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[54] **JOINT FOR STRUCTURAL ASSEMBLIES**
9 Claims, 6 Drawing Figs.

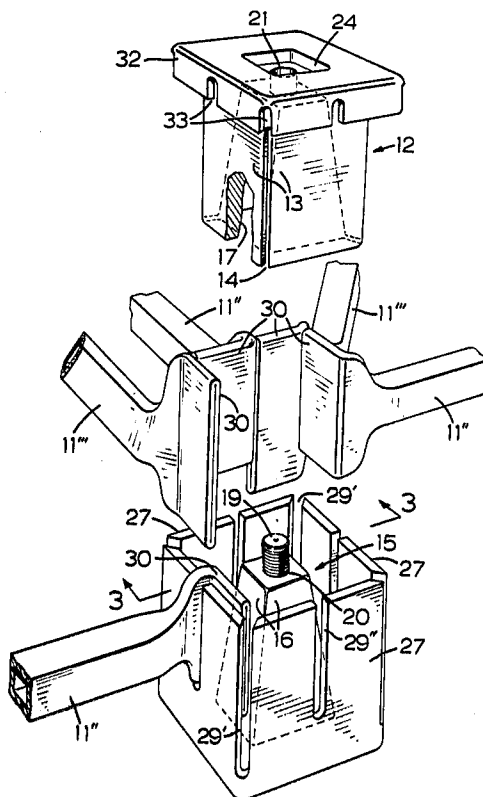
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287/54
[51] Int. Cl. **F16b 7/04**
[50] Field of Search 287/189.36
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126, 1; 211/(Inquired); 248/188.7; 108/150, 152;
52/726, 648, 649, 650, 651, 652, 653, 654, 655;
135/(Inquired)

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ABSTRACT: A joint comprising a first member, and a second member which is axially urged relative to the first member by a nut and bolt assembly interconnecting the two members. One of the members has sidewalls spaced from the other member by a distance which is decreased by axial urging together of the members, and which is increased by axial urging apart of the members. The sidewalls are provided with openings through which end portions of structural members are disposed, these end portions being located between the sidewalls and the above-mentioned other member thereby to be securely clamped therebetween when the members are axially urged together, and to be released when the members are axially urged apart.



