United States Patent

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[54] **CHAIR CONSTRUCTION**
22 Claims, 20 Drawing Figs.

[52] **U.S. Cl.** **297/451,** 297/160, 297/445
[51] **Int. Cl.** **F16m 11/20,** A47c 7/00
[50] **Field of Search** 297/239, 445, 451, 452; 248/188

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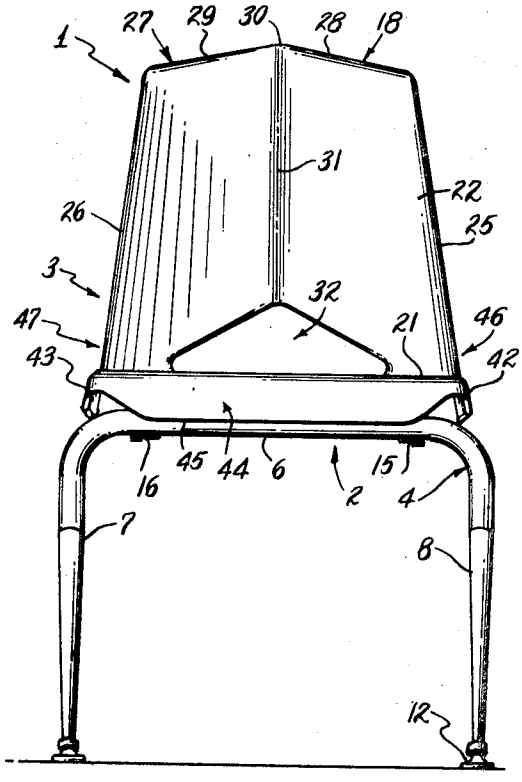
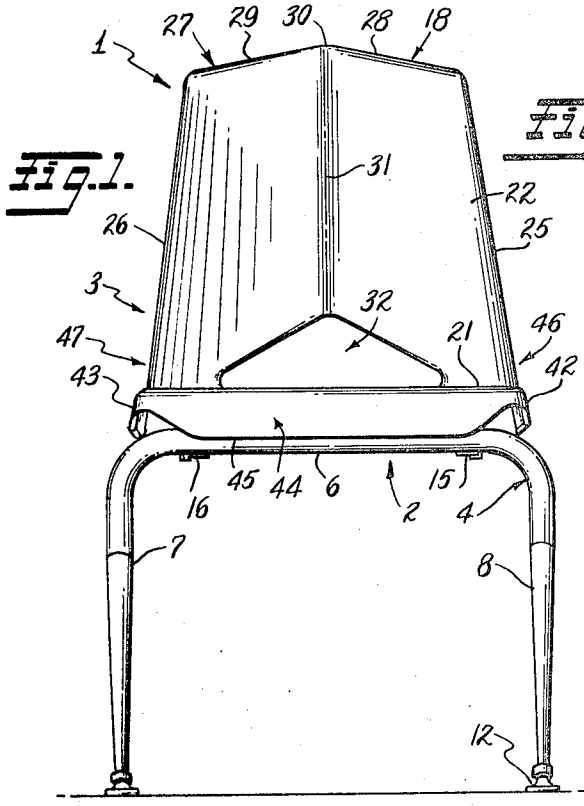
ABSTRACT: The chair includes a base structure and a seat structure secured to the base. The base structure has pairs of downwardly extending legs connected by a horizontal portion. The horizontal portions are secured to each other by spaced apart pairs of angle bracket assemblies, with each angle of a pair separated from the other to facilitate assembly. The seat structure includes an integrally molded seat-back shell mounted on a tubular frame having brackets which slip over and are secured to one of the angles of each of the angle bracket assemblies. The seat structure is held to the base structure by machine screws so that the chair assembly can be shipped in a knocked-down condition and readily assembled after shipment. A tablet arm or desk arm can be secured to the chair if required. While the seat-back shell is molded from an essentially rigid plastic material, the construction is such that the back can deflect slightly relative to the seat to enhance comfort. The comfort of the shell is further enhanced by the upwardly curved seat, the buttocks relief opening in the back of the shell, and the shallow V-shaped spine relief along the back of the shell.





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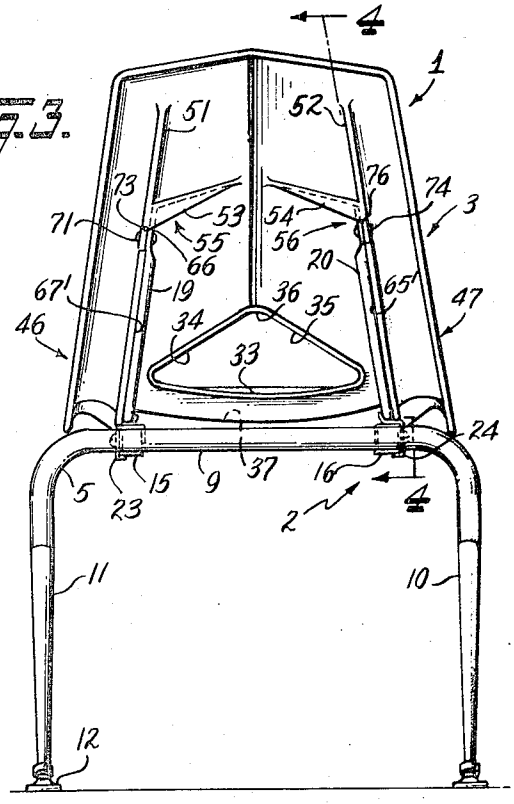

Fig. 3.

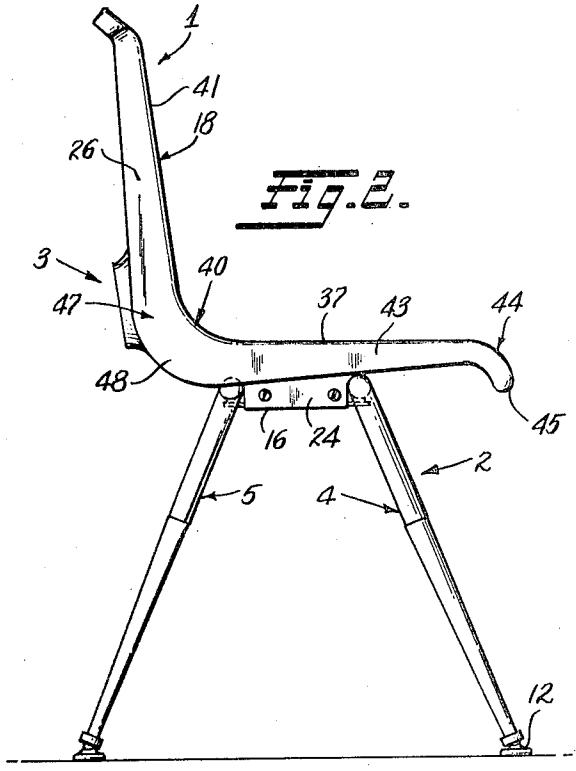

Fig. 2.

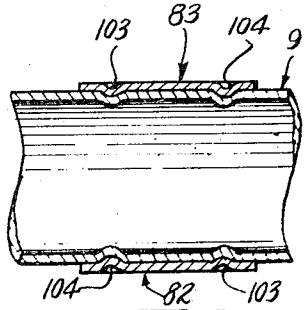

Fig. 9.

