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CA 2425811 A1 2004/10/17

(21) 2 425 811

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2003/04/17

(41) Mise à la disp. pub./Open to Public Insp.: 2004/10/17

(51) Cl.Int.^{7}/Int.Cl.^{7} E02D 27/32, E02D 29/02

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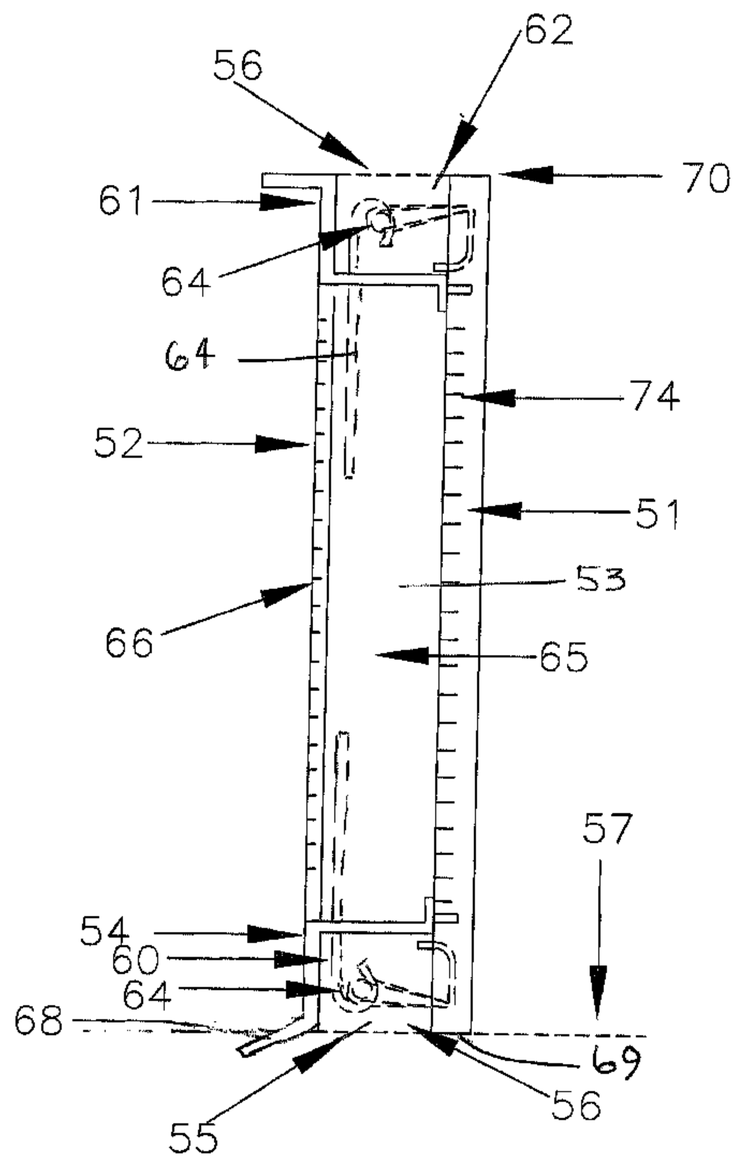
(54) Titre : SYSTEME MURAL MODULAIRE AVEC COFFRAGE A SEMELLE
(54) Title: MODULAR WALL SYSTEM WITH FOOTING FORM



(57) Abrégé/Abstract:
A precast panel has forms mounted thereon for forming post-like flanges and a footing. Upon erection of on array of panels the flanges and footing may all be cast on-site, with appropriate reinforcing/coupling means present within the form core volumes by filling such forms with binder material such as concrete. Optionally, an upper "sill/beam" may also be formed in a similar manner, the precast panel being provided with a sill/beam form attached to the wall portion of the panel.

Abstract

A precast panel has forms mounted thereon for forming post-like flanges and a footing. Upon erection of on array of panels the flanges and footing may all be cast on-site, with appropriate reinforcing/coupling means present within the form core volumes by filling such forms with binder material such as concrete. Optionally, an upper "sill/beam" may also be formed in a similar manner, the precast panel being provided with a sill/beam form attached to the wall portion of the panel.

Title: **MODULAR WALL SYSTEM WITH FOOTING FORM**

Field of the Invention

This invention relates to the construction industry. More particularly it addresses a modular wall system based upon precast concrete panels and accessory elements that may be erected on a site to provide a wall suitable for a building.

Background to the Invention

Construction techniques based upon the use of precast panels for forming walls are known. This includes panels which are tipped-up for positioning on a pre-installed foundation and then fastened together by various means.

In the building construction business it is often necessary to install footings in the ground that extend below the frost line. A "Frost wall" is intended to provide a load-bearing support for aboveground walls for one or two-story buildings that are constructed without any basement. In one form of construction a Frost Wall is formed by pouring concrete into a narrow three or four foot deep trench onto a bedding of compacted gravel. In this proceedure, both a concrete footing and the wall are formed simultaneously. While forms may be used to contain such a poured concrete wall, such forms may be omitted to save the cost of their erection and removal. But omission of such forms is at the expensive of consuming larger, unnecessary, volumes of concrete.

A number of prior art references that describe the use of precast concrete wall panels are referred-to in U.S. Patents No's 5,864,999 and 6,244,005, the contents of which are adopted herein by reference. These latter references describe a precast wall panel with rearwardly extending flange portions that have reinforcing members protruding downward for embeddment in a linear, pre-cast footing member having a U-shaped trough that is eventually filled with concrete grout.

The casting of footings on-site in conjunction with the simultaneous casting of vertical members is addressed in a number of prior art references. US Patents 5,367,845; 5,922,236 and 6,332,599 all contemplate the simultaneous filling of a wall form and a footing form to produce a continous wall overlaying a footing. US Patents 4,830,543 and 5,785,459 as well as application US 2002/0079424 A-1 refer to the simultaneous formation of a post over a footing wherein the forms for an interconnected footing and post are left in place after the concrete grout has been poured and set.

In both of these classes of systems no reliance is placed on the use of preformed wall panels to reduce the amount of concrete to be poured on site, and to serve as a support to guide in the pre-alignment of forms.

The first above two referenced U.S. patents describe a system for installing a partially prefabricated wall below ground. According to the design of one of these two prior art systems, precast concrete panels are fitted with hollow forms which allow “beams” and “posts” to be cast

on-site, after the panels have been erected on precast footings to form continuous walls. Conceptually, this is the reverse of classic beam and post construction wherein the walls are added as in-fill after the beams and posts are erected.

According to this latter prior art system the precast panels are installed with their hollow flange forms extending across the precast concrete footings; overlying the footing trough that is to be filled with grout. This grout forms a continuous connection with grout used to fill the sheet metal flange forms used to create the "posts". Preferably, the grout contains reinforcing bar that has been pre-wired into positioned both within the flange forms and within the footing trough.

A complication of this prior art system is that it premises the separate installation of a concrete footing that is either precast or has previously cast in place. The following invention addresses a system that avoids such complications.

The invention in its general form will first be described, and then its implementation in terms of specific embodiments will be detailed with reference to the drawings following hereafter. These embodiments are intended to demonstrate the principle of the invention, and the manner of its implementation. The invention in its broadest and more specific forms will then be further described, and defined, in each of the individual claims which conclude this Specification.

Summary of the Invention

The invention according to one aspect relies upon the presence of hollow forms coupled to a precast wall panel for subsequent filling with a binder material such as concrete. These forms produce both a vertical flange on the panel, once the open hollow interior of the form is filled with the binder material, and a footing. The flange on the wall panel may then function as a post to support a top-side horizontal beam.