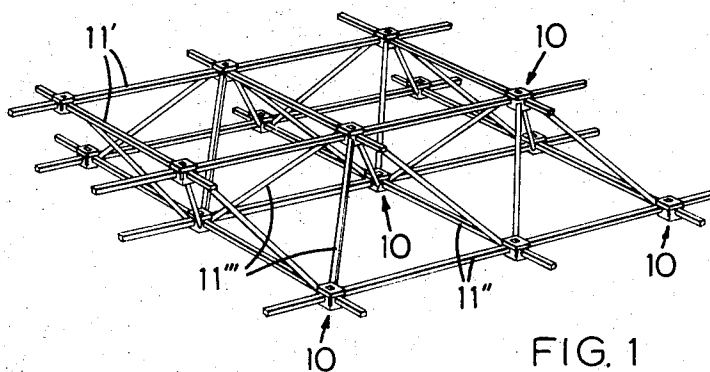


FIG. 1

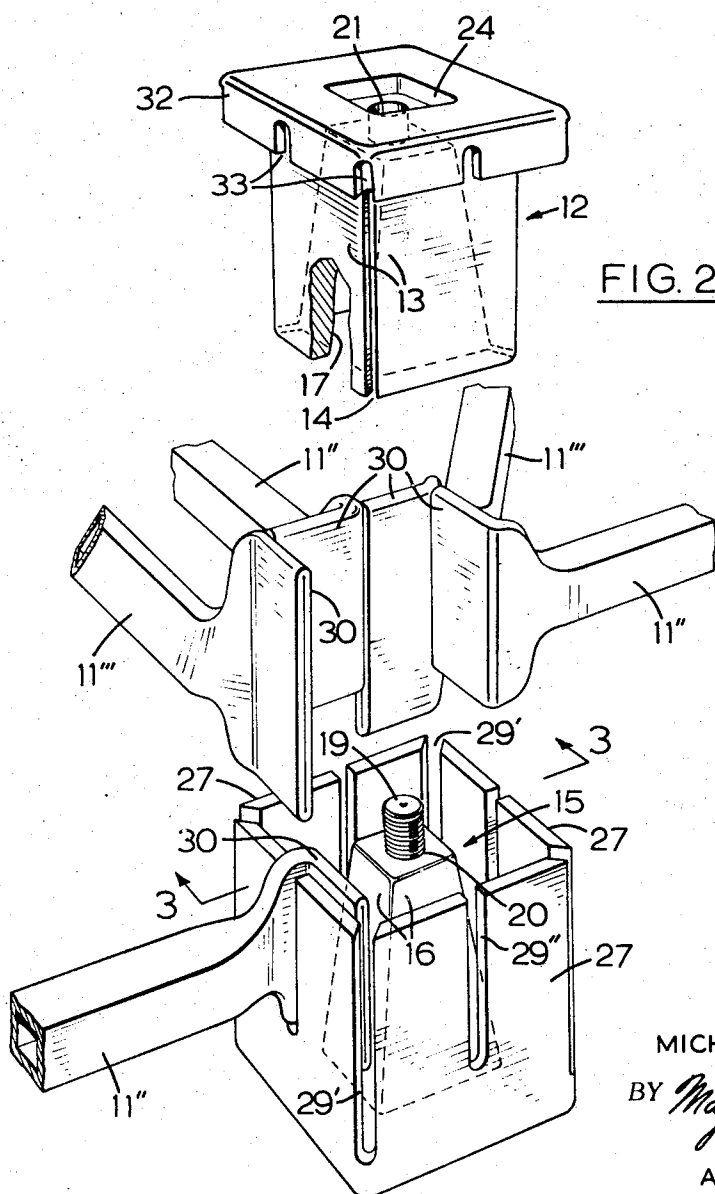
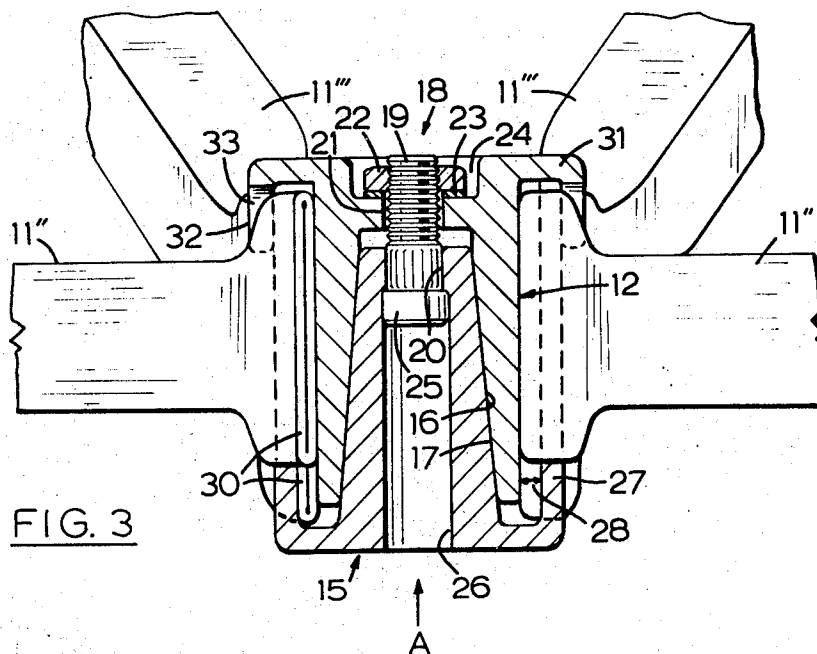
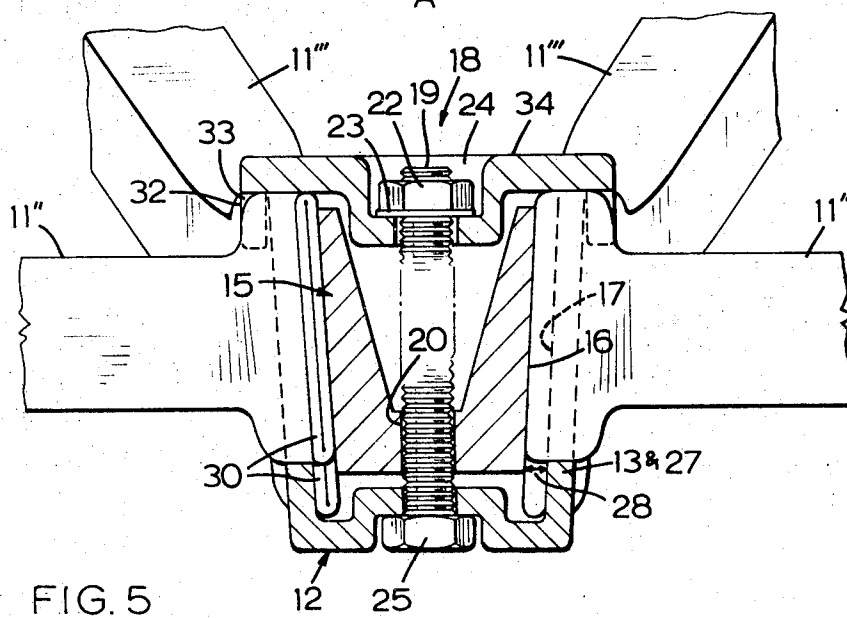