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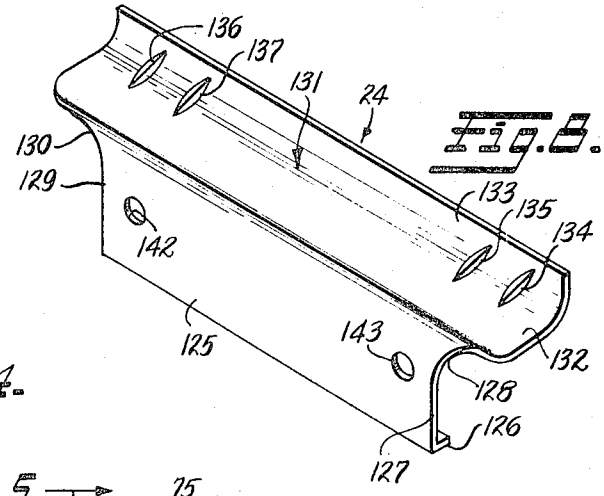
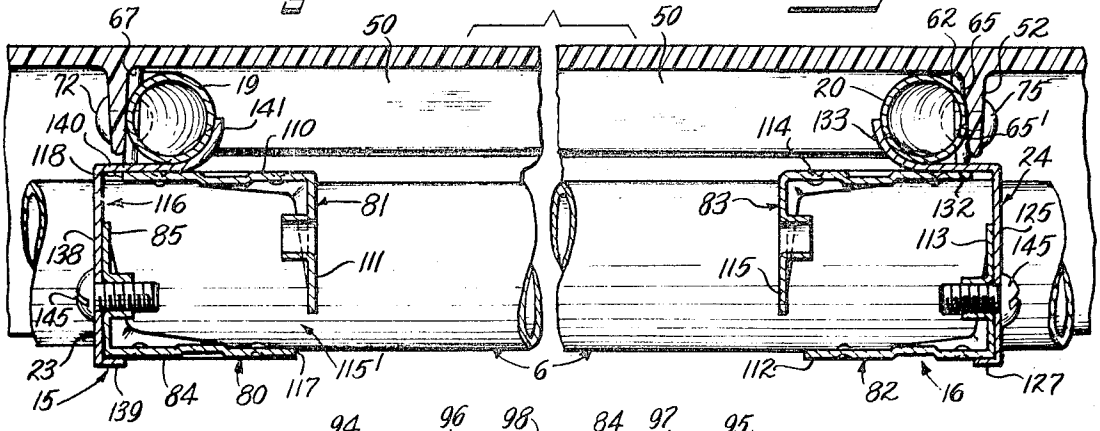


Fig. 8.

Fig. 4.



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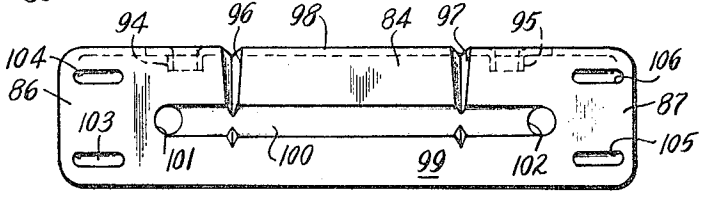

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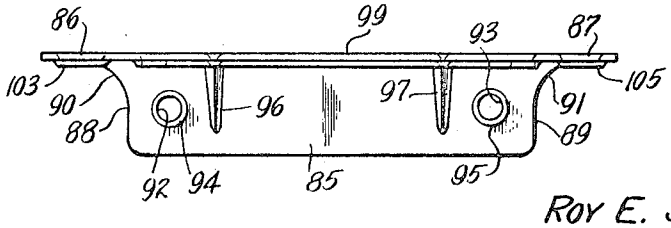

Fig. 7.

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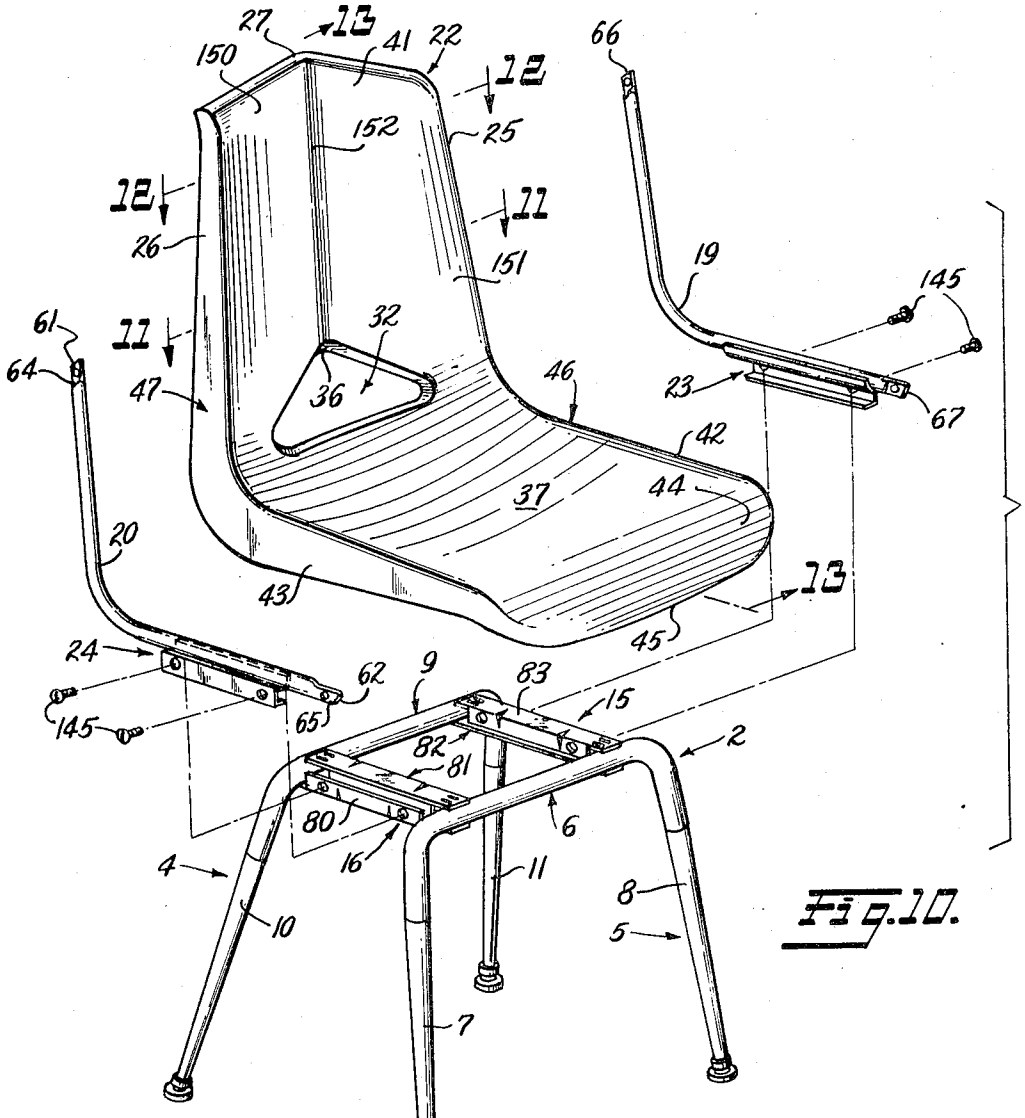
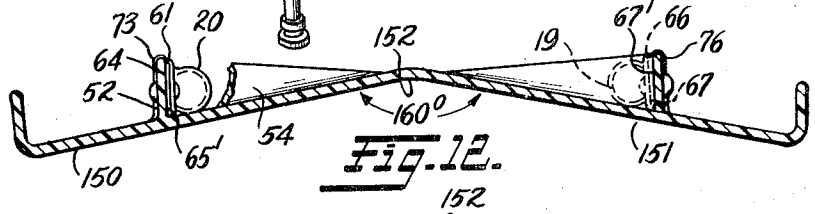


Fig. 10.



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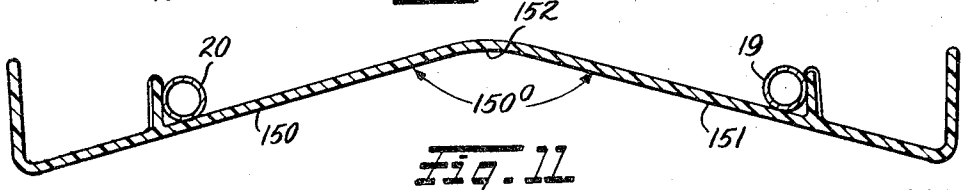

Fig. 11

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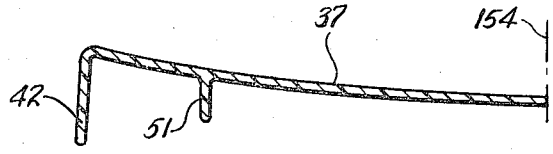

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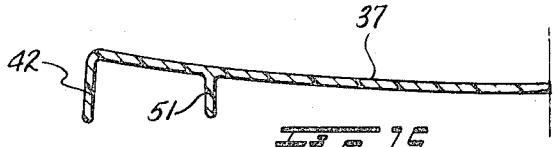

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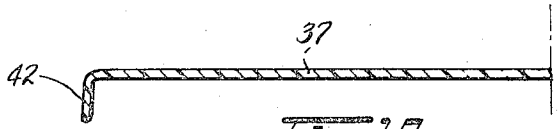

Fig. 16.

