United States Patent

[11] 3,545,625

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Original application Nov. 22, 1967, Ser. No. 685,064, now abandoned. Divided and this application June 20, 1969, Ser. No. 842,770

[54] **MODULAR CONSTRUCTION FRAME**
4 Claims, 19 Drawing Figs.

[52] **U.S. Cl.** **211/148;** 108/159; 248/239; 287/54, 287/189.36; 312/257
[51] **Int. Cl.** **A47f 5/00, F16b** 7/00
[50] **Field of Search** ..... 248/188.1, 221, 222, 250, 243, 247, 239; 287/189.36, 20.92(D), 20.92(B), 20.92(J), 54(B); 108/159; 211/182, 148; 312/257

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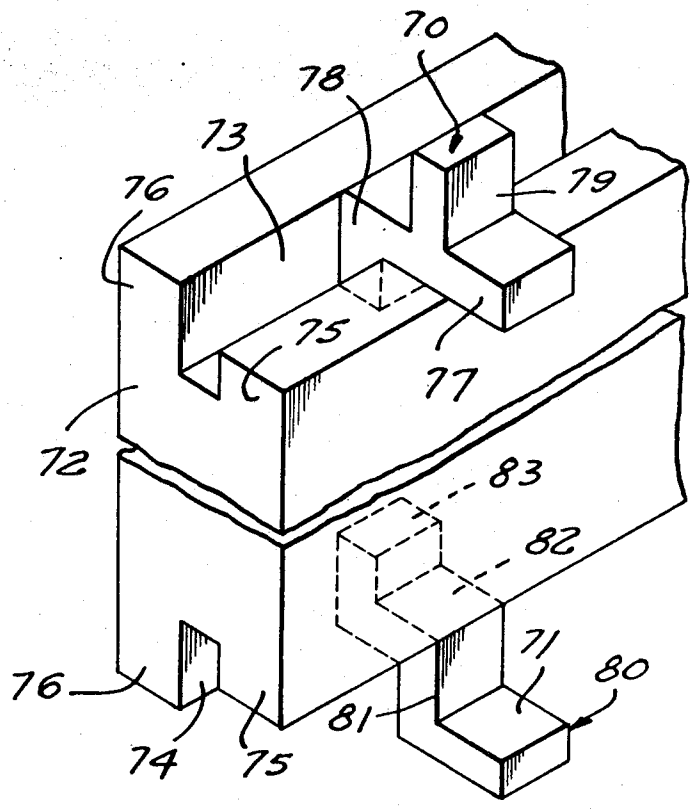
ABSTRACT: A modular construction frame for use in the assembly of furniture display cases, and the like wherein the structure is to be readily assembled to a predetermined configuration and then readily collapsed for transportation or reassembly. The frame consists of at least one corner lock-joint which has at least one expandable prong extending from its base portion. A tube which is substantially hollow is slidably mounted on the prong which has means within to expand it so that its outer surface engages the inner surface of the tube and locks the tube in position. There is access means on the tube and on the prong to allow the operator to activate the expansion means. When it is desired, the expansion means may be returned to its initial position thereby closing the prong and allowing the tube to be removed therefrom during disassembly of the frame. A plurality of corner lock-joints and tubes may be interconnected to provide a modular frame structure of a predetermined size and configuration. Self support means and panel clips are also provided with the modular construction frame to facilitate its employment in the construction of furniture, display cases, or similar articles.



