Jan. 18, 1966 R. L. STAPLES 3,230,005

MULTI-SEATING ASSEMBLY

Filed Jan. 27, 1964 2 Sheets-Sheet 1

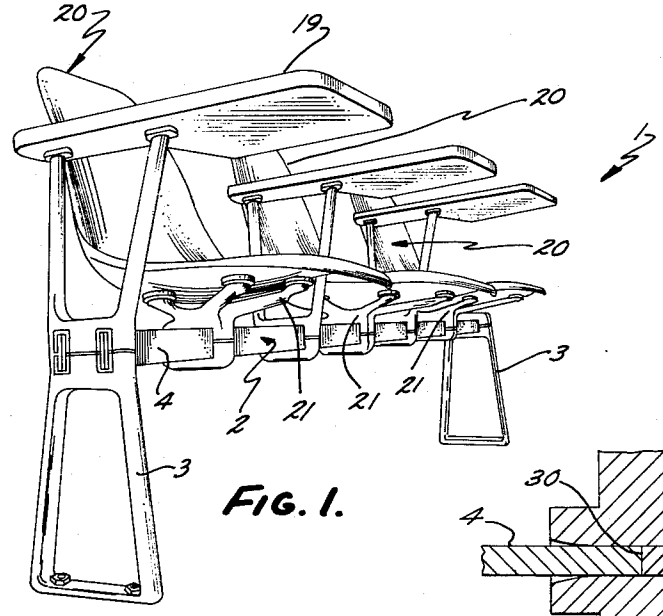


FIG. 1.

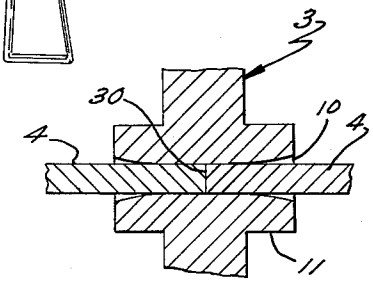


FIG. 6.

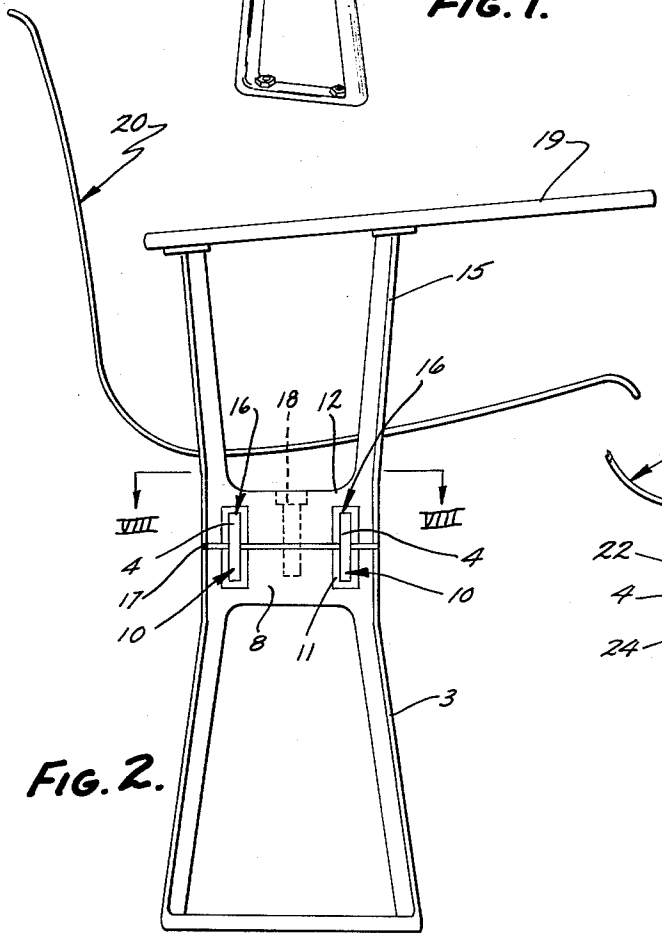


FIG. 2.

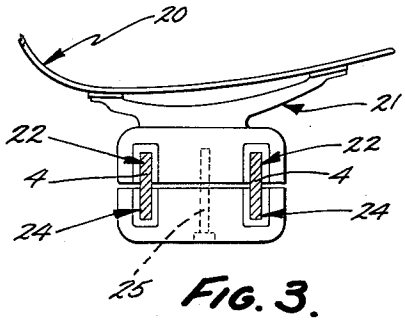


FIG. 3.

