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(54) **Barrier assembly**

(57) A barrier assembly comprises at least one barrier member (34) arrangeable adjacent a wall extending between a roof (6) and a floor (8), and a plurality of support members (12, 112) for supporting the, or each, barrier member. Each support member is adjustable in length, and is arrangeable between the roof and the floor. The barrier assembly also includes fixing means (20, 22, 120, 122) to fix the support members adjacent to the wall.

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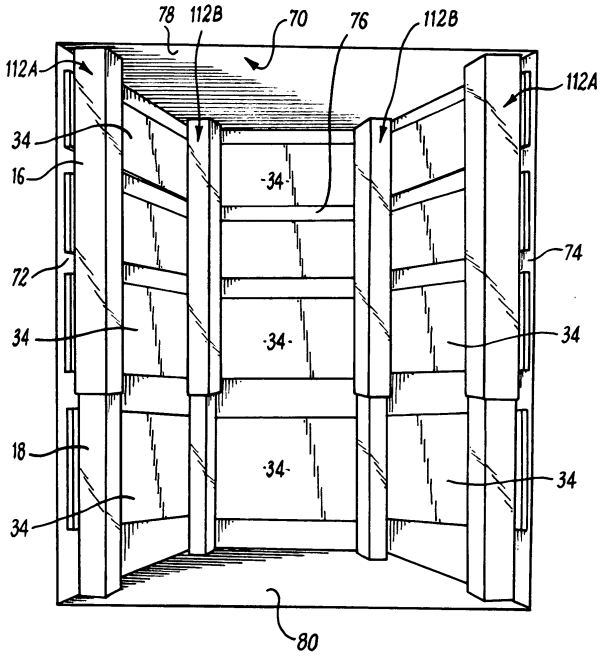


FIG. 13

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## Description

**[0001]** This invention relates to barrier assemblies. More particularly, but not exclusively, the invention relates to barrier assemblies to prevent the debris from collapsed tunnel walls falling into the main part of a tunnel.

**[0002]** This invention may also relate to fixing brackets for use with barrier assemblies. This invention may also relate to barrier assemblies for use in an alcove in a tunnel wall.

**[0003]** In the mining industry, there is often in danger that a tunnel wall in a mine working can collapse (referred to as "spalling"). This is not only dangerous, but can also render a tunnel inoperative.

**[0004]** According to one aspect of this invention, there is provided a barrier assembly arrangeable adjacent a wall extending between a roof and a floor, comprising at least one barrier member arrangeable adjacent the wall, a plurality of support means for supporting the, or each, barrier member, and fixing means to fix the support means adjacent to the wall, wherein each support means is variable in height, and is arrangeable between the roof and the floor.

**[0005]** The barrier assembly may comprise a plurality of barrier members arranged one above the other adjacent the wall. Each barrier member may comprise an elongate generally planar member, such as a plank.

**[0006]** The support means may comprise a holding means to hold the, or each, barrier member.

**[0007]** The holding means may comprise a plurality of holding elements. Each holding element may comprise a generally C-shaped element, which may define a space to receive at least a portion of a barrier member.

**[0008]** Each support means may comprise first and second support elements, which may be movable relative to each other to effect the aforesaid variability in height of the support means.

**[0009]** The first and second support elements may be slidably movable relative to each other. The first and second support elements may be telescopically mounted relative to each other.

**[0010]** Each support element may be of a rectangular cross-sectional configuration in plan. Each support element may be of a box sectional configuration.

**[0011]** Each support means may be elongate. The support means may be adjustable in length to effect the aforesaid variability in height. The first and second support elements may each be elongate. The fixing means may be arranged to fix the support means to the roof and the floor.

**[0012]** The fixing means may comprise first and second fixing members provided at the opposite ends of the support means. The first and second fixing members may be provided on respective free ends of the first and second support elements. The first fixing member may be arranged to fix the first support element to the roof. The second fixing member may be arranged to fix the second support element to the floor.

**[0013]** Each fixing member may comprise a generally planar element. The fixing member on at least one end of the support means may define an aperture for receiving a securing member therethrough.

**[0014]** The fixing member on the opposite end of the support means may also define an aperture for receiving a securing member therethrough.

**[0015]** In a first embodiment, the, or each, fixing member may extend in one direction from the respective support element.

**[0016]** In a second embodiment, the, or each, fixing member may extend from the respective support element in opposite directions.

**[0017]** In the second embodiment, each fixing member may define an aperture. Desirably, each fixing member defines first and second apertures in respective opposite sides of the fixing member. Each fixing member may comprise a rectangular plate.

**[0018]** In the second embodiment, the fixing means may comprise a reinforcing member arranged between the, or each, fixing member and the respective support element. The, or each, reinforcing member may extend from the respective support element in one direction.

**[0019]** The, or each, reinforcing member may comprise a further rectangular plate, and may extend transverse relative to the fixing member.

**[0020]** A strengthening element may extend between the, or each, reinforcing member and the respective support element. The strengthening member may comprise a strengthening web and may be triangular.

**[0021]** The, or each, securing member may comprise a rock bolt for insertion into the roof, floor or wall.

**[0022]** The fixing means may also comprise a fixing device, which may comprise a fixing bracket. The fixing device may be mountable on an end region of the support means.

**[0023]** In one embodiment, the fixing device may be mountable on the lower end region of the support means. The fixing device may be mountable adjacent to the fixing member at said end of the support means.

**[0024]** The fixing device may comprise a first fixing portion for receiving a securing member therethrough, and a second fixing portion for receiving an end region of the support means. The second fixing portion may comprise a sleeve for receiving the end region of the support means.

**[0025]** According to another aspect of this invention, there is provided a fixing device for use in fixing a support means adjacent a wall, the fixing device comprising a first fixing portion for receiving a securing member therethrough, and a second fixing portion for receiving the end region of the support means, the first portion having a first main axis along which the securing member can extend when the securing member is received by the first portion, and the second portion having a second main axis along which the support means can extend when the end region of the support means is received in the

second portion.

**[0026]** The first fixing portion may define an aperture having said first main axis, which may be directed in a first direction. The second fixing portion may comprise a sleeve for receiving an end region of the support means, said sleeve having said second main axis, which may be directed in a second direction.

**[0027]** The first and second axes may be transverse to one another. The first and second axes may be arranged at an angle of between 15° and 45° to each other. In one embodiment, the first and second axes may be at an angle of generally 30° to each other.

**[0028]** The fixing means may comprise two of said first portions, each being provided on a respective opposite side of the second portion. The, or each, first fixing portion may comprise a fixing member for fixing the fixing means in position. The, or each, first fixing portion and may be generally L-shaped in profile.

**[0029]** In one embodiment, the barrier assembly may be suitable for use in a tunnel of a mine working, adjacent one of the tunnel walls.

**[0030]** In another embodiment, the barrier assembly may be suitable for use in an alcove formed in a tunnel wall. In this embodiment, the barrier assembly may comprise a plurality of support means arranged adjacent opposite walls of the alcove, wherein at least two of the support means comprise two sets of holding means arranged thereon to hold adjacent barrier members in a transverse relationship to one another.

**[0031]** According to another aspect of this invention, there is provided a barrier assembly comprising a plurality of barrier members arrangeable adjacent opposite walls of an alcove in a tunnel wall, and a plurality of support means for supporting the barrier members, holding means provided on the support means for holding the barrier members, wherein at least two of the support means are provided with two holding means, arranged transverse to one another, and fixing means to fix the support means adjacent the walls of the alcove.

