July 16, 1963 R. A. SCHLESS, JR 3,097,901

MOLDED DRAWERS FOR MODULAR STORAGE FACILITIES

Filed Jan. 16, 1961 2 Sheets-Sheet 1

Fig. 1

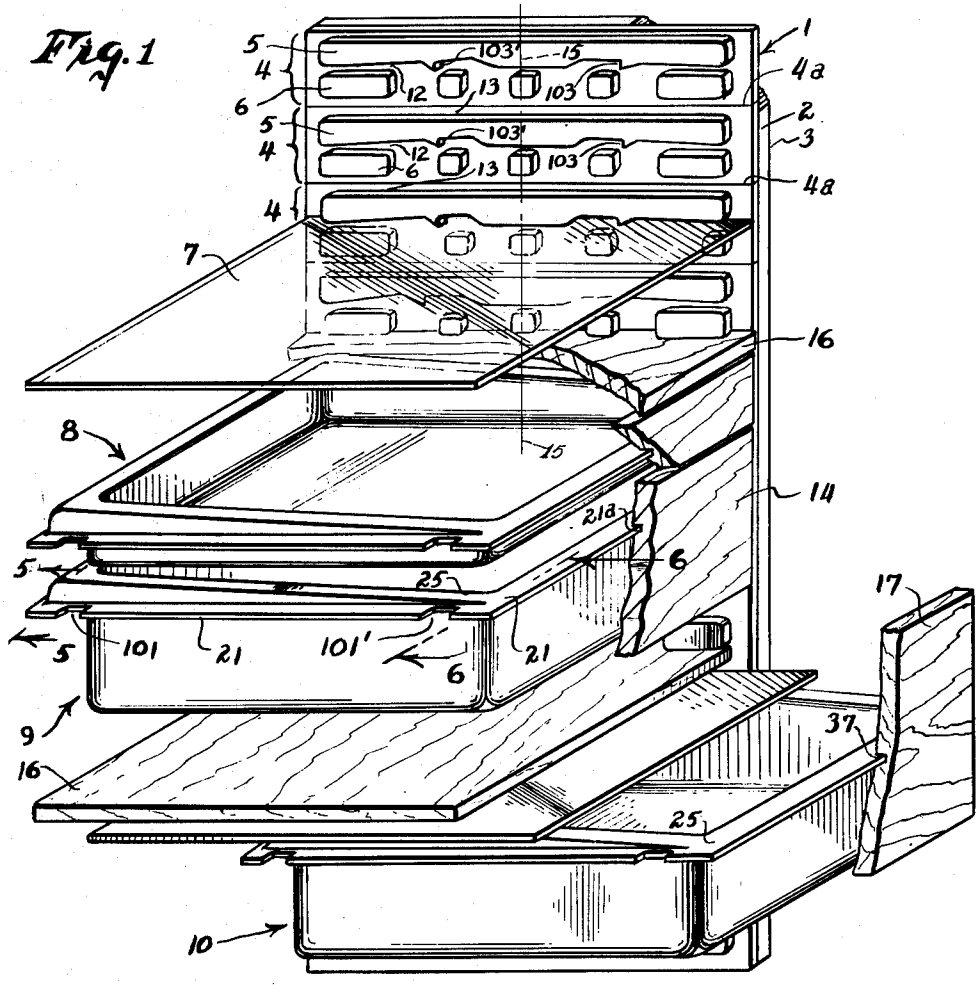



Fig. 2

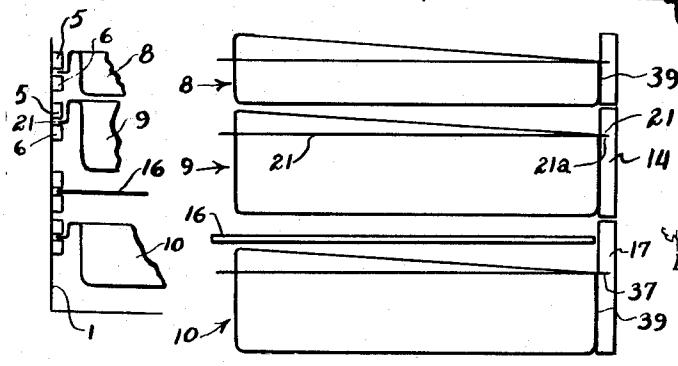
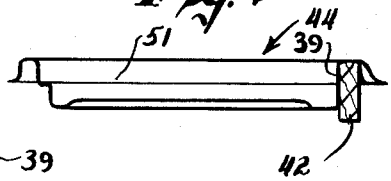