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MULTI-SEATING ASSEMBLY

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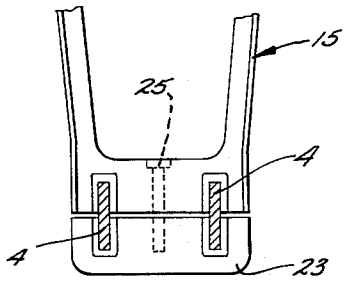


FIG. 4.

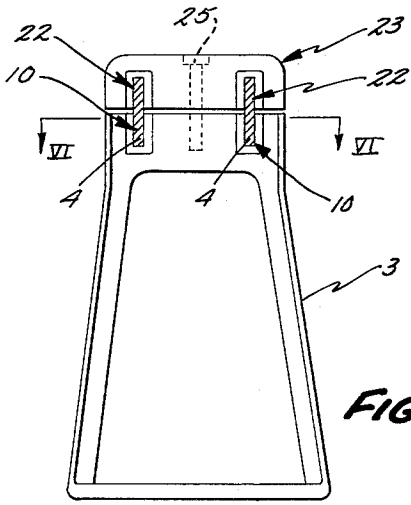


FIG. 5.

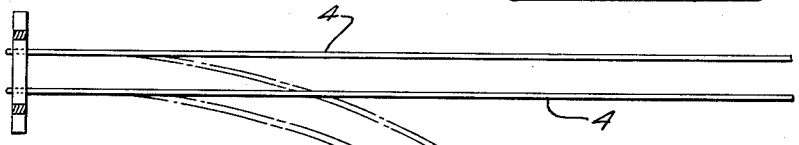


FIG. 7.

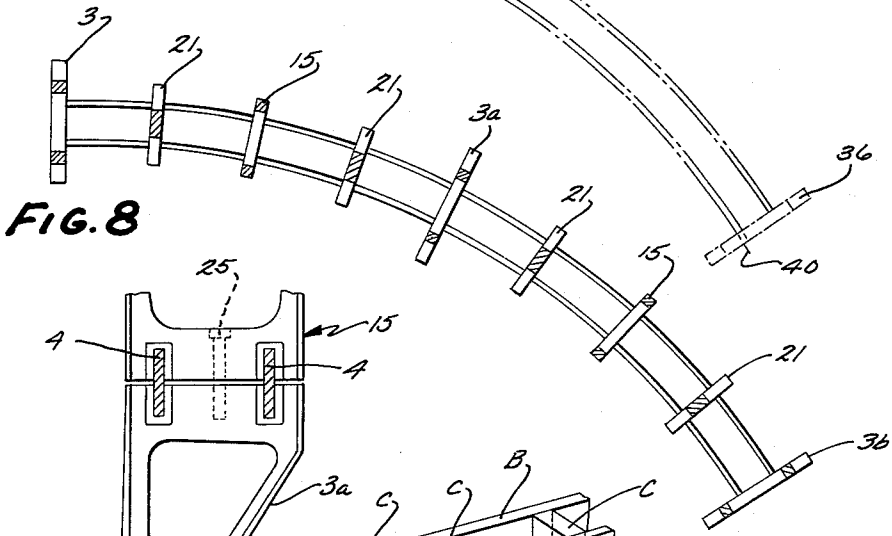


FIG. 8

FIG. 9

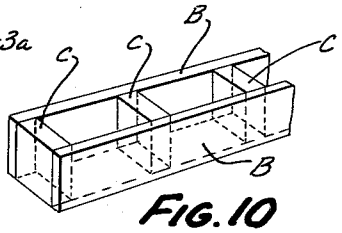


FIG. 10

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MULTI-SEATING ASSEMBLY

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Filed Jan. 27, 1964, Ser. No. 340,409
10 Claims. (Cl. 297—160)

This invention relates to seating, and more particularly to seating arranged in tandem or rows such as is used in many public facilities.