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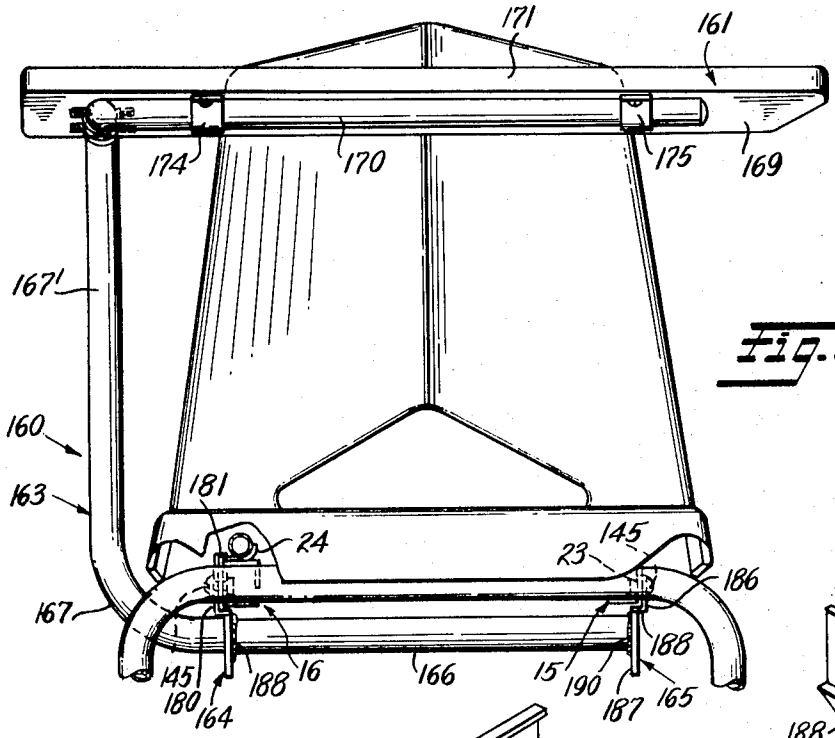

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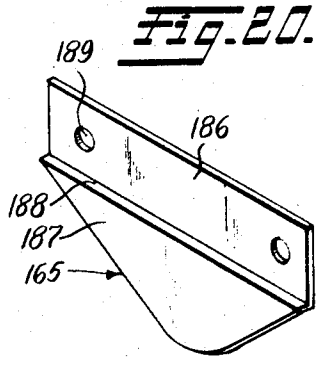

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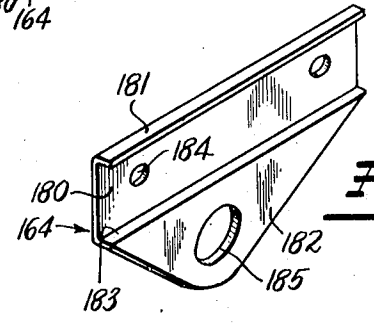

Fig. 19.

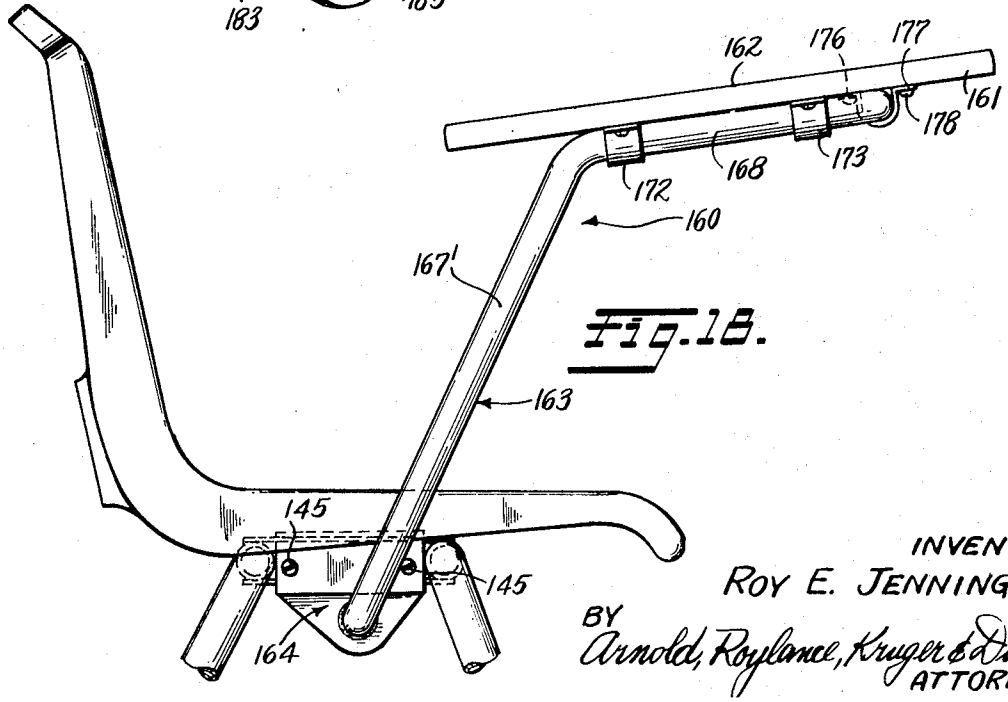

Fig. 18.

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CHAIR CONSTRUCTION

This invention relates generally to chair assemblies and particularly to chair assemblies for schoolroom use.

Schoolroom or educational furniture is uniquely different from other types of household and business furniture. Schoolroom furniture must necessarily be quite rugged to withstand the rough treatment of the furniture by school age children. The furniture must be available in sizes for the various age groups of the school children. Another important requirement of school furniture is that it must be easy to clean and not contain materials to support bacterial or insect growth. In addition, school furniture should be comfortable. Otherwise, the student's attention may be diverted from the classroom activities to the uncomfortable chair in which he sits. While the comfort factor has been considered by school authorities in the past, usually, cost considerations are more significant than the matter of comfort. As a result, school authorities have not deemed comfort to be a primary consideration in the purchase of classroom furniture, but have instead looked for low cost and durability.

From the standpoint of the manufacturer, the desirable features of classroom furniture are durability, economy of manufacture, economy of shipment, appearance, and comfort. Since a handsome chair enhances the atmosphere of the classroom, certainly, appearance is a primary consideration to the manufacturer in the sale of the product. With regard to economy of manufacture, simplicity is indeed a primary consideration of the manufacturer since the less complex the chair or other furniture is, the less expensive it will be to manufacture. Related to simplicity is the cost of tooling to make the chair or other item of furniture on a mass production competitive basis.

Not to be overlooked by the manufacturer is the comfort of the chair. Comfort in a chair, while not considered important in the past, is becoming increasingly significant in the salability of chairs and other school furniture. The increase of the significance of comfort is believed to be based on the recent realization that attention and grades are better and disciplinary problems are fewer where the student is comfortable in the chair in which he sits for perhaps 6 hours each school day. Hence, the educational rating of the institution which uses comfortable furniture correspondingly increases.

With regard to economy of shipping, it is desirable that the chair or other furniture be so constructed that it can be shipped in a knocked-down condition, and that it can be quickly and easily assembled with simple handtools after shipment. Applicant has found that with the chair of this invention, where the seat-back structure can be readily removed from the base structure, and where both the seat and base are nestable with like seats and bases, both the volume of the shipping space required, as well as the amount of carton material for packing the chairs is substantially decreased.

Another consideration from the standpoint of the manufacturer is the ease with which various accessories, such as tablet arms or desk arms can be added to the basic chair. It is indeed desirable to be able to add, for example, a tablet arm to a basic chair so the chair may be sold with or without the tablet arm. In addition, a tablet arm which is readily installed after shipment is advantageous because of lower shipping costs.

With the chair of this invention, applicant satisfies the requirements of both the school authorities and the manufacturer by providing a unique chair construction for schoolroom and other educational purpose use. As will subsequently be described in detail with reference to a preferred embodiment of the chair of this invention, the chair embodies a base structure comprised of downwardly extending pairs of tubular legs connected by an integral generally horizontal portion. The horizontal portion of each pair of legs is secured to angle brackets which extend between the horizontal portions. Each angle bracket is comprised of two unattached separate angle members which engage and are fixed to the horizontal portions of the leg pairs. The angle brackets are so arranged that the seat structure, to which tubular support members are connected, can be secured to the base structure by slightly spreading connecting brackets fixed to the tubular members and then securing same directly to the angle brackets with bolts. This arrangement provides for shipping the chair structure in a knocked-down condition with the seat removed from the base so that several seat units and several base units can be nested for shipping, or the seat structure can be inverted over the base structure to provide a low profile package.