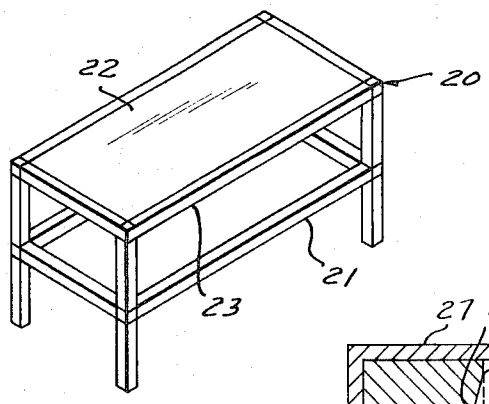


FIG. 1

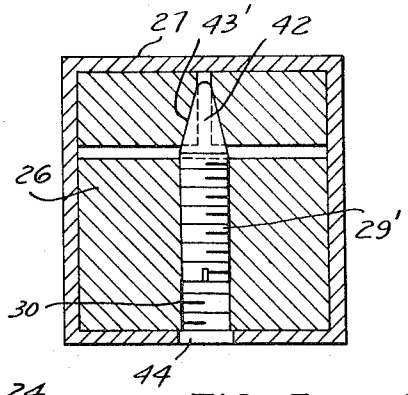


FIG. 5a

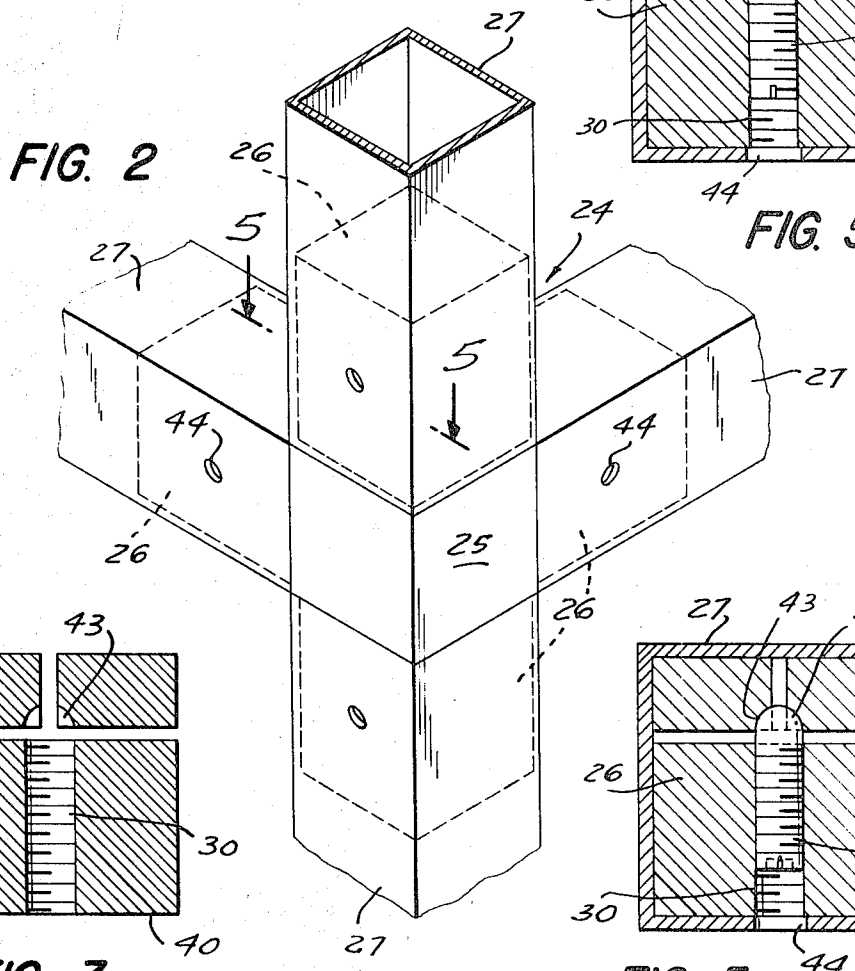


FIG. 2

FIG. 3

FIG. 5

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FIG. 4

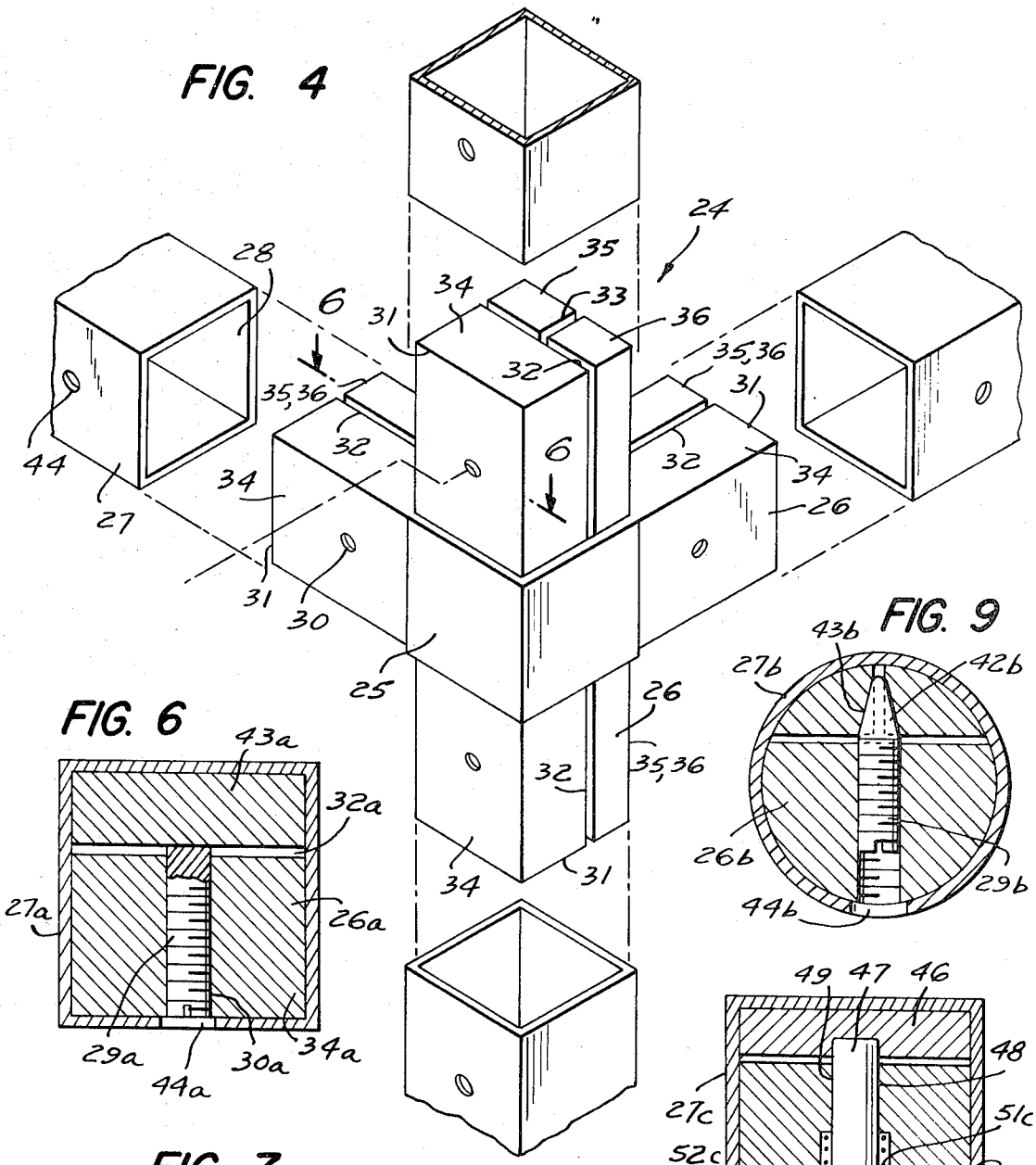

FIG. 6

FIG. 9

FIG. 7

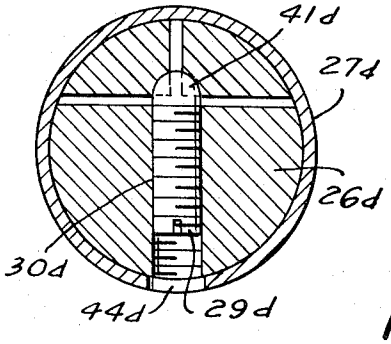

FIG. 8

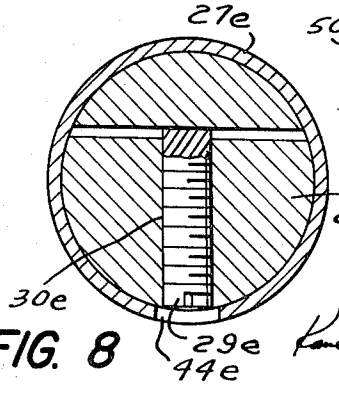

FIG. 10

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FIG. 11

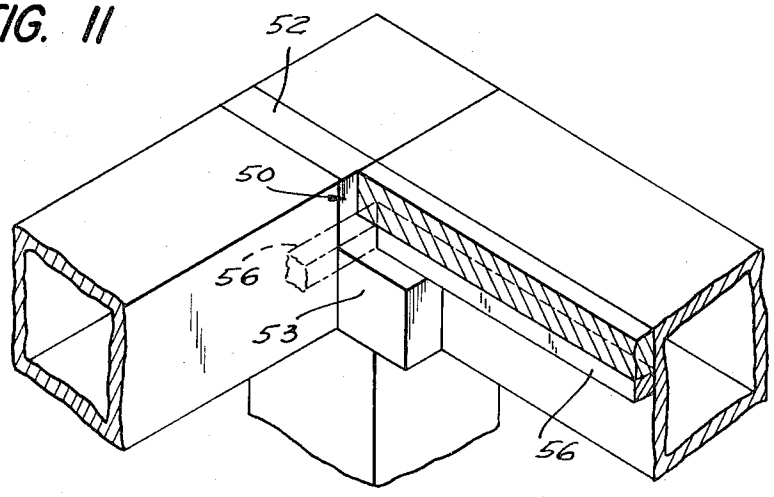
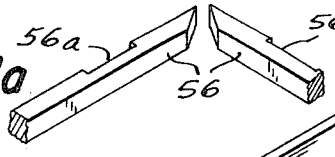