FIG. 2

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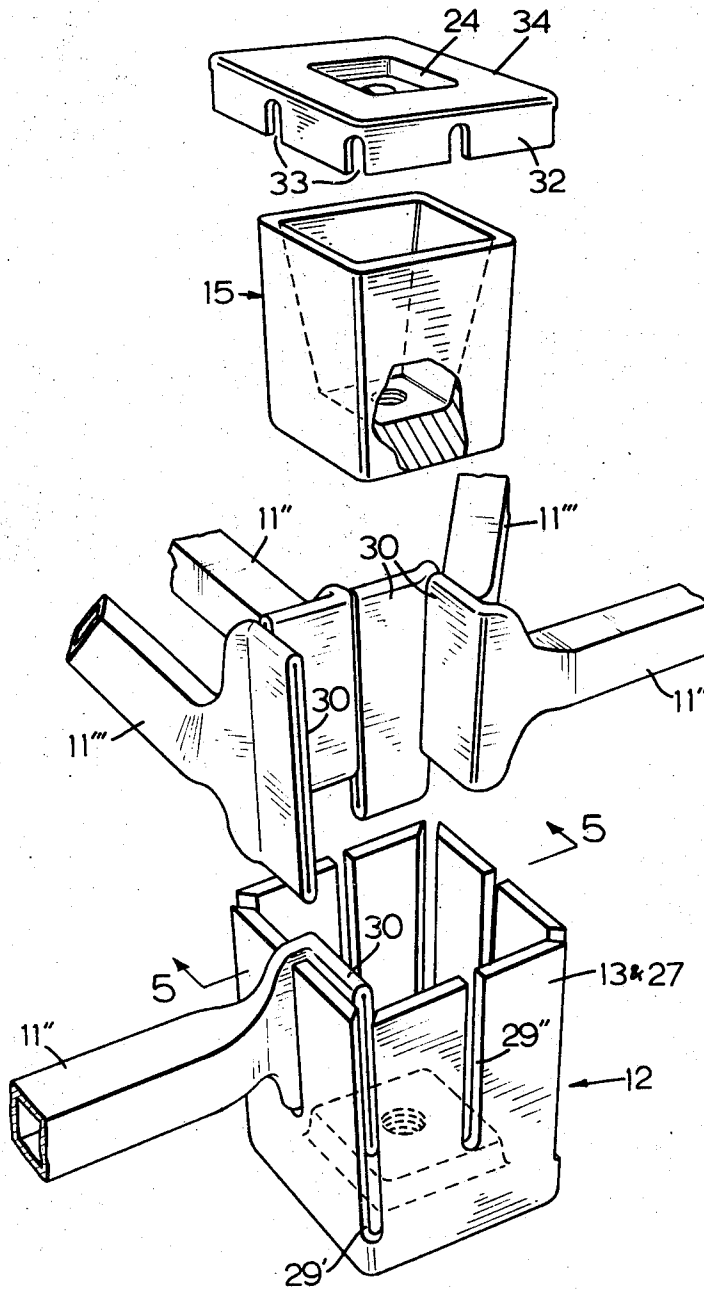


