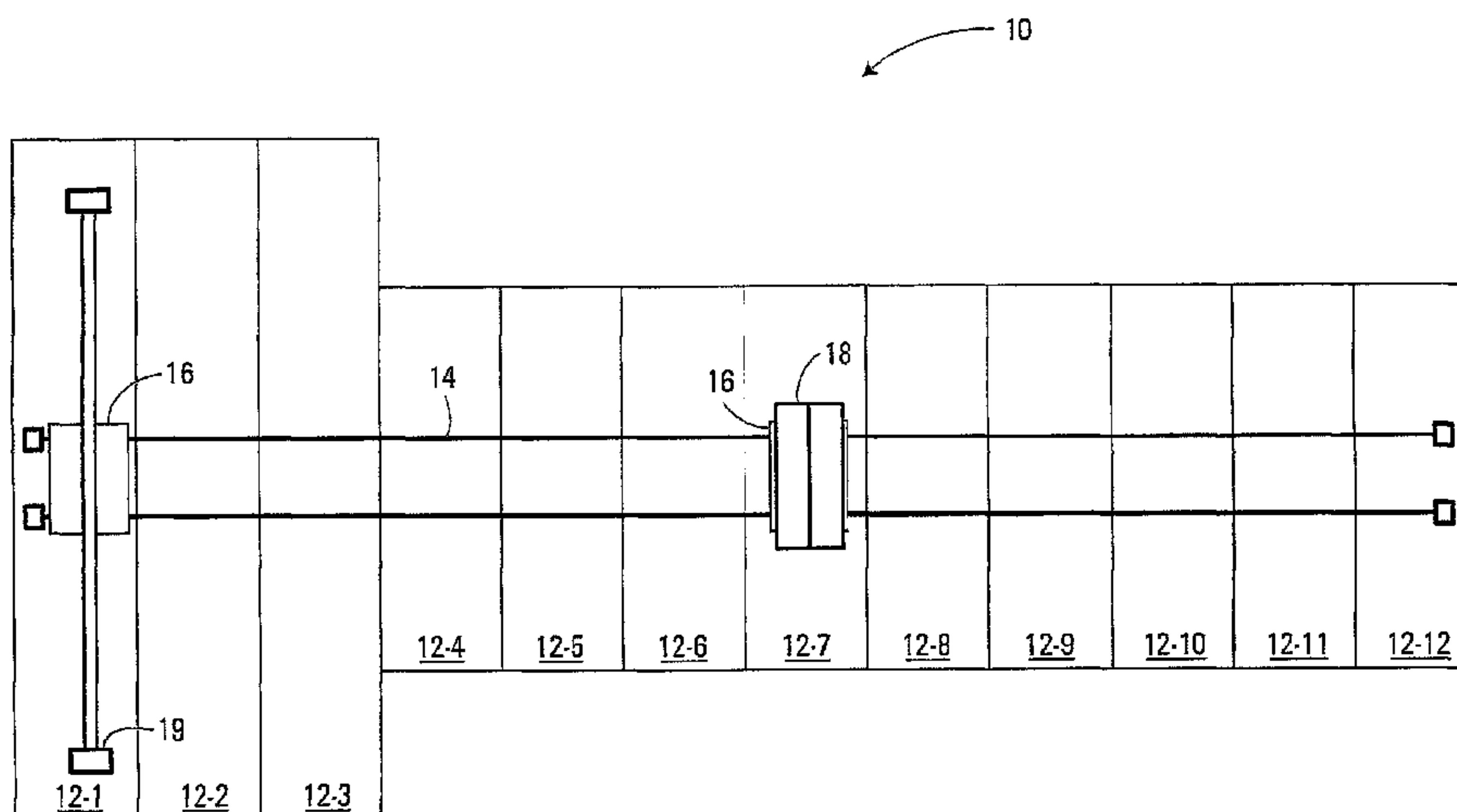




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 (54) Title: HOMES AND HOME CONSTRUCTION



(57) **Abrégé/Abstract:**

In constructing a home, a plurality of upwardly opening U-shaped channel members are installed onto a floor structure. Wall sections are then set into the plurality of U-shaped channel members. The result is that the U-channel members locate the wall sections. Each wall section may be pre-fabricated with lines for service (e.g., electrical lines or plumbing conduit) running through it. After the wall sections are set in place, the lines for service may be interconnected. Cut-outs may be provided at the sides of the wall sections to provide access to the lines for service to allow their interconnection.

## ABSTRACT

In constructing a home, a plurality of upwardly opening U-shaped channel members are installed onto a floor structure. Wall sections are then set into the plurality of U-shaped channel members. The result is that the U-channel members locate the wall sections. Each wall section may be pre-fabricated with lines for service (e.g., electrical lines or plumbing conduit) running through it. After the wall sections are set in place, the lines for service may be interconnected. Cut-outs may be provided at the sides of the wall sections to provide access to the lines for service to allow their interconnection.

## HOMES AND HOME CONSTRUCTION

## BACKGROUND OF THE INVENTION

This invention relates to a method for constructing a home and to home constructions.

In a traditional manner of constructing a home, a foundation is laid, then beams and floor joists are supported on the foundation. A sub-floor is installed and lines may be drawn on the sub-floor to indicate the location of interior walls. Wooden wall frames are constructed and then erected along the periphery of the floor and where indicated by the lines. Roof sections are constructed and installed at the top of the wall frames. Sheeting may then be installed on the roof sections and the roof shingled. A cladding (e.g., brick) may be installed on the outside of the outside walls. Electrical wiring and plumbing conduit may be run through the wall frames and drywall thereafter installed on the wall frames. Various finishing steps are then undertaken. This traditional manner of home building is labour intensive, is not particularly fast, and the quality of the homes are highly dependent upon the skill of the on-site labour.

US5,402,618 issued April 4, 1995 to Biffis discloses a method of mass producing homes where a factory is located proximate a sub-division to be built. A base frame for a home is positioned on a conveyor and the home is constructed as it moves through the factory. The home may then be lifted by the base frame to be placed on a foundation in the sub-division.

While the approach in Biffis allows for faster and more uniform quality home construction, improvements to allow speedier and more uniform quality assembly would be desirable.

## SUMMARY OF INVENTION

5 In constructing a home, a plurality of upwardly opening U-shaped channel members are installed onto a floor structure. Wall sections are then set into the plurality of U-shaped channel members. The result is that the U-channel members locate the wall sections. Each wall section may be pre-fabricated with lines for service (e.g., electrical lines or plumbing conduit) running through it. After the wall sections are set in place, any such lines for service may be interconnected. Cut-outs may be provided at the sides of the wall sections to provide access to the lines for service to allow their interconnection.

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In an aspect, there is provided a final assembly facility for constructing homes from substantially planar floor and wall sections comprising: a single crane having a range of operation defining an envelope, said envelope encompassing at least one roof assembly area; a plurality of in-line assembly stations adjacent to said envelope; a track extending within said envelope at said roof assembly area and extending within said plurality of in-line assembly stations; said crane operating within said envelope for lifting roof sub-components in said roof assembly area and for assembling a roof comprised of said roof sub-components onto a house, said house assembled from said planar floor and wall sections; said plurality of in-line assembly stations for providing operations for finishing said house.

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In another aspect, there is provided a method for the final assembly of homes from substantially planar floor and wall sections in a final assembly facility comprising: with a single crane having a range of operation defining an envelope, said envelope encompassing at least one roof assembly area, lifting roof sub-components in said roof assembly area and assembling a roof comprised of said roof sub-components onto a house, said house assembled from said planar floor and wall sections; moving said house to a plurality of in-line assembly stations adjacent to said envelope along a track extending within said envelope and extending within said plurality of in-line assembly stations; operating on said house at each of said plurality of in-line stations that are subsequent to said envelope, each of said in-line stations for providing operations for finishing said house.