Fig. 3




Fig. 4




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MOLDED DRAWERS FOR MODULAR STORAGE FACILITIES

Filed Jan. 16, 1961 2 Sheets-Sheet 2

Fig. 5

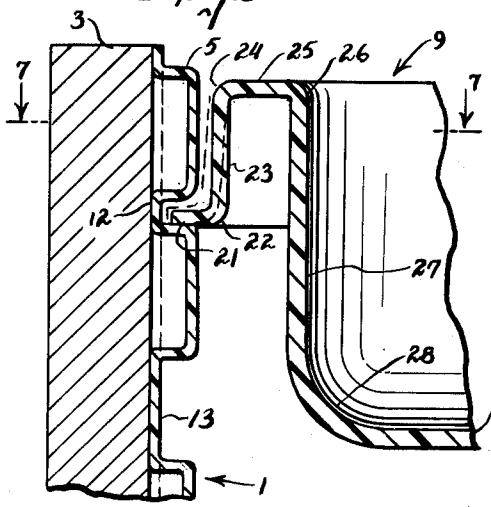



Fig. 7

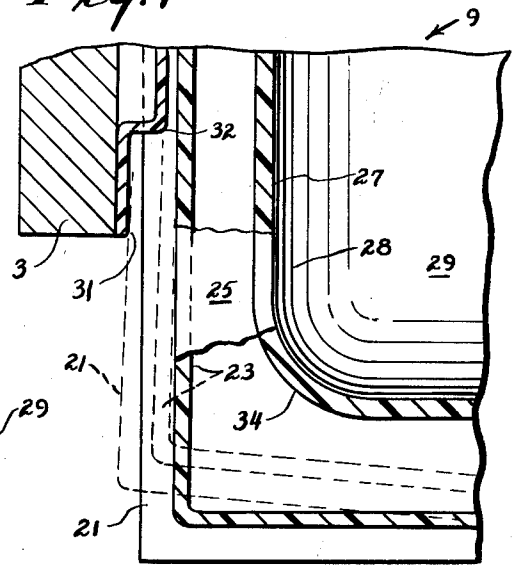



Fig. 6

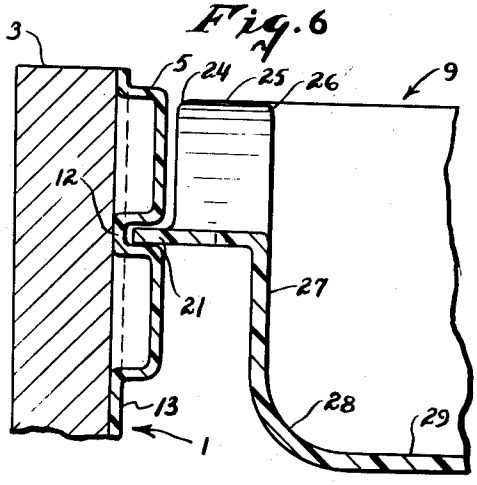



Fig. 8

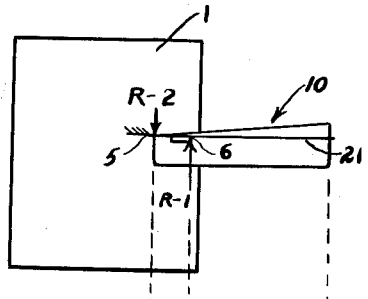
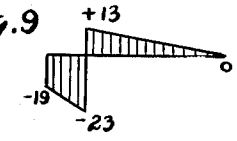



Fig. 9




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3,097,901

# MOLDED DRAWERS FOR MODULAR STORAGE FACILITIES

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9 Claims. (Cl. 312—330)

This invention relates to drawers and more especially to drawer constructions that can advantageously be made of plastic material. In the preferred construction, the entire drawer is made of a single thermoplastic sheet, and the sections are capable of manufacture by vacuum forming.

