July 22, 1952 L. J. HOLMES 2,604,342

PREFABRICATED STRUCTURAL ASSEMBLY

Filed Dec. 12, 1944 2 SHEETS—SHEET 1

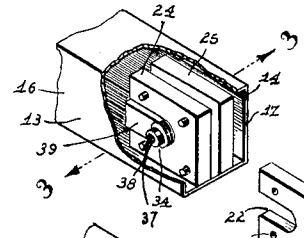


Fig 1

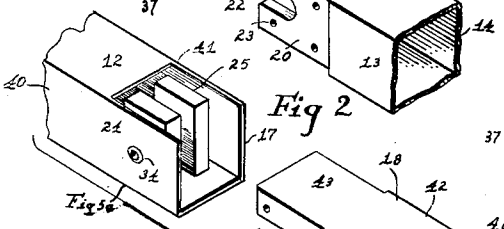


Fig 2

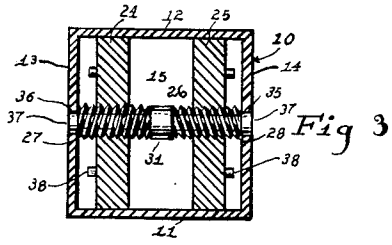


Fig 3

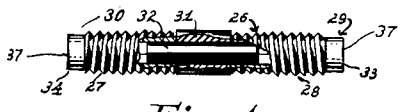


Fig 4

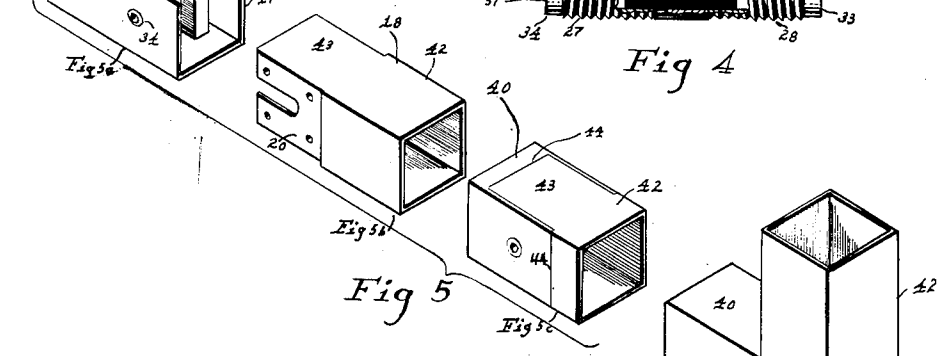


Fig 5



Fig 6

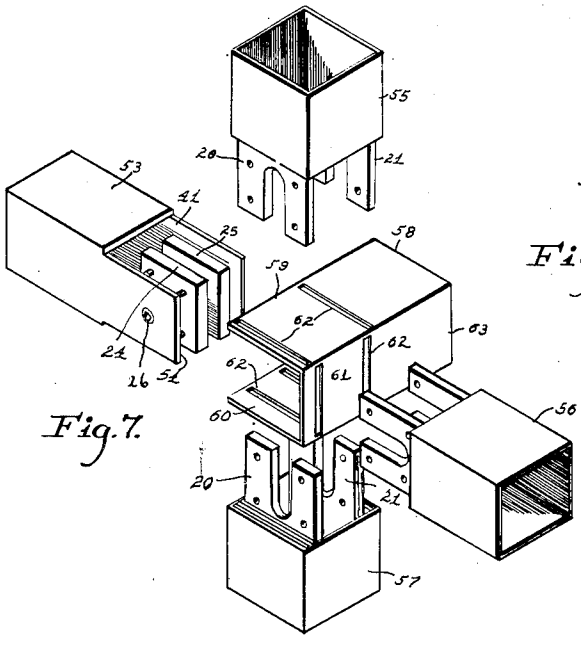


Fig. 7.