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Other features and advantages will become apparent after a review of the following description in conjunction with the drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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In the figures which disclose example embodiments of the invention,

**FIG. 1** is a schematic view of a factory for the assembly line production of homes;

**FIG. 2** is a perspective view of a base for a home;

**FIG. 2A** and **2B** are perspective views of partially completed bases;

**FIG. 3** is a perspective view of a gang fastening device useful in the assembly line  
5 production of homes;

**FIGS. 4** and **5** are perspective views of a wall section for a home in different stages  
of fabrication;

**FIG. 6** is a partially broken away perspective view of a partially constructed home;

**FIG. 7** is a schematic side view of an hydraulic press with a gang fastening device in  
10 place in a partially manufactured home; and

**FIG. 8** is a bottom perspective view of a series of roof sections.

#### DETAILED DESCRIPTION

With reference to **FIG. 1**, a factory **10** for the assembly line production of homes has  
15 twelve linearly arranged stations **12-1** through **12-12**. A track **14** runs along the factory floor and  
trolleys **16** run on the track. The trolleys support the homes under construction **18** as they  
progress from station-to-station. The factory includes an overhead gantry crane **19**.

At station **12-1** parts for bases, or bases which are completed or partially completed,  
are received and stored. Where required, bases are constructed or completed at this station.  
20 Turning to **FIG. 2**, a base **20** may comprise a rectangular steel frame **22** with wooden cross-  
beams (not shown) and with lifting lugs **24** about periphery of the frame, all as described more  
fully in the aforereferenced US5,402,618. A sub-floor **26** is provided on the top surface of base  
**20**. Metal U-shaped channel members **28** are mounted to sub-floor **26** along the periphery of the  
sub-floor and also inwardly of the periphery of the sub-floor. These U-shaped channel members  
25 define the location of the exterior and interior walls of a home that will incorporate the base.

Where bases are built up at station 12-1, with reference to FIG. 2A, the steel frame 22 may be welded together and brackets 23 welded to the frame to which the wooden cross-beams 25 are bolted. The lifting lugs 24 may also be attached to the frame 22 in any suitable manner. Next, with reference to FIG. 2B, sub-flooring 26 may be fastened to the wooden cross-beams. To complete the base, the U-shaped channel members 28 (FIG. 2) are attached.

Conveniently, the sub-flooring 26 may be fastened to the wooden cross-members with the gang fastening device of FIG. 3. Turning to FIG. 3, gang fastening device 30 has a carriage 31 slidably mounted to the side walls 32 of a frame 33 by, for example, frictionless bearings (not shown). A number of fastener drivers 34, such as nail guns or pneumatic screw drivers, may be mounted to the carriage by mounts 35. The mount for each driver may allow the lateral position of each driver to be adjusted, either without restriction or so that the drivers may be placed apart by a distance which is the expected distance between cross-beams 25 (FIG. 2A) – typically, either 16” or 24” apart. Where the mounts allow unrestricted lateral adjustment, the carriage may carry markings which indicate the spacing between drivers. Eyelets 36 are wired to a hook 38 to allow the gang fastening device 30 to be moved into place by the overhead gantry crane.

In use, the sub-flooring may first be laid in place, then the gang fastening device 30 lifted onto the sub-flooring. Assuming that device 30 is oriented with its sides 32 parallel to cross-beams 25 (FIG. 2A), the spacing between the drivers is then adjusted to match the spacing between the cross-beams 25. The drivers may then be loaded with fasteners and operated. In this regard, where the drivers can be loaded automatically, conveniently one control may be provided to operate all of the drivers at once.

The gantry crane 19 may lift a completed (or partially completed) base 20 onto a trolley 16. After taking any necessary steps to complete the base, the trolley 16 is then moved along track 14 to station 12-2. Station 12-2 may receive parts for wall sections, or completed, or partially completed, wall sections. Where required, wall sections are constructed or completed at this station. Turning to FIG. 4, a wall section 40 comprises a wall frame 42 and may also comprise one or more sheets 45 of sheathing, such as drywall sheets. Referencing FIG. 5, which shows a wall section 40' without sheathing, along with

**FIG. 4**, one or more lines **46a**, **46b** for service run along the wall frame inside the sheathing. As illustrated, line **46a** is an electrical line and line **46b** is plumbing conduit. As is known, the electrical line may, optionally, run through its own conduit.

With specific reference to **FIG. 5**, wall frame **42** is constructed to provide cut outs (openings) **58a**, **58b**, **58c**, **58d**, with each cut out extending from one of the sides **42**, **44** of the wall frame and exposing a termination of a line **46a**, **46b** for service. As will be described, during installation of a wall section, each cut out is covered by a cover **48** (**FIG. 4**). The wall frame **42** may also have a one or more studs **52** to strengthen the frame. Each stud may have openings to accommodate the lines for service.

With reference to **FIG. 6**, a completed wall section **40** (with or without sheathing) may be lifted onto a base **20** at station **12-2** and set into a U-shaped channel member **28**. The U-shaped channel members therefore locate each wall section and may also provide a measure of support for each wall section. Notably, the wall sections are configured so that the adjacent terminal ends of the lines **46a**, **46b** of service line up. For example, side-by-side wall sections **40-2** and **40-3** each have an electrical line **46a** and a plumbing conduit **46b**, the terminal ends of which are aligned. These terminal ends may have complimentary terminals which allow them to be joined. For example, electrical lines **46a** may have terminals **60** which may lock together (as illustrated in respect of the electrical lines between wall sections **40-2** and **40-1**). In this regard, the electrical line **46a** in each wall section may have some slack to allow the terminals to be pulled together. A telescoping terminal **62** is illustrated installed on one end of plumbing conduit **46b** which may be telescoped over, and sealingly clamped to, the end of the conduit in the adjacent wall. It will be appreciated that within a wall section, a line may terminate or have a branch. For example, line **46a** in wall section **40-2** has a branch (not shown) to feed power outlet **64**. Additionally, plumbing conduit **46b** terminates at an outlet **66** for connection to a plumbing fixture. In consequence of this, plumbing conduit **46b** does not extend in wall section **40-2** to wall section **40-1**. Further, wall section **40-1** has no plumbing conduit running through it.

Where the wall sections **40'** when set in place lack sheathing, Sheathing with drywall may be quickly accomplished by using a gang fastener device similar to that of

**FIG. 3.** Referencing **FIG. 3** a fastening device **30** adapted for use in sheathing wall frames may lack eyelets **36** and the accompanying wires and hook **38**. Further, the adapted fastening device may have a carriage **31** that may be latched in any given position along the sides **32** of frame **33** of the device. This may be accomplished, for example, by providing a carriage with releasable end clamps for clamping the ends of the carriage to the frame **33**. Turning to **FIG. 7**, such an adapted gang fastening device **30'** may be hinged to a base **72** of a hydraulic press **70**. The hydraulic press may have an hydraulic cylinder **74** connected by a pivot **76** to fastening device **30'**. An eyelet **78** of press **70** may be used to move the unit. In use, the hydraulic press with its attached fastening device **30'** may be placed by overhead gantry crane **19** (**FIG. 1**) on a base **20** adjacent a wall frame **40'** such that the device **30'** cants away from the wall frame, as shown in **FIG. 7**. A sheet of sheathing **45** may then be rested against the device **30'** and the cylinder **74** operated to press the drywall sheet against the wall frame **40'**. The spacing between the drivers **34** may be adjusted so that they overlie the studs of the frame **40'**, the vertical position of the drivers set, and the drivers loaded and operated to simultaneously drive fasteners through the drywall and into the wall frame. This may be repeated, as desired, after changing the vertical position of the carriage **31** (**FIG. 3**) in order to secure the drywall in place.