Accordingly a precast concrete panel, which serves as a wall, may fitted with a sheeting material which provides one or more vertical flange forms for creating one or more flanges on the wall panel when filled with concrete. The panel is also provided with sheeting material to define a footing form extending along the base of the wall. This footing form serves to contain concrete poured into the footing form through the vertical flange form(s). This panel, so fitted, is installed in a prepared trench, preferably on top of a prepared base, such as a consolidated bed of gravel, crushed stone or the like.

With the base leveled to a true height, several panels according to the invention may be placed in line along the base. To keep the panels in line, short wooden props extending to the adjacent soil may be used and/or the panels may be partially backfilled. As a further alternative for maintaining alignment, straightening brackets in the form of lengths of 2X4 lumber may be clamped along the upper edge of the panels.

Concrete "grout" is then poured into the upper exposed ends of the vertical forms to serve as a fill or binder. The concrete is mixed to a flowable consistency, optionally with additives to maintain flowability. After concrete has been poured into the vertical forms, vibrators may be applied to the forms to remove air pockets and encourage flow.

The concrete poured into the vertical forms descends into the void within the footing form and spreads-out within such void along the base of the panel until the concrete flows to the base of the next vertical form. By progressively filling the vertical form, the footing forms can be filled with a continuous volume of concrete that serves as the footing for the wall. Such wall also now contains vertical, concrete-filled flanges which serve as posts as well as a concrete-filled footing. The concrete or binder within the footing and flanges is integrally connected.

Preferably, coupling means such as reinforcing bar is present within the hollow interiors of the hollow flange form, such coupling means protruding downwardly from the lower end of each of the hollow flange forms to connect with binder and/or coupling means present within the interior of the hollow footing form. Such coupling means becomes cast in place when the respective hollow interiors are filled with binder material.

Alternately or additionally, portions of coupling means connected to the outer sheeting material or surface walls of the forms may extend into the binder to serve with

such form walls as coupling means and provide reinforcement for the binder.

A panel may have a single flange form or two or more hollow flange forms for casting multiple flanged portions positioned. Thus a preferred form of panel of "F"-shaped cross-section may be provided. Further, flange forms at the ends of the panel may be half-forms of the type described in U.S. Patent 6,244,005

The panel of the invention may also, preferably, be provided with a sheeting material defining a form mounted along its upper edge to serve as an upper trough for receiving concrete at the same time that the vertical and footing forms are being filled. With concrete/binder cast in this upper trough an upper horizontal fie beam or sill beam in formed along the top edge of the wall panel. Reinforcing bar or other coupling means may be laid in this trough before it is filled with concrete. This reinforcing bar is preferably connected to reinforcing bar or coupling means placed in the vertical and footing forms to become embedded therein once these forms are filled. With such upper trough coupling means extending for the length of encircling walls, as for a basement frost wall or foundation wall, such walls are effectively "belted" or tied in place. The upper beam cast in the trough then qualifies as a tie beam.

The invention in another aspect is directed to a modular panel system comprising a plurality of panels wherein each panel comprises:

(a) a wall portion and one or more hollow flange forms each having a hollow interior and being mounted on such wall portion for casting one or more outwardly extending flanges on said wall portion; and

(b) a hollow footing form for forming a footing, the interior of the hollow footing form communicating with the interior of the hollow flange form

wherein the panels are dimensioned to be joined end to end to provide a continuous wall of extended length.

Preferably, the material for the flange and footing forms are of sheet material, e.g. galvanized steel or plastic which is fastened along one edge of the sheet material, as by embedment or through fasteners, to the precast wall portion. To improve coupling between these forms and the binder with which such forms are eventually to be filled without precipitating fracturing of the panel material, portions of the side walls of the flange forms may be depressed or deformed inwardly to provide dimples or tabs to be embedded within the binder when the binder is poured into the forms.

As stated earlier an upper horizontal, tie beam or sill (referenced as a "lintel" member in the cited prior art) member may be provided, positioned along the tops of each panel, overlying the wall and flanged portions. Such a sill/beam member can be provided by having a sill/beam trough form fitted to the wall along its upper edge defining an upper trough volume which may be filled with binder, e.g. concrete. Adjacent trough form may be joined

so that a continuous cast-in-place sill/beam may be created spanning the tops of the precast panels.

Upper trough reinforcing means may be present in the upper trough volume, preferably connected to upper coupling means associated with the flange forms and extending continuously through the trough volumes of adjacent panels. Such upper coupling means are then imbedded in the binder that is placed in the sill/beam trough at the same time that the hollow flange form(s) are filled with binder.

Additionally or alternately, reinforcing/couple means may extend from the pre cast wall portion into the trough volume. This may be in the form of reinforcing bar embedded in the wall portion and extending horizontally or at an angle into the trough volume. Such reinforcing bar may also serve as lifting loops during installation of the wall panels.

Similarly, coupling means such as reinforcing bar of flange form portions may extend from the bottom of the wall portion of each panel into the footing volume defined by the footing forms. Again, as for the sill/beam trough, embedded reinforcing may extend along and through the footing volume, preferably spanning the juncture between adjacent panels.

The sheeting material of the footing forms is seated with its wall-mounted edge extending along the side of the wall portion near the bottom end of each panel. The sheeting material of the footing forms may then extend

outwardly away from the wall and downwardly to define an enclosed footing volume, for overlying a supporting foundation base. This sheeting material may proceed directly downward from the wall panel to its terminal edge or may form a bend between these two limits. To ensure firm engagement of the outer edge of the sheeting material with the base, such material may be resiliently elastic, with the lower edge of the other boundary of the sheeting material for the footing form extending below the lower edge of the wall portion in its relaxed state before the panel is placed upon the base. When placed on a horizontal, flat base such lower edge will then be deflected upwardly into alignment with the lower edge of the wall, while bearing resiliently, with a downward pressure, against the base. Spikes or the like may optionally be used to further anchor the outer end of the footing form to the base.

The foregoing summarizes the principal features of the invention and some of its optional aspects. The invention may be further understood by the description of the preferred embodiments, in conjunction with the drawings, which now follow.

Summary of the Figures

Figure 1 is a face view of the side of a prior art panel with sill/beam trough and flange forms.

Figure 2 is an upwardly directed, cross-sectional end view of the panel Figure 1.

Figure 3 is a side edge view of the panel of Figure 1.

Figure 4 is a partially cut away side view of the panel of Figure 1 installed on a pre-cast footing with grout/filler in place in the sill/beam and flange forms and within the footing trough.

Figure 5 is a side face view of a wall panel according to the invention with flange and footing forms present and including a preferred but optional sill/beam form.

Figure 6 is an edge view of the panel of Figure 5.

Figure 7 is a pictorial view of a wall structure formed of multiple panels as in Figure 5.

Figure 8 is a pictorial detail view of the juncture of abutting panels having edge flange form means as in Figure 7 and footing forms as in Figure 5.

Figure 7 is a top, cross-sectional view through the wall panel downwardly-directed of Figure 5.

Figure 8 is a cross-sectional end view of the lower portion of one variant of the footing trough anchored to a base.

Figure 9 is a cross-sectional end view of the upper trough and wall panel portion showing reinforcing bar.

Figure 10 is a cross-sectional side view of a n erected wall based on the wall panel of Figure 5 installed in site.

Description of the Preferred Embodiment

Figures 1, 2 and 3 show a prior art panel as depicted in US patent 6,244,005 with two hollow flange forms 30. The forms 30 are of a sheet material, such as galvanized sheet steel, bent to a "U"-shaped cross-section with the legs 36 of the "U" embedded in the panel 1 at the time of casting the panel 1. Each flange form 30 has a hollow core 31 which serves as a flange volume.

A sill/beam trough form 32 may also be cast into the panel 1, spanning between the flange forms 30. The interiors 31 of the flange forms 30 communicate with the volume 33 of the trough formed by the sill/beam trough form 32.