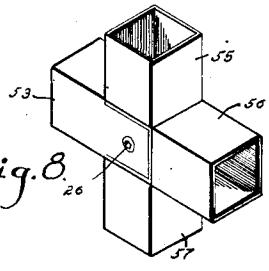


Fig. 8.

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PREFABRICATED STRUCTURAL ASSEMBLY

Filed Dec. 12, 1944 2 SHEETS—SHEET 2

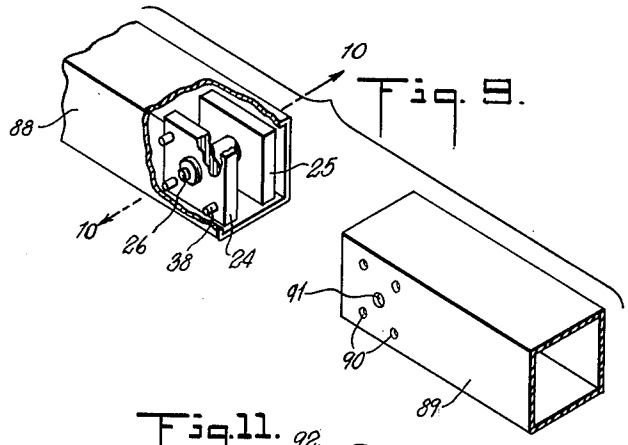



Fig. 9.

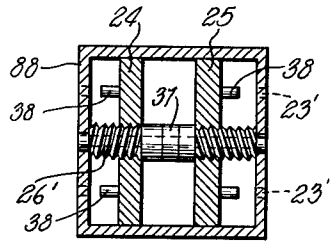



Fig. 10.




Fig. 11.

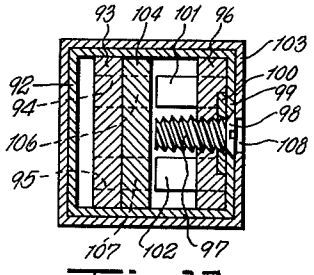
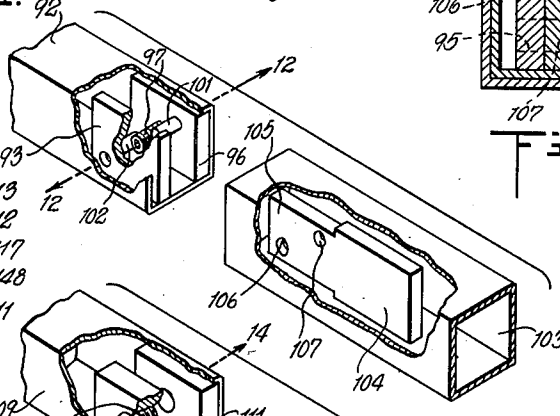



Fig. 12.



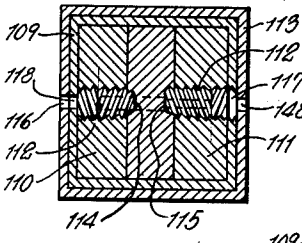




Fig. 14.

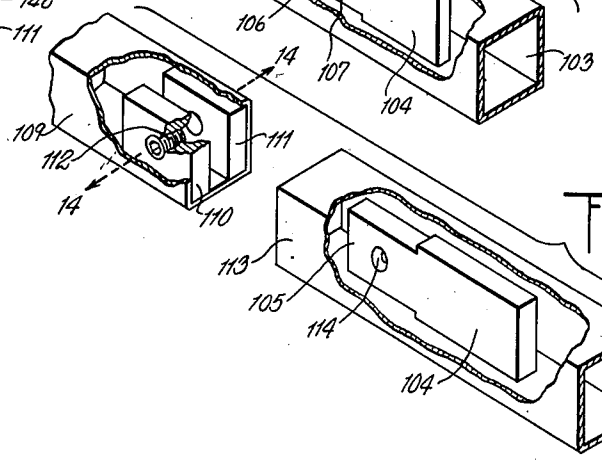



Fig. 13.