After setting of the wall sections, the trolley moves to station **12-3** where parts for roof sections, or roof sections which are completed or partially completed, are received and stored. Where required, roof sections are constructed or completed at this station. Turning to **FIG. 8**, the lower lip of each roof section has a downwardly directed U-shaped channel **82** extending along the periphery of a ceiling section **83** at the base of the roof section. Additionally, all but one of the roof sections intended for a given home has a sheath **86** extending from one side. More specifically, a first end roof section **80** has a U-shaped channel **82** extending along its two ends and one of its sides. A middle roof section **84** has a U-shaped channel **82** extending along its two ends and a sheath **86** extending from one of its sides. A second end roof section **88** has a U-shaped channel **82** extending along its two ends and one of its sides and a sheath **86** extending from one of its sides.

The first end roof section **80** is hoisted in place first by the gantry crane **19** such that the tops of the outer wall sections underlying the first end roof section are received by the U-shaped members of the first end roof section. The middle roof section is next hoisted

into place with its U-shaped channel members receiving the tops of the outer wall sections underlying it and such that its sheath 86 extends over a portion of the first end roof section. Finally, the second end roof section 88 is placed with its U-shaped channel members receiving the tops of the outer wall sections underlying it and such that its sheath 86 extends over a portion of the middle roof section 84. The sheaths 86 help ensure that the resulting roof will not leak. While three rectangular roof sections have been shown, obviously a different number, or sections with a different configuration, may be appropriate, depending upon the home design.

The trolley then moves to station 12-4 where the terminal ends of the lines for service in the wall sections are joined. At station 12-4 a ceiling may also be installed.

The trolley then moves to station 12-5 where the openings at the joins between the lines for service are covered with covers 46 (FIG. 4). These covers may be sealed in place with elongated caps having a T-shaped cross-section. If, on the other hand, the wall sections were not sheathed before being set in place, they may be sheathed at station 12-5. In such instance, it may not be necessary to provide cut outs 58a, 58b, 58c, 58d (FIG. 5) in the wall frames or openings through the sheathing at the cut outs.

Once manufacturing at station 12-5 is completed, the trolley is moved to station 12-6 where exterior finishes are applied. Next, at station 12-7, flooring is installed on the sub-floor. At station 12-8, interior trim is applied. At station 12-9, cabinetry is installed. At station 12-10, plumbing fixtures are connected to the terminations of the plumbing conduit (as, for example, to termination 56 seen in FIG. 5). At station 12-11, light fixtures are installed. And at station 12-12 a quality inspection is undertaken.

The home is then ready to be transferred to the subdivision and this may be accomplished as described in aforereferenced US5,402,618.

Modifications will be apparent to those skilled in the art and, therefore, the invention is defined in the claims.

CLAIMS:

1. A final assembly facility for constructing homes from substantially planar floor and wall sections comprising:

- 5           a single crane having a range of operation defining an envelope, said envelope encompassing at least one roof assembly area;
- a plurality of in-line assembly stations adjacent to said envelope;
- a track extending within said envelope at said roof assembly area and extending within said plurality of in-line assembly stations;
- 10           said crane operating within said envelope for lifting roof sub-components in said roof assembly area and for assembling a roof comprised of said roof sub-components onto a house, said house assembled from said planar floor and wall sections;
- said plurality of in-line assembly stations for providing operations for finishing said house.

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2. The final assembly facility of claim 1 wherein said envelope is wider than said plurality of in-line assembly stations.

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3. The final assembly facility of claim 1 or claim 2 further comprising a rail system comprising said track for moving houses from station to station.

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4. The final assembly facility of claim 3 wherein said track of said rail system comprises floor mounted tracks and wherein said rail system further comprises trolleys running on said tracks.

5. The final assembly facility of any one of claim 1 to claim 4 wherein said in-line assembly stations comprise an in-line assembly station at which a ceiling is installed.

6. The final assembly facility of any one of claim 1 to claim 5 wherein said in-line assembly stations comprise an in-line assembly station at which exterior finishes are applied.

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7. The final assembly facility of any one of claim 1 to claim 6 wherein said in-line assembly stations comprise an in-line assembly station at which flooring is installed.
8. The final assembly facility of any one of claim 1 to claim 7 wherein said in-line assembly stations comprise an in-line assembly station at which interior trim is applied.
9. The final assembly facility of any one of claim 1 to claim 8 wherein said in-line assembly stations comprise an in-line assembly station at which cabinetry is installed.
10. The final assembly facility of any one of claim 1 to claim 9 wherein said in-line assembly stations comprise an in-line assembly station at which plumbing fixtures are installed.
11. The final assembly facility of any one of claim 1 to claim 10 wherein said in-line assembly stations comprise an in-line assembly station at which lighting fixtures are installed.
12. A method for the final assembly of homes from substantially planar floor and wall sections in a final assembly facility comprising:  
    , with a single crane having a range of operation defining an envelope, said envelope encompassing at least one roof assembly area, lifting roof sub-components in said roof assembly area and assembling a roof comprised of said roof sub-components onto a house, said house assembled from said planar floor and wall sections;  
    moving said house to a plurality of in-line assembly stations adjacent to said envelope along a track extending within said envelope and extending within said plurality of in-line assembly stations;  
    operating on said house at each of said plurality of in-line stations that are subsequent to said envelope, each of said in-line stations for providing operations for finishing said house.
13. The method of claim 12 wherein said roof comprises a downwardly opening U-channel member and wherein said assembling said roof onto said house comprises positioning said roof on said house such that a top of at least one of said wall sections receives said downwardly opening U-channel member.

14. The method of claim 13 wherein said roof sub-components comprise a first roof section having a first downwardly opening U-channel member and a second roof section having a second downwardly opening U-channel member, each roof section positioned on said house  
5 such that a top of at least one of said wall sections receives said first first downwardly opening U-channel member and said second downwardly opening U-channel member.

15. The method of claim 13 wherein said second roof section has a sheath extending along one side and comprising lifting said second roof section onto said house so as to position said  
10 second roof section such that said sheath overlaps a portion of a top surface of said first roof section to guard against leaking.

16. The method of any one of claim 12 to claim 15 wherein said moving said house along said track comprises moving said house on a trolley running on floor mounted tracks.

15 17. The method of any one of claim 12 to claim 16 wherein said operating comprises installing a ceiling at one of said in-line assembly stations.

18. The method of any one of claim 12 to claim 17 wherein said operating comprises  
20 applying exterior finishes at one of said in-line assembly stations.

19. The method of any one of claim 12 to claim 18 wherein said operating comprises installing flooring at one of said in-line assembly stations.