**[0032]** Where the support means are of a rectangular cross-section, having adjacent transverse faces, the two sets of holding elements may each be provided on respective adjacent faces. This feature provides the advantage in one embodiment of allowing at least two of the support means to hold barrier members transverse to one another so that all three walls of a rectangular alcove have barrier members across them.

**[0033]** Embodiments of the invention will now be described by example only, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a barrier assembly;

Figure 2 is a front view of the barrier assembly shown in Figure 1;

Figure 3 is a side view of a barrier assembly, showing an alternative fixing;

Figure 4 is a front view of the barrier assembly shown in Figure 3;

Figure 5 is a perspective view of a support means;

Figure 6 is a top plan view of a fixing member;

Figure 7 is a side view of the fixing member shown in Figure 6;

Figure 8 is a side view of a fixing device;

Figure 9 is a top view of the fixing device shown in Figure 8;

Figure 10 is a bottom perspective view of the fixing device shown in Figure 9;

Figure 11 is a side view showing the fixing device in use;

Figure 12 is a front view of the fixing device in use;

Figure 13 is a front view of an alcove in a wall with a barrier assembly installed in the alcove;

Figure 14 is a perspective view of the support means used in the alcove shown in Figure 13;

Figure 15 is a front view of a further embodiment of a support means;

Figure 16 is a side view of the support means shown in Figure 15; and

Figure 17 is a view along the lines XVII-XVII shown in Figure 15.

**[0034]** Referring to the drawings, Figures 1 to 4 show embodiments of a barrier assembly 10 for use in holding up the collapsed debris of a tunnel wall after spalling of the wall. Figures 1 to 4 also show a tunnel 2, which may be, for example, a tunnel in a mine working.

**[0035]** The tunnel 2 comprises a tunnel wall 4 which is believed to be susceptible to spalling. The tunnel 2 also includes a roof 6 and a floor 8.

**[0036]** The barrier assembly 10 comprises a plurality of support means 12 arranged in spaced relationship to one another along the tunnel wall 4. In Figure 2, only two of the support means 12 are shown for clarity, but it will be appreciated that any desired number of support means 12 can be used to provide a barrier extending along as much of the tunnel wall 4 as necessary.

**[0037]** Referring to Figure 5, each support means 12 comprises a first support element 16, and a second support element 18. The second support element 18 is telescopically received within the first support element 16 and, as indicated by the double headed arrow 19, is sli-

dable relative to the first support element 16 to allow the length of support means 12 to vary to accommodate varying heights of the roof 6 above the floor 8, and to accommodate variations in height due to movement of the roof and/or floor after the barrier assembly has been installed.

**[0038]** Each of the first and second support elements 16, 18 is of a rectangular cross-sectional profile, typically referred to by those skilled in the art as a box-section.

**[0039]** First and second fixing members 20, 22 are attached respectively to the free ends of the first and second support element 16, 18. One of the first and second fixing members is shown in Figures 6 and 7.

**[0040]** The first and second fixing members 20, 22 are generally the same as each other and, therefore, only the first fixing member 20 is shown in Figures 6 and 7. The second fixing member 22 has the same features as the first fixing member 20 shown in Figures 6 and 7.

**[0041]** The first fixing member 20 comprises a generally rectangular plate 23, which may be formed of steel or other suitable material.

**[0042]** The free end of the first support element 16 is welded to one end region 24 of the first fixing member 20, as shown by broken lines in Figure 6. A generally circular aperture 26 is defined towards the opposite end region 28 of the first fixing member 20.

**[0043]** The aperture 26 is a suitable size to allow a rock bolt 30 to be received therethrough to secure the first fixing member 20, and thereby the first support element 16, to the roof 6 of the tunnel 2.

**[0044]** The support means 12 are provided with holding means comprising C-shaped holding elements 32, in the form of brackets. As shown, the first support element 16 has three holding elements 32 arranged one after the other on one of its rectangular faces 33 along its length.

**[0045]** The second support element 18 is provided with one holding element 32 on one of its rectangular faces 35. The holding element 32 on the second support element 18 is arranged adjacent the free end of the second support element 18, and is arranged in line with the holding elements on the first support element 16.

**[0046]** The roof 6 of the tunnel 2 has previously been reinforced by a plurality of rock bolts 30, which extend into the rock, transverse to the roof 6, and are arranged in succession across the tunnel 2, and in succession along the tunnel 2.

**[0047]** Referring again to Figures 1 and 2, the first fixing member 20 is mounted on one of the rock bolts 30 adjacent the wall 4 of the tunnel 2, by first removing the nut and washer on the rock bolt 30, arranging the first fixing member 20 so that the end region of the rock bolt 30 extends through the aperture 26 in the first fixing member 20, and then arranging the nut and washer tightly back on the rock bolt 30.

**[0048]** The second fixing member 22 can be secured to the floor 8 of the tunnel 2 in a similar manner. However, where no rock bolts 30 are previously installed in the floor 8, it will be necessary to install a rock bolt 30 through the aperture 26 in the second fixing member 22, in a manner which would be understood by those skilled in the art,

**[0049]** After installation of the rock bolt 30 in the floor 8, an end region of the rock bolt 30 protrudes through the aperture 26 in the second fixing member 22, and a domed washer and a nut can be arranged thereon, and tightened to secure the second support element 18 to the floor 8.

**[0050]** The plurality of support means 12 are arranged along the tunnel, such that the holding elements of each support means 12 are generally in alignment with each other to allow barrier members 34 to be held by the holding elements 32.

**[0051]** The barrier members 34 extend across from one support means 12 to the adjacent support means 12, as shown in Figure 2. The barrier members 34 are generally planar, and are in the form of planks.

**[0052]** It will be appreciated by the skilled person, that if the barrier members 34 are long enough, and/or if the support means 12 arranged close enough to each other, the barrier members can extend across more than two adjacent support means 12.

**[0053]** Thus, when the barrier members 34 had been installed, as shown in Figure 2, a barrier is provided, which, in the event of spalling of the wall 4, the spalled material is held by the barrier assembly 10, and is prevented from falling across the floor 8 of the tunnel 2.

**[0054]** Referring back to Figures 3 and 4, there is shown the fixing of the support assembly 10 in a tunnel 2, there is not possible to use the fixing member 22 mounted on the lower end of the second support element 18. In such a situation, it is necessary to use a fixing device 40 to mount rock bolts 30 in the tunnel wall 4 or the floor 8.

**[0055]** Figures 8, 9 and 10, show a close-up view of the lower end region of the second support element 18, in which the fixing device is more clearly shown. The fixing device 40 is used to fix the support means to the wall 4, or the floor 8 of the tunnel 2, where it is not possible or practical to install a rock bolt 30 through the aperture 26 in the fixing member 22.

**[0056]** The fixing device 40 comprises a first fixing portion, in the form of a sleeve 42 of a square cross-sectional profile. The sleeve 42 is of a suitable size and configuration to receive therein an end region of the second securing element 18.

**[0057]** The fixing device 40 also comprises a pair of L-shaped second fixing portions 44, 46 mounted on opposite sides of the sleeve 42. The second fixing portions 44, 46 comprise a respective mounting element 44A, 46A welded to the first fixing portion 42.