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2,604,342

# UNITED STATES PATENT OFFICE

2,604,342

## PREFABRICATED STRUCTURAL ASSEMBLY

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Application December 12, 1944, Serial No. 567,798

19 Claims. (Cl. 287—103)

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The invention relates in general to a prefabricated structural assembly and specifically relates to fastening means for securing the component units into an interlocking and easily dismantled structure. More specifically defined, the invention relates to a skeleton framework of an article of manufacture such as a building, a machine, a piece of furniture, a bridge, a toy, or in fact any structure which is usually made up of structural units such as lengths of tubing more or less permanently secured together.

An object of the invention is to provide a simple form of fastening means, the coacting elements of which will constitute permanent parts of the component units forming the completed structure, and which fastening will insure not only a quick, positive and secure interlocking of the units but which will equally facilitate a quick and easy unlocking of the parts when it is desired to dismantle the assembly.

Another object of the invention is to provide in such a fabricated assembly a type of concealed fastening means which by its avoidance of the usual evidence of its presence will contribute to the artistic appearance of the completed structure taken as a whole and which at the same time by minimizing as far as possible external projections will contribute to a compact assembly of the component parts when stacked in storage or during transportation.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and in part will be more fully set forth in the following particular description of one form of device embodying the invention, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

In the accompanying drawings:

Figs. 1 and 2 are perspective views respectively of the female and male elements of a structural assembly utilizing tubular length members shown separated from each other and when assembled as in Figs. 5c and 6 constituting a physical embodiment of a simplified form of the invention;

Fig. 3 is a transverse sectional view slightly enlarged and taken on the line 3—3 of Fig. 1 with the locking blocks or nuts in about the position they would occupy when the locking pins thereof are in operative engagement with the male element shown in Fig. 2;

Fig. 4 is an enlarged detail view of the screw of Fig. 3;

Figs. 5 and 6 are perspective views of a first

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modified form; Fig. 5a being the female element corresponding to the showing in Fig. 1; Fig. 5b the male element resembling the one shown in Fig. 2; Fig. 5c showing the elements of Figs. 5a and 5b assembled in end to end relation, and Fig. 6 showing the same elements assembled in right angled relation;

Fig. 7 and Fig. 8 are perspective views of a second modification, Fig. 7 showing the parts in an exploded view and Fig. 8 showing the parts assembled;

Figs. 9 and 10 disclose a third modification, Fig. 9 being an exploded view of the component parts, and Fig. 10 being a transverse sectional view taken on the line 10—10 of Fig. 9;

Figs. 11 and 12 disclose a fourth modification, Fig. 11 being an exploded view of the component parts, and Fig. 12 being a transverse sectional view of the parts when assembled and taken on the line 12—12 of Fig. 11; and

Figs. 13 and 14 disclose a fifth modification, Fig. 13 being an exploded view of the component parts and Fig. 14 being a transverse sectional view of the parts when assembled and taken on the line 14—14 of Fig. 13:

In the several figures it will be understood that there is illustrated only the interlocking of the different length members and that the completed structure in each case is that of the completely fabricated article and which may of course comprise different lengths of the component tubing, with the lengths arranged either in axial alignment or at various angles to each other and which may include preformed forms not necessarily of any definite length and which composite structure will include all the necessary interlocking features required to form the completed article.

Referring to the more simplified form of the invention shown in Figs. 1–4, there is disclosed two length members square in cross section. In all the forms of the invention, the length members are for the most part sections of commercial square metallic tubing of drawn thin gauge steel, copper, brass, aluminum or in fact any material even including plastics best suited for the particular article to be formed. In the case of metallic lengths, the sections are cut off from stock material to form the requisite lengths desired and preferably the fastening means herein featured are formed therein or mounted thereon more or less permanently at the factory so as to insure that every piece intended to be fitted to another piece will do so without necessity of making adjustments at the time the parts are fabricated.