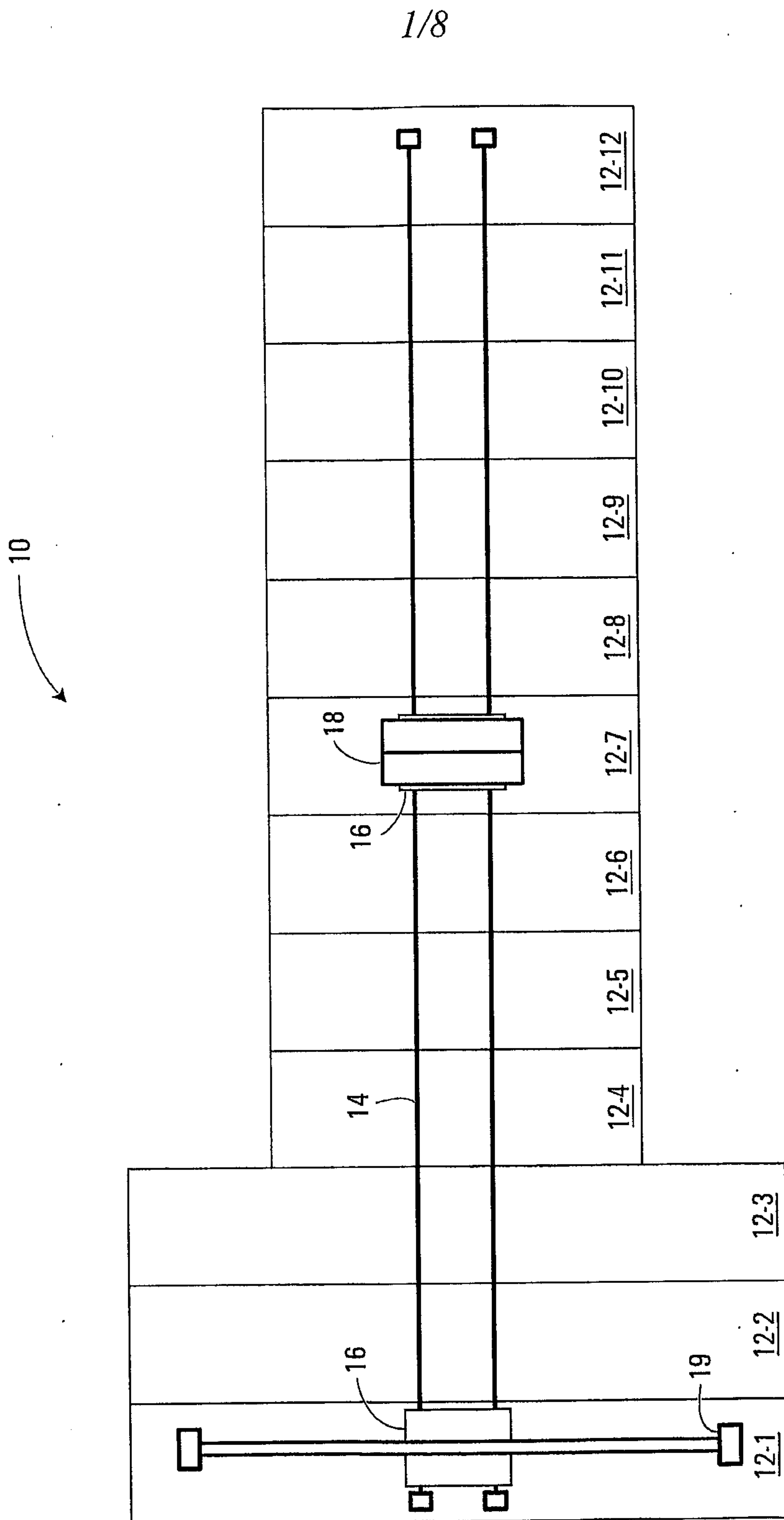
25 20. The method of any one of claim 12 to claim 19 wherein said operating comprises applying interior trim at one of said in-line assembly stations.

21. The method of any one of claim 12 to claim 20 wherein said operating comprises installing cabinetry at one of said in-line assembly stations.

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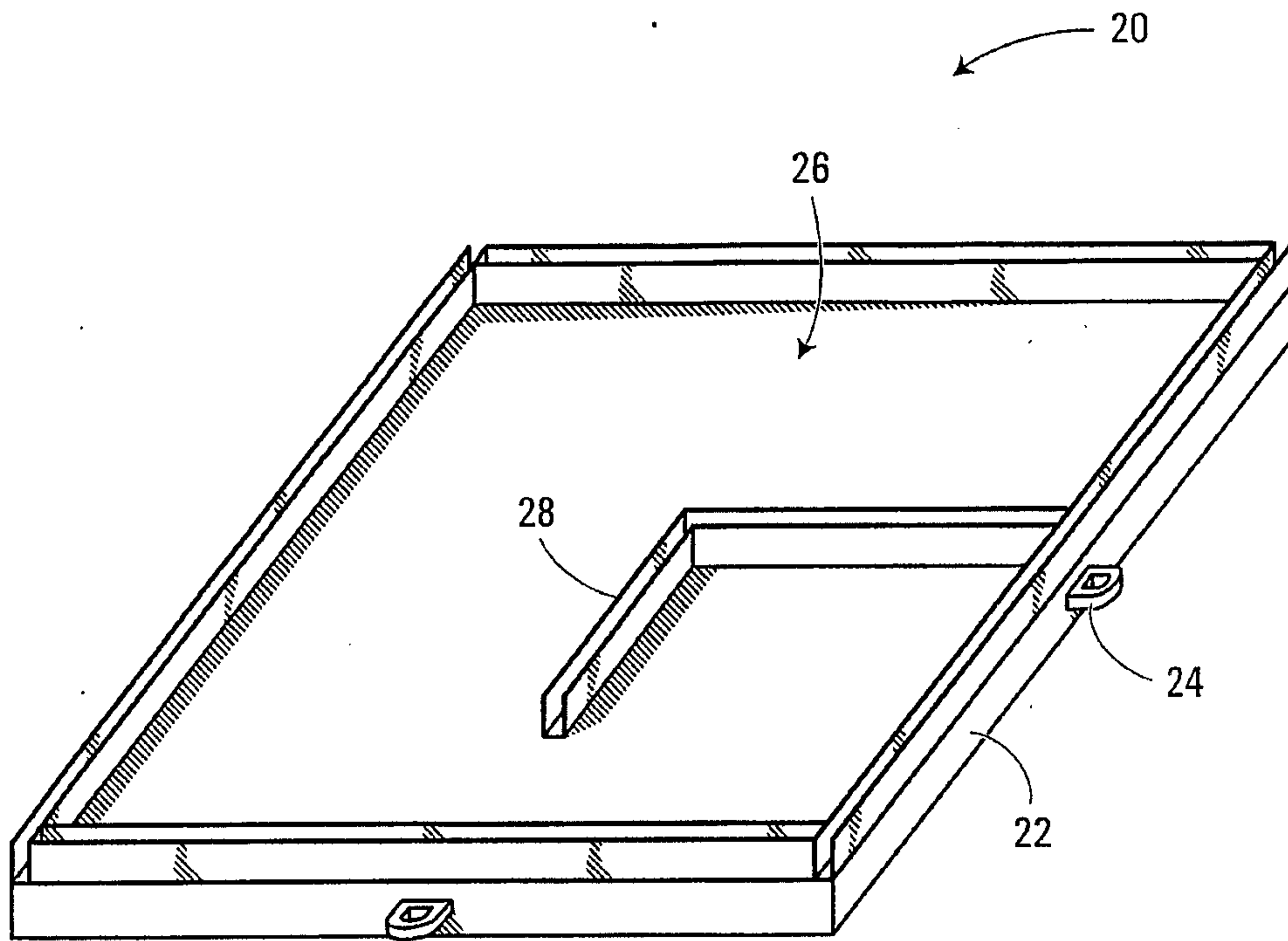
22. The method of any one of claim 12 to claim 21 wherein said operating comprises installing plumbing fixtures at one of said in-line assembly stations.

23. The method of any one of claim 12 to claim 22 wherein said operating comprises  
5 installing lighting fixtures at one of said in-line assembly stations.