The seat-back shell is of unique molded construction and includes strengthening ribs as well as connector ribs by which the tubular seat support elements are secured to the seat shell. The arrangement of the reinforcing ribs coupled with the tubular support members provides a seat with some "give" which permits the back of the seat to flex somewhat relative to the base of the seat about the junction of the seat and base. This "give" or flexure provides for a springiness which enhances the comfort of the chair to students of various builds and sizes. An additional significant feature of the seat-back shell is a buttocks relief opening which provides room for some expansion of the buttocks through the opening when a student sits erect with the base of his spine at the rear of the seat. The buttocks relief opening cooperates with the generally shallow V-shaped configuration of the seat back to provide a structure with enhanced comfort over that of the prior art molded seat shells. For students of a build termed as "skinny," with a protruding spine, the shallow V-shaped configuration of the chair back provides a space for spine relief along the vertical center of the chair back. Thus, the spine of even a very lanky or skinny student will not directly engage the stiff material of the chair back. A husky or stocky student will also attain comfort from the chair because the portions of the chair back which flank the apex of the "V" will than be engaged by the flesh or muscle of the stocky student with the result that he too is comfortable in the chair of this invention. Comfort in the chair is further enhanced by the dished configuration of the chair seat which curves upwardly to conform to the configuration of the flanks of the student seated in the chair.

The connector ribs, molded integral with the seat-back shell, permit securing the shell to its supports with fasteners which do not extend through either the seat or back of the shell. Hence, there are no exposed rivet or screw heads on the seat or back portions of the shell.

Correspondingly, an object of this invention is a unique chair structure primarily intended for, but certainly not limited to educational or classroom use.

Another object is a chair structure in which a seat structure assembly is readily connectable to a base structure either before or after shipment of the chair to the place of use.

Another object is a unique base structure for a chair which includes pairs of opposed parallel angle brackets which cooperate to secure the horizontal or transverse portions of pairs of legs together to form the base structure.

Another object related to the immediately preceding object is a chair structure in which the connecting brackets at each side of the chair are completely separated from each other and are held together by the transverse portions of the chair leg pairs.

Another object is a chair structure including a seat-back shell so constructed that the back is somewhat resilient to give rearwardly in response to pressure applied by the back of a student seated in the chair.

A further object is a seat-back shell of integral molded construction having a back with an inside surface of generally V-shape which provides a spine relief for the student seated in the chair.

A further object is an integrally molded seat-back shell in which a shallow V-shaped inside surface of the back cooperates with a generally triangular buttocks relief opening to enhance the comfort of the chair.

A further object is a seat-back shell wherein the seat portion of the molded shell curves upwardly from a region of greater depression toward the back, from a downwardly rolled front

edge, and cooperates with an integral back having a triangular buttocks relief opening and a shallow V-shaped spine relief at the center line of the back, with the apex angle of "V" increasing in a direction from the top to the bottom of the seat back.

A still further object is a seat shell having integrally formed connecting ribs to facilitate attachment of the tubular seat-back support elements by passing fasteners through the ribs and the elements at locations other than any exposed portions of the seat or back of the shell.

A still further object is a chair of the type described which may readily be termed a "basic chair" and which is readily converted to a tablet arm or desk arm chair merely by connecting the necessary arms to the base structure, and in which the seat shell assembly is so constructed that the basic shell, support elements and brackets permit use of this shell assembly with other educational furniture constructions.

Numerous other objects, features, and advantages of this invention will become apparent with reference to the accompanying drawings which form a part of this specification and in which:

FIG. 1 is a front elevational view of the chair structure of this invention;

FIG. 2 is a side elevational view of the chair structure;

FIG. 3 is a rear elevational view of the chair structure;

FIG. 4 is a partial side elevational view in section taken along line 4—4 of FIG. 3;

FIG. 5 is an enlarged view in section taken along line 5—5 of FIG. 4;

FIG. 6 is a plan view of one of the leg connector elements;

FIG. 7 is a front elevational view of the element of FIG. 6;

FIG. 8 is a pictorial view of a seat connector bracket;

FIG. 9 is an enlarged view in section taken along line 9—9 of FIG. 4;

FIG. 10 is a pictorial view showing the manner in which the several parts of the chair are assembled;

FIG. 11 is an enlarged view in section taken along line 11—11 of FIG. 10;

FIG. 12 is an enlarged view in section taken along line 12—12 of FIG. 10, with portions thereof cut away for purposes of illustration;

FIG. 13 is a vertical sectional view of the seat-back shell taken along line 13—13 of FIG. 10;

FIG. 14 is a horizontal sectional view taken along line 14—14 of FIG. 13;

FIG. 15 is a horizontal sectional view taken along line 15—15 of FIG. 13;

FIG. 16 is a horizontal sectional view taken along line 16—16 of FIG. 13;

FIG. 17 is a partial front elevational view of the basic chair with a desk arm attached;

FIG. 18 is a partial side elevational view of the basic chair and desk arm of FIG. 13;

FIG. 19 is a pictorial view of one desk arm support bracket; and

FIG. 20 is a pictorial view of the other desk arm support bracket.

Referring now to the drawings in detail and particularly to FIGS. 1–4 and 10, there is shown a chair 1 which includes a base structure 2 and a seat structure 3 secured to the base structure.

Base structure 2 includes a first inverted U-shaped leg unit 4 and a second inverted U-shaped leg unit 5. Front leg unit 4 has a transverse or horizontal tubular portion 6, integrally joined to legs 7 and 8 extending downwardly from smoothly curved bends at the respective ends of transverse portion 6. Rear leg unit 5 is identical to front leg unit 6 and includes a tubular transverse or horizontal portion 9 parallel with portion 6 and integrally joined to downwardly projecting tapered legs 10 and 11 along smoothly curved bends at the respective ends of the transverse portion 9. The lower portions of the legs taper inwardly. Secured to the lower end of each leg is a glide assembly including a glide 12 mounted at the end of the leg to swivel so the bottom surface of the glide rests flat against the floor or surface on which the chair is placed.

Base structure 2 also includes a left-hand connector set 15 (as viewed from the rear of the chair) and a right-hand connector set 16, the connector sets extending between the parallel transverse portions 6 and 9 of the leg units, and securing the leg units together. As shown at FIGS. 2 and 3, connector sets 15 and 16 are spaced apart from each other transversely of the chair, with left connector set 15 offset toward the left side of the chair and right connector set 16 offset toward the right side of the chair. The connector sets are welded directly to the tubular transverse portions 6 and 9 of the respective leg sets and maintain the legs of the respective leg sets in the inclined relationship shown at FIG. 2.

Seat structure 3 includes an integrally molded seat-back shell 18 and tubular support elements 19 and 20 secured to shell 18. The molded shell 18 has a horizontal seat 21 molded integral with an upright back 22. As shown at FIGS. 3 and 4, tubular support elements 19 and 20 are L-shaped and each extends from a location adjacent the front of seat 21 of the shell to a location slightly more than midway above the back of the shell, and generally follows the curvature of the under-surface or rear surface 22' of the shell. Secured to the generally horizontal portions of support elements 19 and 20, beneath seat 21, are connector brackets 23 and 24 which are adapted to be removably secured to the respective connector sets 15 and 16 to secure the seat structure 3 to base structure 2.

Back 22 is of generally trapezoidal shape having sidewalls 25 and 26 which converge in a direction away from seat 21, and having a continuous top wall 27 of shallow inverted V-shaped configuration with wall portions 28 and 29 which meet at an apex 30 along the vertical center line 31 of shell 18.

At the base of seat portion 22 is opening 32 of isosceles triangle shape, having a lower generally horizontal upwardly bowed edge 33 and upper side edges 34 and 35 of the same length and which extend upwardly from each end of the lower edge at an angle of approximately 30°. Edges 34 and 35 meet at a rounded apex 36 that lies along vertical center line 31, the junctions between horizontal edge 33 and edges 34 and 35 respectively are smoothly rounded. With reference to FIGS. 3 and 10, it will be observed that the maximum horizontal width of opening 32 is slightly greater than one-half the width of the back, as measured along horizontal edge 33, and is approximately twice the height of triangular opening 32. Edge 33 is slightly curved and is parallel with, yet spaced slightly above the correspondingly curved upper surface 37 of seat 21 of the shell.