In general the square tubing identified generally by the reference character 10 includes a bottom side 11, a top side 12 and upstanding sides 13 and 14 integrally connected to form a hollow tube with a bore 15 extending therethrough from end to end. As the members are intended to have one telescoped into the other, the member 16 of Fig. 1 is sometimes hereinafter called the female member and has a squared off end 17. The member of Fig. 2 hereinafter sometimes called the male element 18 is likewise provided with a squared off end 19 designed to abut against the end 17 to form an almost invisible line on all four sides at the joint. The member 18 is provided with two parallel spaced apart prongs or flanges, 20 and 21, located to be intruded into the open end 17 with a snug but sliding fit and with each flange in close relation to its adjacent side walls 13 and 14 of member 16. The flanges are preferably welded to the inner faces of the side walls 13 and 14 and thus constitute fixed extensions projecting from the end 19 of the male member 18. Each flange is provided with a slot 22 and with a plurality of pin holes 23 of which four are shown in Fig. 2.

Located in the open end 17 of the female member 16 are two nut forming rectangular blocks 24 and 25 designed to ride along a locking screw when the screw is rotated. The blocks engage respectively the left hand threads 27 and the right hand threads 28 of the transversely disposed screw 26. The screw 26 as by reference to the showing in Fig. 4 comprises four parts, a right screw forming end 29, a left end 30, a spacer 31 between the ends and an internal non-circular connector 32 which extends through the spacer and through the ends to secure them together. From this construction it will be understood that the parts may be formed on simple screw machinery. The right end 29 includes threads 28 and a smooth key forming bearing 33 and the left end 30 includes threads 27 and a smooth key forming bearing 34. The smooth bearings 33 and 34 are journalled respectively in key holes 35 and 36 drilled in the side walls 14 and 13. The outer ends of the smooth bearing portions are provided with a non-circular socket 37 flush with the outer face of the associated side wall 13 or 14, as the case may be. These sockets are designed to be engaged by a wrench, screw driver or by a tool particularly designed to be intruded into the socket to rotate the screw. It is a feature of this disclosure to make these key holes and sockets as small as possible and otherwise to avoid their presence being noticed in the finished structure.

Each of the blocks 24 and 25 is provided on its outer face with four locking pins 38, one for each of the pin holes in its associated flanges 20 or 21 as the case may be. Also each outer face has welded thereto a filler piece 39 designed to fit into and thus fill the associated slot 22.

In operation and assuming that the members 16 and 18 have been forced one into the other, the telescoped parts interfit with a frictional tight fit between the flanges 20, 21 and the side walls 13, 14 of member 16, and thus the parts may be assembled temporarily without necessity of operating the locking device. In order to lock the members together positively, either end and of course the end of the screw most accessible is turned in that direction which will cause the locking blocks to move outwardly as viewed in Fig. 3; this causes the four pins 38 of each block to move into their associated pin holes and at the same time the filler piece 39 of each block is located in the slot 22 of its associated flange. In this way the members are locked against endwise separating movement. The interlocks provided by the two slots and filler pieces tend to give additional structural rigidity to the joint and act to resist lateral bending movements between the members at the joint.



Referring to the form of the invention shown in Figs. 5 and 6, there is disclosed a pair of telescopic units fashioned to be connected either in end to end coaxial relation as shown in Fig. 5 or in right angled relation as shown in Fig. 6. In this case the female member 40 has its top side 12 cut back to form a side opening 41 continuous with the open end 17 and of the same dimensions. The male member 42 has a continuation 43 of its top side 18 integrally connecting the flanges 20—21 and fits in the opening 41 in the member 40. The fastening elements are the same as described for the Figs. 1–4 form.