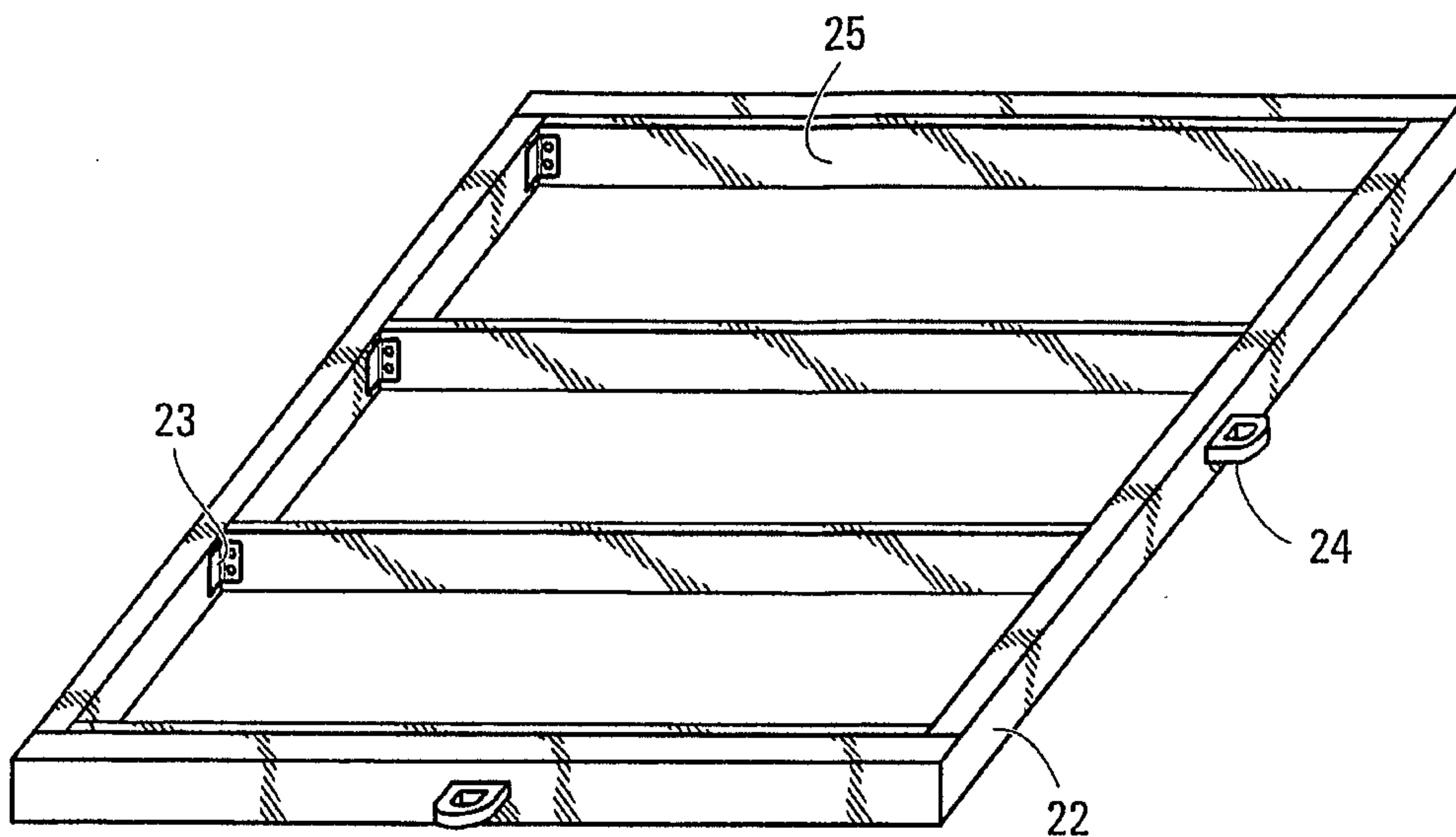
**FIG. 1**

2/8

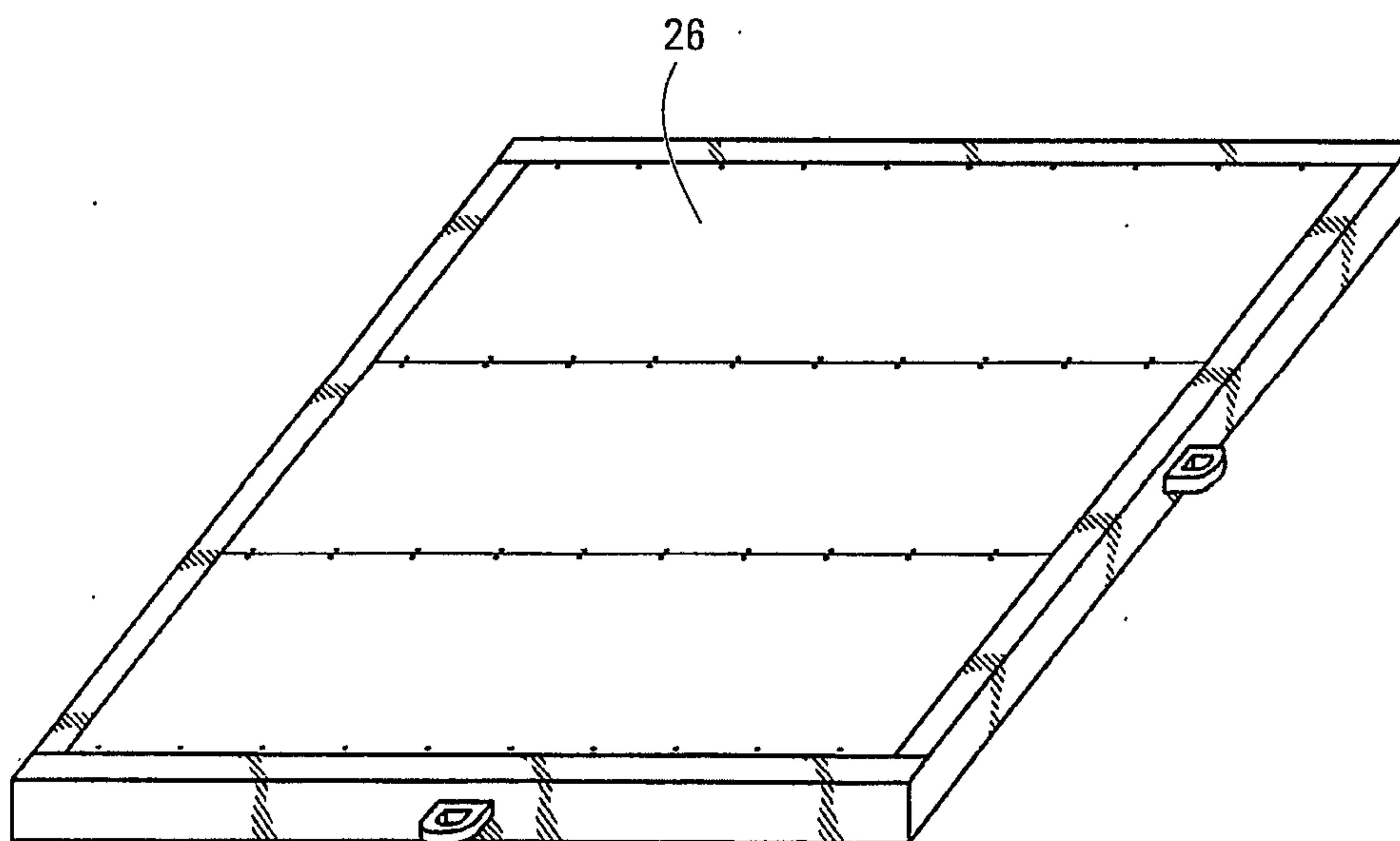


**FIG. 2**

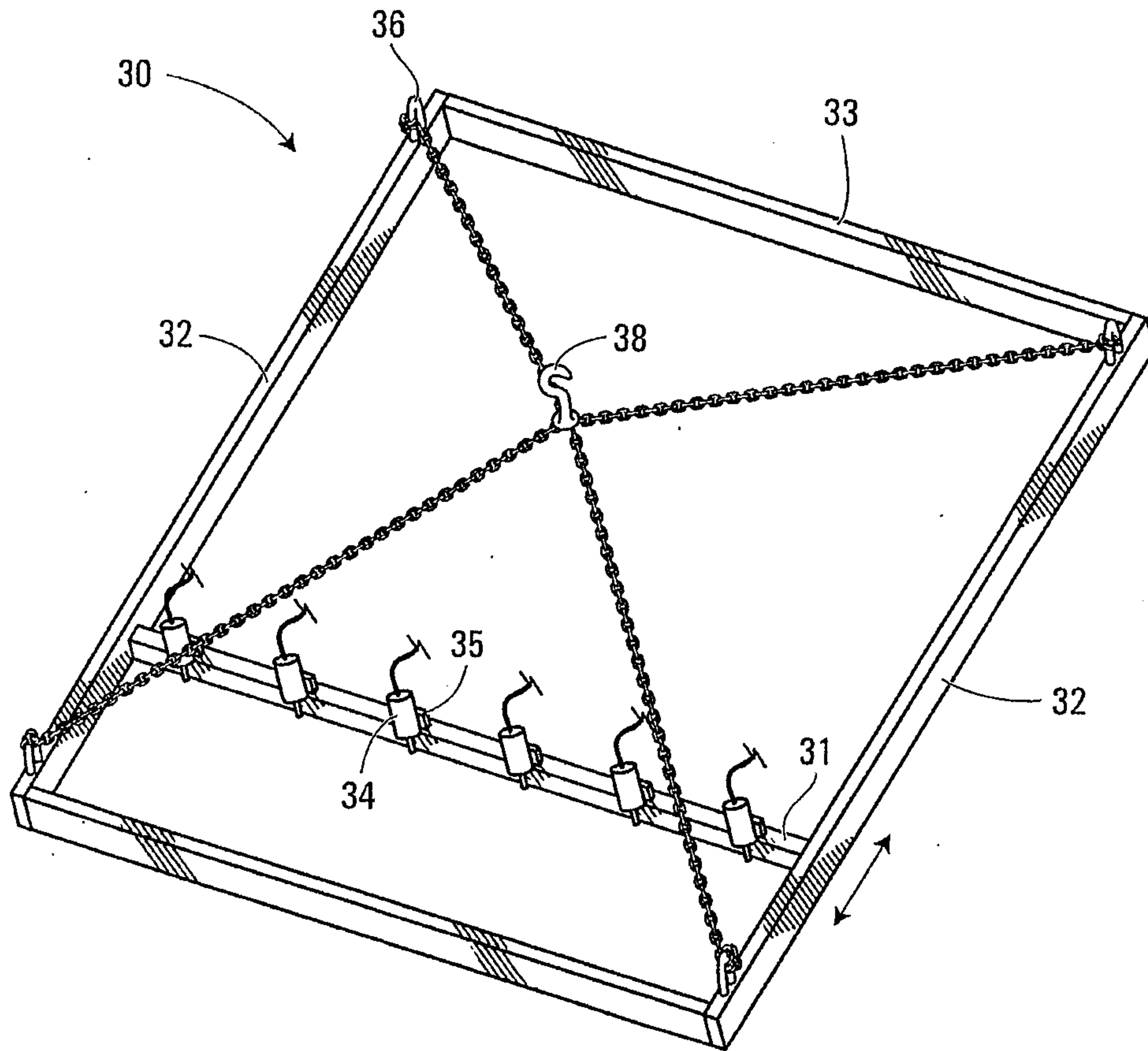
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**FIG. 2A**