On assembly as a wall panel, reinforcing bar 7, 8 which serve as upper and lower coupling means may be inserted into the interior volumes of the flange form cores 31, protruding to respectively lie within the sill/beam trough volume 33 and to extend downwardly below the panel to engage with a footing. Sill/beam horizontal reinforcing bars 24 may be placed in the sill/beam trough and optionally tied to the reinforcing coupling bar 7. In lieu of bar inserted into the flange interior 31, a portion 38 of the flange form 30 itself may protrude into the trough volume for engagement with the sill/beam and/or footing which is to be formed alternately, an anchoring plate may be bolted to the form 30 to protrude in a similar manner.

To couple the wall panel 1 more securely to the sill/beam to be formed in the trough 33, reinforcing 40 may be embedded in the wall 1 next to the trough interior 33.

This may be in the shape of expanded metal plates located at intervals along the top portion of the panel 1 preferably intermediate the forms 30. As well, upwardly extending handling hooks (not shown) of heavy gauge wire or rod may also be embedded in the upper end of the wall panel 1 to provide lifting attachments and serve as supplemental reinforcing.

The walls of the flange forms 30 may have bent tabs 35 punched inwardly into the flange core 31. These tabs 35 become embedded in the cement or binder material to be used as binder when the flange cores 30 and sill/beam trough volumes 33 are filled. This increases the coupling between the form 30 and the binding filler, increasing their composite strength.

In Figure 4 the prior art panel of Figure 1 is shown mounted on a precast footing assembly 9, 21 over a base 22. A trough 11 in the footing members receives reinforcing bar 24 from a flange form 30. Both the footing trough 11 and sill beam trough volume 33 are filled with concrete 39. Earth 28 has been back-filled against the wall panel 1.

Figures 5 and 6 show an improved prefabricated wall panel 50 in accordance with the invention. The wall panel 50 has a wall portion 51, preferably of concrete, fitted with sheeting material 65, preferably galvanized steel, to constitute a central vertical flange form 52 that will provide a flange or post on the wall portion 51 when filled with concrete. This flange form 52 has an inner

flange form volume 53. Outer forms 30A are in half-form format.

At the base of the wall portion 51, sheeting material is coupled to the side surface of the wall portion 51 to provide a footing form 54. This footing form 54 has an interior footing form volume 55 and is preferably open in the downwardly directed direction. The flange form volume 53 and footing form volume 55 are interconnected to permit such volumes 53, 55 to filled with a continuous quantity of binder material.

Wall panels 50 are assembled on a base 22 with the vertical edges 58 of the wall portions 51 abutting to produce a continuous wall structure. The footing forms 54 of each individual wall panel 50 extend horizontally to be interconnected to each other. Thus the interconnected footing forms 54 provide continuously interconnected footing form volumes 55.

The base 22 is preferably of compacted aggregate or such other material as is required to provide a stable support for the footing that is to be cast within the footing form 54.

Optionally, but preferably sheet material is coupled to the side surface of the wall portion 51 near its upper edge to provide a sill/beam form 61. This sill/beam form 61 is open in the upwardly directed direction and defines a sill/beam form volume 62.

This sill/beam form volume 62 is interconnected with the flange form volume 53 to permit such volumes 53,

62 to be filled with a continuous quantity of binder material, providing a "funnel" action during the pour.

When assembled to provide a continuous wall structure, the sill/beam forms 61 of each individual wall panel 50 extend horizontally to be interconnected to each other. The sill beam forms 61 may overlap and be connected by sheet metal screws. The interconnected sill/beam forms 61 thereby provide continuously interconnected sill/beam form volumes 62 for filling with a continuous volume of binder material 56.

Reinforcing means such as rod 64 may be laid in any or all of these form volumes 53, 55, 62. Preferably such rod is interconnected respectively along the lengths of the sill/beam form volumes 55 and footing form volumes 62. Further, optionally but preferably, reinforcing rod 64 within the flange form volume 53 may be connected to rod 64 in either the footing form volume 62, or sill/beam volume 55, or both. The rod 64 in the flange form volume 53 need not extend all the way between the rod 64 in the respective sill/beam and footing form volumes 62, 55. It is sufficient, when employed, for rod 64 in the flange form 52 to extend only partially into the flange form volume 53.

The surface of the footing form 54 has an outer edge 68 which is directed downwardly to bear against the base 22 on which the wall panels 50 are positioned as shown in two variants in Figures 6 and 8. The sheeting material of the footing form 54 is preferably made of an elastically resilient material. The outer edge 68 may be constructed,

as shown in Figure 6 to underlie the bottom edge 69 of the wall portion 51 when the wall panel is freely suspended. By this means the outer edge 68 may be caused to bear with a resilient force against the base 22 when installed in position, reducing the tendency for the edge 68 to lift when the footing form colume 55 is being filled with binder material. Spikes 73 may suppliment the attachment of the outer edge 67 top the base 22, as shown in Figure 8.

The wall panel 50 may be provided with embedded loops along its bottom, Figure 8, and top, Figure 9, edges 69, 70. Protruding from ends embedded into the wall portion 51, rods 72 may serve both as lifting loops and, when bent down, as coupling means between the wall portion 51 and grout that will fill the respective forms 61, 54. Such rod 72 may optionally be coupled to reinforcing rod 64 present in the sill/beam and footing form volumes 62, 55. A further end 71 of such rod 72 may protrude from the wall panel 50 into the trough volume 55to serve as a guide when the rod 72 is being cast in place and to couple the sill beam to the walls 51.

In embedding sheet material edges in concrete it is preferable to interrupt the straight run of the edge with indentation and/or deflection to avoid formation of a path which will serve as a focus for the creation of cracks in the concrete. Thus the form edges as shown in Figures 5, 8 and 9 are interrupted by bent tabs 74.

By casting both the flanges which serve as posts and footing on site in one operation, costs are reduced. Because key parts are precast and incorporate pre-affixed

forms, no forms need be created on-site. Further, by being fastened to precast panels, the forms are precisely placed in the exact locations where flanges and the footing should be eventually installed. This greatly facilitates the erection process.

Although suited for basement and above ground walls, the invention is particularly suited for use as a Frost Wall.

Conclusion

The foregoing has constituted a description of specific embodiments showing how the invention may be applied and put into use. These embodiments are only exemplary. The invention in its broadest, and more specific aspects, is further described and defined in the claims which now follow.

These claims, and the language used therein, are to be understood in terms of the variants of the invention which have been described. They are not to be restricted to such variants, but are to be read as covering the full scope of the invention as is implicit within the invention and the disclosure that has been provided herein.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY IS CLAIMED AS FOLLOWS:

1. A preformed wall panel, comprising:

a) a wall portion fitted with a vertical flange form with an interior flange volume for creating a flange on the wall portion when filled with binder material; and

b) a footing form fitted along and proximate to the base of the wall portion to provide a downwardly open footing volume,

wherein said vertical flange form and footing form define an interconnected volume and wherein said forms serve to contain binder material poured into the footing form through the vertical flange form to provide said wall portion with both a flange and a footing.

2. A preformed wall panel as in claim 1 comprising a trough form mounted along the upper edge of the wall portion defining a trough volume that communicates with said flange volume for receiving concrete at the same time that the flange form and footing form are being filled with binder material.

3. A building wall comprising a plurality of panels as in claim 1 mounted on a base surface wherein the footing forms of the respective panels are aligned to provide with said base surface a series of continuous footing volumes extending between consecutive footing forms of each panel whereby the footing forms can be filled with a continuous

which communicates with the interior flange volume of the flange form

wherein both interior volumes are interconnected so as to permit them to be filled with a continuous quantity of binder material.

8. A system as in claim 7 comprising footing coupling means protruding downwardly from the lower end of the flange form into the footing volume whereby such footing coupling means will be cast in place within the footing volume when the respective flange and footing volumes are filled with binder means.