FIG. 4

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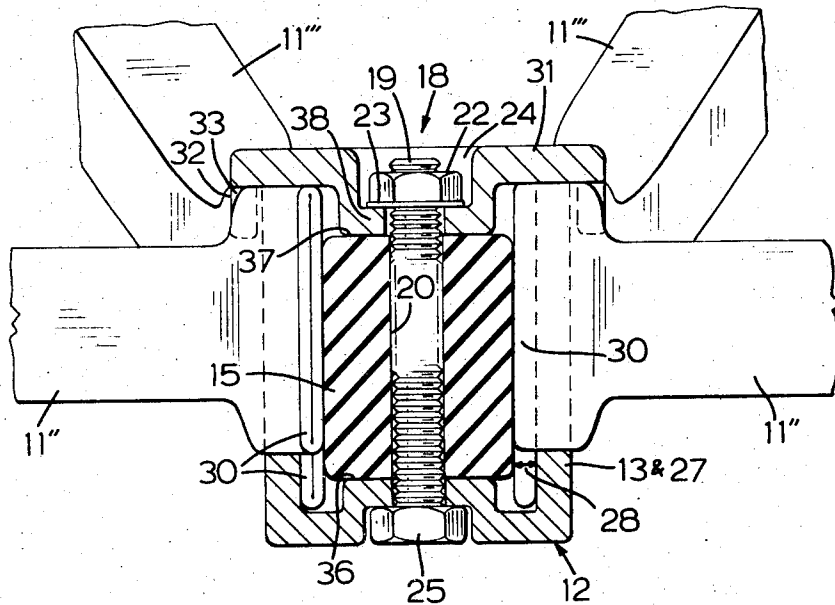


FIG. 6

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JOINT FOR STRUCTURAL ASSEMBLIES

This invention is concerned with joints for structural assemblies, such as structural assemblies of the three-dimensional type which are presently in general use as, for example, roofing deck supports and the like. An advantage of structural assemblies which are of the three-dimensional type is that such assemblies are capable of spanning relatively large distances, with the result that the number of vertical support columns or the like may be reduced to a minimum. The importance of this advantage will be readily appreciated, particularly where the assemblies are used in, for example, theatres in which the presence of vertical support columns is extremely undesirable.

Structural assemblies of the three-dimensional type comprise essentially a plurality of structural members such as beams, some of which are interconnected in the form of an upper grid, others of which are interconnected in the form of a lower grid, and the remainder of which interconnect the upper and lower grids. The interconnections between the structural members are constituted by joints, and it is with an improved form of such joints that the present invention is concerned.

It is to be understood, however, that the present invention is not restricted in scope to joints for use in three-dimensional structural assemblies, but includes joints for use in interconnecting the structural members in any form of structural assembly.

It is an important requirement of joints for use in structural assemblies, including structural assemblies of the above-described three-dimensional type, that the joints be capable of securely interconnecting the adjacent ends of the appropriate structural members, and it is a primary object of the present invention to provide such a joint which is of improved form, and which can be assembled and dismantled quickly and with ease by unskilled labor.