FIG. 11a



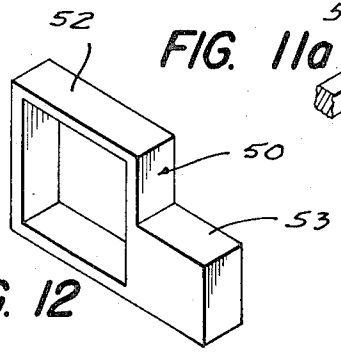


FIG. 12

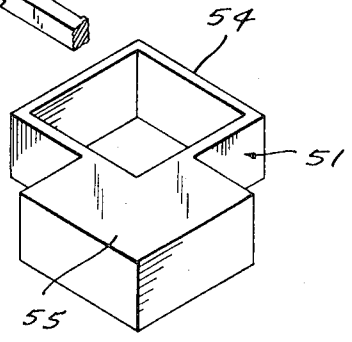


FIG. 14

FIG. 13

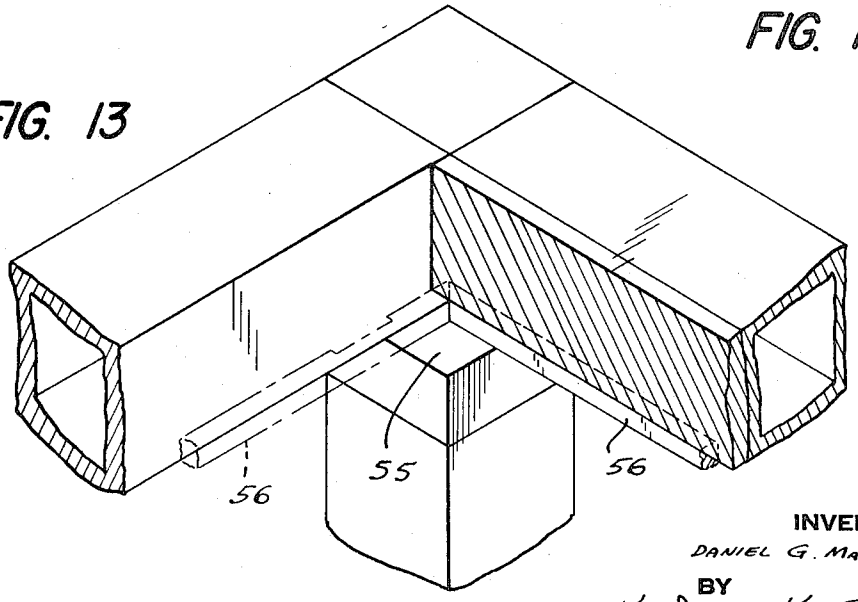


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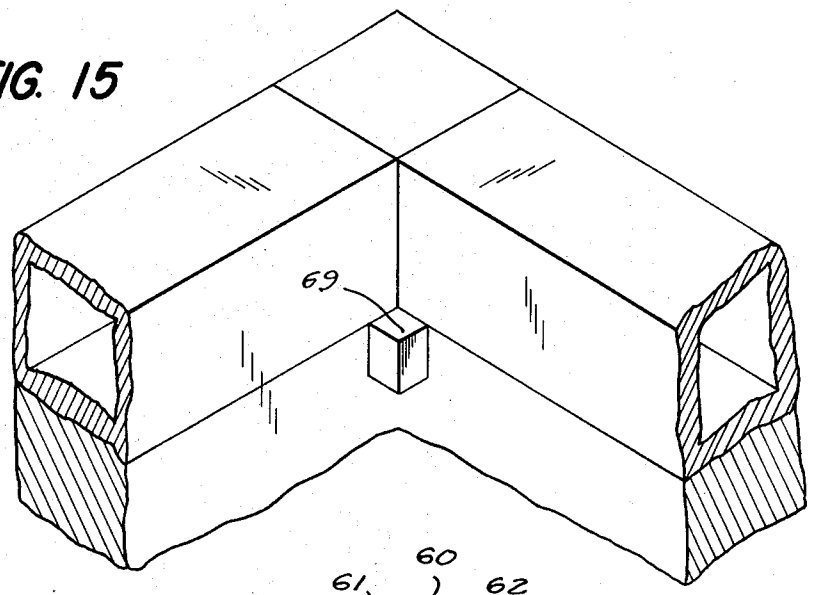
FIG. 15



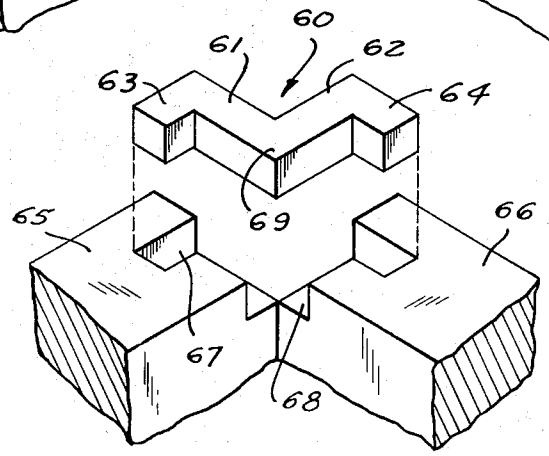
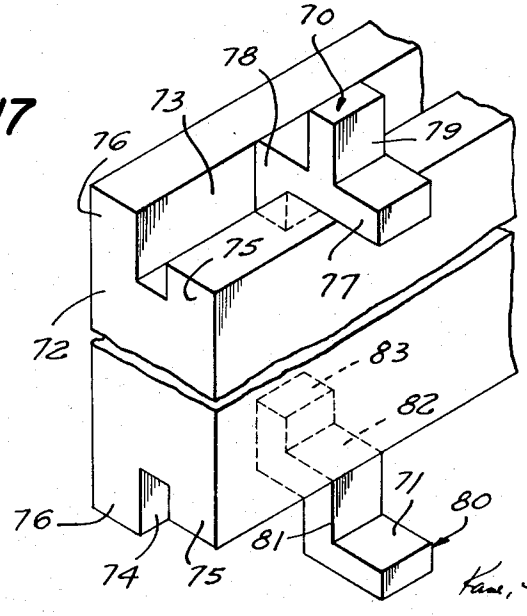


FIG. 16

FIG. 17



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MODULAR CONSTRUCTION FRAME

BACKGROUND OF THE INVENTION

This is a division of application Ser. No. 685,064 filed Nov. 22, 1967 now abandoned.

A number of simple, but fundamental, marketing principles underlie the invention. The first and perhaps the most important of these is the ever-present necessity of cutting distribution costs by conserving space in storage, in transit and in retail display areas, by minimizing handling and warehousing, and by holding retail inventories to the lowest possible levels. This principle applies with particular force to the manufacture, transportation and distribution of furniture and other similar articles. Secondly, the desirability of providing maximum flexibility in style and design, in size and configuration, and in the use of materials and finishes is also of major importance to the modular construction frame or system as described above. Finally, the case of assembly and disassembly tends to maximize the collapsibility and hence the portability of articles constructed with the said modular frame or system, including not only furniture, store fixtures, counters, display cases and the like, but also heavy-duty work benches, assembly benches, scaffolding and other industrial applications.

At the manufacturing level the basic principles which govern the mechanics and fabrication of the modular construction frame require only, but not necessarily inclusively, that machined or finished castings, stampings and other components, such as precut tubes of standard I.D. and O.D. dimensions, table tops, shelves, side panels and packaging materials be assembled and inventoried in one location preparatory to packing and shipping in accordance with the customer's or ultimate user's requirements. Thus articles to be constructed of such components, which together constitute the modular construction frame, can in general be virtually custom-made to the customer's or user's specific needs and desires.

With specific reference to retail outlets which offer furniture and other similar products for use in home or office, or in hotels, motels and the like, the retailer can sell either from assembled floor models or from scale models. And because of the modular construction frame's pronounced flexibility, including not only precut and drilled tubes of varying lengths, but also table or cabinet tops, shelves and side panels which in many cases are either reversible or interchangeable or both, the retailer can hold his floor inventory, whether it consists of full-size units or scale models, to a minimum. Hence with the customer's order in hand, he can ship from prepackaged, space-saving shelf stocks rather than from large, open warehouse stocks.

A principal feature of the modular construction frame, moreover, is the simple, and hence almost classical, appearance of articles constructed therefrom, especially such articles as furniture and the like. This is because the sleeve-type fastenings which support tops and shelves, as well as panel slips and dual-purpose panel-clip-and-shelf-supports which hold side panels in alignment with said frame, are so unobtrusive as to be almost invisible to the public. Hence they tend to enhance the overall symmetry and continuity of such articles rather than to interfere with same. Thus the sum total of the advantageous features of the invention makes its design and construction principles applicable to a wide range of products.

SUMMARY OF THE INVENTION

It is the principal objective of this invention to provide a modular construction frame or system which is particularly useful in the construction of readily assemblable and collapsible articles or products. A principal feature of said frame or system of modular construction is a lock-joint, to be positioned at a corner of said frame or at an intersection of tube members forming said frame, from whose base portion one or more expandable prongs extend vertically or horizontally. The prongs may also extend in a diagonal plane or direction within

a 90° angle formed by a vertical and a horizontal prong. There are many alternative embodiments of prongs applicable to the invention and several of them are discussed herein. Each of the prongs has its own distinctive locking mechanism, with each prong being either round or square or rectangular to receive a tube which is substantially hollow and of like configuration with the underlying prong on which it is to be slidably mounted.