Row or tandem arrangement of seating is utilized in such public facilities as auditoriums, stadiums, classrooms and lecture halls. In some of these installations the seating is arranged in a straight row, but more often it is arranged in curved rows. This is particularly desirable where the main point of interest is focused on a limited area such as on a stage or podium. In many installations part of the seating is arranged in straight rows and part of it is arranged in curved rows. Past designs for tandem seating have presented a number of problems in installations employing curved rows. The seats must be pre-engineered and pre-designed to exactly fit the proposed curvature. Most buildings are designed not to a standard curvature, but are designed to fit a particular site or architectural concept or to serve a particular purpose. Therefore, every building involves it own special curvature requiring custom design.

With conventional designs these seats have to be engineered and specifically built to fit the particular curvature which will be encountered at the time of installation. In many cases, special dies are necessary to fabricate the seating. This adds greatly to the cost of the product. Also, should there be an error in the fabrication of the product, or should there be a subsequent change in design, the necessity for scrapping many components becomes an important cast factor.

This invention overcomes this problem by making it possible to shape the seating base to the particular curvature involved at the situs of the installation. Therefore, the problems of pre-design and pre-engineering and the necessity for custom designed parts is eliminated. This permits a wide flexibility of design and allows modication of the specifications during the actual construction, and in fact even during actual installation of the seating.

This invention furthermore permits the seating arrangement to be changed after installation. This affords great flexibility not only to the original design, but also materially reduces the cost of subsequent remodeling of the structure.

At the same time, the invention provides a particularly strong structure. It utilizes a small number of components of standardized construction. The installation can be changed in many ways such as in the type of equipment it provides, the spacing between the seats, and the type of seating provided. This is done merely by selection and use of standard component parts. Thus, it provides a relatively inexpensive, simple, flexible, and durable type of seating.

These and other objects and purposes of this invention will be understood by those acquainted with the problems of public seating upon reading the following specification and the accompanying drawings.

In the drawings:

FIG. 1 is an oblique view of a seat assembly incorporating this invention viewed from the underside;

FIG. 2 is an end elevation view of seating incorporating this invention;

FIG. 3 is a fragmentary end sectional view of one of the mounting brackets for the seat;

FIG. 4 is a fragmentary end sectional view of one of the arm rest support brackets;

FIG. 5 is a sectional end view of an intermediate support standard;

FIG. 6 is an enlarged fragmentary sectional view taken along the plane VI—VI of FIG. 5;

FIG. 7 is a schematic view of the installation of the rails for this seating showing the rails as initially mounted in solid lines and after on site bending to the desired curvature in broken lines;

FIG. 8 is sectional view taken along the plane VIII—VIII of FIG. 2 showing a typical installation after its assembly has been completed;

FIG. 9 is a fragmentary end elevational view of a modified standard for this invention; and

FIG. 10 is a schematic view of the beam-support structure utilized by this invention.

To embody this invention in practical form at least two standards are provided and these are connected by a pair of rails. These rails are of rectangular shape with their greater dimension arranged vertically permitting them to be flexed in a horizontal plane. The rails are spaced in a fore and aft direction and may be bent at the point of installation to any particular curvature which may be desired. After the rails have been bent to the desired curvature, they are secured to at least two standards, one on each end, and may be locked to additional intermediate supporting standards. After this has been done, the necessary fittings to mount the individual seats, and if desired, arm rests, tablet arms or other equipment are mounted on the rails. The standards and the additional equipment mounted on the rails are detachably secured to the rails and are of a design which forms a cross brace between the rails at each point of attachment, thereby collectively forming, with the rails, a box beam. The resulting beam is rigid and capable of withstanding substantial loads, both without vertical bending and without twisting under torsional loading.

Refering specifically to the drawings, the numeral **1** indicates a seating assembly having a base portion **2**. The base **2** has at least a pair of standards **3** connected together by a pair of rails **4**. As better seen in FIG. 2, the rails **4** are each of rectangular cross section having a substantially greater vertical dimension than horizontal dimension. Thus, they are rigid vertically but are capable of being flexed or bent in a horizontal direction. Preferably, the rails are fabricated of steel bar stock which provides strength and yet permits a degree of flexing at the time of installation. An example of a rail structure which has been found to be satisfactory is a hot rolled steel bar of 3/8 x 1¾ inches. The rails **4** are spaced apart in a fore and aft direction as is indicated in FIG. 2.