A joint according to the present invention comprises a first member, a second member which may be axially urged relative to the first member, and means interconnecting the first and second members for axially urging said members together. One of the members has sidewalls which in at least one plane containing the longitudinal axis of the members are each spaced from the other member by a distance which may be decreased by axial urging together of the members, and which may be increased by axial urging apart of the members. The sidewalls are provided with openings through which end portions of structural members may be disposed for location between said sidewalls and said other member thereby to be securely clamped therebetween when the members are axially urged together, and to be released when the members are axially urged apart.

In certain preferred embodiments of the invention, the first member is constituted by a female member, and the second member is constituted by a male member which, by operation of the interconnection means, may be so urged relative to the female member as to enter into the female member. In these embodiments of the invention, opposed faces of the male member intersected by the above-mentioned at least one plane containing the longitudinal axis of the members are convergent in the sense of the direction in which the male member is moved relative to the female member during entry of the male member into the female member, and the corresponding faces of the female member are correspondingly convergent in said sense of said direction.

In order that the invention may be more clearly understood and more readily carried into effect, the same will now, by way of example, be more fully described with reference to the accompanying drawings in which:

FIG. 1 is a isometric view of a portion of a three-dimensional structural assembly which includes joints according to the present invention;

FIG. 2 is an isometric, exploded view of a joint according to a first embodiment of the invention;

FIG. 3 is an axially sectioned view, on the line 3-3 in FIG. 2, of the first embodiment with the various elements shown in their assembled condition;

FIG. 4 is a view corresponding to FIG. 2 of a second embodiment of the invention;

FIG. 5 is an axially sectioned view, corresponding to FIG. 3, on the line 5-5 in FIG. 4; and

FIG. 6 is an axially sectioned view, corresponding to FIGS. 3 and 5, of a third embodiment of the invention.

In the various views of the drawings, like reference numerals are used to denote like parts.

With reference to the drawings, and particularly FIG. 1 thereof, the reference numerals 10 denote generally each of a plurality of joints, while the reference numerals 11 denote each of a plurality of structural members constituted by beams which are interconnected by the joints 10 whereby to form a three-dimensional structural assembly which may be used as, for example, a roofing deck support or the like. As will be noted from FIG. 1, some of the members 11, namely the members 11', are interconnected to form an upper grid, and others of the members 11, namely the members 11'', are interconnected to form a lower grid, the remaining members 11, namely the members 11''', interconnecting the upper and lower grids.

With reference to the embodiment of joint 10 which is illustrated in FIGS. 2 and 3, 12 denotes a first or female member having walls 13 which are disposed substantially in the form of a square. Slots 14 are provided at the corners of the member 12 between the adjacent walls 13 so that the walls 13 of each opposed pair thereof may be resiliently urged apart as is hereinafter more fully explained, the member 12 which is preferably of integral construction being formed of an appropriate material, such as an appropriate metal, to permit the above resilient urging apart of the walls 13 of each opposed pair thereof.

15 denotes generally a second or male member which may be so axially urged relative to the female member 12 that the male member 15 enters into the female member 12 between the walls 13 thereof.

The opposed faces 16 of the male member 15 are convergent in the sense of the direction in which the male member 15 is moved relative to the female member 12 during entry of the male member 15 into the female member 12, i.e. in the sense of the direction indicated by the arrow A in FIG. 3. The corresponding faces 17 of the walls 13 of the female member 12 are correspondingly convergent in said sense of said direction as indicated by the arrow A in FIG. 3.

Means constituted by a nut and bolt assembly 18 interconnects the female and male members 12, 15 for so urging these members that the male member 15 enters into the female member 12, the assembly 18 comprising a bolt 19 which passes through an aperture 20 formed in the male member 15 and through an aperture 21 formed in the female member 12, and a nut 22 which is in screw-threaded engagement with the bolt 19 and which is in abutting contact, through a washer 23, with a recessed portion 24 of the female member 12. The head 25 of the bolt 19 is disposed within an axial recess 26 formed in the male member 15.