Among the embodiments of prongs discussed herein are: (1) an expandable prong divided into either two portions or into three portions, thus being either bifurcated or trifurcated, in either of which case the larger or the largest portion of said prong is bored and tapped from one lateral side to the other to receive a set screw to be positioned therein; (2) an expandable prong including a solid portion which is bored from one lateral side to the other, the upper portion of said bore being tapped to receive a set screw of larger diameter than the lower, smooth portion of said bore, and a movable, spring-mounted plate being mounted on the solid portion. In the case of all of the above mentioned embodiments, there are access means on the prong which match or coincide with similar access means on the tube which is to be mounted thereon, thus permitting the operator to reach the end of the setscrew which is opposite its distal end and to thread it forward or backward.

When threaded forward, the distal end of the setscrew positioned within the threaded bore of a bifurcated prong exerts pressure upon the opposing inner surface of the prong, thus tending to make the two portions expand equally in opposite directions until their outer surfaces engage the opposing surfaces of the tube mounted on the prong, thereby locking said tube in a predetermined position; when threaded forward, the distal end of the setscrew positioned within the threaded bore of a trifurcated prong exerts pressure upon a matching cavity formed by the inner surfaces on two adjacent legs or portions of the trifurcated prong, thus making the three portions of the prong expand in four directions until their outer surfaces engage the opposing inner surfaces of the tube mounted on the prong, thereby locking the tube in a predetermined position. When threaded forward, the distal end of the setscrew positioned within the threaded upper bore of the solid portion and movable plate combination prong exerts pressure upon the movable, spring-mounted plate mounted on the prong until the plate engages the opposing inner surface of the tube mounted on the prong, thereby locking said tube in a predetermined position.

When threaded in the opposite direction, the setscrew positioned within either a bifurcated or a trifurcated prong releases the pressure theretofore exerted upon the inner surface or inner surfaces of the prong portions, thus allowing them to return to their normal, unexpanded configuration. It follows that when the setscrew positioned within the solid portion and movable plate combination prong is threaded in the opposite direction, the pressure theretofore exerted by the setscrew upon either the inner wall of the tube or upon the movable, spring-mounted plate, as the case may be, is released. Regardless of the type of prong and lock-joint in use, once the pressure generated by the setscrew is released, the tube slidably mounted thereon can be easily removed or dismounted.

In general, the setscrew positioned within the bore of a bifurcated prong has a distal end with a flat surface, but the surface may also be blunt or slightly rounded or cup-shaped. The distal end of the setscrew positioned within the bore of a trifurcated prong is preferably a ballpoint or a stylus-shaped point which, in either case, matches a similar opening or cavity formed by the adjacent inner surfaces of the two smaller portions of the trifurcated prong. The shape of the distal end of said setscrew, whether it be a ballpoint or a stylus-point facilitates the entrance of the screw into the opposing cavity and tends to prevent the erosion of contacting surfaces; but the distal end may be shaped or tapered in any reasonable manner which will facilitate its entrance into either the cavity itself or, in the absence of such cavity, simply into the slot

which divides the two smaller portions of the trifurcated prong. The distal end of the setscrew positioned within the bore of a solid portion and movable plate combination prong may be of any standard shape, either flat or blunt or slightly rounded or cup-shaped.

It is a further objective of this invention to provide various embodiments of lock-joints to meet the specific requirements of different types of frame construction. For instance, a lock-joint with a bifurcated prong exerts sufficient pressure upon two opposing inner walls of a tube to make it particularly suitable for the construction of furniture and other similar articles, while a lock-joint with a trifurcated prong exerts equal pressure upon four inner walls of a tube, and hence makes it particularly acceptable for the construction of heavy-duty work benches, scaffolding and for other industrial applications. A lock-joint with a prong having a solid portion and a movable, spring-mounted plate incorporated therewith is particularly useful with thin-walled tubing, such as is required in the construction of scale models and other miniaturized articles, because the movable plate is perhaps even more efficient in distributing pressure evenly over the inner wall of such tubing than the distal end of a setscrew with raised concentric circles. Naturally all of the above prongs are adaptable for many other uses such as those previously mentioned.

It is yet another objective of the invention to provide modular construction frames whose edges and flat surfaces exhibit smooth, unbroken continuity, thereby tending to give such frames a classical simplicity. Thus the outer dimensions of the base portion of a lock-joint or its diameter, if such lock-joint be of a round or arcuate configuration, is flush with the outer surface of the tube which is slidably mounted thereon. In this connection also, sleeve shelf supports, whether they be of the vertical or horizontal type, panel slips and combination panel-clip-and-shelf-supports are so inconspicuous when in place on such frames as to be practically unnoticed by the casual observer.

Furthermore, other objectives of the invention are to provide, sleeve shelf supports, panel clips, and combination panel-clips-and-shelf-supports, mitered lift supports to give addition self support, and a movable plate locking assembly for use with a modular construction frame.

Quite apart from its artistic values, the modular construction frame or system envisioned by this invention has definite practical advantages with respect to current marketing concepts. By way of summation, then, it offers the retailer or other distributor, as well as the ultimate user, a wide range of products which can be completely disassembled, yet easily reassembled, thus giving such products or other articles maximum portability. And because the components of the modular construction frame pack flat, ship flat and store flat, and hence are prepackaged at the manufacturing level for ultimate shipment to the end user, the said modular construction frame tends to eliminate crating, saves space in storage, in transit and in retail display areas, and hence minimizes handling, warehousing and transshipment of articles made with said frame. The resultant cost savings should be welcomed by both the retail trade and such end user.

Therefore, in general, this invention provides a modular construction frame for use in the assembly of furniture, display cases, and the like wherein the structure is to be readily assembled to a predetermined configuration and then readily collapsed for transportation or reassembly. The frame consists of at least one corner lock-joint which has at least one expandable prong extending from its base portion. Expanding means are located within the prong. A tube having at least one open end slidably receives the prong therein when the prong is of normal unexpanded configuration. Access means are positioned in the tube so as to communicate with access means in the prong to permit activation of the expansion means to expand the prong and thereby cause the outer surfaces of the prong to engage the inner surfaces of the tube and lock the tube in position. The communicating access means also permitting activation of the expansion means to return the prong to its normal unexpanded configuration thereby providing a readily assemblable and collapsible modular construction frame. A plurality of corner lock-joints and tubes may be interconnected to provide a modular frame structure of a predetermined size and configuration. Shelf support means and panel clips are also provided with the modular construction frame to facilitate its employment in the construction of furniture, display cases, or similar articles.

These objectives and advantages will perhaps become more apparent from the following description, which is to be read with specific reference to the accompanying drawings, such drawings illustrating several somewhat preferred embodiments of the invention as it applies to articles of furniture.