The upper end of the pedestal or standard **3** is flat, and opening upwardly through this flat top surface are a pair of slots **10**. The slots **10** are spaced apart fore and aft. The depth of the slots **10** is such that approximately one half of the rail is received in the slot, the other half projecting above the top surface of the standard **3**. For purposes of strength, the slots **3** may be surrounded by a reinforcement lip **11** to provide greater bearing for the rails **4**.

As is more particularly visible in FIG. 6, both ends of the slot **10** flare slightly. This permits the standard to receive the rail **4** even though the rail itself is traversing a curve. The importance of this will be more clearly understood in the subsequent description of this invention. However, it will be noted that the central portion of the slot closely fits about the rail to assure positive restraint of the rail against fore and aft movement with respect to the standard **3**.

As the invention is illustrated in FIGS. 1 and 2, an arm rest bracket **15** is mounted to the top of the standard **3**. Its lower face is flat and opening through it are a pair of slots **16** identical to the slots **10** in the standard **3**. The combined depth of the slots **16** and **10** is such that when the arm bracket **15** is aligned over the standard **3** and seated on top of the rails **4**, its lower surface does not quite contact the upper surface of the standard **3** leaving a small clearance space **17**. Thus, when the arm bracket **15** is secured to the standard **3** by installation of the cap screw **18**, the rails **4** will be positively clamped between the bracket and the standard. This positive clamping action is assured since the presence of the clearance space **17** prevents actual contact between the bracket and standard. The clamping of the rails locks them against movement in any direction including sliding movement relative to the standard and bracket.

It should be noted that the standard **3** has a web **8** between the slots **10** and the arm bracket **15** has a web **12** between the slots **16**. These webs provide a rigid cross-brace between the rails preventing them from tipping fore and apt. When the cap screw **18** is tightened, these webs act in the same manner as would blocks welded to and between the rails.

As illustrated in FIGS. 1 and 2, the upper end of the arm bracket mounts a tablet support **19**. It will be recognized that various other types of arm rests or tablet supports may be substituted for the particular one illustrated without in anyway affecting this invention.

Mounted on the rails **4** at spaced intervals between the standards **3** are seats **20**. In the particular form illustrated, the seats are shells of any suitable material such as molded reinforced synthetic resin. It will be recognized that seats of any other construction may be substituted for the shells as illustrated without in any way affecting this invention. Each of the seats **20** is secured to the rails by means of a bracket **21**. Each of the brackets **21** has a pair of slots **22** identical to the slots **10** in the standard **3**. The slots **22** are identical in depth, width, design and spacing, and are designed to receive the rails **4**.

Cooperating with the bracket **21** is a clamping cap **23**. It also has slots **24** identical with the slots **10** in the standard **3**. Thus, when the clamping cap **23** is secured to the bracket **21** by the cap screw **25** (FIG. 3), the rails **4** will be positively secured to the bracket and held against movement in any direction with respect to the bracket. Once again, the clamping cap when tightened into place will be spaced slightly from the bracket to assure a positive engagement between the rails and the ends of the slots **22** and **24**. Also, like the construction of the standard and the cooperating arm bracket, the bracket **21** and the clamping cap **23** provide a positive brace between the rails **4**, thus forming a box out of the rails holding them both parallel and vertical.

It will be recognized that the practice of this invention is not limited to the use of a single bracket for mounting the seat. A pair of brackets may be substituted for the single spider-like bracket illustrated.

Where it is necessary to secure one of the arm brackets to the rails at a point removed from one of the standards **3**, one of the clamping caps **23** is used as the cooperating part to secure the arm bracket. This is illustrated in FIG. 4. Preferably, one of these arm brackets is used adjacent each of the seats **20**. Where it is desired to provide a standard without the use of the arm bracket, one of the caps **23** can be substituted for the arm bracket as is indicated in FIG. 5.

If it is desired to mount the seating unit to a vertical surface rather than a horizontal surface, a standard **3*a*** may be substituted for the standard **3** (FIG. 9). Except for the provision for mounting against a vertical surface, the standard **3*a*** is identical to the standard **3**, and is secured to the arm bracket **15** and the rails **4** in the same manner.