It is an object of the invention to provide an improved drawer construction having a bottom, and front, back and side walls with the upper portions of at least some of the walls extending outwardly and then downwardly to rims that support the drawers in guideways in which the rims slide.

Another object is to provide a drawer of the character indicated and in which the upper portions of the walls are shaped to sections which serve as beams for bracing the drawer against undue bending; and the beams on opposite sides of the drawer are tapered in the direction of their length to facilitate the connection of the front of the drawer with a panel, such as a wooden panel that serves as a decorative front brace or reinforcement for the front of a stack of drawers.

In the preferred construction the drawers are reversible and can be used with or without the wooden fronts. This permits drawers that are used merely as tote trays to be inserted into guide panels in a fashion similar to the drawers with the decorative fronts; and the tapered beam construction is correlated with the guides so that at maximum cantilever loading, the beam construction is adequate to brace the drawer.

Another object is to provide a plastic drawer construction that eliminates sticking in its supporting guides without recourse to conventional space-wasting wooden centerslide constructions, and at less cost than is possible with metal roller bearing constructions.

It is another object to provide a waterproof construction which will not rot, warp, rust, oxidize, corrode or mildew, and which may be used in any climate and under any natural conditions of heat and humidity.

The invention provides greater simplicity of construction and simplification of parts for built-in storage; and it provides for improvements in drawer design which result in a combination of lightness and strength.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views;

FIGURE 1 is an isometric view showing a panel glued to any stiff backing and supporting molded drawers with wood fronts, and wood and glass shelves; the corresponding panel for the near side of the drawers being omitted for clarity;

FIGURE 2 is a diagrammatic view showing the way in which the drawers and slides of FIGURE 1 are supported by one of the side panels;

FIGURE 3 is a simplified, fragmentary, side elevation showing the relation of the drawers to one another in the construction shown in FIGURES 1 and 2;

FIGURE 4 is an enlarged, fragmentary, sectional view showing a modified form of the invention;

FIGURE 5 is a fragmentary, vertical, sectional view,



on the line 5—5 of FIGURE 1, and showing how the slide area varies with drawer weight;

FIGURE 6 is a view similar to FIGURE 5 but taken on the line 6—6 of FIGURE 1;

FIGURE 7 is a sectional view on the line 7—7 of FIGURE 5, and shows in part how drawer-sticking has been virtually eliminated in this construction;

FIGURE 8 is a diagram showing the cantilever suspension of the pulled-out part of a drawer when at one limit of its sliding movement; and

FIGURE 9 is a shear diagram for the drawer when located in the position shown in FIGURE 8.

FIGURE 1 shows a panel of sheet material **1** glued with an industrial contact-type adhesive **2** to any stiff backing **3** which may be wood, plywood, pressed board, plastic, metal, wallboard or an existing wall. It will be seen that the panel is composed of equal vertically-repeated areas **4**, each containing identical groups of outwardly-projecting or raised elements. Each area **4** may be 3″ high. The term "vertical module" will be used hereafter when referring to the vertical height of an area **4**; and the term "slide group" will be used to refer to the combination of elements on each of the areas **4**.

It will also be seen in FIGURE 1 that the right and left sides of the panel **1** are symmetrical about a centerline **15**, enabling the panel to be used interchangeably to the right and left of drawers, and further, enabling drawers and shelves to be inserted and withdrawn from both sides of the panel.

The horizontal lines **4***a* between successive areas **4** are module lines, or lines of equal vertical measure, which are molded into or marked upon the panel, marking the juncture between vertical modules. They may constitute weakened lines which allow the panel to be readily fractured, thus separating the adjacent slide groups. For shallow installation where a full panel height is not needed, single or multiple slide groups are cut or broken from a single panel and used to both right and left of drawers and shelves.