**[0058]** The second fixing portions 44, 46 also comprise a respective bolt holding element 44B, 46B arranged perpendicular to the respective mounting elements 44A, 46A. The bolt holding elements 44B, 46B each define a respective aperture 48, 50 to receive a rock bolt 30 therethrough to secure the fixing device 40 to the floor 8.

**[0059]** Referring to Figure 8, it can be seen that the

sleeve 42 defines a first main axis X, and the aperture 48 in the bolt holding element 44B of the second fixing portion 44 defines a second main axis Y. The first and second main axes X, Y are arranged transverse to each other at an angle $\alpha$. In the embodiment shown, the angle $\alpha$ is substantially 30°.

**[0060]** The aperture 50 in the bolt holding element 46B also has a first main axis X which is arranged at an angle $\alpha$ to the second main axis Y. Thus, the bolt holding elements 44, 46 are aligned with each other.

**[0061]** Figures 11 and 12 show the fixing device 40 in use. Before the second support element 18 is telescopically slid within the first support element 16, the fixing device 40 is slid over the second support element 18, with the sleeve 42 receiving the first support element 16 therethrough.

**[0062]** The fixing device 40 is then slid down the second support element 16 to the lower end region thereof. A suitable drill is then used to drill holes in the wall 4 through the apertures 48, 50 in the wall. The holes drilled in the wall 4 are of a length to receive two rock bolts 30.

**[0063]** Two rock bolts 30 are then passed through the apertures 48, 50 in the bolt holding elements 44B, 46B and into the holes drilled in the wall 4 were to be secured therein by any suitable means known in the art. Washers 52 and nuts 54 (see Figure 11) are arranged over the protruding ends of the rock bolts 30 to secure the rock bolts 30 to the fixing devices 40, thereby securing the lower end region of the second support element 18 in position.

**[0064]** Referring to Figures 13 and 14, there is shown an embodiment of the invention for use in an alcove 70 in a tunnel wall 4 of a mine working. Such alcoves 70 are generally known as manholes and are used as a safety feature in which miners can hide in the event of danger in the tunnel.

**[0065]** The alcove 70 comprises side walls 72, 74 and a rear wall 76. The alcove 70 also has a roof 78 and a floor 80. An embodiment of a barrier assembly, designated 110 in Figure 13, is installed in the alcove 70.

**[0066]** The barrier assembly 110 comprises first and second pairs of support means 112A, 112B. The first pair of support means 112A is installed at the front of the alcove 70, and the second pair of support means 112B is installed at the rear of the alcove 70, as shown.

**[0067]** A plurality of barrier members 34 extend between the front support means 112A and the rear support means 112B. The barrier members 34 also extend between the two rear support means 112B.

**[0068]** Each of the first pair of support means 112A is generally the same as the support means 12 shown in Figures 1 to 5 above. Each of the second pair of support means 112B differs from the support means 12 described above, in that the support means 112B have two sets of holding elements 32.

**[0069]** An example of one of the support means 112B is shown in Figure 14, and comprises many of the features of the support means 12 shown in Figures 1 to 5, and these features have been designated with the same reference numerals as the corresponding features of the support means 12.

**[0070]** As can be seen from Figure 14, the support means 112B comprises a first set of holding elements 32 arranged along the faces 33A and 35A of the first and second support elements 16, 18. It also has a second set of holding elements 32 arranged along the faces 33B, 35B adjacent the faces 33A, 35A.

**[0071]** The provision of two sets of holding elements 32 on both of the support means 112B means that the support means 112B can hold two sets of barrier members 34 at right angles to each other at the rear of the alcove 70, as shown in Figure 13.

**[0072]** There is thus described an effective and advantageous barrier assembly that can be used to restrict the spalling of material from the walls of mine working tunnels.

**[0073]** Various modifications can be made without departing from the scope of the invention. For example, any desired suitable number of holding elements can be arranged on the support means. Also, all four of the support means of the barrier assembly 110 could be the same as the support means 112B.

**[0074]** Figures 15 to 17 show a further embodiment of a support means, a generally designated 112, in which the features corresponding to similar features of the embodiments described above have been designated with the same reference numerals as in Figures 1 to 14.

**[0075]** The support means 112 shown in Figures 15 to 17 differs from support means 12 described above in that the first and second fixing members 20, 22 of the above embodiments are replaced by the first and second fixing members 120, 122. The first and second fixing members 120, 122 extend outwardly on opposite sides of support element 16, 18 and forwardly thereof.

**[0076]** The first and second fixing members 120, 122 are rectangular in configurations and each defines first and second apertures 126, 127.

**[0077]** Rock bolts 30, similar to the rock bolts 30 described above can be inserted through the apertures 100 increases, 127 to secure the fixing element 16, 18 to the roof and the floor in the same way as described above.

**[0078]** A reinforcing element 128 is provided between the fixing members 120, 122 and a respective support element 16, 18. Each reinforcing element 128 is rectangular in shape and extends forwardly of the respective support element 16, 18. The fixing members 120, 122 are attached to the respective reinforcing element 128.

**[0079]** A triangular strengthening web 130 is provided between the support element 16, 18 and a respective reinforcing element 128.

**[0080]** Although not shown in Figures 15 to 17, the first and second support elements 16, 18 are provided with holding elements 32, as described above.

**Claims**

1. A barrier assembly arrangeable adjacent a wall extending between a roof and a floor, the barrier assembly comprising at least one barrier member arrangeable adjacent the wall, a plurality of support means for supporting the, or each, barrier member, and fixing means to fix the support means adjacent to the wall, wherein each support means is variable in height, and is arrangeable between the roof and the floor.

2. A barrier assembly according to Claim 1, wherein each barrier member comprises an elongate generally planar member.

3. A barrier assembly according to Claim 2, comprising holding means to hold the, or each, barrier member.

4. A barrier assembly according to Claim 3, wherein the holding means comprises a plurality of holding elements, and each holding element comprises a generally C-shaped element, which defines a space to receive at least a portion of a barrier member.

5. A barrier assembly according to any preceding Claim, wherein each support means comprises first and second support elements, which are movable relative to each other to effect the aforesaid variability in height of the support means.

6. A barrier assembly according to Claim 5, wherein the first and second support elements are slidably movable relative to each other.

7. A barrier assembly according to Claim 6, wherein the first and second support elements are telescopically mounted relative to each other.

8. A barrier assembly according to Claim 6 or 7, wherein each support means is elongate, and the first and second support elements are elongate.

9. A barrier assembly according to any preceding Claim, wherein the fixing means is arranged to fix the support means to the roof and the floor.

10. A barrier assembly according to any preceding Claim, wherein the fixing means comprises first and second fixing members provided at the opposite ends of the support means.

11. A barrier assembly according to Claim 10, wherein the first and second fixing members are provided on respective free ends of the first and second support elements, the first fixing member being arranged to fix the first support element to the roof, and the second fixing member being arranged to fix the second support element to the floor.

12. A barrier assembly according to Claim 10 or 11, wherein the, or each, fixing member extends in one direction, or in opposite directions from the respective support element.

13. A barrier assembly according to Claim 10, 11 or 12, wherein each fixing member comprises a generally planar element, and the first and/or second fixing member defines an aperture for receiving a securing member therethrough.

14. A barrier assembly according to Claim 13, wherein the, or each, securing member comprises a rock bolt for insertion into the roof, floor or wall.

15. A barrier assembly according to any preceding Claim, including a fixing device mountable on an end region of the support means.