The male member 15 presents outer sidewalls 27 which are spaced distances 28 from the female member 12, and more specifically from the outer faces of the walls 13 of the member 12. The walls 27 are provided with openings 29 through which end portions 30 of the structural members 11 may be disposed for location between the sidewalls 27 and the walls 13 of the member 12, in the manner illustrated in FIG. 3. While in the embodiment illustrated in FIGS. 2 and 3 there are four sidewalls 27, it is to be understood that alternative embodiments (not shown) of the invention may incorporate sidewalls 27 which are spaced distances 28 as described above in only one plane containing the longitudinal axis of the members 12, 15.

The members 11 are preferably of square tubular form, each end portion 30 of each member 11 being, however, flattened and being disposed at an angle to the longitudinal axis of the member 11. The openings 29 extend from the upper edges of the walls 27 of the member 15, and include openings 29' which are formed at the corners of the member 15 between adjacent walls 27 and which extend downwards for a greater distance than the remaining openings 29'', which are formed

substantially centrally in the walls 27. The reason for the openings 29' being of greater length than the openings 29'' is that the flattening of the end portions 30 of the members 11 which are disposed through the openings 29'' is formed transversely to the longitudinal axis of each said member 11 so that, with reference to FIG. 1, these members 11 are disposed horizontally and constitute members of the upper or lower grid, whereas the flattening of the end portions 30 of the members 11 which are disposed through the openings 29' is formed at an acute angle to the longitudinal axis of each said member 11 with the result that the depth of the end portions 30 of the latter members 11 is greater than the depth of the end portions 30 of the former members 11. Said latter members 11 constitute, with reference to FIG. 1, the members 11''' which are inclined and which interconnect the upper and lower grids.

A cover plate portion 31 presented by the female member 12 overlies the ends of the outer sidewalls 27 presented by the male member 15, the portion 31 including a depending flange 32 in which is formed a plurality of notches 33. Each of the notches 33 is, when the joint 10 is in the assembled condition as shown in FIG. 3, in alignment with the upper portion of one of the openings 29 so that the upper part of the flattened end portion 30 of the member 11 which is disposed through said one of the openings 29 is also disposed through the notch 33 in alignment therewith.

The distances 28 are operatively decreased, thereby securely to clamp the end portions 30 of the members 11 between the sidewalls 27 and the walls 13 of the member 12, by tightening of the nut 22 on the bolt 19 which causes relative movement between the members 12, 15 such that the male member 15 is urged into the female member 12. This relative movement between the members 12, 15 thus causes, through the interaction of the faces 16 and 17 of the members 15, 12, respectively, the walls 13 of the opposed pairs thereof to be resiliently urged apart towards the sidewalls 27 presented by the member 15.

Conversely, slackening of the nut 22 on the bolt 19 permits relative movement between the members 12, 15 in the opposite direction which, in turn, permits the walls 13 to return towards their unstressed condition with resultant increase in the distances 28. The end portions 30 of the members 11 are thus released.

To dismantle the joint 10 the nut 22, and the washer 23, are removed from the bolt 19. The female member 12, including of course the cover plate portion 31, is then completely separated from the male member 15 thereby permitting the end portions 30 of the members 11 to be slidably removed from the openings 29 as shown in FIG. 2. Assembly of the joint 10 is achieved by performing these operations in reverse and in the opposite sequence.

When the joint is in the assembled condition the end portions 30 of the members 11 are all disposed in the same direction with the end of the end portion 30 of one member 11 substantially in abutting contact with the end portion 30 of the next adjacent member 11, in the manner in which four of the members 11 are illustrated in FIG. 2.

The embodiment of the invention illustrated in FIGS. 4 and 5 differs from that illustrated in FIGS. 2 and 3 in that, in the second embodiment, the end portions 30 of the members 11 are operatively disposed between the faces 16 of the member 15 and the corresponding faces 17 of the walls 13 of the member 12, the members 12 and 15 being inverted relative to the orientation of these members as shown in FIGS. 2 and 3. Furthermore, in this second embodiment the walls 13 of the female member 12 constitute the sidewalls 27 in which the openings 29 are formed, the distances 28 being the distances between the faces 17 of the walls 13 of the member 12 and the faces 16 of the member 15. In this second embodiment, the walls 13 of the member 12 are not, of course, resiliently separable and hence the slots 14 of the first embodiment are omitted.