As disclosed in Fig. 5c the members have been telescoped in axial relation so that the top 12 of the member 42, the continuation 43 thereof and the top 12 of the member 40 are in the same plane and thus form in effect a continuous flat surface. The only visual evidence that the structure is not of one piece is the fine lines 44 which as noticed above are disguised so as to minimize their visbility.

As disclosed in Fig. 6 the member 42 is intruded into the member 40 laterally thereof to cause the flanges 20—21 to extend respectively into the spaces between the blocks 24 and 25 and the adjacent sides 13 and 14 perpendicularly rather than horizontally as previously described. In this case the depending continuation 43 closes the end opening 17 rather than the side opening as in the Fig. 5c disclosure. Here again the surfaces are intended to be in their respective planes and otherwise to simulate as far as possible, a one-piece unitary structure.

Referring to the modification shown in Figs. 7 and 8, it is seen that there is disclosed a jointure of four main members in one plane and interlock which may be cut away on one side to provide an extension in the form of a channel member and which interlock extends laterally and perpendicular to said plane. Noting the parts shown in Fig. 7 there is disclosed a female member 53, resembling the similar member in Fig. 5*a* except that its bottom wall 11 is also cut back to provide a bottom opening 54 of the same dimension as its top opening 41. This member 53 is provided with a pair of locking blocks 24 and 25 and a screw 26 for moving them to and from their locking position as has been described for the Figs. 1 and 5*a* forms. The other three members marked clockwise 55, 56 and 57 in Figs. 7 and 8 are male members corresponding in each case to that of Fig. 2.

An interlocking channel 58 is fitted between the meeting ends of the members 53—57 and this in effect duplicates the continuation 43 of Figs. 5 and 6. The top face 59 of the channel extends across and thus closes the upper side of the member 53 as well as the open bottom end of the bore 15 of the member 55. The bottom face 60 of the channel similarly closes the bottom opening 54 of the member 53 and the open upper end of bore 15 of member 57.

The web face 61 provides a closure for the adjacent open ends of the bores in both of the members 53 and 56. All three sides of the channel

member are provided with long narrow slots 62 located in relatively offset relations to receive the overlapping pairs of flanges 20—21 projecting from the male members 55, 56 and 57 into the female member 53 in position to be engaged by the walking blocks 24 and 25.

In the showing in Fig. 7 the interlocking channel 58 is provided with an extension 63 which may be regarded as a beam, the opposite end of which is supported from a structure corresponding to that illustrated in Figs. 7 and 8.

In assembling the Fig. 7 showing, the interlocking channel is inserted over the adjacent end of the member 53, the several pairs of flanges inserted through the slots 62 provided therefor and by turning the screw 26 in the proper direction the locking blocks are advanced relatively outward from each other and into locking engagement with all of the flanges and finally there is found the locked cross structure shown in Fig. 8 with or without the lateral extension 63.

From this construction it will be seen from Fig. 8 that there is found a cross-like structure composed of the four length members 53, 55, 56 and 57 which project radially from a point or rather line of intersection defined by the axis of the screw 26.

Referring to the disclosure in Figs. 9 and 10 the male member 88 at the left is similar to the corresponding member 16 of Fig. 1. The female member 89 is a section of tubing dimensioned to have the open end of the member 88 intrude into the same. The member 89 is provided with pin holes 90 to receive the pins 38 on the locking blocks 24 and 25 and is also provided with a key or wrench hole 91 to provide access to the screw 26'. The screw 26' resembles the screw 26 of Fig. 4, except that the parts on opposite sides of the spacer 31 and adjacent thereto are unthreaded.

The pins 38 in this case have a length sufficient to extend through the pin hole 23' shown in outline in Fig. 10 and into the pin holes 90 in the outer member 89 preferably to the surface of the sides of the member 89. Extending the pins so that their outer surfaces are flush with the outer exposed surfaces of the member 89 tends to provide a smooth surface to the outside of the member 89 and thus assists in avoiding any noticeable presence of fastening means.