BRIEF DESCRIPTION OF THE DRAWINGS

In describing the invention, reference is made to the accompanying drawings, in which:

FIG. 1 is a perspective view of a piece of furniture having a modular construction frame;

FIG. 2 is a perspective view of a corner lock-joint portion of a modular construction frame with tubular members positioned on its prongs;

FIG. 3 is a cross-sectional elevation view of a trifurcated prong of a modular construction frame with the bore in the prong adapted for receiving an inset screw having a ball shaped distal end;

FIG. 4 is a perspective view of a corner lock-joint of a modular construction frame with prongs having tubular members positioned thereon;

FIG. 5 is a cross-sectional elevation view of a trifurcated prong of a lock-joint taken along the plane of line 5–5 of FIG. 4 and with a setscrew positioned therein;

FIG. 5*a* is a cross-sectional elevation view of a trifurcated prong of a lock-joint taken along the plane of line 5–5 of FIG. 4 and with a setscrew positioned therein having a stylus point distal end;

FIG. 6 is a cross-sectional elevation view of a bifurcated prong of a lock-joint with a setscrew positioned therein;

FIG. 7 is a cross-sectional elevation view of an alternate embodiment of FIG. 5 showing a trifurcated prong of round or tubular configuration with a setscrew having a ball-shaped distal end positioned within the threaded bore thereof;

FIG. 8 is a cross-sectional elevation view of another alternate embodiment thereof showing a bifurcated prong of tubular configuration with a setscrew positioned within the bore thereof;

FIG. 9 is a cross-sectional elevation view of an alternative embodiment of FIG. 5*a* showing a trifurcated prong of round or tubular configuration with a setscrew having a stylus shaped distal end positioned within the threaded bore thereof;

FIG. 10 is a cross-sectional elevation view of an alternative embodiment of prong showing a movable, spring-mounted plate assembly with a setscrew positioned therein;

FIG. 11 is a perspective view of a corner lock-joint portion of a modular construction frame showing a horizontal sleeve-type shelf support and a mitered lift support associated therewith;

FIG. 11*a* is a perspective view of several mitered lift supports to be used with a modular construction frame of the invention;

FIG. 12 is a perspective view of a horizontal sleeve-type shelf support;

FIG. 13 is a perspective view of a corner lock-joint portion of a modular construction frame showing an alternative embodiment of a sleeve-type shelf support, said alternate embodiment being a vertical sleeve-type shelf support, associated with said frame;

FIG. 14 is a perspective view of such alternate embodiment, being a vertical sleeve-type shelf support;

FIG. 15 is a perspective view of a corner lock-joint portion of a modular construction frame showing a panel clip associated therewith which connects two adjacent side panels at

their common junction with said corner lock-joint, said panel clip acting additionally, if desired, as a shelf support;

FIG. 16 is an enlarged perspective view of the panel clip shown in FIG. 15, which may act additionally as a shelf support when desirable, said panel clip being shown in position for assembly with two adjacent panels; and

FIG. 17 is a perspective view of a portion of a side panel for use with a modular construction frame showing two alternate embodiments of a combination panel-clip-and-shelf-support, one being mounted at the top and the other being mounted at the bottom of said panel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Although the ready assemblability and collapsibility of a modular construction frame of this type makes it applicable to a wide range of products, as discussed above, including miniaturization and scale models of such products or articles, for descriptive purposes we will apply the modular construction frame in this disclosure to the furniture art, as particularly shown in FIG. 1.

The table 20 shown with a type of modular frame 21 and the provision of two horizontal shelves 22 and 23 demonstrates the continuity of the finished structure, such smooth continuity adding considerably to the aesthetic value of the finished product.

The basic element of the modular construction frame or system is a lock-joint 24, to be positioned at a corner of said frame or at an intersection of two or more tubular members thereof, said lock-joint 24 being shown in FIGS. 2 and 4. In FIG. 4 lock-joint 24 has trifurcated prongs extending therefrom. In any case lock-joint 24 may have a variety of configurations, either round or square or rectangular, in which case the prongs extending therefrom basically conform to such configuration. It may be fabricated of metal or a variety of alloys. It may also be fabricated of plastic, wood or other materials.

Lock-joint 24 consists basically of a base portion 25 and one or more prongs 26 extending therefrom, such prongs being dimensioned to receive standard sizes of tubing 27 as shown. The configuration of said tubing 27 determines the configuration of the underlying prong and hence of the base portion of lock-joint 24. It should also be noted that the clearance between the outer surface of prongs 26, whether they be round or square or rectangular, and the inner surfaces of tubes 27 is generally small. Such clearance should be sufficient to permit the tubes to be easily and slidably mounted on the prongs when their respective locking mechanisms are in an inactivated state. Prongs may extend from one or more surfaces of base portion 25 according to the position of locK-joint 24 in the assembled modular construction frame. Although not shown in the drawings, an additional base portion 25 may be positioned, if desired, within the 90° angle formed by a vertical prong adjacent to a horizontal prong to receive a tubular member extending in a diagonal plane or direction. For descriptive purposes, lock-joint 24 in FIG. 4 has four prongs extending therefrom. Tubes 27, which are shown in position for assembly, are then extended on to prongs 26 until the forward edge 28 of said tubes 27 abuts and mates with edge of base 25 in concentric relationship with the outer surface of prong 26. The tubes are now ready for the application of internal pressure upon their inner surfaces which will lock them securely in position on the modular construction frame. When such pressure is released, tubes 27 can be easily removed from prongs 26.

The direction of the internal pressure generated and the exact method of its application depends upon the purpose for which the assembled structure is intended, the weight it must carry and the abuse it must withstand. These factors in turn govern the gauge and dimensions of the tubing to be used, including its wall thickness.

As previously noted, a trifurcated prong, which together with the integral base portion forms a lock-joint, is generally used for heavy-duty applications, such as work benches, scaffolding and similar industrial equipment. This is because such a prong or lock-joint which is illustrated in FIG. 4, when expanded by internal pressure bottoms on all four inner walls of tube 27, thus providing maximum grip or locking power. A setscrew 29, as shown in FIG. 5, is threaded into bore 30, as shown in FIG. 3, said setscrew being positioned within the larger portion 34 of prong 26, as shown in FIG. 4.

Prong 26 is slotted from its outer extremity 31 up to, or close to, the head or shoulder of base portion 25 of lock-joint 24 in two planes at right angles to each other, thus trifurcating prong 26. One slot 32 extends across the entire lateral width of prong 26, while the other slot 33 extends between slot 32 and one lateral side of prong 26. This forms three portions, a larger portion 34 and two smaller portions 35 and 36. When setscrew 29 is threaded in a forward direction, it will emerge in slot 32 and engage slot 33, thus forcing prong portions 35 and 36 to the left and right and also backward in the direction of its travel. At the same time setscrew 29 exerts backward pressure upon larger portion 34 with the net result that all three portions of trifurcated prong 26 tend to bottom on all four inner walls of tubing 27, thereby locking such tubing firmly in place. Bore 30 is open on the outer surface 40 of larger portion 34, thereby enabling the operator to reach the end of setscrew 29 which is closer to the operator and hence is opposite its distal end. Setscrew 29 is headless, but its driving end, which is activated by the operator, may have a conventional screwdriver slot, an Allen hexagonal or a square socket, or a Phillips-type engaging slot. When setscrew 29 is rotated in the opposite direction from its original clockwise rotation, it will release the pressure theretofore exerted upon the inner surfaces of the three prong portions, thus permitting them to return to their normal, unexpanded configuration.

It should be noted that each trifurcated prong, such as prong 26 in FIG. 4, requires only a single threaded bore 30 to receive a single setscrew The preferred configuration of the distal end of such setscrew is a ballpoint 41 and 41*d*, FIGS. 5 and 7 respectively, or a stylus-shaped point 42 in FIG. 5*a*. In either case a similar opening or matching cavity 43 and 43', FIGS. 5 and 5*a* respectively, is formed by the adjacent inner surfaces of the two smaller portions 35 and 36 of trifurcated prong 26. The matching cavity, whether ball-shaped or stylus-shaped, not only facilitates the entrance of the appropriate setscrew 29 into slot 33, but such cavity tends to prevent the erosion of such contacting surfaces when the setscrew is threaded forward. A ball-shaped or stylus-shaped cavity may be formed in any well-known manner, such as casting or machining. Although a ballpoint distal end 41 and 41*d* or a stylus-shaped distal end 42 is the preferred configuration in this instance, the distal end of setscrew 29 may be shaped or tapered in any reasonable manner which will facilitate its entrance into either the said opposing cavity 43 and 43' or, in the absence of such cavity, into slot 33.

