

[54] ELEVATING PERIMETER RAILING

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[51] Int. Cl. E04h 17/14

[58] Field of Search 256/59, 65-70, 256/24, 1; 182/82, 113; 248/237

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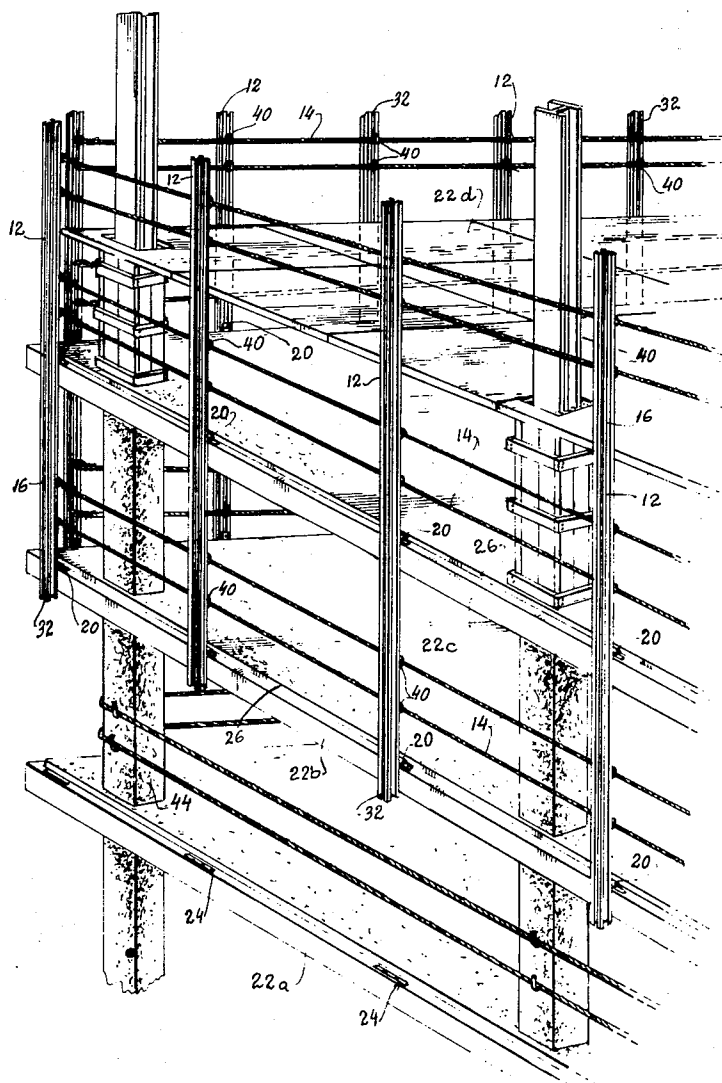
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Attorney, Agent, or Firm—Stoll and Stoll

[57] ABSTRACT

For use about the perimeter during construction of multi-story building, a safety railing comprising a plurality of substantially vertical stanchions interconnected with substantially horizontal safety cables, the stanchions being vertically slidably secured to two lower floors and extending upwardly a sufficient distance to form a safety railing about the perimeter of a third, upper floor. Each stanchion may be vertically raised so as to continually protect the perimeter of each uppermost floor as the same is formed in the progress of construction. By virtue of being fastened to lower floors and extending in cantilever fashion to the uppermost floor without being fastened thereto, a safety railing is provided on the uppermost floor before workmen are permitted general unrestricted access thereto.

