in use, an object is suspended from the hook 18. The weight of the suspended object causes the cup neck 16 to bend and distort the cup body 36 as shown in FIGS. 9 and 10. The cup neck 16 is bent forward in the direction of the arrow of FIG. 10. Both long and short cup radii 24 and 22, respectively, are bent into curved shapes, and the vacuum chamber 26 is displaced from its resting position. As shown in FIG. 9, however, the offset location of the cup neck 16 allows the vacuum chamber 26 to be evenly spaced from the outer perimeter of the cup body 36. Distance 38 is therefore substantially constant about the entire perimeter of the cup body 36. This constant spacing helps to prevent air from leaking into the vacuum chamber 26 from the exterior environment.

While I have described a present preferred embodiment of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise embodied and practiced within the scope of the following claims.

I claim:
1. A suction cup device for mounting on a flat surface, comprising:
a - cup section having a concave front face and a rear face, the concave front face adapted to be affixed to the flat surface, forming an air space therebetween;
 - a neck section extending outwardly from the rear face and offset from the geometric center of the rear face, to a position such that when the neck is displaced by a preselected load, the air space between the cup section and the flat surface is substantially equidistant from any perimeter point of the cup section.
2. A suction cup device as described in claim 1, further comprising hook means, affixed to the neck.
3. A suction cup device as described in claim 2, wherein the hook means is permanently affixed to the neck.
4. A suction cup device as described in claim 1, wherein is divided into a top portion and a bottom portion by a chord through the geometric center of the cup portion, and wherein the neck is located in the bottom portion.
5. A suction cup device as described in claim 4, wherein hook means are affixed to the neck, the hook means having a hook body extending outwardly from the neck, the hook body extending away from the top portion of the cup.
6. A suction cup device as described in claim 5, wherein the cup section has a perimeter edge, the cup section further comprising a tab extending outwardly therefrom.
7. A suction cup device as described in claim 6, wherein the tab is located on the perimeter edge of the cup in the top portion of the cup.
8. A suction cup device as described in claim 1, wherein the cup is circular in shape.
9. A suction cup device as described in claim 1, wherein the cup is oval in shape.
10. A suction cup device as described in claim 1, wherein the cup section has a perimeter edge, the cup section further comprising a tab extending outwardly therefrom.
11. A suction cup device as described in claim 1, wherein the cup is bisected by a major diameter, the neck mounted on said major diameter and dividing the major diameter into a long and a short radius such that the ratio of the radii is within the range of 1.5:1 to 2:1.
SUCTION CUP WITH SOLAR CELL

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Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 772 days.

Appl. No.: 11/484,429
Filed: Jul. 11, 2006

Prior Publication Data

Int. Cl.
A45D 42/14 (2006.01)
F16B 47/00 (2006.01)

U.S. Cl. ................. 248/205.5; 248/363; 248/683; 136/252

Field of Classification Search ........... 248/205.5,
248/206.2; 206.3; 363; 683; 136/251, 252,
136/243

See application file for complete search history.

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ABSTRACT

A suction cup has a cup portion and a head attached to the cup portion. A solar cell is positioned within the head or the cup portion. The solar cell can be placed in a cavity in the head or cup portion or may be molded or formed into the suction cup. The contacts of the solar cell may be positioned so that an object can be hung on the suction cup and be powered by the solar cell. One can also provide a sensor and transmitter or alarm in or on the suction cup and connected to the solar cell such that when the suction cup is moved an alarm will sound.

9 Claims, 4 Drawing Sheets
FIG. 4

FIG. 5
SUCTION CUP WITH SOLAR CELL

FIELD OF INVENTION

The invention relates to suction cups of the type used to hold objects on flat surfaces, particularly window panes.

BACKGROUND OF THE INVENTION

Suction cups have been used for many years to hold objects on window panes and other slick surfaces. The suction cup consists of a flexible cup portion having a concave surface and a head extending from the surface. The head typically is cylindrical and may have a collar, tabs or other structures which facilitate the holding of objects on the suction cup. Suction cups with a slotted head such as disclosed in U.S. Pat. No. 4,588,153 to Boston et al. and my U.S. Pat. No. 5,402,974 have also been used to hold objects on windows.