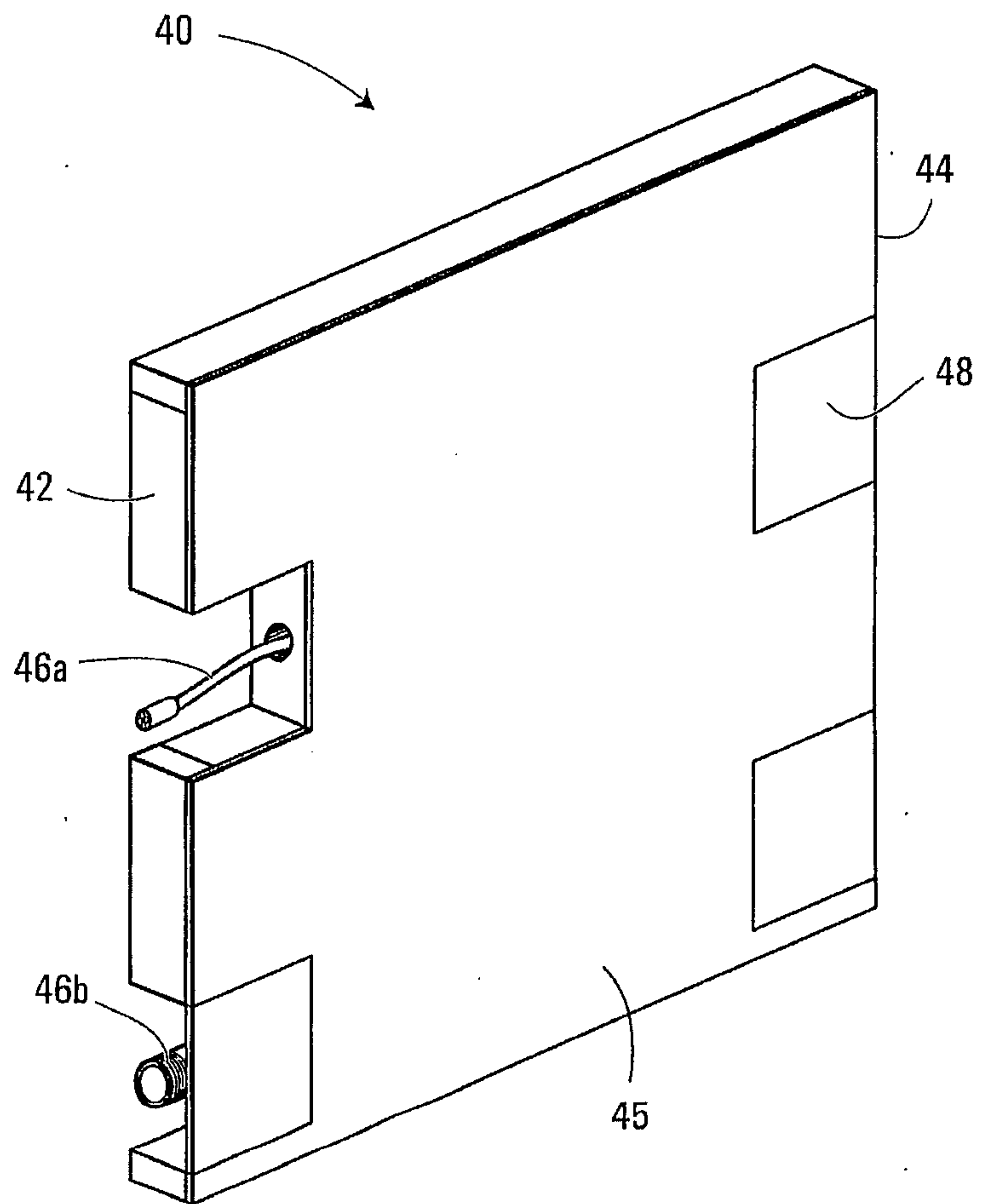


**FIG. 2B**



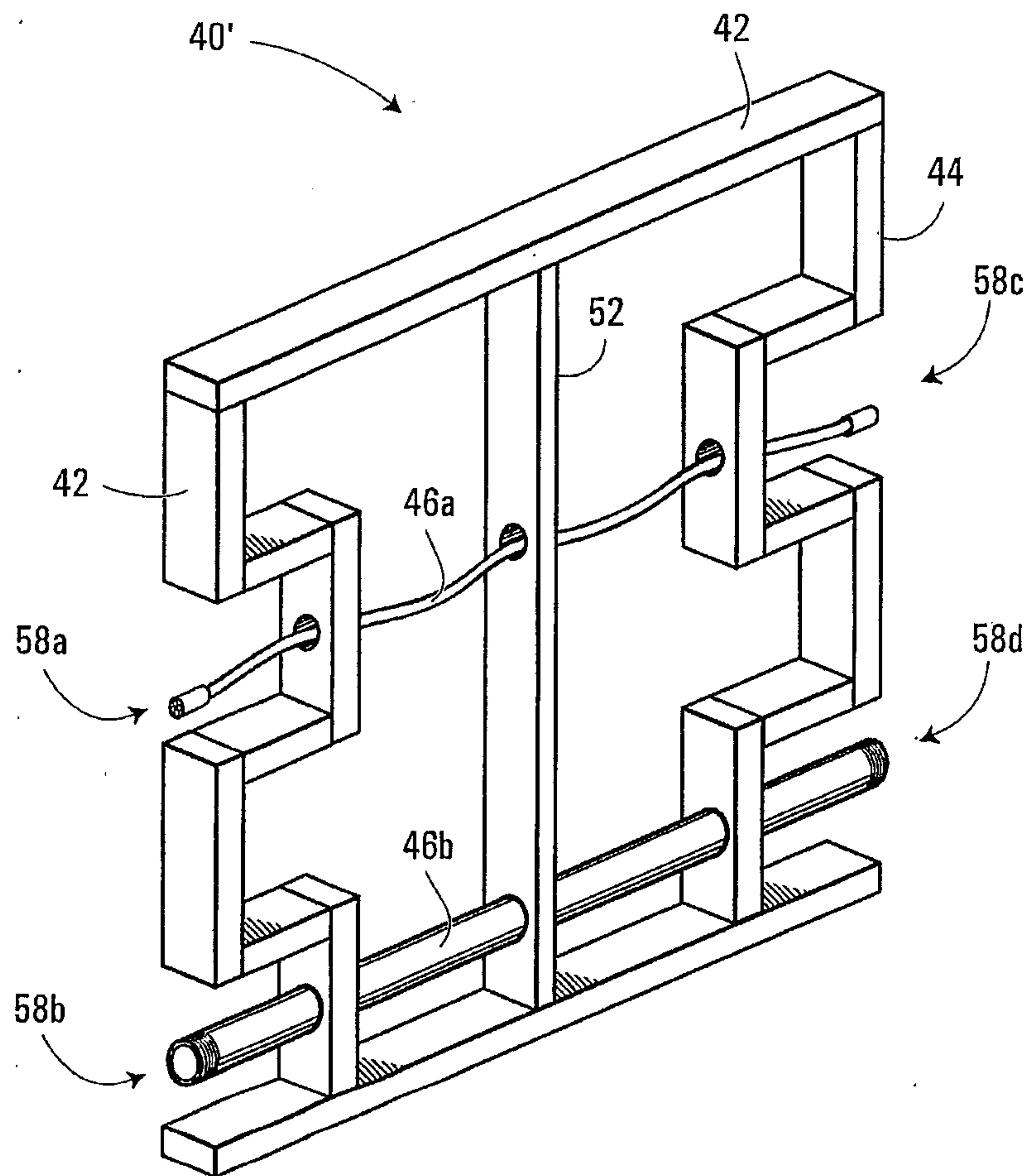