Seat 21 of shell 18 joins back 22 at the smoothly curved juncture 40 so the front surface 41 of the back extends upwardly at a slight rearward incline to seat 21. Seat 21 has sidewalls 42 and 43 respectively, and a rounded front portion 44 which terminates at a downwardly facing front 45. As shown at FIGS. 1 and 10, sidewall 43 of seat 21 is coplanar with sidewall 26 of back 22, and the two sidewalls merge smoothly at juncture 40 to provide a smooth continuous sidewall 47 extending from the front 44 of the seat to adjacent top edge 27 of the back. Likewise, sidewall 42 is coplanar with sidewall 25 and the two sidewalls merge smoothly at juncture 40 and cooperate to provide a continuous sidewall 46 of shell 18 which extends from front 44 of the seat to the top of back 22. It will be observed with reference to FIGS. 1–4 and 10, that the front portion 44 of the seat is slightly wider than the rear of the seat adjacent juncture 40 and that the sides of the back converge in a direction toward the top edge 27 of the back. Hence, it is apparent that sidewalls 46 and 47 diverge essentially uniformly from the top edge 27 of the back to front portion 44 of the seat. Front 45 curves downwardly and inwardly, and has curved sides that blend into the front edges of sidewalls 46 and 47.

It will be observed with reference to FIGS. 1–3 and 10, that the respective sidewalls 46 and 47 of the shell extend rearwardly away from front surface 49 (which includes front surface 41 of the back and upper surface 37 of the seat) of the shell, and that the portion 48 of each sidewall adjacent juncture 40 has a height or width which is greater than the height or thickness of these sidewalls along the seat and along the

back. This portion 48 of greater width provides additional strength for the shell 18, at the juncture 40 between the seat 21 and back 22, which is weakened somewhat by the material of the shell eliminated at opening 32. As will subsequently be explained, there is additional reinforcing at the juncture 40 between the seat and the back, so the shell is quite rugged and durable, yet, this strengthening is such that the back can flex somewhat relative to the seat and thereby improve the comfort of the seat for the student sitting on the chair.

It will also be noticed with reference to FIGS. 1–3 and 10, that top walls 28 and 29 cooperate with sidewalls 45 and 46 and that the sidewalls cooperate with the downwardly rounded front 45 to form a continuous peripheral skirt or frame which projects away from and borders front surface 22' of the shell.

At a position spaced rearwardly of front 45 of shell 18 is a transverse bottom rib 50 molded integral with the shell and which extends downwardly and rearwardly at an acute angle with the undersurface of seat 21. Bottom rib 50 has a length which is somewhat less than the distance between sides 42 and 43 of seat 21. One end of bottom rib 50 is integrally joined to the front end of a longitudinally extending rib 51 that originates at the end of rib 50 and extends rearwardly and then upwardly along the rear surface of back 22 and terminates at a location spaced slightly from top edge 27 of the back. Similarly, the other end of bottom rib 50 is joined integrally with the front end of a second longitudinally extending rib 52 which extends rearwardly and then upwardly and terminates at the same horizontal plane as the upper end of rib 51. Ribs 51 and 52 are offset respectively toward opposite sides of the shell, are each continuous along their length, and are parallel respectively with sidewalls 46 and 47 of the shell.

At the back of seat 22 are gusset-shaped strengthening ribs 53 and 54 which are integrally joined to ribs 51 and 52. As shown at FIGS. 3 and 4, gusset ribs 53 and 54 incline downwardly to form downwardly facing pockets 55 and 56, respectively, at opposite sides of the back. Gusset ribs 53 and 54 each extend inwardly from ribs 51 and 52, respectively, toward the center of the back and merge with the material of the back at their inner ends. Front rib 50, longitudinal ribs 51 and 52, and gusset ribs 53 and 54 cooperate to provide a second strengthening frame spaced inwardly of the periphery or border of shell 18, the outline of this second strengthening frame being generally parallel with the outline of the shell and spaced inwardly thereof.

Support elements 19 and 20 are each formed from weldable metal tubing. As shown at FIG. 4, support element 20 has a single bend 60 formed therein and conforms with the curvature of the rear surface 22' of shell 18. The axis of the tube from which support element 20 is formed lies in a generally horizontal plane. Support element 20 has an upper end 61 which is flattened and severed at an angle to conform with the configuration of pocket 56. Similarly, front end 62 of support element 20 is flattened and severed at an angle so front edge 63 lies flat against the inner surface of bottom rib 50. Ends 61 and 62 are are so flattened that the outside surfaces 64 and 65, respectively of the ends lie in a common plane tangent to the outside of the tube from which support element 20 is formed. Hence, when support element 20 is secured to shell 18, surfaces 64 and 65 lie flat against the inner surface of rib 52 (FIGS. 4, 5 and 12) and the side of the tube from which support element 20 is formed in tangent to the inside surface 65' of the rib.

Support element 19 is the mirror image of support element 20 and has a flattened upper end 66 and a flattened front end 67. Ends 66 and 67, however, are flattened so they are tangent with the outside of the tube from which support element 19 is formed. Hence, ends 66 and 67 lie flat against the inside surface 67' of rib 51 when support element 19 is secured to the seat shell, and the outside of the tube is tangent to inside surface 67' along the length of the rib (FIGS. 3, 5 and 12).

Support element 19 is positioned against the inside surface 65' of rib 51 so end 66 extends into pocket 55 and end 67 is closely adjacent the inside surface of bottom rib 50. Upper end 66 is secured to rib 51 with a rivet 71 that extends through aligned openings in end 66 and rib 51. The front end 67 is similarly secured with a rivet 72 which extends through aligned openings in end 67 and rib 51 adjacent bottom rib 50. As shown at FIGS. 3 and 12 the portion of longitudinal rib 51 through which rivet 71 extends is slightly thickened to provide a reinforced section or tab 73 of added strength. It will be observed with reference to FIGS. 3–5, that the end edge of upper end 66 is enclosed in pocket 55, and that the end edge of front end 67 is closely adjacent the inside surface of bottom rib 50, and hence, there are no exposed sharp edges at the ends of the support element.

Similarly, support element 20 is mounted so it extends along rear surface 22' of the shell with upper end 61 in pocket 56 and front end 62 closely adjacent the inside surface of bottom rib 50. One side of support element 20 engages inside surface 65' of rib 52 along its entire length. The respective ends of support element 20 are secured to rib 52 with rivets 74 and 75, respectively, which extend through openings in the respective ends and the rib. Rib 52 is thickened at rivet 74 to provide a strengthening tab 76.

Leg units 4 and 5 are secured together with connector sets 15 and 16, respectively. Connector set 15 includes a lower connector element 80 and an upper connector element 81. Likewise, connector set 16 includes a lower connector element 82 and an upper connector element 83. Since connector elements 80–83 are identical, only connector 80 will be described in detail. As shown at FIGS. 5–7, connector element 80 is generally L-shaped, is formed from a single piece of heavy gauge weldable sheet metal, and has a horizontal wall 84 and a vertical wall 85 projecting perpendicularly from one side of the horizontal wall. Horizontal wall 84 is longer than vertical wall 85 and has generally flat projecting ends 86 and 87. End 86 extends beyond end edge 88 of the vertical wall and end 87 extends beyond end edge 89 of the vertical wall. End edges 88 and 89 have arcuately curved portions 90 and 91 which conform with the curvature of the respective horizontal portions 6 and 9 of the leg units. Near end edge 88 in vertical wall 85 is an opening 92, and near end edge 89 is an opening 93. Each of the openings is stamped in vertical wall 85 in such a manner that the material of the wall is extruded inwardly of the angle to form the respective sleeves 94 and 95. The openings 92 and 93 are threaded internally along the length of the sleeves.

A pair of spaced-apart strengthening gussets 96 and 97 are formed in horizontal wall 84 and vertical wall 85. These strengthening gussets are deformed inwardly from the respective outer surfaces 98 and 99 of the vertical wall and horizontal wall respectively. Gussets 96 and 97 are each continuous from vertical wall 85 to horizontal wall 84 and extend around the corner between the walls. The gussets provide a strengthening function which reduces flexture of horizontal wall 84 relative to vertical wall 85.