It will be obvious from the above description that instead of one of the arm brackets **15** being used on top of one of the standards **3** or **3*a*** that one of the seat brackets **21** may be substituted. This is because all of the parts are completely interchangeable. Therefore, a complete seat installation may be assembled from only a few basic parts, those being the rails **4**, the standards **3** or **3*a***, the arm brackets **15**, the clamping caps **23** and the necessary cap screws to secure the caps to the base structure. With these few simple and fully interchangeable components, a wide variety of seating arrangements may be assembled with a minimum of labor and difficulty.

The brackets **15** and **21**, the standards **3** and the caps **23** may be made of any suitable material. For example, they can be cast of ferrous or non-ferrous alloys. They may have any suitable finish which may match or contrast with the rails. Irrespective of whether it is one of the standards **3**, or brackets **15** or **21** which is to be mounted, one of the other components will cooperate with it to secure it to the rails. Thus, each of the components constitutes a cooperate element for any of the other components.

In preparation for installation of seating incorporating this invention, it is only necessary to determine how many seats and how many arm rests are going to be used, together with the spacing between the supporting standards. The necessary components are then shipped to the installation site. If this is a substantial distance from source, it may be that the rails **4** are not shipped with the other parts since they are simple standard steel bar stock which normally can be procured in the community in which the installation is to be made. Since this is a heavy component, considerable shipping expense can thus be avoided.

At the site, the position and shape of the seating is laid out on the surface to which the seating is to be attached. Thereafter, a number of different methods will serve for purposes of installation. If the seating is to be installed in a straight line, the standards **3** or **3*a*** are secured to the supporting structure at predetermined spaced intervals. The rails **4** are then seated in the slots **10** of the standards. When the length of a particular row of seats exceeds the length of the available bar stock, additional rails are supplied and their ends are abutted together at the center of one of the standards as suggested at **30** in FIG. 6.

If the rails are not of the precise length to fit the spacing of the standards, they can be easily cut at the site to the appropriate length. The necessary equipment for this is quite simple and readily portable. The installation crew can either bring such equipment with them, or normally they can rent it in the community where the installation is to be made. The ability to thus shorten the rails at the site without particularly adding to material or labor costs avoids the difficulty of laying out the precise seating arrangement at the plant before shipment. It permits substantial final adjustment to be made at the site. This eliminates the possibility of costly errors due to misunderstanding of exact design specifications or error in transposition of the measurement figures or in calculation or failure to notify the manufacturer of a change in design requirements.

Once the rails are seated in the slots in the standards, they can be clamped to the standards by installation of either the arm brackets **15** or the clamping caps **23**. These lock the rails in position. Once this is done, the seats **20** are mounted at the predetermined spacings along the rails, together with the additional arm rests or other equipment which is to be installed. These are merely seated over the rails and secured to the rails by attaching one of the clamping caps **23**. It is obvious from this description that each installation involves standard equipment, components and procedures. Yet each can be made a custom installation at the site. Even if an error in shipment occurs, such as failure to provide enough components or the shipment of excessive quantities, no sub-

stantial problem is created. The deficiencies can be made up in a later shipment or the excess returned since the components are few in number, standard in construction and fully interchangeable from one installation to another.

If the installation is to involve curvature of the rows of seating, there are several ways in which this can be done. For example, as suggested in FIG. 7, one of the end standards **3** may be secured to the supporting structure and the ends of the two rails secured to this standard. The rails are then bent as indicated by the dotted lines to the desired curvature and secured to a second end standard **3***b* indicated in broken lines in FIG. 7. It has been found that 1¾ inch deep by ⅜ inch thick hot rolled steel stock 20 feet in length may readily be bent at the site to a curvature having a radius of 15 feet. This is a sharper curvature than is normally ever encountered in commercial seating. The bending does not require any special tools. The ends of the rails are gripped and the rails simply bent to the desired curvature. Where the curvature is gradual, such as for example on a 25 foot radius, the bending can readily be done manually. If the curvature is such that this is not possible, a simple jig which may be secured to the floor and equipped with a winch and cable to pull the bars to the desired curvature may be employed.

The standard **3***b* may be secured to the supporting structure after the rails have been bent to the desired curvature, or it may be secured before the rails are bent and the rails eased up and passed over the standard until they align with and can be pushed down into the slots. Alternatively, the standard **3***b* may be mounted on the rails with the clamping structure secured but not tightened, permitting the rails to slide with respect to the standard. The standard and the rails are then shifted to the desired position, and the standard locked to the supporting structure. It will be noted that the inner rail will project beyond the standard as at **40** in FIG. 7 after bending because the inner rail traverses a shorter distance than the outer rail. After the rails are in the proper position, the excess length of the inner rail may be cut-off to overcome this problem.