To mount a suction cup on a flat surface one presses the cup portion against the flat surface. This causes the cup portion to flex driving out the air between the concave bottom of the suction cup and the flat surface. Memory in the cup portion attempts to return the cup portion to its original shape thereby creating a vacuum between the flat surface and the suction cup. The ability of the suction cup to hold objects depends upon the strength of the vacuum created. If the cup portion has few irregularities and the surface is very smooth, the suction cup may stay in place for months or even years. Over time air from outside the suction cup migrates into the region between the flat surface and curved portion of the cup reducing the vacuum. After a sufficient amount of air has entered that region, the suction cup will come loose from the surface. The rate at which air enters that region will depend upon both the smoothness of the surface and the quality of the suction cup. Air infiltration may also be increased by vibration or movement of the cup or the surface to which it is attached.

Many suction cups are made from a clear plastic such that the cups are less visible. Most suction cups today are made from polyvinyl chloride, thermoplastic elastomers, or silicon. One example of a popular suction cup is disclosed in my U.S. Pat. No. 5,049,035.

Many products have been developed which are powered by solar cells. Such products range from clocks to lights. Furthermore, there are several window decorations which are powered by solar cells that are attached to a window by suction cups. An example of such decorations is disclosed in U.S. Pat. No. 5,237,764. Solar cells have been used to charge batteries. Thompson in U.S. Pat. No. 4,539,516 discloses a solar battery energizer which is hung in a window and uses a solar cell to charge a battery. A suction cup is provided to hang the device on a window.

Although suction cups have been used to hold solar powered devices on windows, the art has not incorporated a solar cell into the suction cup. Doing so, however, would enable a variety of objects to be readily powered. They may be remote, or hung from one or more suction cups such that solar cells in the suction cup may power the device.

SUMMARY OF THE INVENTION

I provide a suction cup having a solar cell molded or fixed into either the head or cup portion of the suction cup. Preferably the suction cup is made of a light transmissive material. In addition, I prefer that the light transmissive material be molded to surround the solar cell. This can be done using insert molding. One can also form a solar cell as part of the suction cup by injecting molding various layers of required material.

I prefer to provide the solar cell in or below the head of the suction cup and provide contacts on the suction cup. Contacts are positioned so that one can hang an object having electrical contacts on the head. Electrical contacts would then engage the contacts in the object of the solar cell. A rechargeable battery, of the type found in hearing aids, for instance, may be connected to the cell to provide power to the object when the sun is not shining.

I also prefer to provide a series of suction cups each having a solar cell wherein the solar cells are interconnected to provide a power source.

It is known that suction cups of a frusto-conical or spherical shape or cross section will focus light in an area behind the suction cup. Proper placement of the solar cell in the suction cup takes advantage of this focusing. It captures maximum light for the solar cell, and allows for the proper cross section of the cup to focus the greatest amount of light on the smallest, least expensive cell, even when not in direct sunlight.

Other objects and advantages of the present invention will become apparent from the description of certain present preferred embodiments shown in the drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a perspective view of a present preferred embodiment of my suction cup for solar cell.

FIG. 2 is a sectional view taken along line II-II in FIG. 1.

FIG. 3 is a front view of the suction cup shown in FIG. 1.

FIG. 4 is a front view of an object hung on the suction cup shown in FIGS. 1, 2 and 3.

FIG. 5 is a front view of a power source formed by a set of suction cups of the type shown in FIGS. 1, 2 and 3.

FIG. 6 is a perspective view of a second present preferred embodiment.

FIG. 7 is a sectional view taken along lines VII-VII in FIG. 6.

FIG. 8 is a sectional view similar to FIG. 6 of a third present preferred embodiment.

FIG. 9 is a perspective embodiment of the second present preferred embodiment of the invention in which the suction cup also contains a small vacuum pump.