An elongated longitudinally extending inwardly deformed strengthening rib 100 is formed in horizontal wall 84. The rib 100 extends along a substantial portion of the length of wall 84 and terminates short of the projecting ends 86 and 87. Openings 101 and 102 are formed respectively at the opposite ends of rib 100. Openings 101 and 102 are locator openings dimensioned to receive suitable locating pins of a welding jig to facilitate positioning the connector element against the horizontal portions of the leg units for welding.

Formed in end 86 of horizontal wall 84 are a pair of longitudinally extending transversely spaced welding projections 103 and 104 which project away from surface 98. Similar projections 105 and 106 are formed in end 87 of wall 84. Projections 103–106 are provided to facilitate welding connector element 80 to horizontal portions 6 and 9 of the respective leg units by resistance welding.

As shown at FIG. 5, connector element 81 has a horizontal wall 110 and a vertical wall 111, connector element 82 has a horizontal wall 112 and a vertical wall 113, and connector ele-

ment 83 has a horizontal wall 114 and a vertical wall 115. As shown at FIGS. 5 and 10, connector element 80 is positioned with the ends of its horizontal wall 84 extending beneath the horizontal portions 6 and 9 of the leg sets and with vertical wall extending upwardly, and connector element 81 is positioned so the ends of its horizontal wall 110 extend above horizontal portions 6 and 9 of the respective leg sets, and its vertical wall 111 extends downwardly. The respective ends of horizontal wall 110 are welded to the upper surface of horizontal portions 6 and 9 respectively, and the respective ends of horizontal wall 84 are welded to the lower surface of the respective horizontal portions 6 and 9. Similarly, connector elements 82 and 83 of connector set 16 are welded to the horizontal portions 6 and 9 at the opposite side of the base structure. As shown at FIG. 9, the welding projections 103 and 104 of connector elements 82 and 83 are deformed into tubular horizontal portion 9 during the welding operation. The connection between the horizontal portions 6 and 9 with the remaining connector element ends is the same.

As shown at FIG. 5, connector elements 80 and 81, when secured between horizontal portions 6 and 9, cooperate to form a generally box-shaped structure with open diagonally opposite corners 115' and 116. In this regard, it will be noted that connector element 81 is offset slightly to the right of connector element 80 and hence, the plane of vertical wall 111 is beyond the end edge 117 of horizontal wall 84. Likewise, the plane of vertical wall 85 is beyond the end edge 118 of horizontal wall 110. Also, vertical walls 85 and 111 have a height less than the diameter of portion 6. By so dimensioning the respective horizontal and vertical walls of the connector elements, the connector elements of each set are in nonengaging relationship to each other which facilitates both handling and positioning the connector elements on the respective horizontal portions of the leg units when the connector elements are welded to the leg units. In addition, the arcuately curved end edges 90 and 91 of each connector element engage the horizontal portions of the leg units, and the horizontal portions are thus spaced apart arcuately. As shown at FIGS. 3 and 10, the respective connector sets 15 and 16 are offset toward opposite sides of the chair, but are slightly inwardly of the respective sidewalls 46 and 47 of the seat structure 3.

Seat structure 3 is secured to base structure 2 with connector brackets 23 and 24. As shown at FIG. 8, connector bracket 24 is formed from a single piece of heavy gauge weldable sheet metal and has a vertical wall 125 and a short horizontal bottom lip 126 bent at a right angle to wall 125, and which extends the length of the lower end of the wall. The end edge 127 has an arcuately curved upper portion 128 which conforms with the curvature of the horizontal portion of the leg sets, and end edge 129 has a similarly curved upper portion 130. Bent at a right angle to vertical wall 125 is an upper wall 131. As shown at FIGS. 5 and 8, upper wall 131 has a horizontal wall portion 132 which extends inwardly across lip 126, and terminates as an upwardly curved wall portion 133 which has a radius of curvature identical to the radius of the tubes from which support elements 19 and 20 are formed. Hence, as shown at FIG. 5, arcuate wall 133 conforms to the curvature of support element 20 along a 90° sector of the circumference of the support element. A pair of transverse longitudinally spaced apart projections 134 and 135 are formed in wall 133 adjacent one of its ends, and similar projections 136 and 137 are formed in the wall 133 adjacent its other end. These welding projections are provided to facilitate resistance welding connector bracket 24 to the horizontal portion of support element 20 which extends beneath seat 21.

Connector bracket 23 is identical with connector bracket 24 and is merely connector bracket 24 rotated end for end. Connector bracket 23 has a vertical wall 138, (FIG. 5) a lower lip 139, and an upper wall with a flat portion 140 and an upwardly curved portion 141 to which support element 19 is welded. The brackets 23 and 24 are welded respectively to support elements 19 and 20 before the support elements are secured to the seat shell, and the brackets are aligned with each other transversely of the chair.

Bracket 24 is so dimensioned that the distance between the inside surface of horizontal wall 132 and the inside surface of lip 126 is only slightly greater than the distance between the outside surface of horizontal wall 114 and the outside surface of horizontal leg 112 of connector set 16. Hence, connector bracket 24 can readily be slipped over the connector elements of connector set 16 to the position shown at FIGS. 4 and 5. The openings 142 and 143 in connector bracket 24 are so located that they align with the respective openings 92 and 93 of connector element 82. The length of horizontal wall 125 is such that connector bracket 24 is a close fit between horizontal portions 6 and 9, and the arcuately curved edges 128 and 130 are closely adjacent the horizontal portions.

With seat structure 3 assembled, and base structure 2 also assembled, the seat structure can be secured to the base structure quite readily using only a screwdriver. This is accomplished by positioning the seat structure over the base structure and then spreading connector brackets 23 and 24 apart a sufficient distance that the lower lips 139 and 126 of the respective connector brackets clear the outside surfaces of the vertical walls 83 and 113 of the respective connector sets 15 and 16. The seat structure is then pushed downwardly until lips 139 and 126 snap across the bottom surface of the horizontal legs of the outside connector element of each connector set. With the connector brackets so positioned, it will be observed that flat upper wall 140 of connector bracket 23 rests on the top surface of horizontal wall 110 of connector element 81 at one side of the chair, and that flat wall 132 of connector bracket 24 rests on the top surface of horizontal wall 114 of connector element 83, at the other side of the chair. Machine screws 145 are then inserted through the openings in the connector brackets and are threaded into openings 92 and 93 of the outside connector element of each set to secure the seat structure to the base structure. Since no special tools, other than a screwdriver, are required to secure the base structure to the seat structure, the chair can be shipped in a knocked-down condition with the base structure separated from the seat structure. Because of the shape of the seat structure, several seat structures can be shipped in the same carton to the desired destination in nested relation to each other. Similarly, a group of base structures 2 can be nested one on the other and shipped in a separate carton to the same destination. At the destination, the seat structure is assembled to the base structure, which can be done by unskilled labor, since it merely entails inserting four screws through the connector brackets into the outside connector elements.

It is believed that the remarkable comfort characteristics of the chair of this invention reside in the configuration of the seat-back shell 18 and the cooperation of the shell with support elements 19 and 20 to provide some flexture of the back relative to the seat, especially at the juncture 40 of the seat 21 and back 22.

As shown at FIG. 10, the front surface 41 of the back is comprised of two substantially flat surfaces 150 and 151 which extend toward each other from the opposite side walls 25 and 26 of the back and merge with each other at the vertical center of the back to provide a shallow V-shaped spine relief area 152 along the vertical center of the front surface 41. As shown at FIG. 12, the angle between surfaces 150 and 151 is approximately 160° at a location spaced slightly from top edge 27 of back 22. At the very top of the chair, the angle is slightly larger, approximately 162°. The angle between surfaces 150 and 151 decreases in a direction toward opening 32. As shown at FIG. 11, the angle between surfaces 150 and 151 is 150° at a location somewhat above the apex 36 of opening 32. At the opening, the angle between surfaces 150 and 151 is even smaller, approximately 145°. Hence, at the intersection of surfaces 150 and 151 adjacent the top edge 27 of back 22, the back is flatter than it is at a lower position along the back, and the angle between the surfaces becomes the sharpest at the apex of opening 32.

As shown at FIG. 13, the center of the back is substantially straight along its length from the apex 36 of opening 32 to the top edge 27 of the back. FIG. 13 shows an additional feature of the seat-back shell which is also believed to enhance the comfort of the shell. It will be observed that the upper surface 37 of seat 21 slopes downwardly in a direction away from front portion 44 of the seat and this slope is substantially uniform along the length of surface 37. In contrast, the upper edge of sidewall 42 of the seat extends horizontally from front portion 44 of the seat to the back.