In this case and assuming the blocks 24 and 25 to be in the position shown in Fig. 10, the male member 88 is intruded into the female member 89 until the pins 38 register with respective pin holes 90 and the screw 26' registers with the key hole 91. Then by means of a key intruded into one or the other of the aligned key holes 91 on opposite sides of the member 89, the screw is advanced in the direction to cause the blocks 24—25 to ride outwardly and thus to advance the pins 38 through the pin holes shown in Fig. 10 and thus into the pin holes 90 in the outer member 89. By this means the resulting joint is of its maximum strength at the point where such devices are usually weakest. Preferably the members 88—89 have a more or less snug telescopic fit and the heavy blocks 24—25 act as rugged internal reinforcements or braces which act to resist both rotary strains and binding stresses on the telescoped ends of the assemblies.

Referring to the disclosure of Figs. 11–12 there is shown an inner or male member 92 provided with a fixed partition 93 extending lengthwise of the member and provided with two pinholes 94 and 95. The member 92 is also provided with a locking block 96 slidably mounted for transverse movement on feed screw 97. This screw is provided with a head 98 countersunk in a side 99 of the member 92 and with its head loosely engaging lock plate 100 secured to the locking block 96. The shiftable block 96 is also provided with a pair of locking pins 101 and 102, one for each of the pin holes 94 and 95. The other or female length member 103 is designed to telescope over the adjacent end of the member 92 and is provided centrally thereof with an internal rib 104 fitted between the top and bottom sides of the member to give it an internal reinforcement. The rib is reduced in height at its advance end to form a tongue 105 of the same depth as the fixed partition 93 and arranged when the parts are in their telescoped relation as shown in Fig. 12 to be close to the partition 93. The tongue is provided with a pair of pin holes 106 and 107 registering with and located between the pins 101 and 102 and the pin holes 94 and 95.

The parts are so arranged that a tool like a screw driver inserted in screw hole 108 turns the screw to cause the locking plate to move to the left from its position shown in Fig. 12. This advances both pins 101 and 102 into and through both sets of aligned pin holes to lock the members 92 and 103 from any relative movement.

Referring to the showing in Figs. 13 and 14 there is disclosed a locking arrangement in which set screws are used instead of the locking blocks disclosed in the preceeding figures. In this case the inner tubular member 109 is provided with a pair of fixed partitions 110 and 111 carrying short set screws 112 in threaded engagement with their respective partitions. The outer member 113 resembles length member 103 except that its tongue 105 is provided on opposite sides with sockets 114 and 115 for receiving the inner ends respectively of the set screws 112. In this form of the invention the tongue 105 is intruded between the fixed partitions 110 and 111 when the screws have been retracted from their sockets 114, 115 sufficiently to permit the insertion of the tongue. By means of a tool reaching into the screw holes 118 or 148 as the case may be, the left or the right set screw or both may be advanced inwardly into their respective sockets 114 or 115 or both.

By following the practices herein disclosed, it is possible to assemble and dismantle quickly and without the necessity of using any special forms of tools, all sorts of prefabricated structures, as large as building units and as small as toys. While there has been disclosed simply the basic skeleton forms, made up of unit lengths of tubular stock material, it is understood that the tubular showings herein illustrated are simply suggestive of other forms and that the same hidden lock schemes herein featured may be used with all sorts of structural units.

I claim:

1. A knock-down structure including two separable parts, disposed with a pair of ends abutting to form a closed joint, said structure with its parts assembled presenting external exposed surfaces free of projections, an element rigidly secured to one part intruding telescopically into the other part, a side of the intruded part at its intruded portion provided with a key hole, an interlock concealed within the parts at the joint for positively and mechanically securing said element to the part into which it is intruded and

said interlock being accessible from the exterior of the assembled structure through said key-hole.