In each slide group, FIGURE 1, there are flat, unraised portions **12** of the panel **1** between the bottom edge of a long projection **5** and the top edge of other projections **6** and these portions **12** may have a height of .200″; while other flat, unraised portions **13** between the bottom of projections **6** and the top of the lower adjacent projections **5** are substantially higher, for example .800″. Thus, the clearance at the flat portions **12** serves to receive the edges of a glass shelf **7** or masonite shelves which may be .187″ thick, and the edges of plastic drawers **8**, **9** and **10**, which may be between .120″ and .160″ thick. The clearance at the flat portions **13** receives the edges of shelves **16**, which may be .750″ thick. In all the above cases, the weights of shelves and drawers and their contents are transferred to the adjacent portions of the panel, and of the projections, and thence dispersed, as will be shown below.

In FIGURE 1, the height of the shallow drawer **8** derives from utilitarian considerations, as will be shown below, and the height of a single module derives from the basic drawer height plus other considerations described below. Thus, the height of the shallow drawer **8** is related to, but less than, the module. The height of deeper drawer **9** exceeds the height of the shallow drawer **5** by exact multiples of the module. If the module were 3″, and the shallow drawer **5** were 2⅝″ high, then deeper drawers would be 5⅝″, 8⅝″, etc.

In addition, both deep and shallow drawers may be used with wood or other fronts **14** and **17**, whose height is the same number of modules or a greater number of modules than the nominal drawer height. Because of the practical considerations of mold amortization and material costs, this later combination of the drawer **10**

with a higher front 17 provides an economical and practical storage for deep articles such as pots and double boilers at a saving to the consumer. In both of the above examples of the use of wood fronts, continuity of vertical drawer spacing is maintained.

Where the drawers are used in conjunction with fronts 14 and 17, the front rim 21 is inserted in a matching groove 21*a* in the rear of the wood front. The front is glued to the adjacent vertical wall of the drawer.

In FIGURE 1 it will also be noted that the shelves 16 cover the drawers 8 and 10, keeping out dust and dirt. This combination of drawer and shelf spacing makes possible variable and discontinuous spacing of the drawers, and eliminates the necessity of continuous vertical banks of drawers.

Because the workability of this system of storage derives from the inter-relationship of the parts of both drawers and panels, it will be necessary to describe these parts and their functions in some detail.

In FIGURE 5, the drawer 8 is molded of plastic material. The flat horizontal rim 21 forms its periphery. From the inside of this rim 21 the material turns upward at curve 22 to a vertical side 23; then curves at 24 to a horizontal topside 25, then extends through a curve 26 to a drawer side wall 27 and then through a curve 28 to the drawer bottom 29. FIGURE 7 shows that this section continues without structural interruption or weakening around the back of the drawer.

In FIGURES 5 and 7, the amount of radii of the curves 22, 24, 26 and 28, although small, strongly control the structural relationship between the horizontal and vertical areas of the portions 21, 23, 25, 27 and 29 of the drawer in such a manner as to cause these areas to act in part individually, as if pivotally connected in a determinate structure, and in part continuously, as in a welded and indeterminate structure.

When the portions 21, 22, 23, 24, 25, 26, 27, 28 and 29 act as a beam to withstand vertical loads, the drawer bottom 29 and the upper rim 25, and to some extent, the outside flange 21, act as the flanges of a beam, while the vertical portions 23 and 27 act as the web of a beam. When withstanding horizontal thrust, as when a drawer is jammed against the interior of a case, the vertical walls 23 and 27 act as the flanges on a beam, and the horizontal portions 21, 25, and 29 act as would the web of a beam. Therefore, it can be seen that the portions 21 through 29 are designed to act simultaneously as two structures, at once deflecting and resisting horizontal thrust and at the same time both resisting and deflecting with vertical load, and that the neutral axis about which bending moments and stresses occur must be visualized as duplicate, and that a clear description of the structural uses of the portions 21 through 29, must artificially separate these actions which in reality, occur in combination.