As shown at FIG. 14 surface 37 curves upwardly from the center 154 of the seat toward the juncture of surface 37 with wall 42. With reference to FIG. 15, it will be noted that the upward curvature of the surface 37 becomes shallower in a direction toward front 44 of the seat. Then, at the junction where surface 37 merges with front portion 44 of the seat, the surface 37 is horizontal, as shown at FIG. 16. Although only one-half of the seat is shown in FIGS. 14–16, the seat is symmetrical about a vertical plane, and the other half of the seat is therefore the mirror image of the half shown at FIGS.14–16.

It is believed that the upwardly curved or dished upper surface 37 of the seat which becomes more shallow and ultimately terminates at a straight surface adjacent the front of the seat is instrumental in providing comfort for the buttocks and thighs of a student sitting on seat shell 18, and that the spine relief area 152 formed adjacent the intersecting planar surfaces 150 and 151 of the rear of the seat cooperate with the surface 37 and the buttocks relief opening 36 to provide a seat construction which, although formed from rigid molded plastic material, provides for extreme comfort of even lanky students. An additional comfort feature is that the shell is so constructed adjacent the juncture of the back and the seat, and the tubular supports 19 and 20 are so arranged that some flexing or give is available both along back 22 and at the juncture of the back 22 with seat 21.

If desired, the basic chair 1, including the seat structure and base structure, may be provided with a tablet arm or desk arm assembly 160 shown at FIGS. 17 and 18. Tablet arm assembly 160 includes a flat desk panel 161 having a smooth top or writing surface 162, a tubular arm support 163, which extends under and is secured to the desk panel, and arm support brackets 164 and 165 which secure the desk assembly to the base structure of the chair.

As shown at FIGS. 17 and 18, arm support element 163 has a lower horizontal portion 166 which extends under the chair seat and below the connector sets 15 and 16. The arm support element is bent as at 167 along a relatively long radius to provide an intermediate section 167' which extends upwardly and forwardly to the underside of the desk panel. At the underside of the desk panel, the arm support is bent again so it extends first forwardly and slightly upwardly, as at portion 168, along the bottom surface 169 of desk panel 161, and then at a right angle to portion 168 to provide upper end 170 which extends transversely of desk panel 161 in parallel relation to but spaced from the front edge 171 of the panel. The desk panel is secured to the tubular support with a plurality of U-shaped connector clips 172–175, each having a pair of outwardly projecting flanges 176, 177. Each flange is provided with an opening to receive a screw 178 which is threaded into the panel from its underside to secure the panel to the arm support.

FIG. 19 shows that arm support bracket 164 has a flat rectangular upper vertical wall 180 which terminates at its upper end at a narrow inwardly extending horizontal wall or lip 181. Support bracket 164 also has a flat triangular lower vertical wall 182 joined to vertical wall 180 by a narrow horizontal wall 183. Formed in upper vertical wall 180 are a pair of spaced-apart openings 184 which align with the openings 92 and 93 of the outside connector element of connector set 16, and with the openings in connector bracket 24. Formed in lower wall 182 is an opening 185 of a diameter to receive the lower tubular portion 166 of the desk arm support 163.

Arm support bracket 165 is quite similar to bracket 164. Arm support bracket 165 has an upper vertical wall 186 joined to a lower vertical wall 187 by a narrow horizontal connecting wall 188. There is, however, no horizontal wall or liplike lip 181, nor is there an opening in wall 187 to receive lower portion 166 of the desk arm support 163. Instead, bracket 165 is welded as at 190 to the end of lower portion 166 and closes this end. Bracket 164, on the other hand, is slipped over lower portion 166 and is welded as at 191.

Connector brackets 164 and 165 are connected to lower portion 166 of the desk arm support so horizontal walls 181 and 183 of bracket 164 project inwardly, and horizontal wall 188 of bracket 165 also projects inwardly. Connector brackets 164 and 165 are aligned transversely of the chair, and are so positioned that the distance between inside surfaces 180 and 186 of the respective connector brackets equals the distance between the outside surfaces of the connector brackets 23 and 24 of the seat structure. Hence, to mount desk arm assembly 160 on the chair, it is merely necessary to extend lower portion 166 under the chair, pivot the arm assembly 160 so lip 181 hooks over the top edge of connector bracket 24, and then pivot the assembly counterclockwise as viewed at FIG. 17, so wall 186 of connector bracket 165 is moved upwardly and adjacent the sidewall of connector bracket 23. Machine screws 145 are inserted through connector bracket 164 and connector bracket 24 and are threaded into the outside connector element of connector set 16, and similarly, at the other side of the chair, machine screws 145 are inserted through connector bracket 165 and connector bracket 23 into the outside connector element of connector set 15. Since the addition of desk arm assembly 160 is optional with the purchaser of the chair, the desk arm can be added quite easily to the basic chair, and hence, desk arm equipped chairs are not a specialty item. It will also be appreciated that several desk arms can be shipped separately in a package or carton separate from the package or carton for the seat structure and base structure.

While a preferred embodiment of the chair of this invention has been shown and described in detail, it is to be understood that numerous changes and variations can be made in the details of the construction shown and described herein without departing from the scope of this invention. For example, the proportions of the seat structure and base structure could be changed to suit the needs of people of various builds and sizes, the base structure may be used with set structures of different types, and the seat shell can, of course, be used with bases other than the one disclosed herein also, without departing from the scope of this invention.

What is claimed is:

1. A chair comprising, in combination a base structure including

an inverted U-shaped front leg unit having a horizontal portion and a pair of spaced-apart front legs extending downwardly from the horizontal portion,

an inverted U-shaped rear leg unit having a horizontal portion and a pair of spaced-apart rear legs extending downwardly from the horizontal portion,

first connector means and second connector means in spaced apart generally parallel relation to each other, each extending between and fixed to said horizontal portions, and maintaining said horizontal portions in parallel relation to each other;

said connector means each having

an upper wall,

a lower wall, and

an upright wall extending from one of said walls in a direction toward the other wall;

a seat structure comprising

a molded integral seat-back shell generally symmetrical about a central vertical plane, and

support means securing said shell to said base structure;

said molded seat-back shell including a seat and a back extending upwardly from the seat;

said support means including

a first support element having a portion extending beneath said seat and a portion extending along the rear of said back,

a second support element having a portion extending beneath said seat, and a portion extending along the rear of said back,

means securing said support elements to said back with said portion extending beneath said seat in spaced-apart relation to each other,

a first connector bracket secured to said first support element and engaging at least the upper and lower walls of said first connector means,

a second connector bracket secured to said second support element and engaging at least the upper and lower walls of said second connector means, and

fastener means securing said first connector bracket to said first connector means and said second connector bracket to said second connector means with said first and second support elements extending above the respective connector means.

2. A chair according to claim 1 wherein said support elements are formed from weldable material; and said connector brackets are each formed from weldable material and are secured to the respective support elements by welding.

3. A chair according to claim 1 wherein said fastener means secure said connector brackets to the respective upright walls of said connector means.

4. A chair according to claim 1 wherein said connector means and said connector brackets are each formed from weldable material; and

said leg units and support elements are each formed from tubular weldable material.

5. A chair according to claim 1 wherein an arm support having a lower end extends beneath said connector means in generally parallel relation to said horizontal portions of said leg units, said arm support extends upwardly and then inwardly above said seat and terminates at an upper end;

an arm is secured to the upper end of the arm support; and

spaced-apart support brackets are secured to and project upwardly from said lower end; and

said fastener means secure said connector bracket, connector means, and support brackets together at each side of the chair.

6. A base structure for supporting the seat of a chair comprising, in combination

an inverted U-shaped front leg unit having a tubular horizontal portion and a pair of spaced-apart front legs extending downwardly from the horizontal portion;

an inverted U-shaped rear leg unit having a tubular horizontal portion parallel with the horizontal portion of the front leg unit and having spaced-apart legs projecting downwardly from the horizontal portion;

first and second connector sets extending between and secured by said horizontal portions in spaced-apart relation to each other, each of said connector sets comprising

a first connector element having a horizontal wall and a vertical wall projecting perpendicularly from the horizontal wall, and

a second connector element having a horizontal wall and a vertical wall projecting perpendicularly from the horizontal wall;

said horizontal wall of the first element of each set extending across and welded to upper surfaces of the respective tubular horizontal portions of said leg units, and the vertical wall of said first element extending downwardly between and closely adjacent said leg units;

said horizontal wall of said second element of each set extending below and welded to lower surfaces of the respective tubular horizontal portions of said leg units, in generally aligned relation to the horizontal wall of the first element, and the vertical wall of said second element extending upwardly between and closely adjacent said leg units;

said vertical walls each having a height less than the diameter of said tubular portions, whereby said connector sets are each generally box-shaped with diagonally open corners;

said vertical wall of the second connector element of each set being outwardly of the vertical wall of the first connector element, relative to the center of the base; and

said vertical wall of the second connector element of each set having a pair of spaced-apart openings therein adapted to receive threaded fasteners to secure a seat to the base.