9. A system as in claim 8 wherein the footing volume contains reinforcing means and the footing coupling means connects with said footing reinforcing means present within the footing volume.

10. A system as in claim 7, said panels each comprising an upper sill/beam trough form fitted to the panel wall portion along its upper edge defining an upper trough volume that communicates with the flange volume whereby said volumes may be filled with a continuous quantity of binder material.

11. A system as in claim 10 comprising coupling means protruding upwardly from the upper end of the flange form into the trough volume to be imbedded in the binder that is

to be placed in the trough volume at the same time that the flange form is filled with binder.

12. A wall system as in claim 8 wherein the coupling means comprises steel of reinforcing bar extending into the interior of the flange form.

13. A wall system as in claim 12 wherein said bar is coupled to steel reinforcing bar laid in the footing form before it is filled with binder.

14. A system as in claim 7 wherein the material for the flange and footing forms is of sheet material which is fastened by embedment to the panel wall portion.

15. A system as in claim 14 wherein the forms are provided by a sheet material comprising a sheet metal.

16. A wall system as in claim 7 wherein said flange form is constituted by half-form means mounted on said wall panels, the half-form means being positioned at wall panel edges to abut against a corresponding half-form means on an adjacent panel and define said flange form volume.

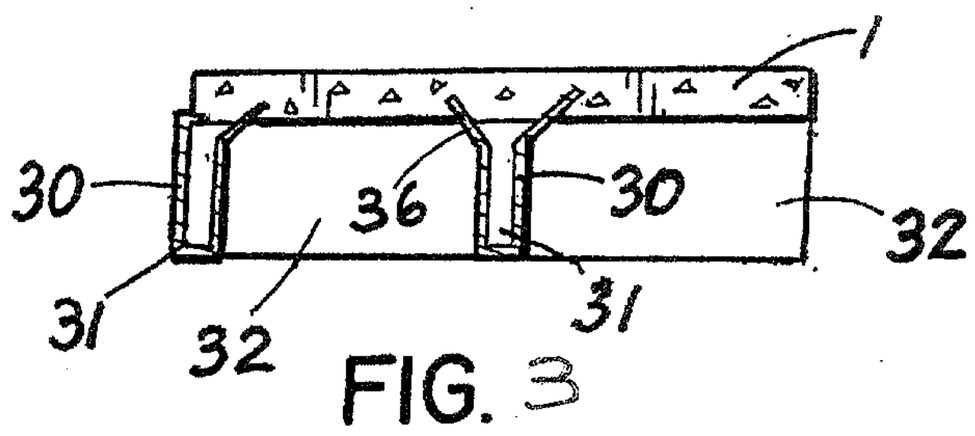


FIG. 3

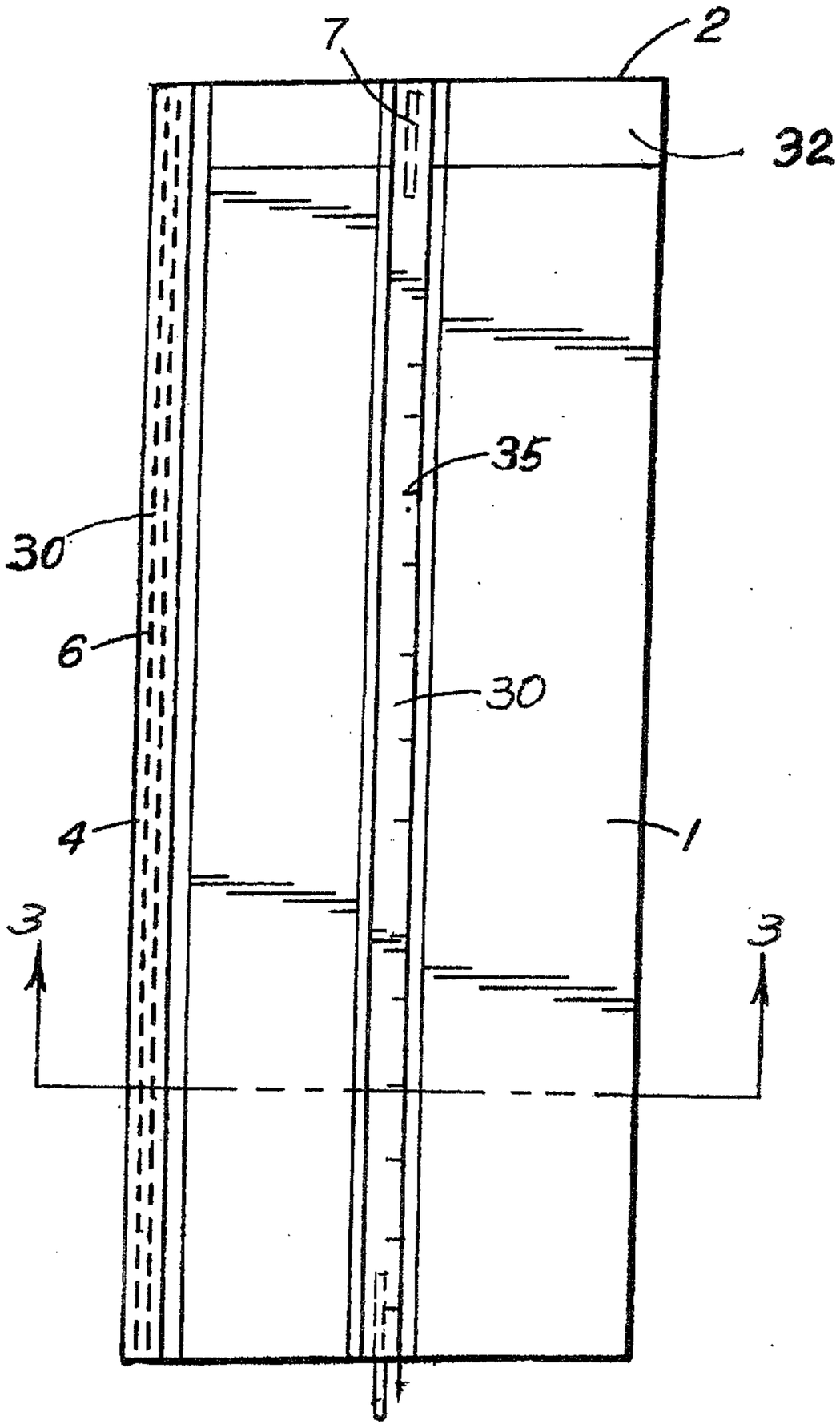


FIG. 1

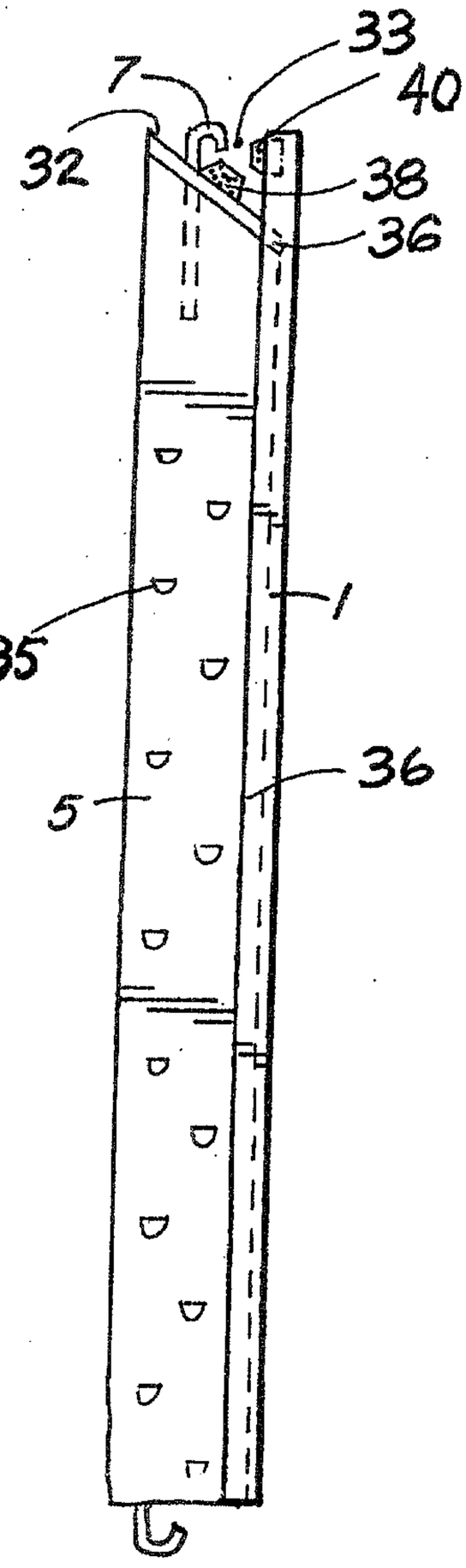


FIG. 3