**FIG. 3**

5/8

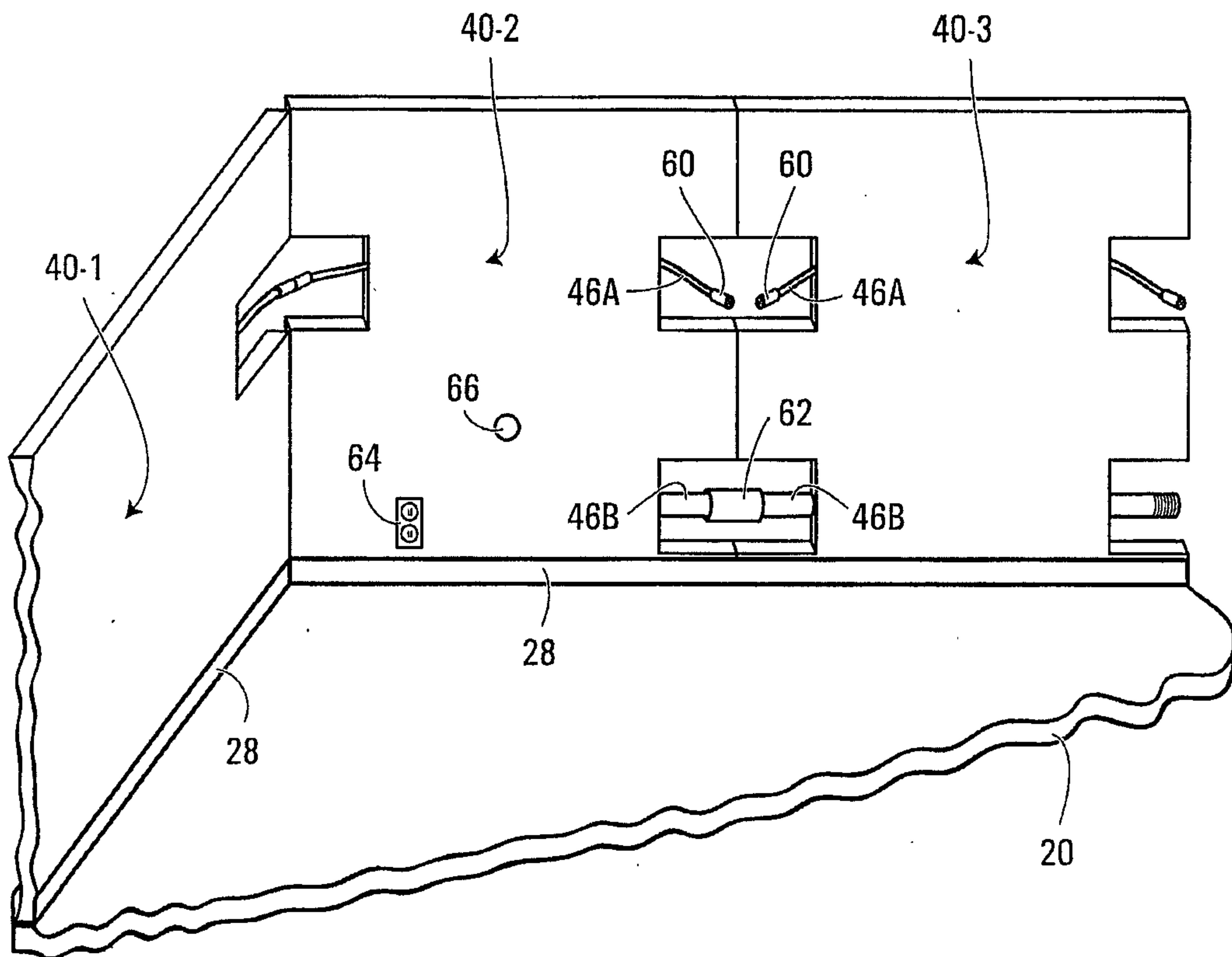


**FIG. 4**

6/8

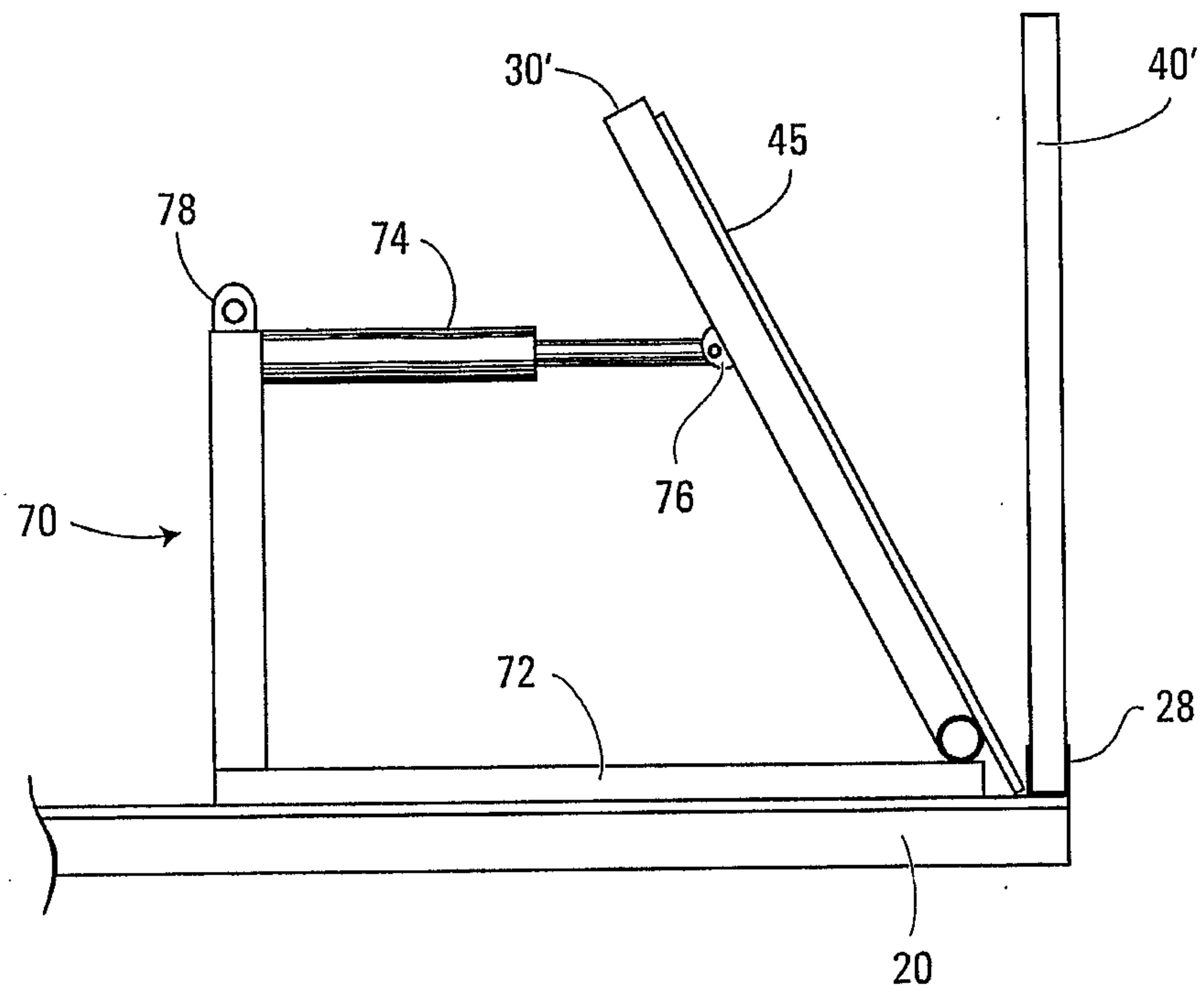