7. A structure according to claim 6 wherein a seat structure is secured to said base structure; said seat structure including first and second connector brackets, each comprising

a horizontal wall adapted to engage the upper horizontal wall of the first connector element of a set,

a vertical wall adapted to engage the vertical wall of the second connector element of a set,

a horizontal lip extending inwardly from the vertical wall and under the horizontal wall of the second connector element of a set,

said vertical walls of each connector element having openings therein alignable with the openings in said vertical walls,

fastener means extending through said openings and securing a connector bracket to the second element of each set, and

means securing said connector brackets to the seat.

8. A chair comprising, in combination a base structure including

an inverted U-shaped front leg unit having a horizontal portion and a pair of spaced-apart front legs extending downwardly from the horizontal portion,

an inverted U-shaped rear leg unit having a horizontal portion and a pair of spaced-apart rear legs extending downwardly from the horizontal portion,

first connector means and second connector means in spaced-apart generally parallel relation to each other, each extending between and fixed to said horizontal portions, and maintaining said horizontal portions in parallel relation to each other;

said connector means each having

an upper wall,

a lower wall, and

an upright wall extending from one of said walls in a direction toward the other wall;

a seat structure comprising

a seat and a back each generally symmetrical about a central vertical plane, and

support means securing said seat and back to said base structure;

said support means including

a first support element having a portion extending beneath said seat, and a portion extending along the rear of said back,

a second support element having a portion extending beneath said seat, and a portion extending along the rear of said back,

means securing said support elements to said back with said portions extending beneath said seat in spaced-apart relation to each other,

means securing said support elements to said seat,

a first connector bracket secured to said first support element and engaging at least the upper and lower walls of said first connector means,

a second connector bracket secured to said second support element and engaging at least the upper and lower walls of second connector means, and

fastener means securing said first connector bracket to said first connector means and said second connector bracket to said second connector means with said first and second support elements extending above the respective connector means.

9. A chair according to claim 8, wherein said fastener means includes threaded fasteners extending through openings in said connector bracket and secured to said connector means.

10. A base structure for supporting the seat of a chair comprising, in combination

a first leg unit having a horizontal portion and a pair of spaced-apart legs extending downwardly from the horizontal portion;

a second leg unit having a horizontal portion parallel with the horizontal portion of the first leg unit and having a pair of spaced-apart legs extending downwardly from the horizontal portion;

first and second connector sets extending between and secured to said horizontal portions in spaced-apart relation to each other, each of said connector sets comprising

a first connector element having a horizontal wall and a vertical wall projecting perpendicularly from the horizontal wall, and

a second connector element having a horizontal wall and a vertical wall projecting perpendicularly from the horizontal wall;

said horizontal wall of the first element of each set extending across and welded to upper surfaces of the respective tubular horizontal portions of said leg units, and the vertical wall of said first element extending downwardly between and closely adjacent said leg units;

said horizontal wall of said second element of each set extending below and welded to lower surfaces of the respective tubular horizontal portions of said leg units, in generally aligned relation to the horizontal wall of the first element, and the vertical wall of said second element extending upwardly between and closely adjacent said leg units;

said vertical walls each having a height less than the distance between the horizontal walls of the respective elements, whereby said connector sets are each generally box-shaped with diagonally open corners, and

a seat structure secured to at least one of said connector elements of each set.

11. A structure according to claim 10 wherein said seat structure includes first and second connector brackets, each comprising

a horizontal wall adapted to engage the upper horizontal wall of the first connector element of a set,

a vertical wall adapted to engage the vertical wall of the second connector element of a set,

said vertical walls of each connector element having openings therein alignable with the openings in said vertical walls,

fastener means extending through said openings and securing a connector bracket to the first element of each set, and

means securing said connector brackets to the seat.

12. A chair according to claim 10 wherein said seat structure includes a molded seat and a molded back;

a pair of spaced apart tubular support elements are secured to the seat and back, said support elements including generally horizontal front portions extending over said connector sets;

first and second connector brackets extending downwardly from said front portions, and

means releasably securing said brackets to said connector elements.

13. A chair according to claim 10 wherein said seat structure includes

a seat-back shell having a rear surface, and ribs projecting from the surface, support elements secured only to said ribs with fasteners unexposed relative to the front surface of the shell, and

bracket means fixed to said support elements and adapted to connect the seat structure to the connector elements.

14. A chair according to claim 12 wherein said connector brackets include

an upper arcuately curved wall conforming with the curvature of and extending partially along the surface of one of said tubular support elements,

an upper horizontal wall engaging the horizontal wall of said first connector element,

a lower horizontal wall engaging the horizontal wall of said second connector element, and

a vertical wall extending between said upper and lower horizontal walls.

15. A chair according to claim 14 which further includes

an arm having writing surface above the level of the seat;

an arm support element having a first portion extending under and secured to said arm, and a second portion extending from said first portion and under the seat and connector sets; and

support bracket means secured to said second portion of said arm.

16. A chair according to claim 15 wherein said support bracket means includes first and second support brackets each comprising

an upper vertical wall, a

lower vertical wall, and

a horizontal wall connecting said upper and lower vertical walls;

said upper vertical wall engaging said vertical wall of said connector bracket;

said horizontal wall engaging said lower horizontal wall of said connector bracket;

said lower vertical wall supporting said second portion of said arm support element.

17. A claim according to claim 16 wherein at least one of said support brackets further includes

a horizontal lip projecting from the top of said upper vertical wall, said lip extending across and engaging said upper horizontal wall of said connector bracket.

18. A claim according to claim 16 wherein common releasable fastener means secure said support brackets and connector brackets to said connector elements of said connector sets.

19. A base structure for supporting the seat of a chair comprising, in combination

a first leg unit having a horizontal portion and a pair of spaced-apart legs extending downwardly from the horizontal portion;

a second leg unit having a horizontal portion parallel with the horizontal portion of the first leg unit and having a pair of spaced-apart legs extending downwardly from the horizontal portion;

first and second connector sets extending between and secured to said horizontal portions in spaced apart relation to each other, each of said connector sets comprising

a first connector element having a horizontal wall and a vertical wall projecting perpendicularly from the horizontal wall, said vertical wall presenting oppositely facing edges of a configuration conforming with the surface configuration of said horizontal portions of said leg units along at least a portion of the length of said edges, and

a second connector element having a horizontal wall and a vertical wall projecting perpendicularly from the horizontal wall, said vertical wall of said second connector element presenting oppositely facing edges of a configuration conforming with the surface configuration of said horizontal portions of said leg units along at least a portion of the length of said edges;

said horizontal wall of the first element of each set extending across and welded to upper surfaces of the respective tubular horizontal portions of said leg units, said vertical wall of said first element extending downwardly between said leg units, and said end edges engaging said horizontal portions of said leg units;

said horizontal wall of said second element of each set extending below and welded to lower surfaces of the respective tubular horizontal portions of said leg units, said vertical wall of said second element extending upwardly between said leg units, and said end edges engaging said horizontal portions of said leg units; and

a seat structure secured to at least one of said connector elements of each set.

20. A structure according to claim 19 wherein

said horizontal portions of said first and second leg units each have an arcuately curved surface configuration;

said end edges of said first and second connector elements each curve arcuately along and engage a portion of the arcuately curved surface of each of the horizontal portions of said leg units; and

said connector elements are identical to each other.

21. A structure according to claim 19 wherein

said horizontal portions of said first and second leg units each have cylindrical surfaces; and

said end edges of said first and second connector elements curve along and engage portions of said cylindrical surfaces.

22. A structure according to claim 19 wherein

said first and second connector elements of each set have their horizontal walls generally aligned with each other and cooperate to provide connector sets of generally box-shaped configuration.

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