Once the two end standards are secured and the rails are bent to the desired position, the remainder of the equipment can be mounted. For example, an intermediate standard **3***c* can be placed midway between the standards **3** and **3***b* (FIG. 8). Thereafter, the seat brackets **21** can be positioned at the desired spacing along with the additional arm support brackets **15**. These are locked to the rails. Thus, not only at the standards **3**, **3***b* and **3***c*, but also where the seat brackets **21** and the additional arm rest brackets **15** are secured to the rails, the rails are positively locked together and cross-braced. These brackets hold the rails at a constant, predetermined spacing. They hold them vertical and against slippage lengthwise with respect to each other.

The end result is a box beam A of which the rails **41** form the sides B and the various brackets for the standards and the other equipment form the cross-braces C as is suggested in FIG. 10. The cross-braces C are placed at sufficiently close intervals along the box beam that the beam is supported against twisting in torsion because of the inability of the rails to shift with respect to each other in any direction. The strength of the rails is such that the short spacing between the cross-braces formed by the brackets is too small to permit any significant flexing or twisting of the material of the rails. Thus, the end result is an extremely rigid and positive structure. This is true whether the seating is arranged along a straight line or in a curved pattern. However, the curved pattern has even greater resistance to bending and rotational twisting because the bending of the rails effects a certain degree of prestressing of the rails. This increases their resistance to deflection.

The structure is simple to erect and at any time may be modified by substituting different equipment than the particular arm rests or seat members which were initially installed. Further, the spacing between the seats and the arm rests can be varied at the time of installation or at any subsequent time since by simply loosening the brackets, this equipment can be moved lengthwise of the rails to reposition it. This permits rapid and easy adaptation of the equipment at the installation site since none of the equipment is limited to predetermined factory dimensions so far as spacing and curvature are concerned. Because of the slight flaring of the slots **10** as indicated in FIG. 6, the curved rail can pass through any of the slots without binding with the brackets or the clamping caps. Yet, engagement will occur between the walls of the slots and the rails to assure firm support.

It will be recognized that the invention provides a sufficiently flexible system that the curvature need not be constant nor need be always in the same direction. It is entirely possible, should conditions demand, that the seating be laid out on a reversed curve whereby it will form a wavy type of line. None of this needs to be considered at the point of manufacture since the equipment is universal in application, and the few components can be mass produced irrespective of the nature of the ultimate installation which is to be made.

The method of installing furniture which has been disclosed above is believed to be entirely new. It is not believed that a flexible, yet ultimately rigid, common support has ever been developed for seating which permits the seating to be adapted to site requirements at the point of installation. For the first time, this invention permits the engineering of the seating and its final arrangement to be made at the point of installation rather than pre-calculated at the point of manufacture. The flexibility of the resulting system is greatly increased.

While there has been disclosed a preferred embodiment and a preferred method of installation, it will be recognized that various modifications may be introduced into both the structure and the method without departing from the core or spirit of the invention. Such of these modifications as incorporate the principle of either the structure or the method of installation are to be considered as included in the hereinafter appended claims, unless these claims by their language expressly state otherwise.

I claim:

1. A seat assembly having a plurality of seats arranged in side-by-side relationship; a plurality of supporting means; a pair of rails; said rails being rectangular in cross section with their greater dimension extending vertically; said rails being spaced apart fore and aft of said supporting means and arranged parallel to each other; each of said supporting means having a pair of fore and aft spaced openings separated by a web, and each of said openings receiving one of said rails therein with the walls of said openings engaging the vertical sides of said rails and said web forming a rigid cross-brace between said rails; means securing said rails in said openings; at least one seat supporting member for each of said seats; each of said seat supporting members being secured to both of said rails and holding said rails in said predetermined spaced relationship; said rails being bendable about an axis parallel to their greater dimension to permit said plurality of seats to be arranged in a curved pattern.