16. A barrier assembly according to Claim 15, wherein the fixing device is mountable on the lower end region of the support means, and is mountable adjacent to the fixing means at said end of the support means.

17. A barrier assembly according to Claim 15 of 16, wherein the fixing device comprises a first fixing portion for receiving a securing member therethrough, and a second fixing portion for receiving an end region of the support means.

18. A barrier assembly according to Claim 17, wherein the second fixing portion comprises a sleeve for receiving the end region of the support means.

19. A barrier assembly according to any preceding Claim comprising a plurality of barrier members arrangeable one above the other adjacent the wall, and the support means comprises a holding means to hold the, or each, barrier member.

20. A barrier assembly according to Claim 19, wherein the barrier assembly comprises a plurality of support means arrangeable adjacent opposite walls of an alcove, and at least two of the support means comprise two sets of holding means arranged thereon to hold adjacent barrier members in a transverse relationship to one another.

21. A fixing device for use in fixing a support means adjacent a wall, the fixing device comprising a first fixing portion for receiving a securing member therethrough, and a second fixing portion for receiving the end region of the support means, the first portion having a first main axis along which the securing member can extend when the securing member is

received by the first portion, and the second portion having a second main axis along which the support means can extend when the end region of the support means is received in the second portion.

**22.** A fixing device according to Claim 21, wherein the first fixing portion defines an aperture having said first main axis directed in a first direction, and the second fixing portion comprises a sleeve for receiving an end region of the support means, said sleeve having said second main axis directed in a second direction.

**23.** A fixing device according to Claim 22, wherein the first and second axes are transverse to one another.

**24.** A fixing device according to Claim 23, wherein the first and second axes are arranged at an angle of between 15° and 45° to each other, preferably at an angle of generally 30° to each other.

**25.** A fixing device according to any of Claims 20 to 24, wherein the fixing means comprises two of said first fixing portions, each being provided on a respective opposite side of the second portion.

**26.** A fixing device according to Claim 25, wherein the, or each, first fixing portion comprises a fixing member for fixing the fixing means in position, the, or each, first fixing portion and being generally L-shaped in profile.

**27.** A barrier assembly comprising a plurality of barrier members arrangeable adjacent opposite walls of an alcove in a tunnel wall, and a plurality of support means for supporting the barrier members, holding means provided on the support means for holding the barrier members, wherein at least two of the support means are provided with two holding means, arranged transverse to one another, and fixing means to fix the support means adjacent the walls of the alcove.

**28.** A barrier assembly according to Claim 27, wherein the support means are of a rectangular cross-section, having adjacent transverse faces, and the two sets of holding elements are each provided on respective adjacent faces.

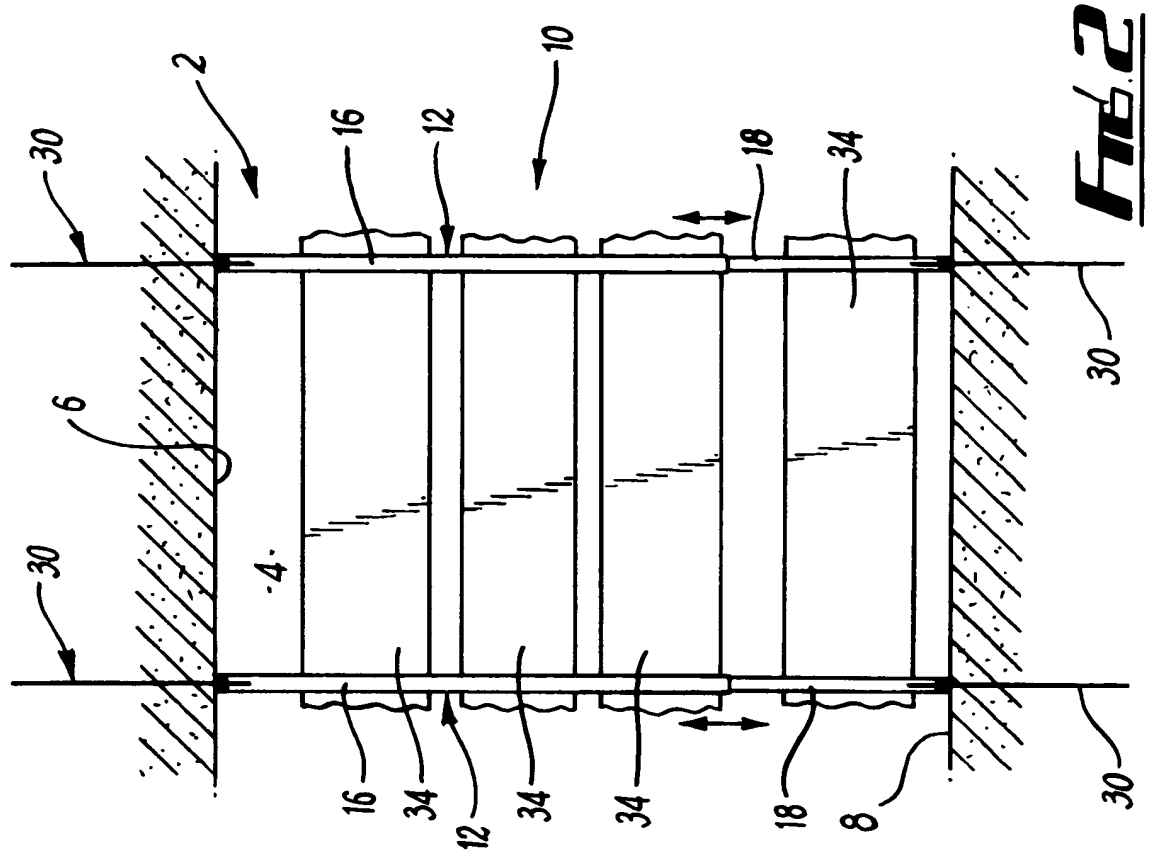
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Fig.2

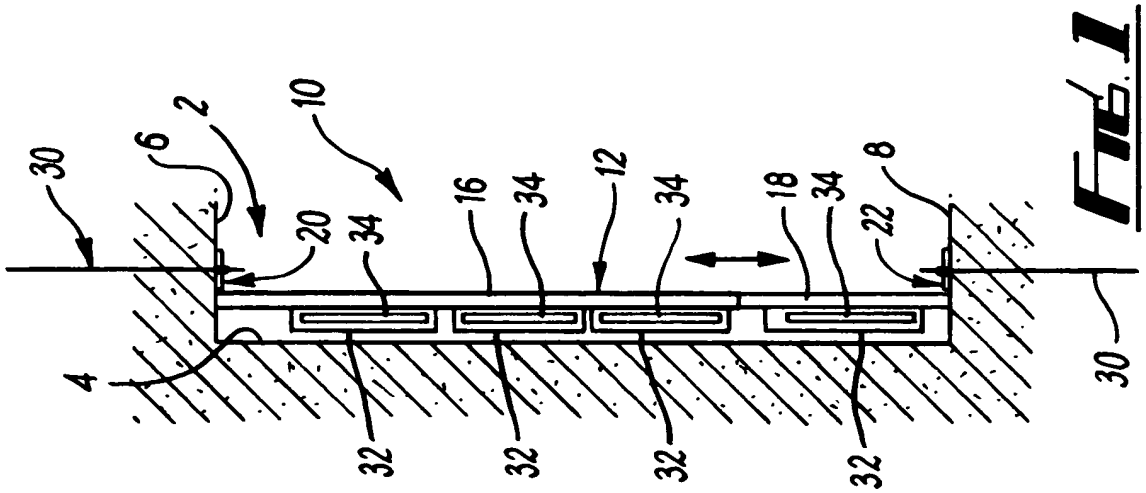
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Fig.1