Upon loading of the drawer, the stresses are transferred from the bottom surface 29 through the curve 28 to the vertical wall 27 and thence through the curves 26, 24 and 22 to the portions 25, 23 and 21. With an increase in the drawer loading, which may be 10 lbs., the flat portions 25, 23, and to some extent 21, are made to rotate about the curves 26, 24 and to some extent 22, in such a manner that the maximum rotation is manifested by a counter-clockwise movement of the flat portion 23, about the curve 24, resulting in an outward movement of the flat surface 21, as shown in the dotted lines in FIGURE 3. This increases the area of contact of the wearing surface of the flange 21 on the projections 6. A slight change occurs in the angle of the flat surface 21 to the horizontal plane. Because the projection 6 is essentially a parallelogram, a compensatory change in the angle of its upper surface occurs.

As a result of these movements, both the major movement by the slide 21 and the extremely slight compensatory movement in the panel projection 6, the unit co-efficient of friction is stabilized to a great extent, since the area of the wearing surfaces have been made to increase in proportion to increases in load. This practical usage of deflection, instead of the destruction of deflection through attempted rigidity, has in practice resulted in enormous increases in wear, permitting drawers and panels made of inexpensive plastic materials to be used as long-term installations in institutions.

Conventionally, both a drawer and its case are assumed to be rectangular, with adjacent parts parallel, and with load fairly equally distributed. The picture is one of a structure which tends to act axially and evenly. However, this convention is essentially untrue because the loading of the drawer, its structure, and the friction between the drawer and the surface upon which it slides, are never precisely the same on both sides of the drawer. Also, because the person inserting the drawer cannot in practice push it in precisely at its center.

The drawer and case structures herein described are based upon the assumption that their natural tendency, in practice, is not toward even, axial movement, loading and stresses, but rather toward an eccentricity and that a simplification of parts and an efficiency of structure results when, instead of working against the natural tendencies of materials, we recognize and then utilize these tendencies to work to our desired ends.

In the drawer structure already described above, the portions 21—29 are here designed so that, as the drawer assumes the position shown by the dotted-lined positions of 21 and 23 (FIGURE 7), the drawer structure will tend to strongly spring back to a position parallel to the drawer slides, and the drawer will not stick, but slide smoothly in place. This spring-back is caused by two factors. First, the edge 21 bumps against the edge of the slide panel at point 31, and is deflected inwardly toward the drawer wall 27 in a springing action. This allows the vertical edge 23 to press against the vertical surface of the projection 5 of the slide panel at 32, FIGURE 7. Because the points 31 and 32 are not aligned vertically, the edge 21 springs, rotating about the point 32, using a lever arm whose length is the distance between the points 31—32. This lever arm may be approximately .872 inch. As this straightening rotation takes place, it is assisted by the tendency of the portion 23 to spring back into position, forcing itself away from the vertical surface of the projection 5.

It should be noted that the same portions 21—28 which were made to deflect to increase wearing surface with increased load have been also shown in FIGURE 7 to deflect in another manner in order to eliminate drawer sticking; and that the control of deflection in this structure is the cause of its successful performance.

Experience has shown that with this structure, one can successfully and continuously slide drawers having a width across the face over three times the drawer depth from front-to-back, and that even with this proportion of width to depth, a loaded drawer may be pushed from one corner and will, because of the control of deflection through the above design, right itself and slide into place.

In earlier constructions of plastic drawers, such as illustrated in my co-pending patent application Serial No. 16,015, filed March 18, 1959 (of which this application is a continuation-in-part), the rim 21 was in a plane parallel to the top wall or rim 25 and this made it difficult to attach front panels ahead of the rim 21. It was necessary to cut away the rim 21, the downwardly-extending portion 23 and sometimes parts of the top wall 25. It was then necessary to rout out a groove in the back of the wood front to conform with the cut-out portion of the drawer. Because of the shape of the drawer at both sides, with the rim 21 spaced below the top of the drawer, it was necessary to rout a groove with complicated curves and this required jigs, and could not be done practically except with factory equipment.

The construction of the present invention avoids these difficulties by having the top edge of the drawer slope

down toward the front of the drawer, or by having the rim **21** slope upwardly so that the rim **21** at the front of the drawer is substantially flush with the top of the drawer. The rim **21** merges into the top wall **25** at the front of the drawer.