FIG. 10 is a sectional view taken along the line X-X in FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1, 2 and 3 I provide a suction cup 1 having a cup portion 2 and head portion 4. The bottom of the cup portion 2 has a concave surface 3 which is pressed against a mounting surface. Within a cavity 14 in the head 4 of the suction cup 1 I provide a solar cell 6 having contacts 7. I prefer to provide a pair of slots 8 in the head of the suction cup into which the contacts 7 of the solar cell extend. Then, one can hang an object 20 shown in FIG. 4 on the head of the suction cup. The object has a pair of contacts 22 adjacent a key hole slot 21. The object is hung on the head 2 of the suction cup in a manner so that the contacts 22 of the object engage the contacts 7 of the solar cell. One can provide a small rechargeable battery 9 in the suction cup to provide power to the object when the sun is not shining.

Yet another option is to provide a sensor 17 and transmitter 19 in the suction cup with the battery. The sensor 17 could activate the transmitter when the suction cup is moved to cause an alarm to sound. That alarm may be remote, or may be the object hung on the suction cup. All can be powered by the
solar cell. Hence, the suction cup could be used as a burglar alarm, on a door or window and as a thermal alarm in a refrigerator.

As can be seen in FIG. 2, I prefer to mold the solar cell 6 into the head 4 such that the top surface 5 of the head covers the active surface 9 of the solar cell. A suction cup constructed in this way would be placed on an outside surface of a window with the top surface 5 facing the sun. Alternatively, the solar cell may be reversed and placed lower in the head 2 than shown. In this orientation the active surface would face the cup portion and the suction cup would be placed on the inside surface of the window. It is also possible to provide a solar cell having opposite faces which are both activated by light. A suction cup with this type of solar cell could be placed upon either the inside surface or the outside surface of a window.

Although I prefer to mold the solar cell into the head of the suction cup as shown in FIGS. 1 and 2, there are certain solar cells which can be configured to conform to the cup portion of the suction cup. As an alternative, one can place the solar cell on the upper part of the cup portion adjacent the head where minimal flexing occurs. This alternative position 16 is indicated in dotted line in FIG. 3. The solar cell may completely encircle the head or have a semicircular shape as indicated in FIG. 3. It is also possible to form a solar cell in the cup portion by creating conductive or semi-conductive layers or regions within the suction cup which together operate as a solar cell. These layers may be films which are inserted molded into the suction cup or mixtures of materials that are co-injected to create the solar cell. Each layer will work with the layers above and below that layer to maximize utilization of the light and adhesion to the surface. The layers may also be molded into the cup by putting the layer into the mold cavity and injecting the material so that the layer is attached to the cup. It is well known that solar cells formed of layers are most efficient. Adequate efficiency may be obtained by putting the materials that transform solar power into electricity directly into the cup, using dissimilar injection or extrusion materials whose different characteristics roughly approximate the use of thin layers working in conjunction when used in conjunction with the elements and compounds that actually change light into usable electricity. One embodiment uses co-injection to put the different materials into the mold cavity. Such injections may be precisely tuned to put the desired material in the desired position in the finished product. The same techniques may be used for extrusions of dissimilar materials which will work together to achieve the desired end.

Turning now to FIG. 5, I provide three suction cups 1a, 1b and 1c of the type shown in FIGS. 1, 2 and 3. I further provide a set of leads 11, 12 which extend from each of the contacts of each of the solar cells. The leads are then coupled together to form contact points 11a and 12a which can be coupled to a product to be powered by a solar cell.

It is not necessary that the solar cell be molded into the suction cup. Another way to secure the solar cell to the suction cup is to provide a slot in the head of the suction cup similar to the slot in my U.S. Pat. No. 5,402,974. That slot would be configured to form a cavity sized to receive and hold the suction cup. The solar cell would be placed into the suction cup by spreading at least two of the arms of the head wide enough to fit the solar cell between them. The solar cell is inserted between the spread arms and then the arms are allowed to retreat to their original position and grip the solar cell or secure the solar cell within the cavity in the head.

A second present preferred embodiment 40 shown in FIGS. 6 and 7 has a cup portion 42 and a head 44. The suction cup 40 is shown affixed to a piece of glass 49. The head 44 is open and has a channel 46 about its inside surface 47. The channel 46 is sized to receive the edge of a solar cell 41 such that when the solar cell is attached to the head an airtight seal is formed between the head 44 and the solar cell 41. Essentially, this forms a reasonably air-tight gasket around the solar cell. This cell may be formed conventionally, or may be extruded, or co-extruded in layers. One may provide a bead of silicon or other appropriate material around the edges of the solar cell to improve the seal. It should be understood that the surfaces and structure of the selected solar cell will be designed to be reasonably impenetrable to air, as is true with most solar cells.