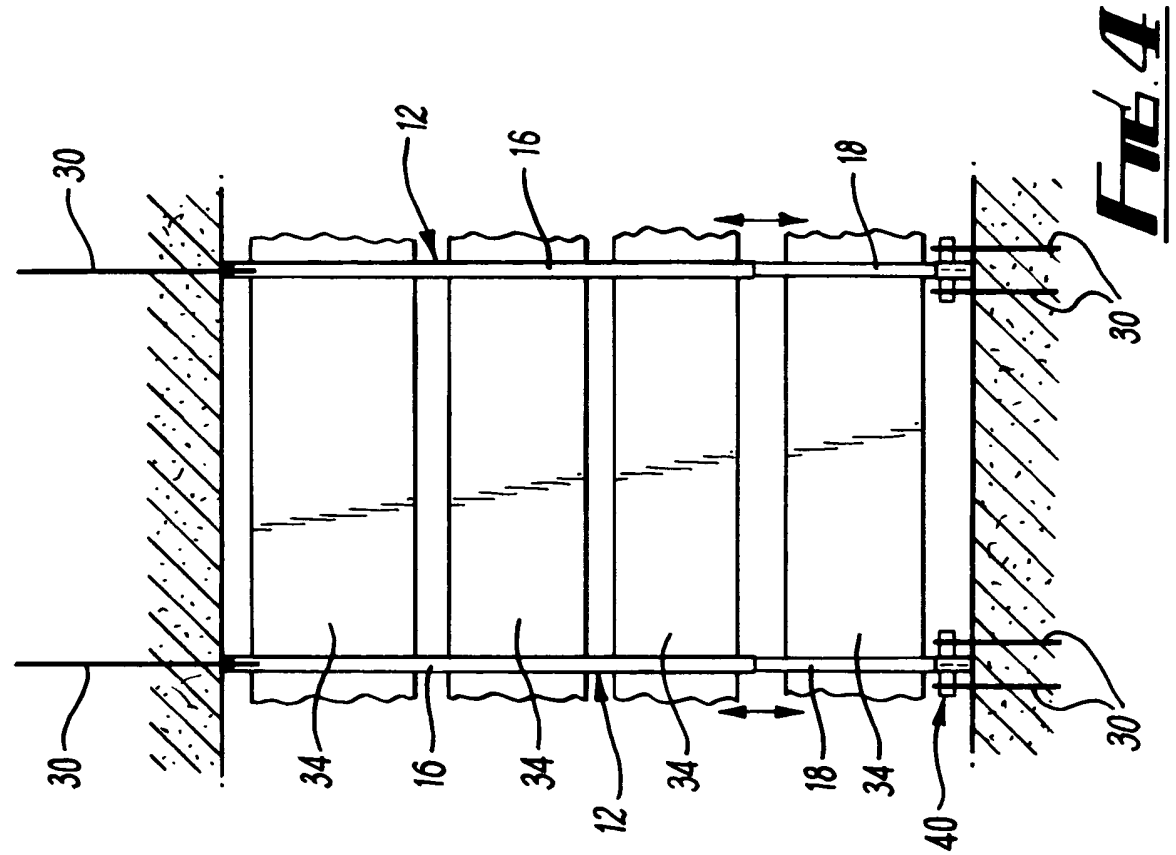
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FIG. 4

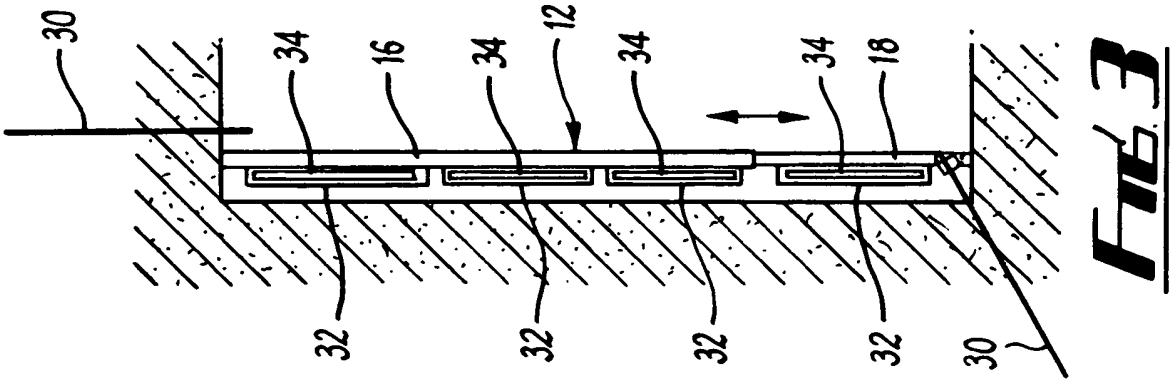
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FIG. 3