FIG. 6 depicts a bifurcated prong and shows slot 32*a*, which divides prong 26*a* into a larger portion 34*a* and a smaller portion 43*a*. A threaded bore 30*a* is positioned in larger portion 34*a* and extends from its outer surface to its inner surface so as to communicate with slot 32*a*. Setscrew 29*a* is inserted within bore 30*a*, so that when it is threaded in a forward direction by clockwise rotation, it will emerge in slot 32*a* and exert pressure upon the inner surface of portion 43*a*. Continuous threading causes setscrew 29*a* to force portion 43*a* backward, at the same time exerting equal and opposite pressure upon larger section 34*a*. Hence both portions, 43*a* and 34*a*, tend to bottom upon opposite inside walls of tube 27 simultaneously. Exact simultaneity, however, is not necessary, because even after portion 43*a* has bottomed, its opposite member 34*a* will continue to move in the opposite direction until it, too, has bottomed on the opposing inside wall of tube 27. When setscrew 29*a*, shown in FIG. 6, is rotated counterclockwise, it travels in the opposite direction to its original forward motion, thus releasing the pressure theretofore exerted upon portion 43*a*. When such pressure is released, portions 43*a* and 34*a*

resume their normal, unexpanded configuration and tube 27 can be easily removed from prong 26*a*.

As indicated in the foregoing discussion, basic elements of the modular construction frame, such as lock-joints with integral prong extensions and the tubing which interconnects such lock-joints, need not necessarily have a square or rectangular configuration. Hence lock-joint 24 and prong 26 which extends therefrom may be of round or arcuate configuration and hence may receive round tubing to be slidably mounted on said prong 26. As descriptive, but not necessarily inclusive of such alternative, FIGS. 7 and 8 show respectively a round trifurcated prong 26*d* slidably engaged with a round tube 27*d* and a round bifurcated prong 26*e* slidably engaged with a round tube 27*e*. In FIG. 7 the distal end of setscrew 29*d* is a ballpoint 41*d*, however, a stylus-shaped point is also applicable as shown in FIG. 9, each of which would engage the respective matching cavity formed by the adjacent inner surfaces of the two smaller portions of the round trifurcated prong. In FIG. 9, when setscrew 29*b* is threaded forward and backward, it acts in the same manner and with the same results as set screw 29' in FIG. 5*a*. Similarly, when threaded forward and backward, setscrew 29*d* acts in the same manner, and with the same results, as setscrew 29 in FIG. 5. By the same token, when setscrew 29*e* in FIG. 8 is threaded forward and backward, it acts in the same manner, and with the same result, as setscrew 29*a* in FIG. 6.

It should be remembered that a bifurcated prong, whether of square or rectangular configuration, as shown in FIG. 6, or of round configuration, as shown in FIG. 8, bottoms on two opposing inner walls of tube 27, when such prong is expanded, and hence it has sufficient grip or locking power to make it suitable for the construction of furniture and other similar articles.

FIG. 10 shows a prong having a solid portion and a movable, spring-mounted plate 46 associated therewith. When forced against the inner wall of tube 27*c* by the forward thrust of setscrew 29*c*, plate 46 applies pressure over the widest possible area of such inner wall, thus minimizing deformation of the outer surface of tube 27*c*. Plate 46 is permanently mounted on a separate spindle 47, the two components thus becoming a single unit. Then spindle 47 is inserted into bore 48 within the solid portion 26*c* of the prong. The overall dimension permits the prong, including plate 46 and solid portion 26*c*, to be easily inserted within tube 27*c*. Although continuous from one lateral side to the other of solid portion 26*c*, bore 48 in effect consists of two portions: a lower, smooth-surfaced portion 49 to receive the clips insertion of spindle 47, and an upper threaded portion 50*c* of larger diameter to receive setscrew 29*c*. When spindle 47 is fully inserted into bore 48, plate 46 abuts snugly against the matching, and hence opposing surface of solid portion 26*c* and the upper end of spindle 47 emerges into the wider portion 50 of bore 48.

A spring 51*c* capable of compressability calibrated to the distance plate 46 must move to bottom solidly upon the inner wall of tube 27*c* fitted over the upper end of spindle 47 and is held in place by a press plate 52*c*, such press plate being friction-forced upon, or otherwise permanently affixed to, the upper portion of spindle 47. Said press plate 52*c* holds spring 51*c* in a state of partial compression, thus assuring flush contact between movable plate 46 and the opposing surface of solid portion 26*c*. It should also be noted that press plate 52*c* is of a diameter, and hence of a circumference, slightly less than the diameter and circumference of upper portion 50*c* of bore 48, thus permitting said press plate to move forward and backward in said upper portion 50*c* of bore 48. Such motion of press plate 52*c* is fractional, if not almost infinitesimal, corresponding as it does to the distance movable plate 46 must move from its rest position to solid contact with the inner wall of tube 27*c*.

Setscrew 29*c* is threaded into the upper threaded portion 50*c* of bore 48 until its distal end, which is basically a flat surface, makes surface contact with the upper surface of press plate 52*c*, at which point the upper surface of setscrew 29*c* opposite its distal end is the same distance from the inner surface of tube 27*c* opposing it as the outer, exposed surface of movable plate 46 is from the inner wall of tube 27*c* which opposes said plate 46. Thus the activating or driving end of setscrew 29*c* is flush with the outer surface of solid portion 26*c*. When said setscrew is threaded forward, it compresses spring 51*c* and hence forces movable plate 46 firmly against the inner surface of tube 27*c*, thus locking said tube securely in position on the prong. Again, when such pressure is removed, by threading setscrew 29*c* in the opposite direction, spring 51*c* causes plate 46 to snap back until it is again flush with the opposing, matching surface of solid portion 26*c*, thus permitting tube 27*c* to be easily removed from said prong.

It is quite apparent from the previous discussion that the working mechanism of any given lock-joint 24 is the prong extension thereof, regardless of the type of such prong extension. To reach said working mechanism, which in all prong embodiments is a setscrew of varying lengths, widths and distal ends, hole 44 in tube 27, as shown in FIG. 4, penetrates one lateral side of tube 27. When said tube is fully extended on to prong 26, hole 44 coincides, and hence is exactly aligned with bore 30 in which setscrew 29 is positioned. Thus hole 44 and the outer opening of bore 30 are the access means on tube and prong which permit the operator to thread the setscrew forward or backward. To activate setscrew 29, he simply extends an Allen-type wrench, or a Phillips-type or conventional screwdriver through such matching access means to engage the driving end of the setscrew.

To preserve the smooth continuity, and hence aesthetic values of the modular construction frame, all access holes in the tubular members thereof are generally drilled only on the inside or bottom surfaces of such tubes, thus rendering such holes less visible, if not entirely invisible, to the casual observer. It follows, therefore, that the prong extensions of the lock-joints are drilled or bored on corresponding surfaces. It should also be noted that no portion of setscrew 29 in any of the embodiments described above extends from the outer surface or surfaces of prong 26, when such setscrew is in an inactivated state, so as to interfere with the sliding engagement between tube 27 and prong 26.

Above all, it should be noted that with respect to bifurcated and trifurcated prongs, the activating mechanism consists of a single moving part, setscrew 29, which is prepositioned in said prongs at the manufacturing level. Hence no other internal or external locking parts, other than tubular members themselves, are required to assemble the modular construction frame as described herein. With respect to a prong having a solid portion and a movable plate, moreover, movable plate 46 is permanently mounted on the solid portion thereof at the manufacturing level.