Drawer breakage on impact when a drawer is dropped is an important consideration, especially when the drawer is used in dormitories and in factories. This problem has resulted in many attempts to stiffen the drawer. The drawer design shown in the figures herein, affords a resiliency which allows the drawer to deflect in a horizontal plane. As has been noted above, the portions **21—29** of the drawer form a compound beam section along each of the four walls of the drawer. The corner curve **34** (FIGURE 7), which may be 1¼" radius, largely controls the transfer of stresses between the adjacent vertical walls of the drawer, as between the side wall **27** and a front wall **38**.

Where the bottom curve **28** intersects the corner curve **34**, a compound curvature is formed at the bottom corner of the drawer. The diameters of these two curves largely control the deflection of the drawer in a horizontal plane and deflection of the bottom of the drawer into twisted positions. The large diameters of the curves **28** and **34** transfer impact stresses throughout the structure, allowing the structure temporarily to twist and thus dissipate throughout its parts the strains caused by impact. It should be noted here that the width of the top wall **25**, (FIGURE 7), substantially increases at the corner with an increase in the diameter of the curve **34**, and that one of the functions of the curve **34** is to control the width of the diagonal corner section of the surface **25**.

The above deflection in the horizontal plane is also of value in equalizing wear of the drawer on the slide panel, since it allows the drawer to tend to assume that position which will keep all portions of the sliding surface **21** snugly against all other portions of the supporting surfaces of the panel, thus greatly decreasing the tendency toward spotty or localized wear which would occur in a rigid structure.

The wooden front **17** (FIGURE 1) has a groove **37** deep enough to receive the full width of the top wall **25** at the front of the drawer so that the rear surface of the front panel **17** is in contact with the front wall of the drawer. The confronting faces of the drawer and panel **17** are preferably secured together by adhesive **39** which may also be used to hold the rim **21** in the groove **37**.

FIGURE 4 shows a modified construction in which a wooden filler panel **42** is secured to a front wall of a drawer **44** by adhesive **39** or other suitable fastening means. The drawer **44** has a rim **51** similar to the rim **21** of the preferred embodiment except that the rim **51** is spaced below the top of the drawer around all sides of the drawer and it is located in front of the panel **42** in position to serve as a drawer pull. This eliminates the necessity for hardware on the drawer, but the construction of FIGURE 4 does not permit the apparatus to be made with adjoining drawer fronts flush with one another and presenting continuous surface effects.

Referring again to FIGURE 1, there are cut-outs **101** and **101'** near opposite ends of the rims **21** along both sides of each drawer. When a drawer is pulled out so far that its center of gravity is beyond the most forward projection **6**, the drawer tends to tilt downward at its forward end, and the rearward end of the rims **21**, on both sides of the drawer, contact with the upper projection **5** to limit further tilting of the drawer and to support the cantilever loading of the drawer.

There is a shoulder **103** along the bottom of each projection **5**, and the rearward edge of the cutout **101** engages the shoulder **103** to limit outward movement of the drawer. There is another shoulder **103'** toward the other end of the projection **5** for use when a drawer is inserted into the guides of the panel from the other end. The cut-out **101'** is used when the drawer is turned around and has no front panel **12** or **17**. This latter use is common when the drawers are being used as tote boxes and stored like drawers within the guides.

FIGURE 8 shows the drawer **10** pulled out to its limit of movement. The fulcrum indicated by the reference R–**1** is the location at which the rim **21** tilts on the most forward projection **6**. The downward force indicated by the reference character R–**2** is the reaction of the rim **21** against the top projection **5** when the cut-out **101'** (FIGURE 1) is hooked on the shoulder **103**.

The drawer **10** is inserted backwards in FIGURE 8, as compared to the other figures. The portion of the rim **21** at the back of the drawer **10** is located at the part of the drawer that pulls out of the guide panels. There is no wooden panel on the drawer **10** of FIGURE 8. This is a case where the drawer **10** is in tote box service.

When the drawer **10** is inserted in the opposite direction from that shown in FIGURE 8, the beam taper is in a direction to reduce its strength toward the cantilever end of the pulled-out drawer. This has the beam strength variation in the same direction as the shear load variation. In FIGURE 8, the taper of the beam is not in the orientation that increass its strength in the direction in which the load decreases. It is necessary, therefore, to compute the beam strength for the condition shown in FIGURE 8.