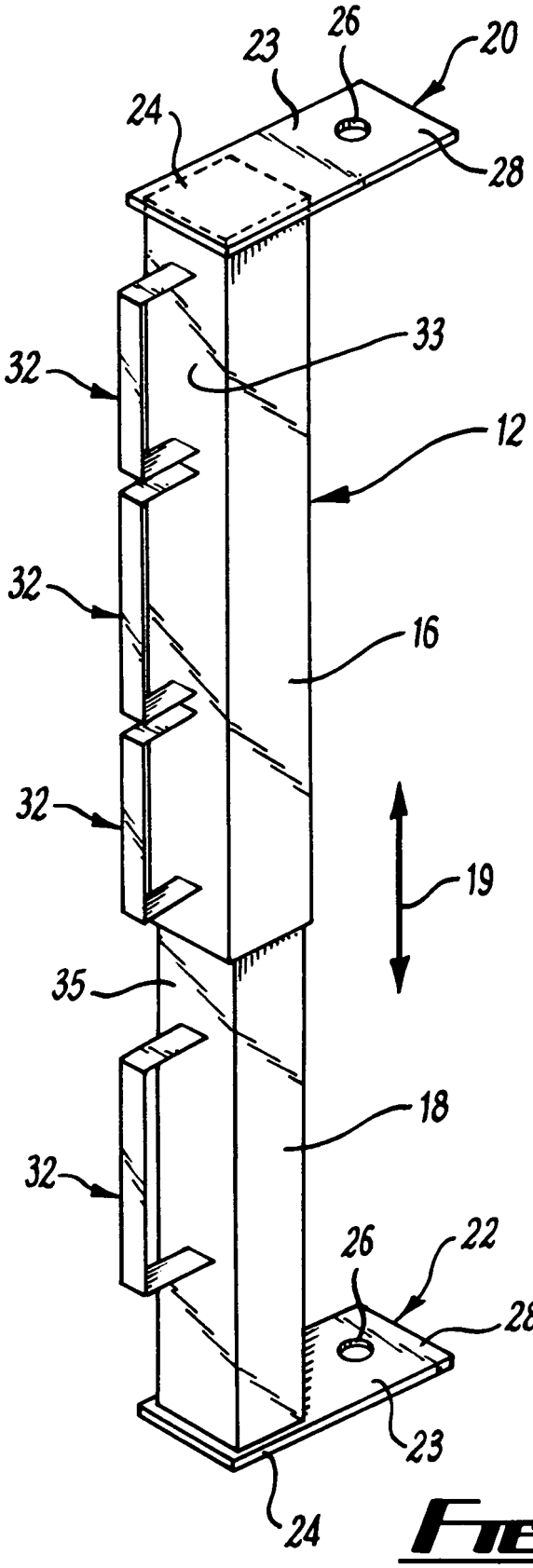


FIG. 5

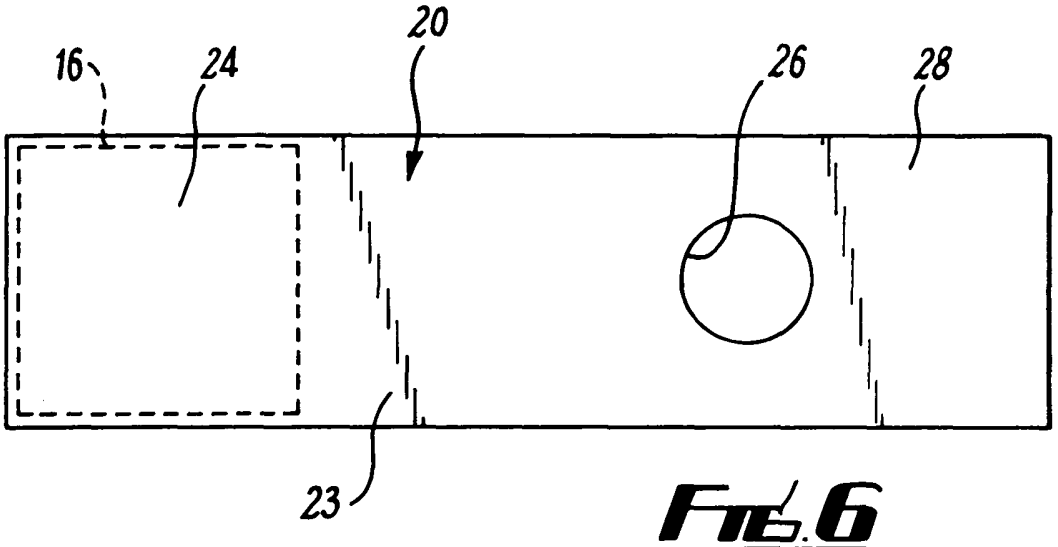


FIG. 6

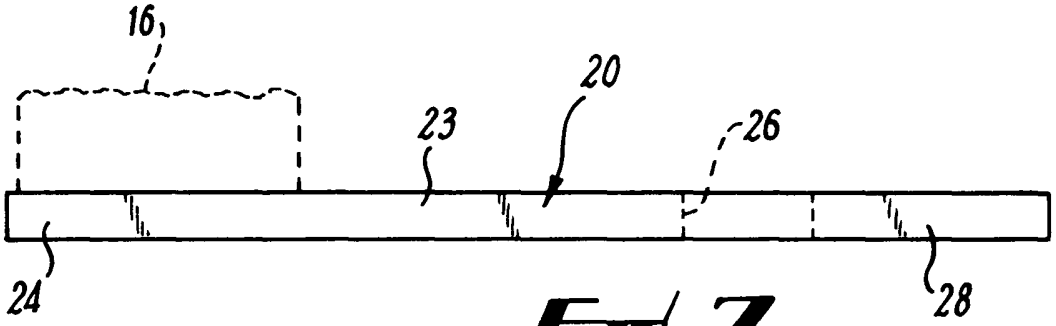


FIG. 7

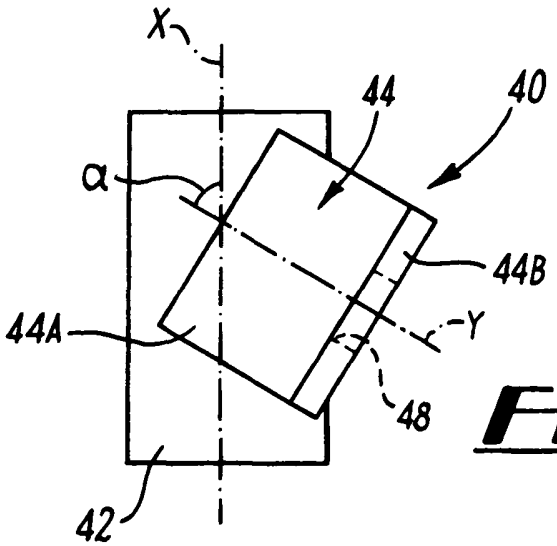


FIG. 8