A third present preferred embodiment 50 shown in FIG. 8 is similar to the second embodiment and has a cup portion 52 and a head 54. There is a channel 56 on the inside surface of the head which receives a solar cell 41. Unlike the second embodiment, head 54 is not open but has a base 58 below the channel 56.

The present preferred cups may be circular, square, or oval shape, and the head can be generally cylindrical or otherwise shaped to most effectively hold the solar cell. The opening in the head 42, 52 which receives the suction cup may be any shape which corresponds to the solar cell including rectangular or square.

One advantage of molding the solar cell into the head of the suction cup or inserting the solar cell into a slot or cavity in the head of the cup is that the orientation of the active surface of the solar cell will remain fixed relative to the cup portion. Hence, the orientation of the solar cell will also be fixed relative to a surface on which the suction cup is attached. Then the solar cell may be at a predetermined angle relative to the window pane which can improve the light receiving ability of the solar cell.

Yet another embodiment in my suction cup with solar cell is shown in FIGS. 9 and 10. This suction cup 30 has a cup portion 32, head 34 and solar cell 36 contained within the head. I further provide a small vacuum pump 38 on the suction cup. The vacuum pump is powered by the solar cell and periodically removes air from the region adjacent the inside surface 33 of the suction cup. This air is removed through a small channel 39 provided between the inside surface 33 and pump 38. A pressure switch 35 is connected to the pump 38. When the pressure within the chamber defined by the inside surface 37 of the cup portion 32 and the surface 49 in which the suction cup is mounted reaches a predetermined level the pressure switch 35 activates vacuum pump 38. Air is drawn from that chamber through channel 39 causing flap 31 to open and expel air. Consequently, the vacuum which keeps the suction cup in place can be maintained.

Although I have shown and described certain present preferred embodiments of my suction cup with solar cell, it should be distinctly understood that the invention is not limited thereto and may be variously embodied within the scope of the following claims.

1 claim:
1. A suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion,
asolar cell positioned within a cavity in at least one of the head and the cup portion, wherein at least one slot is provided in the head of the suction cup and the solar cell further comprises at least one electrical contact that extends into the at least one slot; and
an object having electrical contacts positioned on the head of the suction cup in a manner so that the electrical contacts of the object engage the electrical contacts of the solar cell.
2. A suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion, and
a solar cell positioned within a cavity in at least one of the
head and the cup portion, wherein the head is comprised
of at least two arms which together define the cavity and
the solar cell is positioned within the cavity.

3. A suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion, and
a solar cell positioned within a cavity in at least one of the
head and the cup portion, wherein the head has an inside
surface which defines the cavity such that the cavity is
open and passes through the head, and which inside
surface has a channel in which edges of the suction cup
are contained, the edges of the solar cell and the channel
forming an airtight seal.

4. A suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion, and
a solar cell positioned within a cavity in at least one of the
head and the cup portion, wherein the head is comprised
of at least two flexible arms that together define a gripp-
ing device which holds the solar cell.

5. A suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion,
a solar cell positioned within a cavity in at least one of the
head and the cup portion, and a vacuum pump attached
to the suction cup and powered by the solar cell, the
vacuum pump positioned and configured to draw air
away from the concave surface of the cup portion of the
suction cup.

6. A suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion,
a solar cell positioned within a cavity in at least one of the
head and the cup portion, and a sensor attached to the
suction cup to sense movement of the suction cup.

7. The suction cup of claim 6 also comprising at least one
of a transmitter and an alarm connected to the sensor.

8. The suction cup of claim 7 wherein the at least one of the
transmitters and the alarm are connected to the solar cell.

9. A power source comprised of a plurality of suction cups
each suction cup comprised of:
a cup portion having a concave surface,
a head attached to the cup portion, and
a solar cell molded into at least one of the head and the cup
portion; and
wherein the solar cell in each suction cup is connected to a
solar cell in another suction cup.