With reference to accessory components which tend to make the modular construction frame, as envisioned in this invention, unique in other respects, FIGS. 11 to 14, inclusive, and FIGS. 15, 16, and 17 show shelf supports and panel-clip devices which are as functional as they are unobtrusive, and hence artistic, in appearance. Fundamentally, there are two types of sleeve-type shelf supports, one for use on horizontal prong members, as shown in FIGS. 11 and 12, and the other for use on vertical prong members, as illustrated in FIGS. 13 and 14. There is, moreover, a basic type of panel clip, as shown in FIGS. 15 and 16, which is designed primarily to lock two sides panels together where they meet at a common corner, but which additionally may act as a shelf support when required. Furthermore, there are two basic types of combination panel-clip-and-shelf-supports, a top member and a bottom member, as shown in FIG. 17, which assist in locking side panels to the modular construction frame and at the same time serve as shelf supports for tops and shelving. It should be noted that the panel clip shown in FIGS. 15 and 16 can be used alternatively at the top and the bottom of such side panels. Mitered lift supports as depicted in FIGS. 11 and 11*a* may be used to give additional support for shelves.

The accessory components described in the above paragraph are particularly useful in the assembly of modular bars, bookcases, cabinets, two-tiered tables, display cases, merchandising counters and similar articles.

In FIG. 11 a horizontal sleeve-type shelf support 50 is shown in place on a modular construction frame. Shelf support 50 has a sleeve portion 52 on a solid portion, of substantially the same width as the sleeve, which projects into the inner area of the frame, thereby forming a shoulder or shelf support 53. Sleeve 52 is slipped over prong 26 of lock-joint 24 before tube 27 is placed in position directly behind it, the exposed surfaces of the sleeve being perfectly flush with the exposed surfaces of tubes 27 and base portion 25 of lock-joint 24, thus maintaining the smooth, classical contours of the modular construction frame. When tube 27 is locked in position, sleeve-type shelf support 50 can be neither moved nor removed until said tube is unlocked and dismounted. FIG. 12 shows the sleeve-type shelf support 50, which is of one-piece construction and generally fabricated of the same materials as tube 27 and lock-joint 24, dismounted from the frame.

FIG. 13 shows a vertical sleeve-type shelf support 51 mounted on the modular construction frame. Similar to the horizontal type shelf support, vertical shelf support 51 has a sleeve portion 54 and a solid portion forming a shoulder 55. Only in this case the solid projection or shoulder which forms the shelf support 55 within the inner area of the frame extends from two adjacent surfaces of sleeve 54 beginning at the midpoint of such adjacent surfaces. Shelf support 51 is mounted on said frame in the same manner as the above described shelf support 50, except that shelf support 51 is positioned on a vertical prong member rather than on a horizontal prong. FIG. 14 shows a vertical sleeve-type shelf support 51, which is also of one-piece construction and generally of the same material as tube 27 and lock-joint 24, dismounted from the frame. When in position on a modular construction frame, its exposed surfaces are also flush with the exposed surfaces of tube 27 and lock-joint 24. It should also be noted that a vertical sleeve-type shelf support 51 is interchangeable from one vertical prong member to another. By the same token a horizontal sleeve-type shelf support 50 is interchangeable from one horizontal prong member to another. It is readily apparent, however, that both the horizontal and the vertical sleeve-type shelf supports are as easy to mount and dismount as the tubular members themselves.

Conventional type shelf supports, such as plates, may also be used with the modular construction frame. When they are employed, setscrew 29 is removed from bore 30 and a machine screw of the same thread and diameter is used to bolt the plate to the underside of said frame, such machine screw being of sufficient length to penetrate bore 30 and engage the opposing inner wall of tube 27, thus again locking it firmly in place.

In FIGS. 11, 11*a*, and 13 portions 56 are mitered lift supports, otherwise not shown as dismounted, individual members of the modular construction system under discussion. The notches 56*a* in lift supports 56 may be provided to facilitate proper positioning of the lift supports when panel clips are being used on the frame. When mounted on a modular construction frame, they are positioned individually as separate units on the projecting shoulders of either shelf support 50 or shelf support 51, being of the same width as said shelf support 50 and 51 and thus making the latter completely invisible to the eye. Mitered lift supports 56 form a continuous edge around the inside of a modular construction frame for better support of fragile tops and shelving, such as glass, marble, ceramics and like materials. They also provide a finishing trim, much like a molding, inside and completely around said frame. When desired, moreover, they may be used to lift table and cabinet tops fractionally above the upper surface of a modular construction frame, thus forming an indented edge along such table and cabinet tops as opposed to the usual flush upper surface of said frame.

It is important to note that when the last of four mitered lift supports 56 are positioned within said frame upon shelf supports 50 and 51, its mitered ends serve to lock the four portions or members in place, said four lift supports being enclosed as they are by the tubular members which form the upper framework of the assembled structure.

If certain types of furniture, such as bars, bookcases, cabinets, display cases and other similar articles require side panels or panels in front and back, such panels can be fitted flush inside the modular construction frame by specially designed panel clips and combination panel-clip-and-shelf-supports, as shown in FIGS. 15, 16 and 17.

FIGS. 15 and 16 show a panel clip which is particularly useful in joining two adjacent panels which meet at a corner. In FIG. 16 the panel clip is mounted on a modular construction frame and is almost invisible, except for shoulder 69 which projects into the inner area of the frame and thus may serve additionally, if desired, as a shelf support. When used as a shelf support, however, it is recommended that mitered lift supports 56, as shown in FIGS. 11 and 13, be positioned on shoulder 69 completely around the inside of said frame to provide continuous support for tops and shelves. FIG. 16 shows said panel clip 60 ready for assembly with two adjacent panels that meet at a corner. It has two longer legs 61 and 62, which meet at one end to form the center of panel clip 60, and two shorter legs extending at right angles to longer legs 61 and 62 and being connected to the other end of each such leg 61 and 62. The shorter legs are designated 63 and 64.

The two side panels 65 and 66, which meet at a corner, have corresponding recesses 67 and 68 in their upper surfaces to receive panel clip 60. The recess in each panel is substantially shaped and sized to receive half of panel clip 60 in a locking relationship when such panel clip is in proper position, thus locking panels 65 and 66 together. A short portion of longer legs 61 and 62 adjacent to where they meet extends beyond panels 65 and 66 into the inner area of the assembled frame to form shoulder 69, which may serve as a shelf support when and if required.

Panel clip 60 can be used either at the top or the bottom of adjacent side panels which have been properly notched or recessed to receive the clip. When used at both the top and bottom of such side panels, panel clip 60 securely locks or ties them together. Recesses 67 and 68 are just deep enough to receive panel clip 60 to its entire depth, thereby providing a continuous, flush upper surface across panels 65 and 66 and said clip 60 itself. Said clip is generally referred to as a "W-type" panel clip because of its configuration.

Two types of a combination panel-clip-and-shelf-support are shown in FIG. 17, one for use at the top and the other for use at the bottom of a side panel in locking such panel flush with the outer surfaces of tubes forming a modular construction frame. The upper member 70 is designated as a "T-type" clip, the bottom member 80 as an "S-type" clip. The top of the side panel 72 is grooved 73 on its upper surface to receive the "T-type" clip 70, the bottom of said panel also being grooved 74 on its bottom surface to receive the "S-type" clip 80. The inside edge of panel 72, such inside edge being designated 75, is slightly lower at both the top and bottom of said panel than the outside edge 76 of panel 72. In both cases, the height differential is exactly equal to the thickness of the top and bottom clips 70 and 80 respectively, which are to be inserted in the corresponding grooves 73 and 74. Thus, when inserted, both the top and bottom clips 70 and 80 respectively are flush with the higher edge 76 at the top and bottom of panel 72.

The "T-type" clip 70 consists of a horizontal laterally extending portion 77, a downwardly extending leg 78 from one end of lateral portion 77, and an upright portion 79 extending upwardly from roughly across the ends of lateral portion 77. Downwardly extending portion 78 engages and fits into groove 73 at the top of panel 72.

Both "T-type" clip 70 and "S-type" clip 80 are preferably of one-piece construction, a common method of forming them in metal being a standard stamping operation and a suitable

method of forming them in plastic being injection-molding. Upon disassembly of the modular construction frame of which they may be integral parts, each of said types of panel clips can be easily removed from panel recesses or grooves 73 and 74.