2. A seat assembly as described in claim **1** wherein each of said seat supporting members has a pair of vertical slots into which said rails are received and said means for securing said rails is a cap and fastener means for securing said cap to said supporting members, said slots and cap both securing said seat supporting member to said rails and holding said rails in fixed parallel relationship to each other when torsional loads are imposed on said rails through said seat supporting member.

3. A seat assembly as described in claim **1** wherein said openings in said supporting means are vertical slots; and

said means for securing said rails is a cap and fastener means, said fastener means detachably securing said cap to said supporting means and holding said rails in said slots.

4. A seat assembly as described in claim 3 wherein each of said caps has a pair of vertical slots aligned with said slots in said supporting means and a portion of each of said rails being received in said slots of both said supporting means and said cap.

5. A seat assembly having a plurality of seats arranged in side-by-side relationship; a plurality of supporting standards each having a pair of parallel, vertical first slots opening through its upper end, said first slots being spaced apart in a fore and aft direction and separated by a web; a pair of rails of rectangular cross section each having its greater dimension arranged vertically, each of said rails being seated in one of said first slots in each of said standards with the walls of said first slots engaging the vertical sides of said rails and said web forming a rigid cross-brace between said rails; said rails being of greater vertical dimension than the depth of said first slots whereby they project above said slots; a plurality of cooperating elements, one for each of said standards; each of said cooperating elements having a pair of second slots opening through its lower face to seat over and receive the projecting portions of said rails, with the walls of said second slots engaging the vertical sides of said rails and said web forming a rigid cross-brace between said rails; means for detachably securing said cooperating elements to said standards; the combined depths of said first and second slots being less than the greater dimension of said rails permitting said rails to be positively clamped between said cooperating elements and said standards and locked in parallel relationship to each other.

6. A seat assembly as described in claim 5 wherein each of said seats has a mounting member; each of said mounting members having a pair of spaced downwardly opening third slots to receive said rails and a cooperating element having a pair of upwardly opening fourth slots; fastener means for detachably securing said cooperating elements to said mounting members; the combined depths of said third and fourth slots in said cooperating elements and mounting members being less than the greater dimension of said rails permitting said rails to be positively clamped between said cooperating elements and said mounting members and locked in parallel spaced relationship.

7. A seat assembly as described in claim 6 wherein arm supports are mounted on said rails; each of said arm supports having slots identical to those in said mounting members and cooperating elements and fastener means identical to those for said mounting members for clamping said arm supports to said rails.

8. An elongated base for furniture comprising: a pair of elongated rails, each rail being of a cross-sectional shape having a greater vertical material thickness than horizontal thickness permitting it to be bent into a curved attitude about a vertical axis and resistant to bending about a horizontal axis; said rails being parallel and spaced apart in a radial direction with respect to the axis about which they may be bent; a pair of supporting standards and means for rigidly securing said rails to said standards and holding them in said predetermined spaced relationship with said vertical thickness being greater than said horizontal thickness; a plurality of clamping means spaced at intervals along said rails intermediate said standards; each of said clamping means rigidly holding said rails in said predetermined spaced relationship and aaginst relative movement with respect to each other; seats clamped to said rails at spaced intervals, said rails being the only means of support for said seats.

9. An elongated base for furniture as described in claim 8 wherein each of said supporting standards and said clamping means have channels therein for receiving said rails therein, the portions thereof between said rails serving as rigid cross-bracing between said rails.

10. An elongated base for furniture as described in claim 9 wherein said supporting standards and said clamping means are detachably secured to said rails.

References Cited by the Examiner

UNITED STATES PATENTS

204,006	5/1878	Condict	238—10
212,630	2/1879	Shepherd	238—10
222,880	12/1879	Edwards	297—249
724,583	4/1903	Jones	297—232
1,209,452	12/1916	Kirsch	297—257
1,376,111	4/1921	O'Brien	108—111
1,531,184	3/1925	Hodges	297—232
2,565,359	8/1951	Dubilier	238—10
2,645,427	7/1953	Naud	238—51
3,092,876	6/1963	Cornberg	20—1.126 X
3,102,754	9/1963	Junkunc	297—248
3,114,575	12/1963	Eames	297—248
3,134,627	5/1964	Mason	297—248

FOREIGN PATENTS

665,253	6/1963	Canada.
480,988	5/1953	Italy.
586,910	10/1933	Germany.
866,094	4/1961	Great Britain.

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