2. An article of manufacture constituting a knock-down skeleton structure simulating a permanent skeleton structure and including at least two pre-formed tubular units with an end of one joined to an end of the other to form a substantially invisible thin line form of joint, the visible portions of both units when so assembled being substantially of the same cross-sectional contour and in this way to assist in giving the visual impression that the structure is of one-piece particularly at and adjacent the joint, mechanically locking means concealed within the structure for temporarily and positively locking the units together to form the knock-down structure and said locking means including a screw having one end journaled in one of the units and accessible from the outside of the structure for moving the locking means to and from its mechanical and positive locking position.

3. A demountable structure including two parts, one of said parts provided with an opening into which an element forming a rigid integral part of the other part intrudes telescopically, said first-named part provided with a key hole adjacent said opening and said other part provided with a recess forming a bolt-keeper, and locking means concealed within the outline of the first-named part and including a shiftable bolt for engaging said recess in said intruding element to lock the parts together mechanically and said locking means including a screw accessible through the key hole to move the locking means to and from its operative locking position.

4. The structure defined in claim 1 and wherein the locking means includes a screw actuated latch, with the screw element thereof having its head exposed for engagement by a tool inserted into said key hole whereby the latch may be moved to and from its locking position by a tool actuated from the outside of the structure.

5. A separable structural assembly comprising two units each rectangular in cross section, a side of one of the units recessed at one end to provide a socket, the other unit provided with an extension adapted to be fitted in said recess to form a continuation of the first named side, said other unit provided with at least one flange extending therefrom and intruding into the first-named unit at its recessed end, fastening means including a nut located in the first-named unit facing the socket and a screw journalled in the first named unit and in threaded engagement with the nut and acting as the screw is rotated in one direction to move the nut along the screw and into bearing engagement with one side of the flange.

6. The combination of two structural units fashioned to be assembled selectively either in alignment or at an angle to each other, one of the units provided at one end thereof with a socket open both through the end and through one side thereof and the other unit provided with an extension telescopically fitting in the socket when the units are in either of said relative relations and locking means concealed within the units when assembled for securing the extension in the socket, said locking means including a control element accessible from the exterior of the assembled units.

7. A separable structural assembly comprising two tubular units, a side of one of the units recessed at one end to provide a side opening and the other unit provided with an element adapted to be intruded into said opening to close the same, a nut within the assembly for engaging said other unit to lock the units in their assembled relation and a screw carried by the first named unit in threaded engagement with the nut and accessible exteriorly of the assembly.

8. In a structural assembly, the combination of two similar units in end to end relation and fashioned to be assembled selectively either in axial alignment or at an angle to each other, one of said units provided with a socket and the other with one element fitting the socket in all relative operative positions of the units and concealed fastening means contained in the assembly to lock the units in either of said positions, and a control accessible from the outside of the assembly for actuating said fastening means.

9. In a device of the class described, the combination of two tubular structural units, each rectangular in cross section, of the same cross sectional size and fashioned to extend in end to end relation selectively either in axial alignment or one at right angles to the other, one of said units having an open end and having a side adjacent to said open end, recessed between its two adjacent sides to provide a rectangular side opening, the other unit having one side provided with an extension adapted to fit selectively in the open side when the units are in alignment and in the open end when the units are at right angles to each other, said other unit provided with a pair of parallel flanges, intruded into the first named unit telescopically in close relation respectively with said two adjacent sides and each of said flanges provided with a slot, with the slots in alignment transversely of the units, a screw journalled at its opposite ends in said two adjacent sides and passing through the aligned slots, said screw including a right and a left threaded portion, a pair of nuts, one engaging each of said threaded portions and located between the flanges whereby as the screw is turned in one direction the nuts will move away from each other and in bearing engagement with the flanges.

10. A structural assembly including two preformed units fashioned with an end of one engaging an end of the other to form all of the visible parts of the structure at the jointure between the units, one of said units being formed adjacent the joint with a key hole and the exposed surface of said assembly at the joint being otherwise free of openings and free of projections thereby to form the surfaces except for said key hole, without noticeable breaks at the joints, a projection from one unit intruded into the other, and a lock concealed within the assembly at the joint for connecting the units, said lock including two relatively movable elements one constituting a shiftable latch and the other constituting its keeper.