FIGURE 9 is a shear diagram for the condition shown in FIGURE 8. The drawer is constructed to have the beam strength necessary to resist the force shown in FIGURE 9. The taper of the beam to the left of the fulcrum R–**1** is in the right direction, but the taper to greater beam strength toward the right in FIGURE 8 merely makes the drawer stronger than necessary toward the right end (as viewed in FIGURE 8). When the drawer is turned around, this situation is reversed.

The preferred construction of the invention has been illustrated and described, but changes and modifications can be made, and some features can be used in different combinations without departing from the invention as defined in the claims.

What is claimed is:

1. A drawer formed of plastic sheet material and having a bottom and walls at the front, back and sides thereof, said bottom and walls being of one-piece construction, the drawer also having upper end portions of the side walls extending outwardly and then downwardly and with an outwardly extending rim at the lower end of the downwardly extending portions of the side walls, said upper end portions of each side wall including said outwardly and downwardly extending portions of the rim forming a beam for strengthening the side wall of the drawer, said rim extending at an acute angle to the top of the side wall to give at least a portion of the beam a tapered section in the direction of its length, said rim serving for supporting the drawer from a guide in which it slides.

2. The drawer described in claim 1 and in which the back wall of the drawer has a rim that extends substantially parallel to the top of the drawer and that merges with the rearward ends of the rims that extend from the side walls of the drawer.

3. The drawer described in claim 1 and in which the rims on the opposite sides of the drawer slope toward the top of the drawer toward the front of the drawer and are substantially flush with the top of the drawer at its forward end.

4. The drawer described in claim 3 and in which there is a rim extending outwardly from the top of the front wall of the drawer.

5. The drawer described in claim 4 and in which there is a front panel on the drawer with a back face having a groove therein and into which the rim of the front wall fits, and means connecting the front panel with the front wall of the drawer below said rim.

6. The drawer described in claim 4 and in which the rims of the side walls are generally parallel to the bottom of the drawer and the tapered section of the beam is obtained by increasing the height of the side walls above the rim toward one end of the drawer.

7. The drawer described in claim 4 and in which the bottom, side walls, front and back walls, and the rims comprise one piece of thermoplastic material.

8. A furniture construction including a drawer made of plastic material and having side walls that extend outwardly at their upper ends and then downwardly, an outwardly-extending rim at the lower end of the downwardly-extending portions of the side walls, the rim extending at an acute angle to the top of the drawer and forming with the side wall and downwardly-extending portion of the drawer, a tapered beam for bracing the drawer against bending, side guides by which the drawer is supported, each of the side guides having discontinuous supporting elements below the rim and the foremost one of which serves as a fulcrum on which the drawer tilts downwardly at its forward end when pulled out to its limit of travel, a continuous projection of the side guides above the rim in position to limit downward tilting of the front end of the drawer, a stop that limits the extent to which the drawer can be pulled forward in the guides, the taper of the beam being correlated with the size of the drawer to support the cantilever loading of the drawer when pulled out to its limit of forward travel.

9. In combination, a first furniture component comprising a drawer made of resilient plastic material and having a bottom, a front, back and side walls, all of one-piece construction, a lip around the upper ends of the walls extending downwardly along the side walls, ridges extending outwardly from the lower ends of the downwardly extending lips at both sides of the drawer and at a level below the top of the drawer, the lip at the front wall also extending downwardly and having a portion shaped to serve as a pull for the drawer, a filler panel held at its upper end by the lip along the front wall, said filler panel extending downwardly below the lip and across the front wall of the drawer to the level of the bottom of the drawer, the lips and ridges being of one-piece construction with the walls of the drawer and additional components comprising other similar drawers of a set, the drawers being of different size, each drawer having ridges extending from opposite sides thereof and all at the same distances below the top of the drawer, and all of the drawers being of modular height with the module equal to the distance of the ridge below the top of the drawer, the lowest drawer having a height at least to two times the module.

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