In addition, in this second embodiment there is provided a separate cover plate 34 which overlies the ends of the walls 27

and which is secured by the nut 22 screw-threadedly mounted on the bolt 19, the bolt 19 passing through an aperture 35 formed in the cover plate 34. This cover plate 34 serves the same function as the cover plate portion 31 presented by the female member 12 in the first embodiment.

The distances 28 are, in this second embodiment, operatively decreased, thereby securely to clamp the end portions 30 of the members 11 between the walls 13 of the member 12 and the faces 16 of the member 15 as shown in FIG. 5, by tightening of the nut 22 on the bolt 19 which causes relative movement between the members 12, 15 such that the male member 15 is urged into the female member 12.

Conversely, slackening of the nut 22 on the bolt 19 permits relative movement between the members 12, 15 in the opposite direction with resultant increase in the distances 28. The end portions 30 of the members 11 are thus released.

The third embodiment illustrated in FIG. 6 differs from the second embodiment illustrated in FIGS. 4 and 5 in that the second member 15 is constituted by a body of resiliently deformable material, such as hard rubber, the faces 17 of the member 12 being, in this third embodiment, parallel to one another, i.e. vertical as viewed in FIG. 6, and the body 15 being disposed with a first end face 36 thereof in abutting contact with the member 12 and with a second end face 37 thereof in abutting contact with an end plate 38. The bolt 19 is disposed, on the longitudinal axis of the member 12 and of the resiliently deformable body 15, through the member 12, the body 15 and the end plate 38 with the head 25 of the bolt 19 and the nut 22 being disposed in contact with the faces of the member 12 and of the end plate 38 remote from the body 15. In this embodiment, the cover plate portion 31 is presented by the end plate 38 so that, as will be appreciated, this portion 31 together with the end plate 38 constitute, in effect, a cover plate similar to the cover plate 34 of the second embodiment.

The distances 28 between the sidewalls 27 and the body 15 may be decreased by tightening of the nut 22 on the bolt 19 to cause the end plate 38 to be urged towards the member 12 i.e. to cause axial urging of the second end face 37 of the body 15 towards the first end face 36 thereof, with resultant resilient deformation of the body 15 such that the opposed faces 16 thereof approach the sidewalls 27. Conversely, the distances 28 may be increased by slackening of the nut 22 on the bolt 19 thereby to permit axial movement of the end plate 38 away from the member 12, i.e. axial movement of the second end face 37 of the body 15 away from the first end face 36 thereof, with resultant movement of the opposed faces 16 of the body 15 away from the faces 17 of the walls 13 of the member 12 as the body 15 is permitted at least partially to return to its unstressed condition.

Each of the three embodiments of joint 10 as hereinbefore described with reference to FIGS. 2 and 3, FIGS. 4 and 5, and FIG. 6 of the accompanying drawings thus constitutes a joint by means of which the adjacent ends of structural members in a structural assembly can be securely interconnected in a simple manner, and which can be assembled and dismantled quickly and with ease by unskilled labor.

I claim:

1. A joint for structural assemblies, the joint comprising a first member, a second member which may be axially urged relative to the first member, and means interconnecting the first and second members for axially urging said members together, wherein one of the members has sidewalls which in at least one plane containing the longitudinal axis of the members are each spaced from the other member by a distance which may be decreased by axial urging together of the members and which may be increased by axial urging apart, of the members, said sidewalls being provided with openings through which end portions of structural members may be disposed for location between said sidewalls and said other member thereby to be securely clamped therebetween when the members are axially urged together and to be released when the members are axially urged apart.