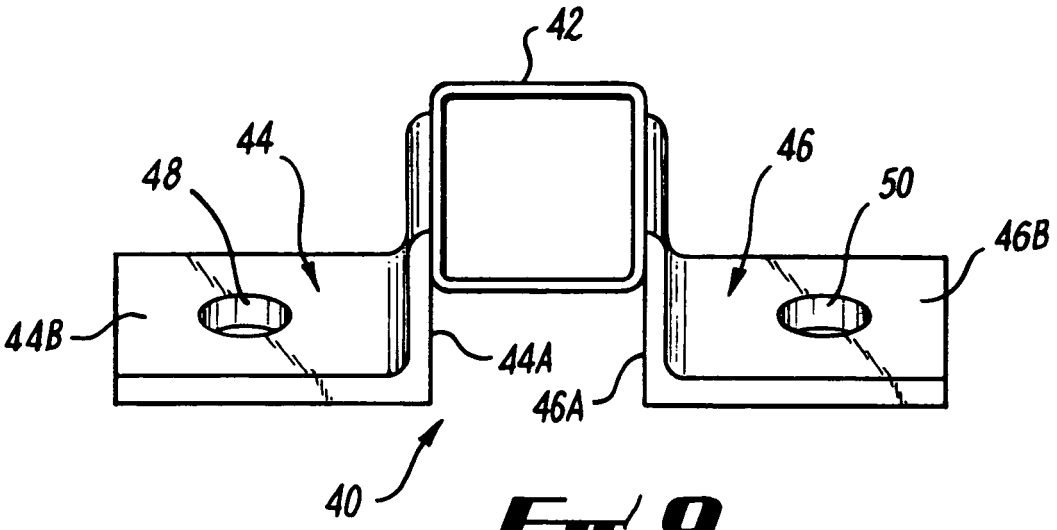


FIG. 9

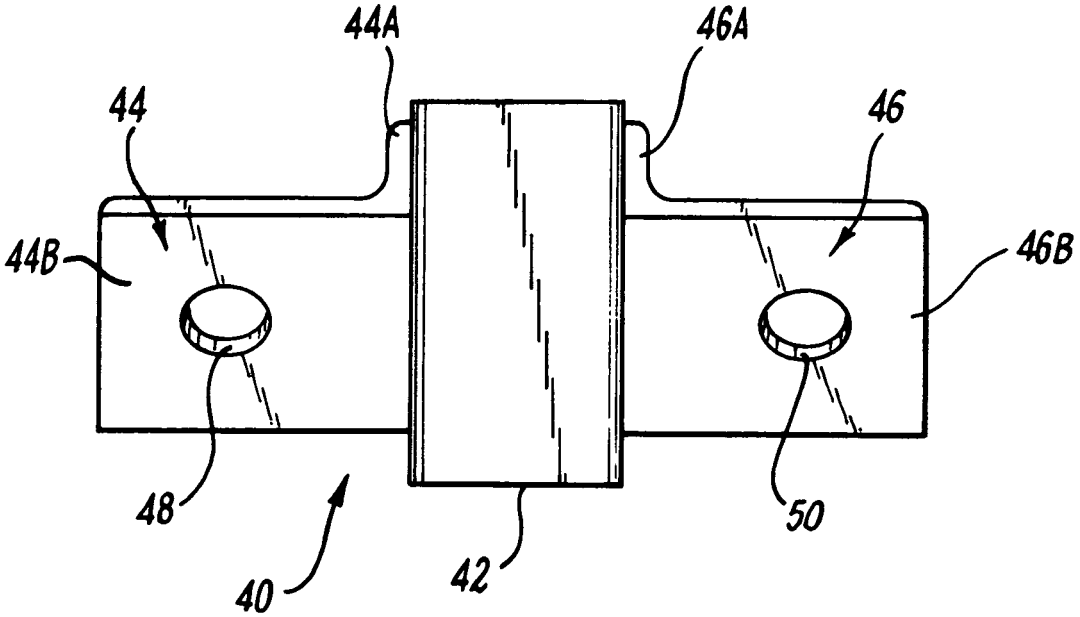


FIG. 10

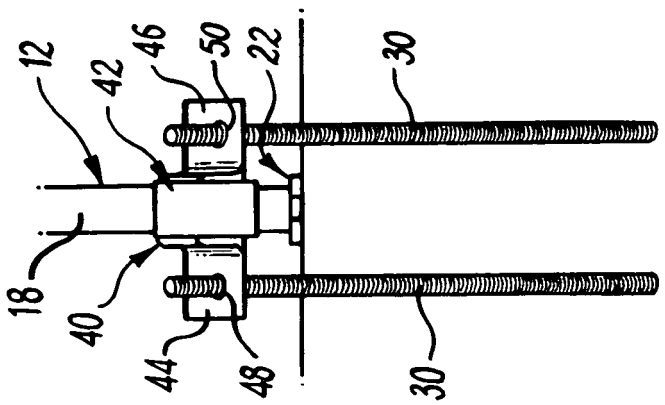


Fig.12

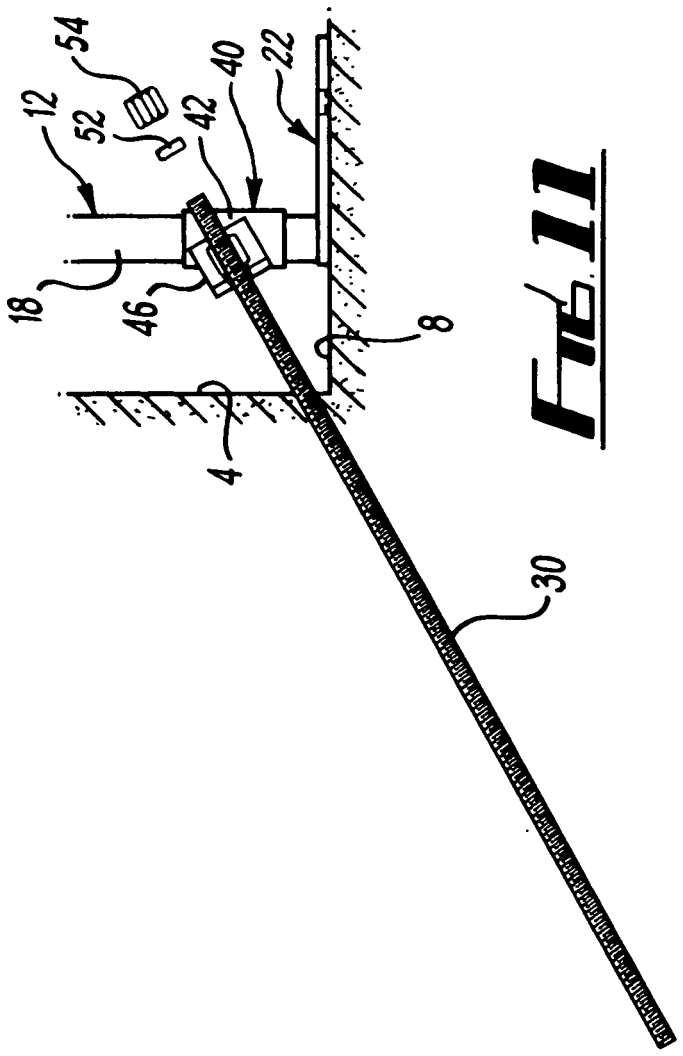


Fig.11

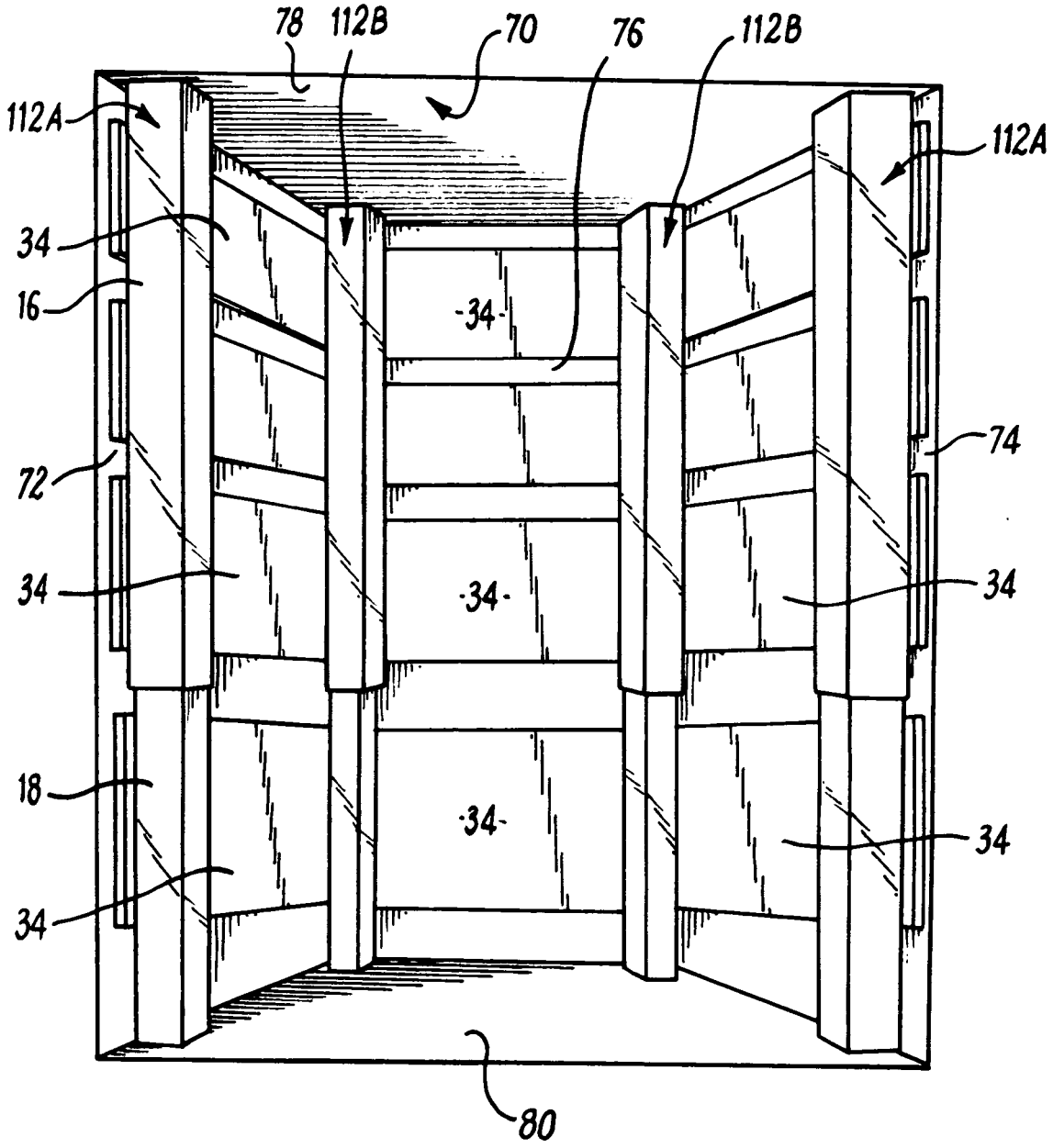