With clips 70 and 80 properly positioned in grooves 73 and 74 respectively, the number of each type of clip to be used at the top and bottom of panel 72 depending upon the length or width of such panel, panel 72 can be snugly positioned within the surrounding framework by slipping said panel into the framework from the inside out. When panel 72 is flush with the lateral surfaces of the tubular members which now enclose it, upright portion 79 of clip 70 and upright portion 81 of clip 80 abut firmly and closely along the inside edges of the horizontal tubing at the top and bottom of the framework.

When panels 72 are thus in place around the frame, said frame being square or rectangular, bottom shelving can be lowered into the framework until its bottom surface comes to rest upon the upper surface of lateral portion 71 of clip 80. When in position, such shelf will abut the inside surface of portion 81 of clip 80, thereby locking the bottom of panel 72 securely in place until the bottom shelving is subsequently removed from the inside of the framework. In the same manner, the top shelving can now be placed within the framework and it will come to rest on lateral portion 77 of clip 70. When the top shelving is in place, it will abut the inside surface of upright portion 79, thus locking the top of panel 72 securely in place until said top shelving is subsequently removed.

Both the "T-type" and "S-type" clips, 70 and 80 respectively, are operable, as described above, with a single side panel, in which case vertical sleeve-type shelf supports 51 can be used at the corners of said frame against whose vertical risers or tubes no side panel abuts. Alternatively, conventional plate-type shelf supports may also be used at such corners, said plates being bolted, as previously described, to the underside of the appropriate tubular members of said frame. It follows that "T-type" and "S-type" clips 70 and 80 are also operable with two, three and four side panels.

To hang interior shelves within a framework which has two or more side panels, holes to receive standard cabinetmaker's shelf clips need only be drilled partially through such side panels at the desired level or levels, such holes naturally being drilled on the inside surface of the side panels.

From the overall description of the modular frame system, as detailed above, certain positive objectives would seem to promise certain definite and unique advantages. A primary objective of a readily assemblable and collapsible system of this kind is total modularity in which collective components of said system are completely separable as individual units and hence pack flat and store flat, with consequent cost savings at both the manufacturing and distribution levels. At the consumer level, such complete modularity enables the consumer or ultimate user to alter the size and configuration, even the design and purpose, of assembled frame structures at substantial savings in time, money and effort. A modular bookcase, for example, can be converted to a home bar simply by the subtraction of certain components, such as specific lock-joints and connecting tubes of certain lengths, and the substitution therefor of alternative components. Even table and cabinet tops, inside shelving and side panels are reversible or, in many instances, interchangeable from one frame to another.

A second objective is to provide various types of lock-joints, each with its distinctive locking mechanism, in order to make the modular construction system applicable to a wide variety of articles and products, such as furniture and display units, industrial work benches and scaffolding, miniature and other scale models. At the same time it was deemed advisable to minimize the number and variety of moving parts in the overall modular construction system, not only to make it easy to assemble and disassemble, but also to obviate the use of special assembly tools and other devices.

Finally, it has been a leading objective of the modular system envisioned in this invention to provide rugged construction at no sacrifice in the outward appearance of resulting articles and products. With respect to the furniture art particularly, the smooth, classical simplicity of end products should commend the system to the trade and the consumer alike.

In view of the foregoing, the aforenoted objects and advantages are effectively attained. Although several somewhat preferred embodiments of the invention have been disclosed herein, it should be understood that the invention is in no sense limited thereby, but is to be determined by the scope of the appended claims.

I claim:

1. A modular construction frame comprising at least one corner lock-joint having a base portion and at least one expandable prong extending therefrom, means in said prong to expand said prong, a tube having at least one open end to slidably receive said prong therein when said prong is of normal unexpanded configuration, access means in said tube communicating with access means in said prong to permit activation of said expansion means to expand said prong and thereby to cause the outer surfaces of said prong to engage the inner surfaces of said tube and lock said tube in position and said communicating access means permitting activation of said expansion means to return said prong to its normal unexpanded configuration thereby providing a readily assemblable and collapsible modular construction frame, and said frame having means to form a shelf support wherein said means to form a shelf support includes a member which additionally acts as a panel clip for retaining a side panel in alignment with said frame, said member having a transverse portion substantially perpendicular to said panel, a downwardly extending portion of said member of one end of said transverse portion, said panel having recess in its upper surface to receive said downwardly extending portion, said recess being defined by an inside edge and an outside edge on said panel, the inside edge being lower than the outside edge whereby the height differential between said edges is approximately the thickness of said clip, an upwardly extending portion of said member intermediate the ends of said transverse portion and positioned so that when the top of said panel is aligned with the tube of the frame surfaces on said member will assist in locking said panel in a predetermined position, the upper surface of said transverse portion between the other end thereof and said upwardly extending member projecting beyond said frame and aligned panel thereby forming a support.

2. A modular construction frame comprising at least one corner lock-joint having a base portion and at least one expandable prong extending therefrom, means in said prong to expand said prong, a tube having at least one open end to slidably receive said prong therein when said prong is of normal unexpanded configuration, access means in said tube communicating with access means in said prong to permit activation of said expansion means to expand said prong and thereby to cause the outer surfaces of said prong to engage the inner surfaces of said tube and lock said tube in position and said communicating access means permitting activation of said expansion means to return said prong to its normal unexpanded configuration thereby providing a readily assemblable and collapsible modular construction frame, and said frame having means to form a shelf support wherein said means to form a shelf support includes a member which additionally acts as a panel clip for retaining a side panel in alignment with said frame, said member having an upwardly extending portion connected at its lower end to one end of a transverse horizontally extending portion of said member, the other end of said transverse portion connected to one end of a downwardly extending portion of said member, the other end of said downwardly extending portion connected to one end of a second transverse portion of said member, the bottom of said panel defining a recess to receive said upwardly extending portion so that when said panel is aligned with surfaces on said member will assist in locking said panel in a predetermined position, the upper surface of said second transverse portion

projecting beyond said frame and aligned panel thereby forming a support, said recess being defined by an inside edge and an outside edge on said panel, the inside edge being lower than the outside edge whereby the height differential between said edges is approximately the thickness of said clip.

3. A shelf support and panel clip for use in mounting a side panel in alignment with a modular construction frame and in supporting a shelf associated therewith comprising a member having a transverse portion substantially perpendicular to said panel, a downwardly extending portion of said member on one end of said transverse portion, said downwardly extending portion adapted to be received by an accommodating recess in the upper surface of said panel, said recess being defined by an inside edge and an outside edge on said panel, the inside edge being lower than the outside edge whereby the height differential between said edges is approximately the thickness of said clip, an upwardly extending portion of said member intermediate the ends of said transverse portion and positioned so that when the top of said panel is aligned with said frame surfaces on said member will assist in locking said panel in a predetermined position, the upper surface of said transverse portion between the other end thereof and said upwardly extending member projecting beyond said frame and aligned

panel thereby forming a shelf support.

4. A shelf support and panel clip for use in maintaining a side panel in alignment with a modular construction frame and in supporting a shelf associated therewith comprising a member having an upwardly extending portion connected at its lower end to one end of a transverse horizontally extending portion of said member, the other end of said transverse portion connected to one end of a downwardly extending portion of said member, the other end of said downwardly extending portion connected to one end of a second transverse portion of said member, said upwardly portion adapted to be received by an accommodating recess in the bottom surface of said panel so that when said panel is aligned therewith, surfaces on said member will assist in locking said panel in a predetermined position, the upper surface of said second transverse portion projecting beyond said frame and aligned panel thereby forming a shelf support, said recess being defined by an inside edge and an outside edge on said panel, the inside edge being lower than the outside edge, whereby the height differential between said edges is approximately the thickness of said clip. -shaped