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2. A joint according to claim 1, wherein said sidewalls are presented by the first member, and wherein said second member comprises a body of resiliently deformable material having a first end face which is in abutting contact with the first member and a second end face with which the interconnection means is in abutting contact, whereby the distance between each said sidewall and the resiliently deformable body may be decreased by axial urging of the second end face towards the first end face of the body through actuation of the interconnection means, and may be increased by axial movement of the second end face away from the first end face of the body said movement being permitted by actuation of the interconnection means.

3. A joint according to claim 2, wherein the interconnection means comprises an end plate, and a nut and bolt assembly, said end plate being in abutting contact with said second end face of the resiliently deformable body, and the bolt being disposed, on the longitudinal axis of the first member and of the resiliently deformable body, through the first member, the resiliently deformable body and the end plate with the head of the bolt and the nut disposed in contact with the faces of the first member and of the end plate remote from the resiliently deformable body.

4. A joint according to claim 3, wherein the end plate presents a cover plate portion which overlies the ends of the sidewalls presented by the first member.

5. A joint for structural assemblies, the joint comprising a female member, a male member which is axially movable relative to the female member, and means interconnecting the male and female members for so urging said members, in a direction relative to one another, that the male member enters into the female member, wherein opposed faces of the male member intersected by at least one plane containing the longitudinal axis of the members are convergent in the sense of said direction in which the male member is moved relative to the female member during entry of the male member into the female member, and wherein the corresponding faces of the female member are correspondingly convergent in said sense of said direction, one of the members having sidewalls which in said at least one plane are each spaced from the other member by a distance which may be decreased by relative movement between the members in said direction, and which may be increased by relative movement between the members in the opposite direction, and said sidewalls being provided with openings through which end portions of structural members may be disposed for location between said sidewalls and said other member thereby to be securely clamped therebetween when the members are relatively moved in said direction, and to be released when the members are relatively moved in said opposite direction.

6. A joint for structural assemblies, the joint comprising a female member, a male member which is axially movable relative to the female member, and means interconnecting the male and female members for so urging said members, in a direction relative to one another, that the male member enters into the female member, wherein opposed faces of the male

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member intersected by at least one plane containing the longitudinal axis of the members are convergent in the sense of said direction in which the male member is moved relative to the female member during entry of the male member into the female member, and wherein the corresponding faces of the female member are correspondingly convergent in said sense of said direction, the walls of the female member presenting said convergent faces being resiliently separable, the male member having outer sidewalls which in said at least one plane are each spaced outwardly from said walls of the female member by a distance which, through resilient separation of said walls of the female member, may be decreased by relative movement of the members in said direction with the convergent faces of the male and female members in contact, and which, through resilient convergence of said walls of the female member, may be increased by relative movement of the members in the opposite direction with the convergent faces of the male and female members in contact, and said outer sidewalls of the male member being provided with openings through which end portions of structural members may be disposed for location between said outer sidewalls of the male member and said walls of the female member thereby to be securely clamped therebetween as said distance is decreased, and to be released as said distance is increased.

7. A joint according to claim 6, wherein the female member presents a cover plate portion which overlies the ends of the outer sidewalls presented by the male member.

8. A joint for structural assemblies, the joint comprising a female member, a male member which is axially movable relative to the female member, and means interconnecting the male and female members for so urging said members, in a direction relative to one another, that the male member enters into the female member, wherein opposed faces of the male member intersected by at least one plane containing the longitudinal axis of the members are convergent in the sense of said direction in which the male member is moved relative to the female member during entry of the male member into the female member, and wherein the corresponding faces of the female member are correspondingly convergent in said sense of said direction, said convergent faces of the female member each being spaced from the adjacent one of the convergent faces of the male member by a distance which may be decreased by relative movement of the members in said direction and which may be increased by relative movement of the members in the opposite direction, and the walls of the female member presenting said convergent faces being provided with openings through which end portions of structural members may be disposed for location between said convergent faces of the male and female members thereby to be securely clamped therebetween when the members are relatively moved in said direction, and to be released when the members are relatively moved in said opposite direction.

9. A joint according to claim 8, further comprising a cover plate which is secured in overlying relationship with the ends of said sidewalls of the female member.

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