FIG. 13

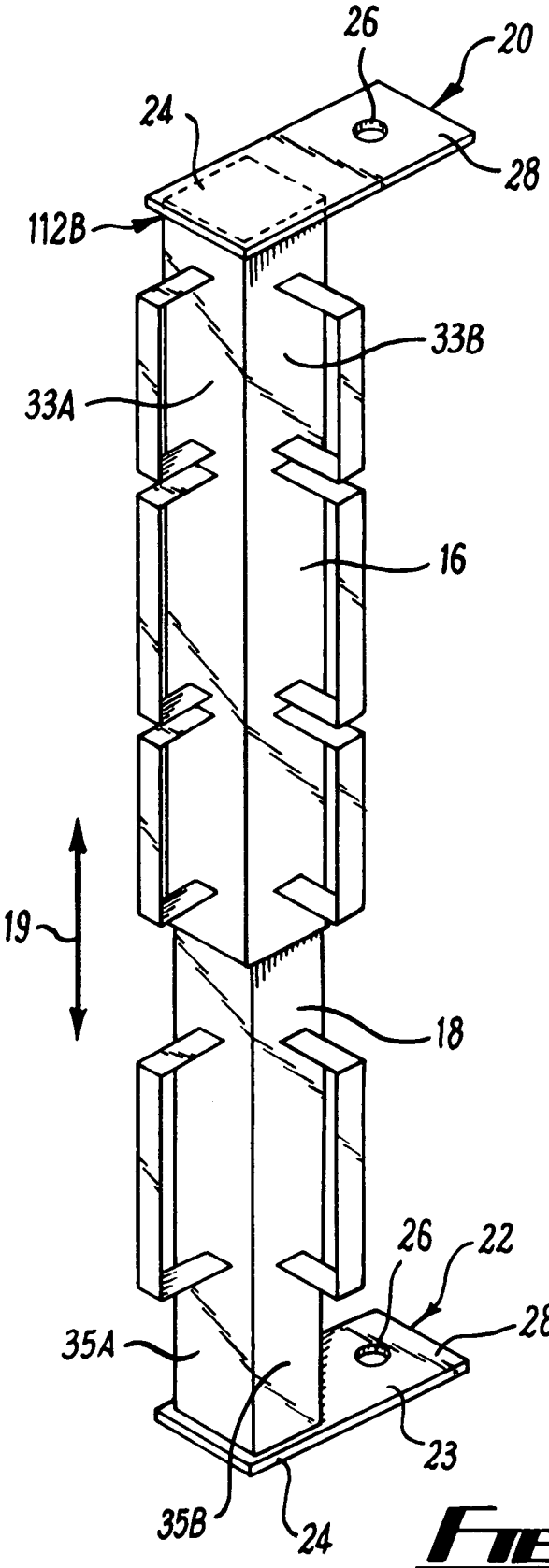


FIG. 14

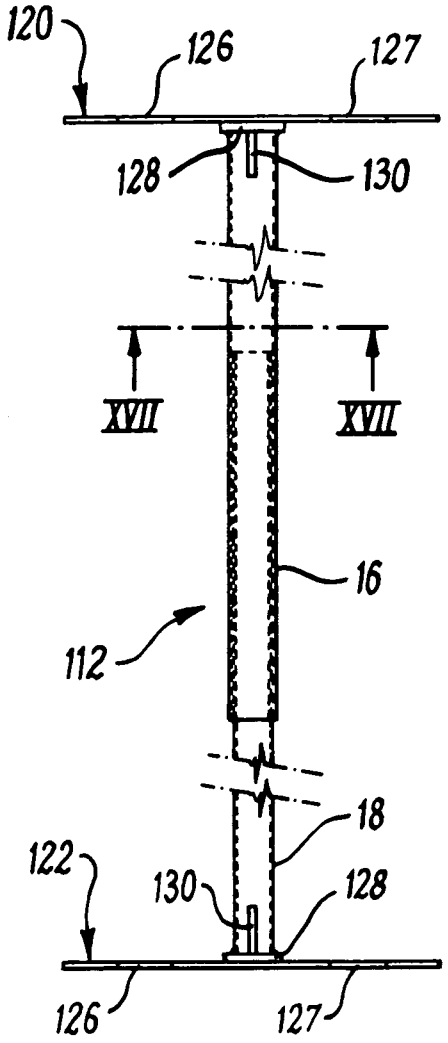


FIG. 15

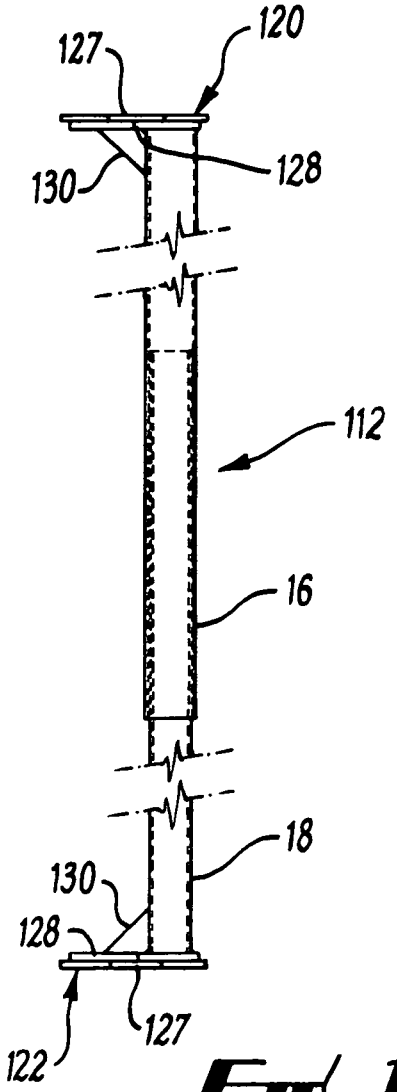


FIG. 16

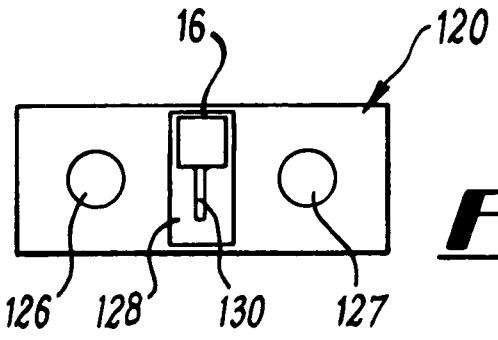


FIG. 17