11. In a device of the class described, a hollow tubing provided therein with means for locking the tubing to a similar tubing, said means including a locking screw having its opposite ends journalled for rotary movement in a pair of opposed side walls of the tubing, said screw being of four parts, a right and a left screw forming ends, a spacer therebetween and a non-circular connector passed through the spacer and having its ends intruded into the screw forming ends.

12. In a device of the class described, the combination of two tubular members adapted to telescope in end to end relation, one of said members being open at one end and having a side wall thereof at said end cut back to provide a side

opening substantially of the same dimensions as the open end, the other member provided with a continuation of one of its sides, said continuation dimensioned to fit into either of the end or side openings in the first named member, and fastening means concealed within the members when assembled to secure them together when the continuation is in either opening.

13. In a device of the class described, the combination of two tubular members, each of the same cross section, square in cross section, with an end of one at an end of the other with the members extending either in axial alignment or in a right angled relation, one of the members provided with an opening in a side wall thereof, and the other provided with an extension from a side wall thereof fashioned to fit either the open end or the side opening of the first named member, and fastening means concealed within the members when assembled for connecting the members in locked relation irrespective as to whether in axial alignment or at right angles to each other.

14. In a device of the class described the combination of at least three tubular length members in end to end relation, one of the members constituting a female member being cut back at top and bottom adjacent an open end, and provided in said open end with elements of a fastening means, an interlocking channel having its sides closing said cut backs and its web face closing said open end and provided in at least two of its sides with slots and two of the other members provided each with at least one flange projecting therefrom for insertion through one of the slots for engagement by the fastening means in the female member to secure its associated member to the female member.

15. A cross-like structure formed of four length members projecting radially from a point of intersection, one of the members constituting a female member and the other three members constituting male members, each male member provided with a pair of flanges intruding into the female member, an interlocking channel provided with slots through which said flanges extend, and said female member provided with means engaging the flanges to lock the four length members and the channel member together.

16. An assembly of structural parts including two preformed units fashioned with one end of one engaging an end of the other to form a butt joint, locking means concealed within the assembly for positively fastening the ends together, said locking means including a pair of relatively lapping elements, one secured to one of the units projecting into the other unit and provided in its projecting part with a recess, and the other element mounted in the other unit provided with a pin coacting with the recess to form an interlock, and control means accessible from the outside of the assembly to move said other element transversely to and from the first-named element and thus to control the interlock.



17. In a device of the class described, the combination of two tubular members with their ends in abutting relation, a flange projecting from the abutting end of one member and extending into the other member, said flange provided with an open end slot and with at least one pin hole, the other member provided with a screw journaled for rotary movement therein and extending transversely thereof, a block riding on the screw and movable thereby to and from the flange, said block provided with a pin for engaging in the pin hole and with a filler piece adapted to fit into and thus fill the slot in the flange.

18. In a device of the class described, the combination of two structural units fashioned to be assembled with an end of one inserted into the other, locking means concealed within the units when assembled, said locking means including a relatively fixed element rigidly and permanently affixed to one of the units and located with at least a portion thereof extending within the other, and a relatively movable element in the other unit and control means accessible from the outside of the units for shifting the movable element of the locking means to and from its operative engagement with its associated fixed element.

19. In a device of the class described the combination of at least three tubular length members in end to end relation, one of the members constituting a female member being cut back adjacent an open end and provided in said open end with elements of a fastening means, said means including at least one flange projecting from one of the other tubular members into said open end and an interlocking channel having its sides closing said cut back and its web face closing said open end, said channel provided with a slot, one of the other members provided with a flange inserted through said slot for engagement by the fastening means, and an extension from said channel forming a beam-like element projecting from said three length members at right angles to the plane which contains said three length members.

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