**FIG. 5**

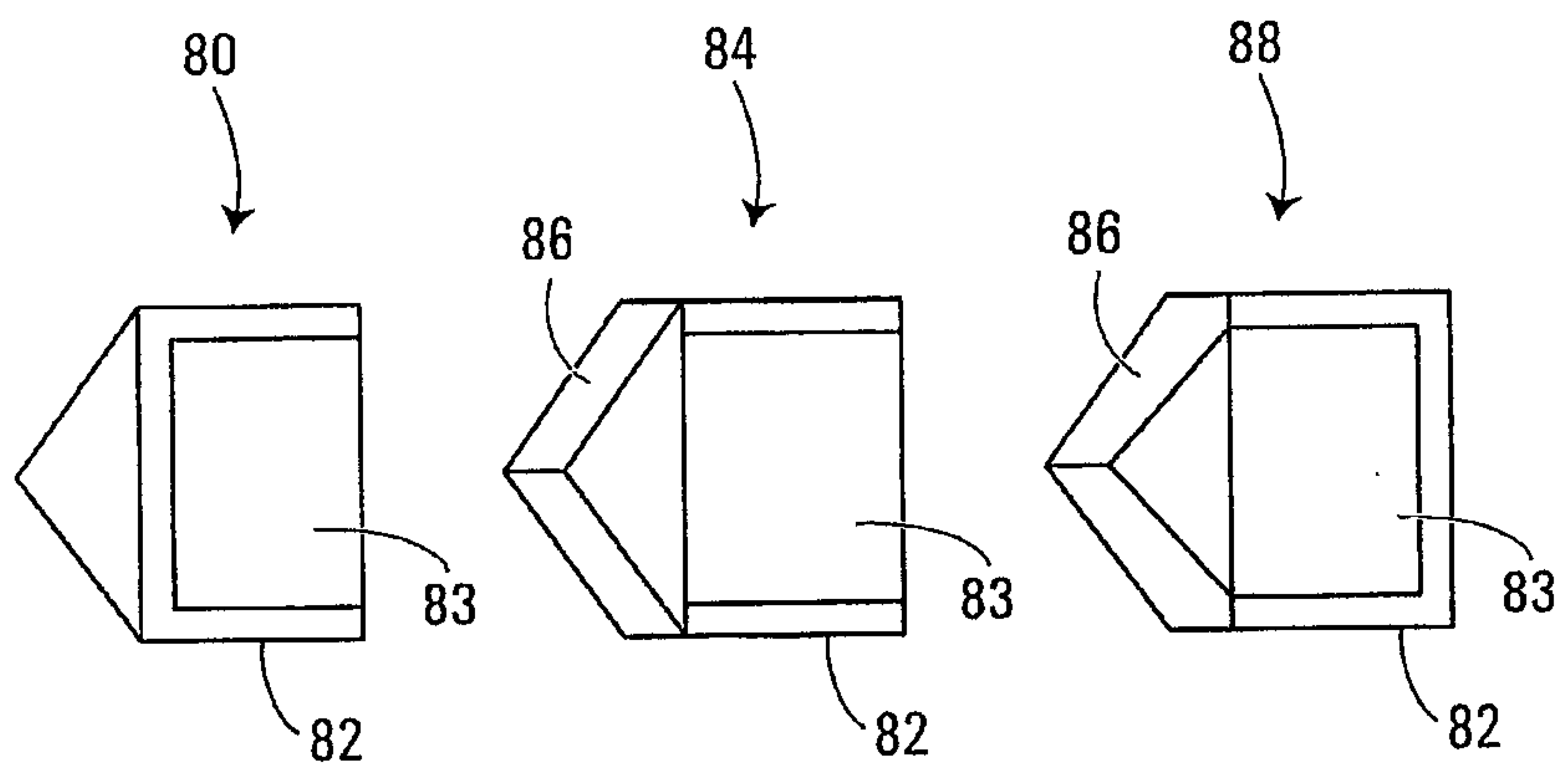


**FIG. 6**

8/8



**FIG. 7**



**FIG. 8**