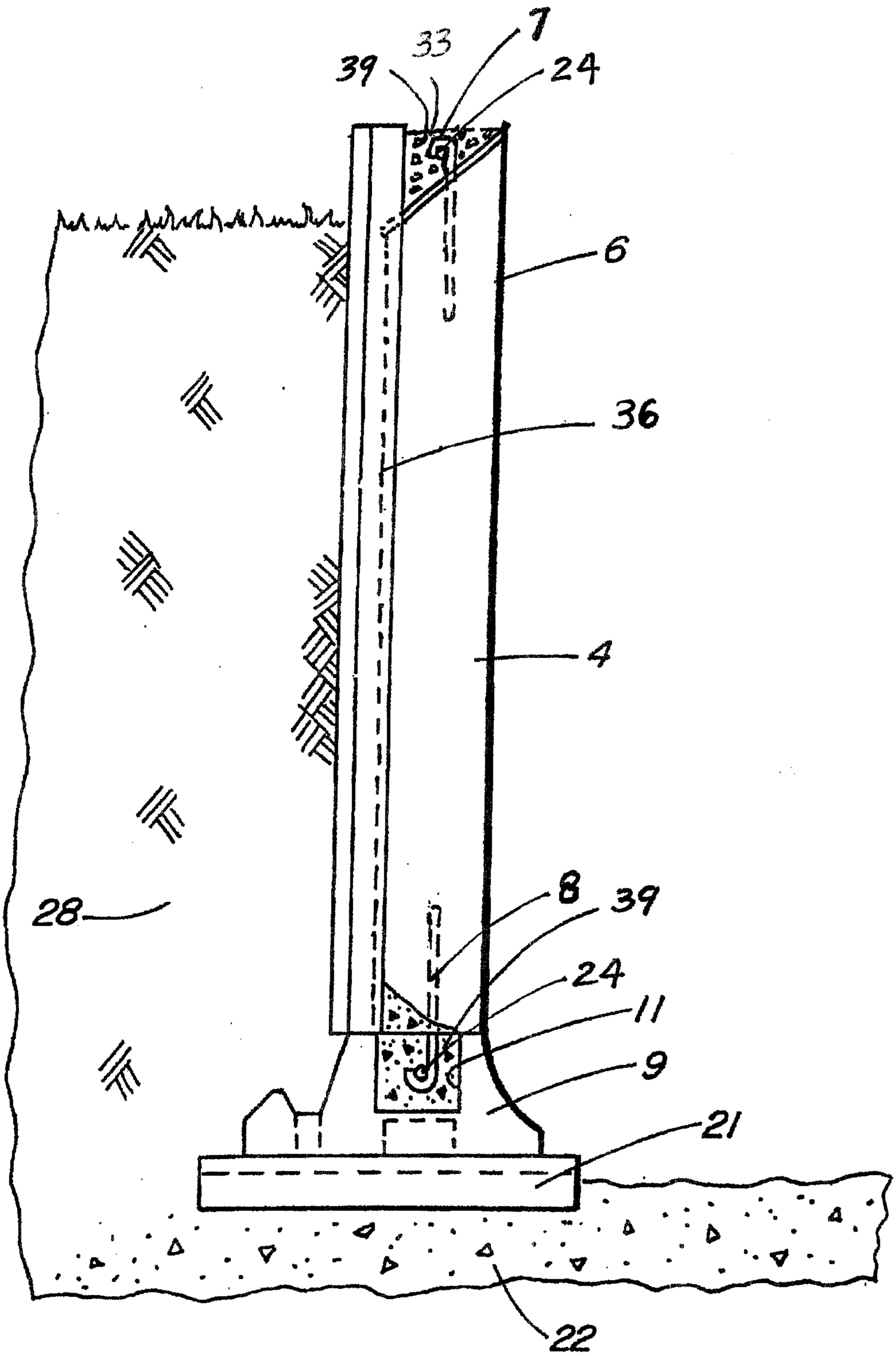


FIG. 4

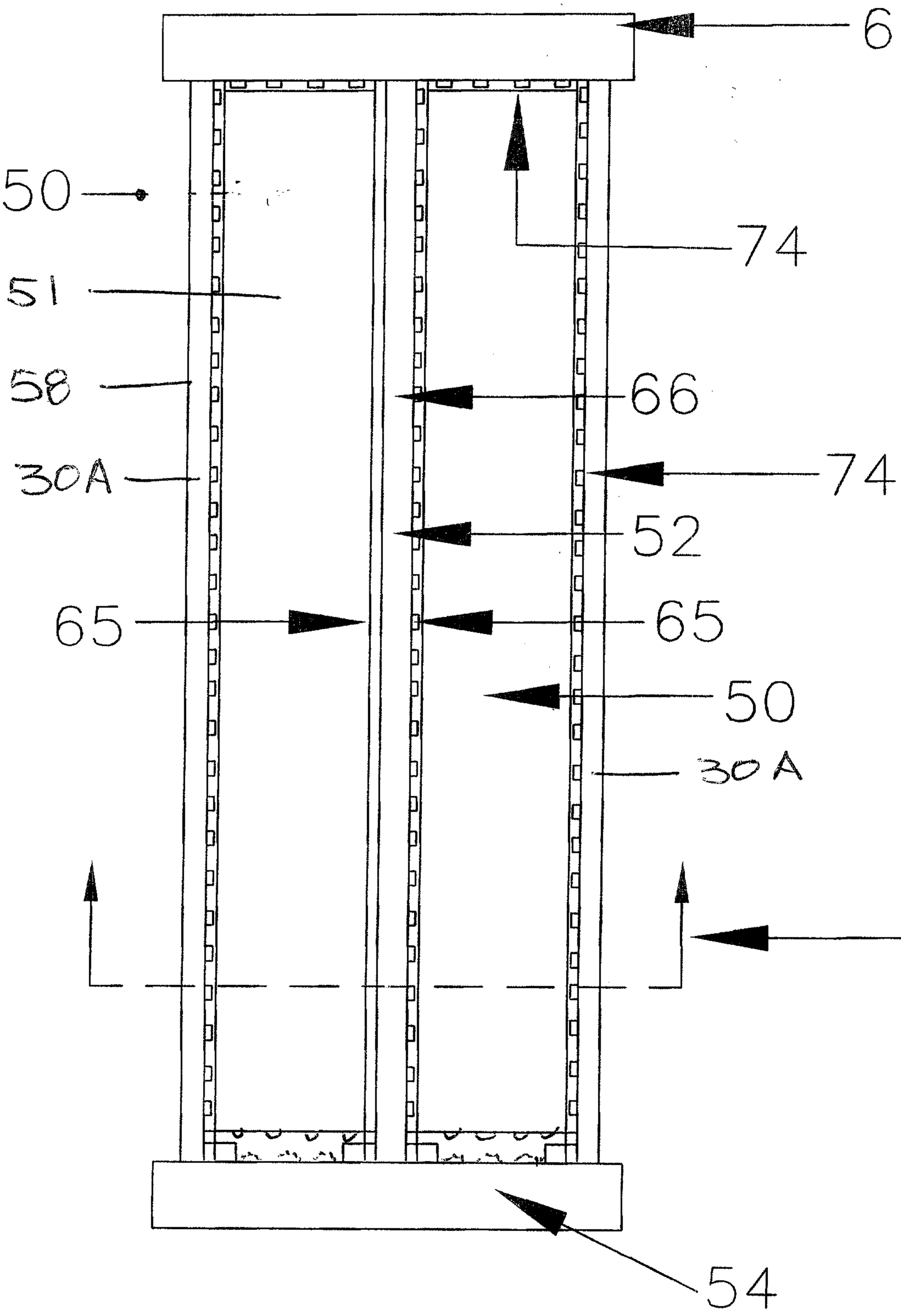


FIG 7

FIG. 5

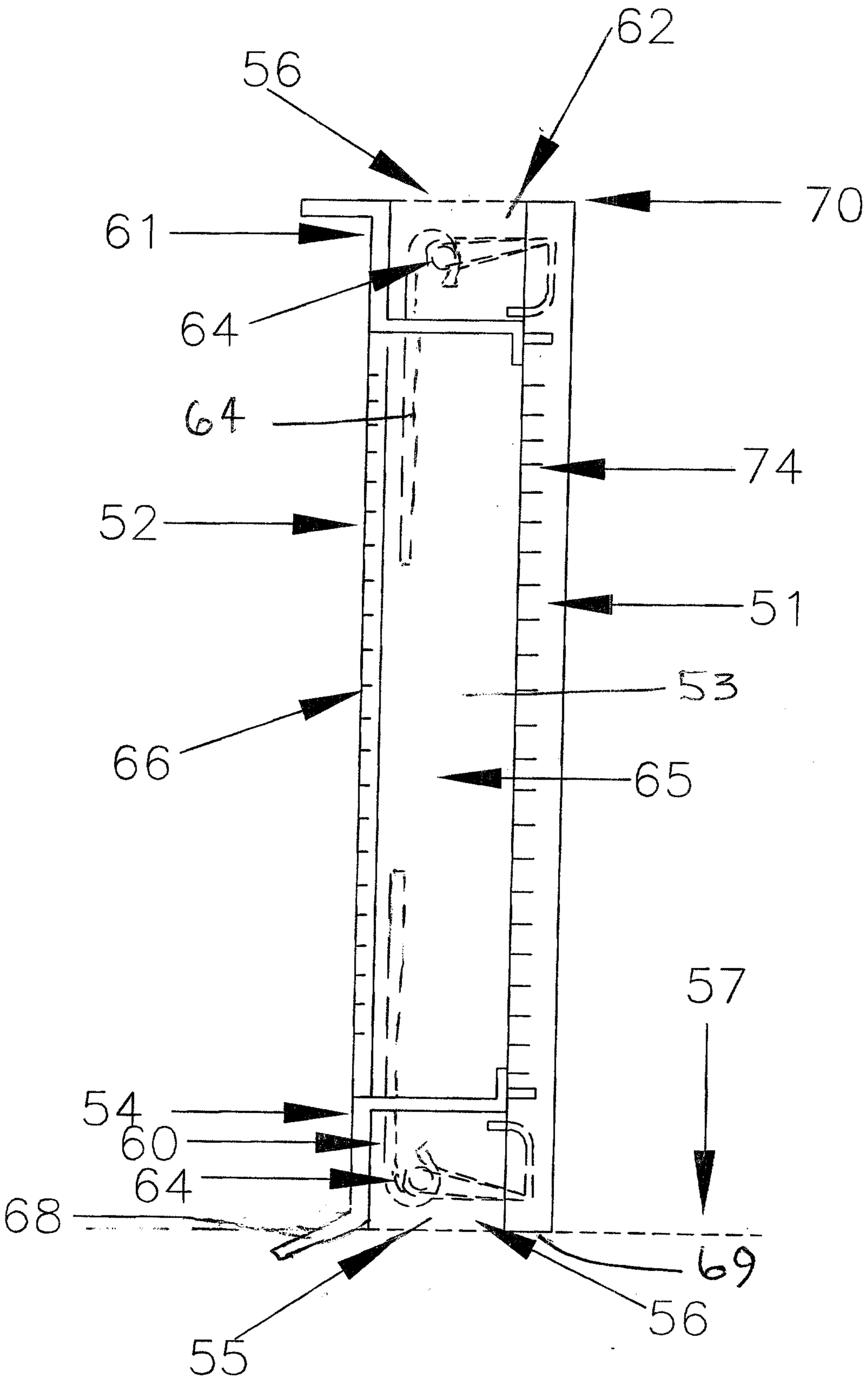


FIG. 6

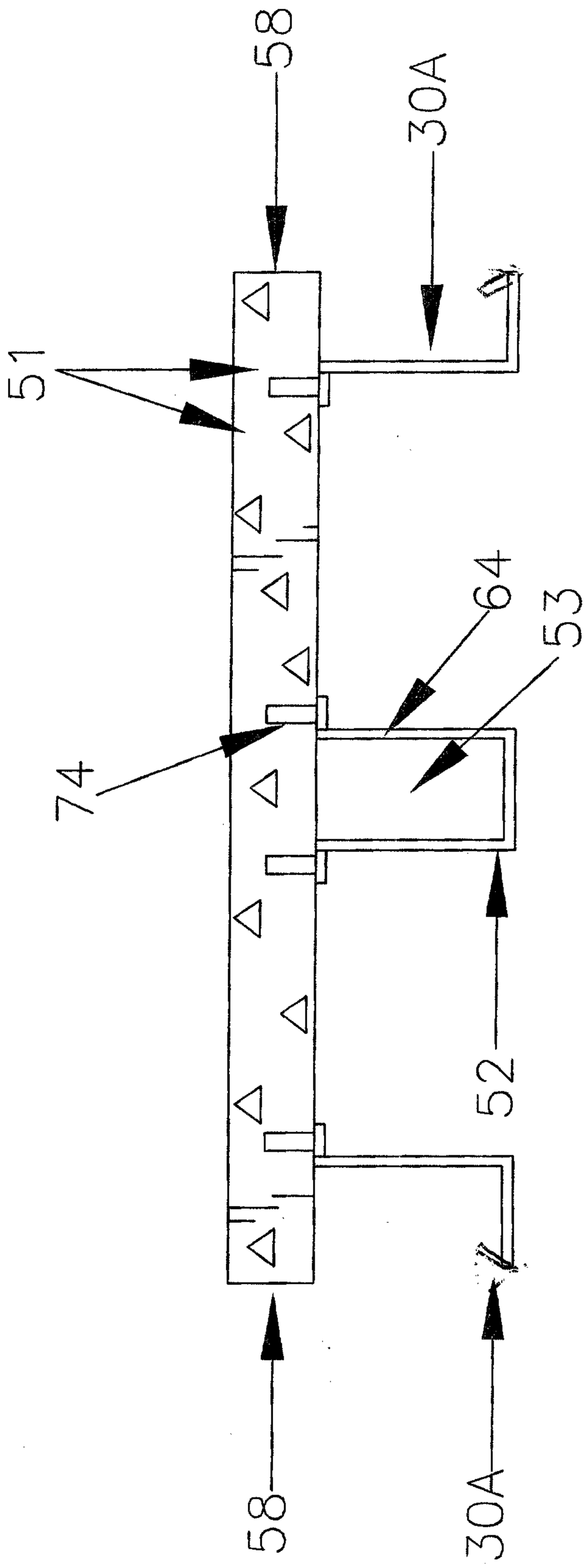


FIG. 7

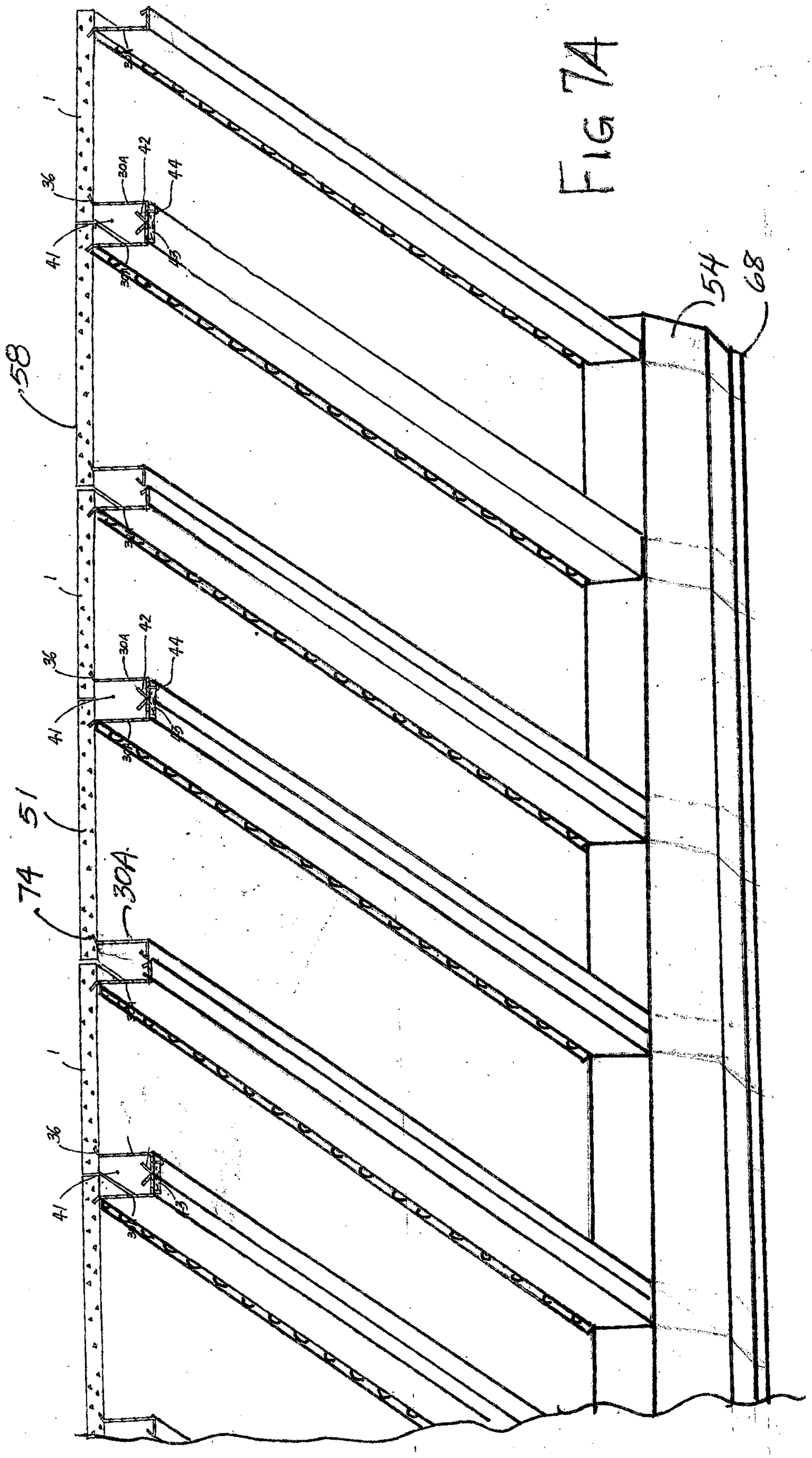


FIG 7A

Fig 9

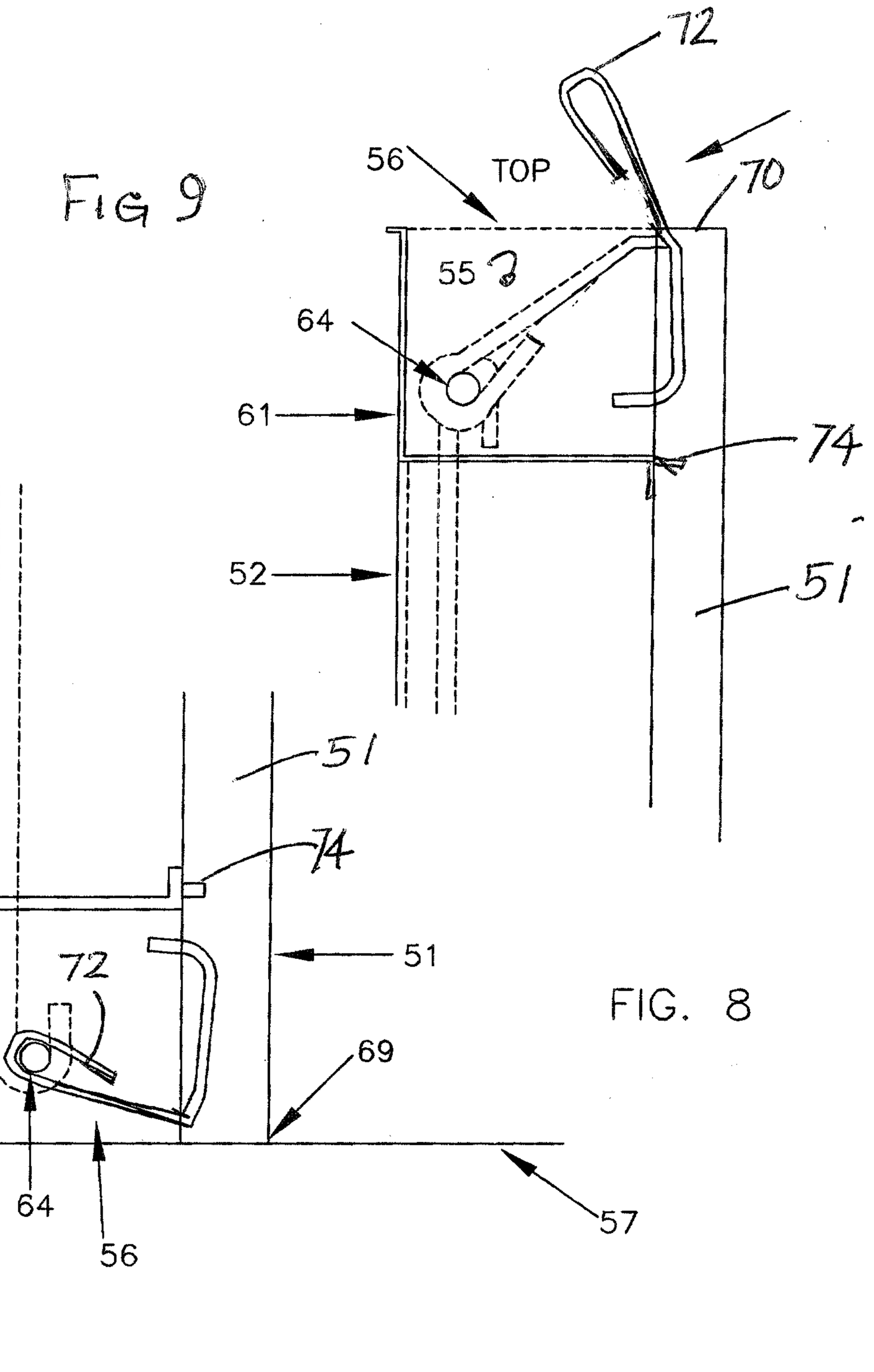


FIG. 8

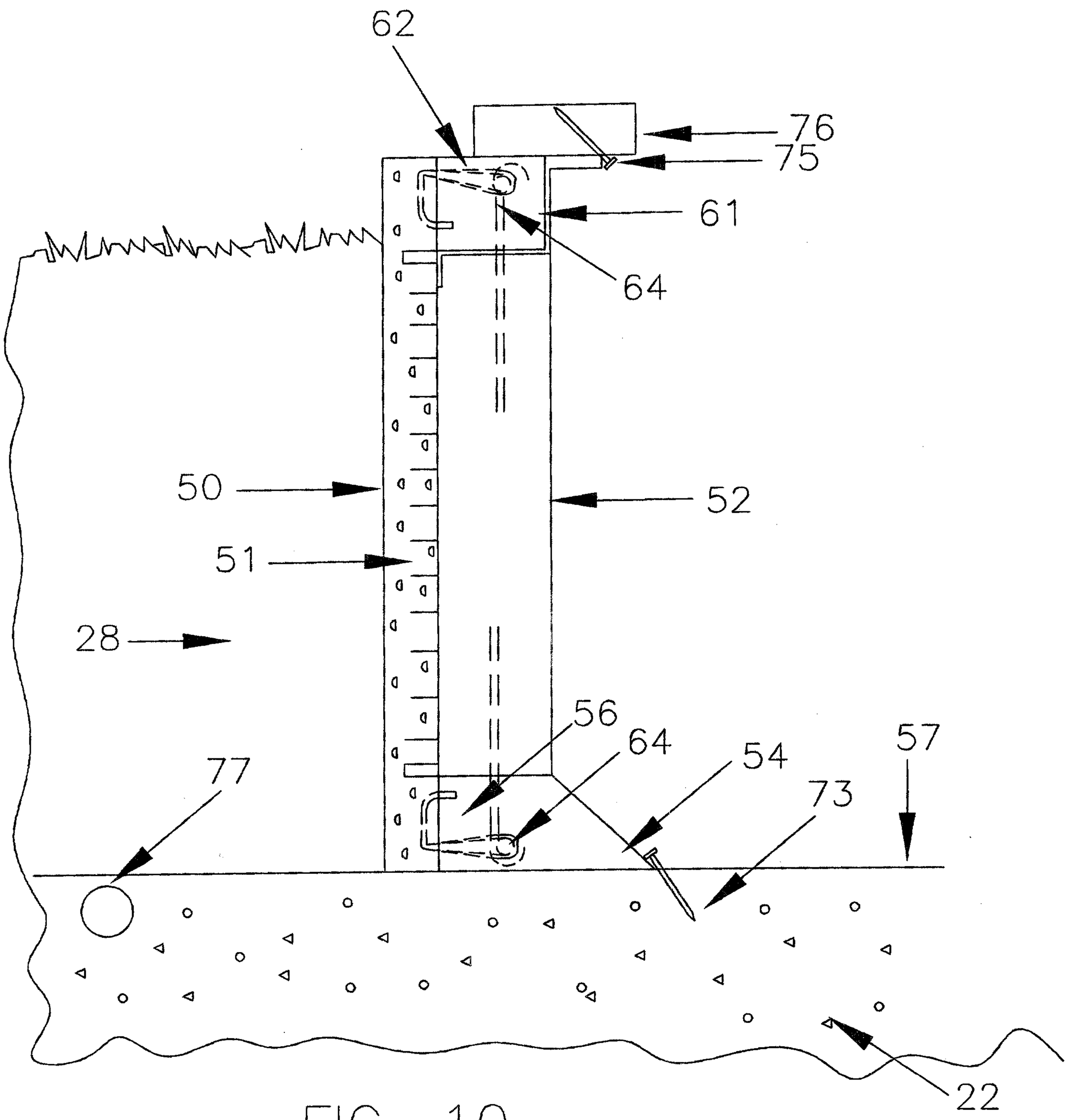
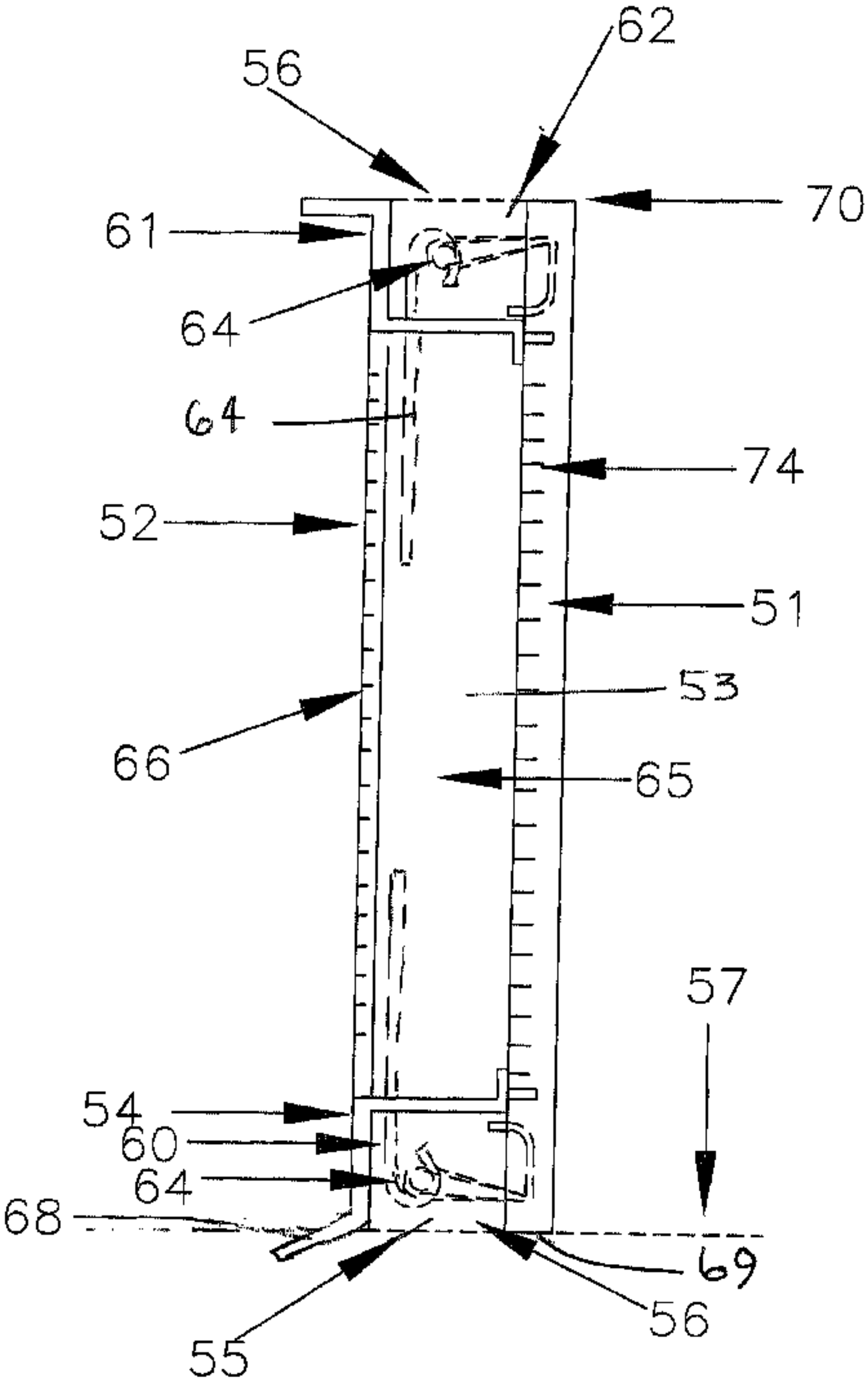


FIG. 10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