5 Claims, 12 Drawing Figures



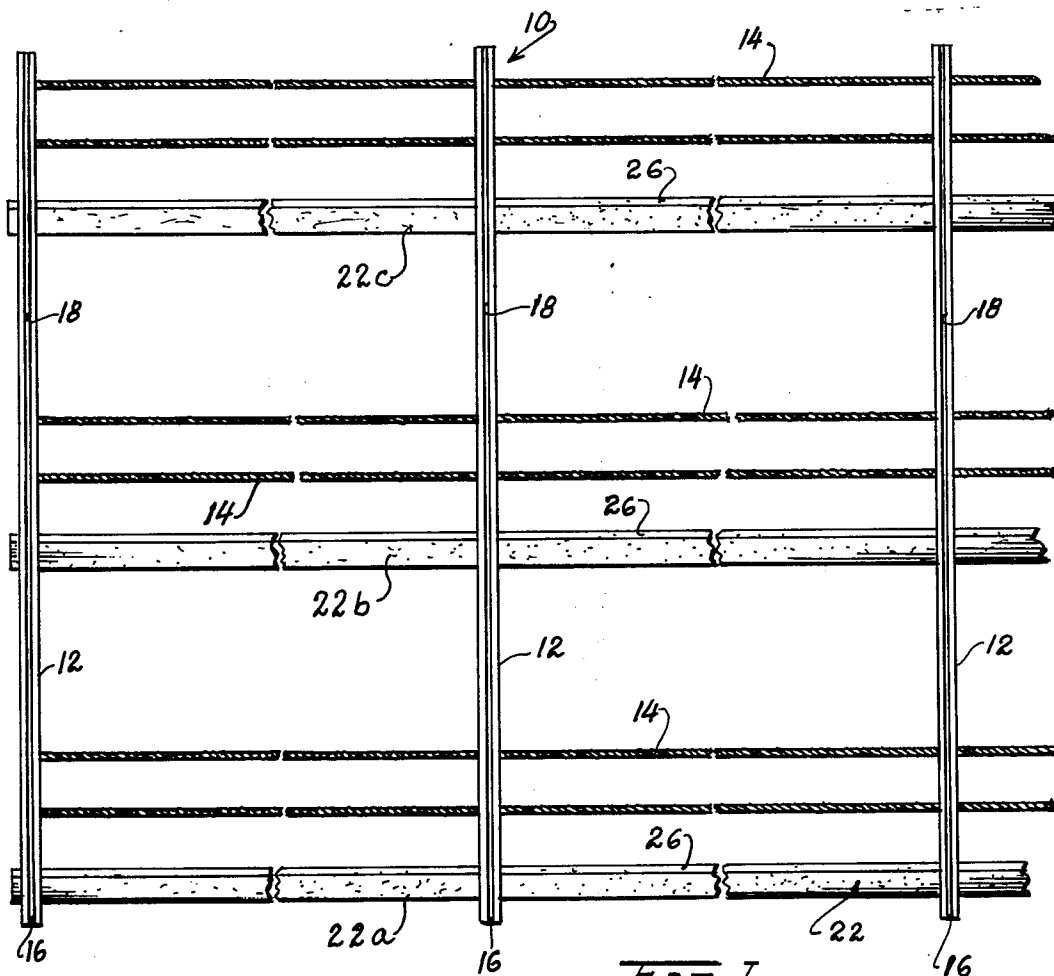


FIG. 1

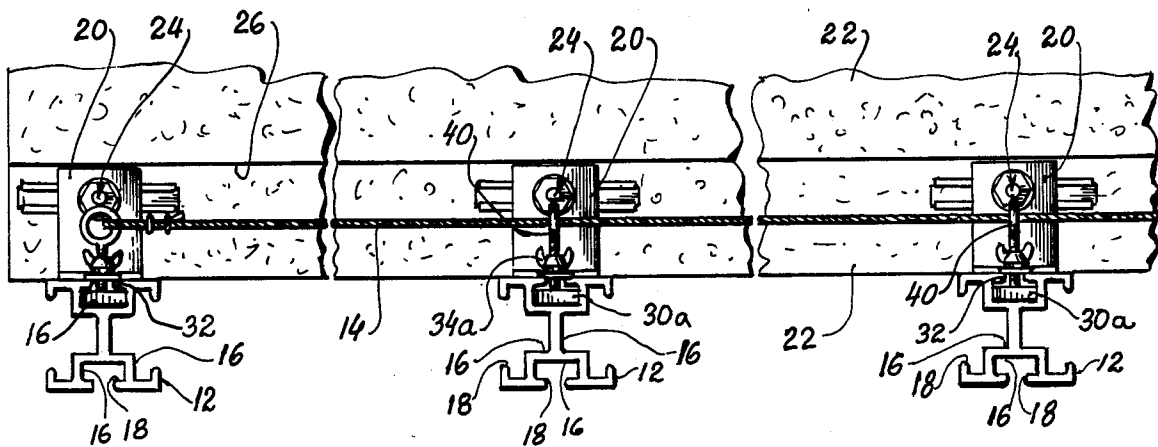


FIG. 2

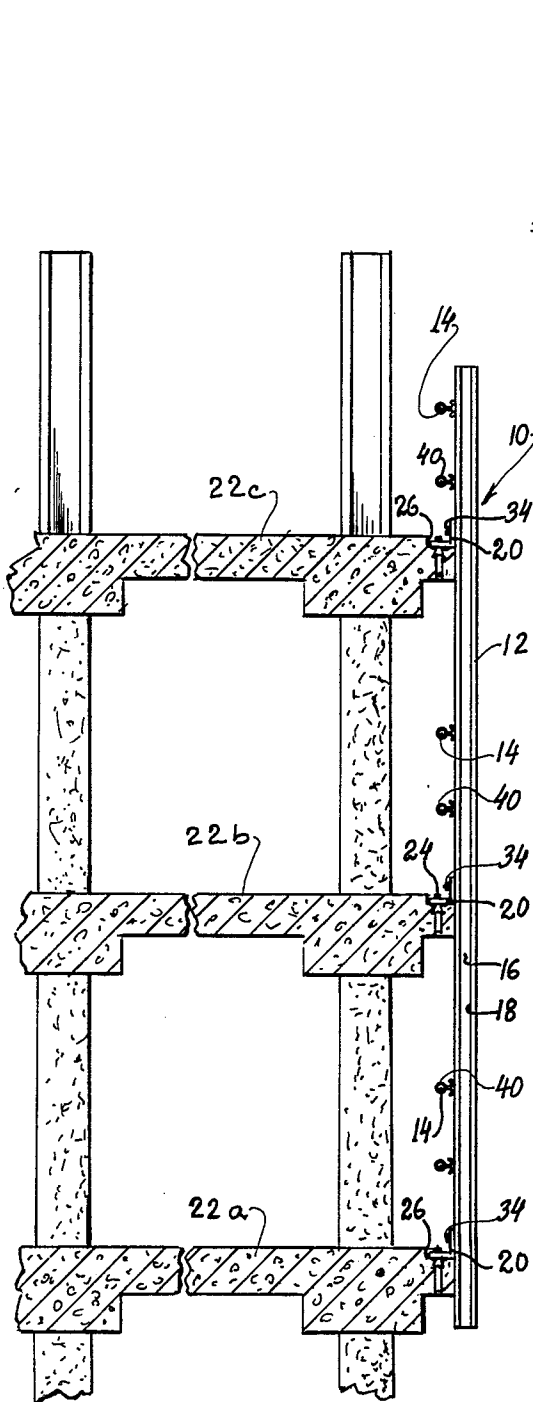


FIG. 3

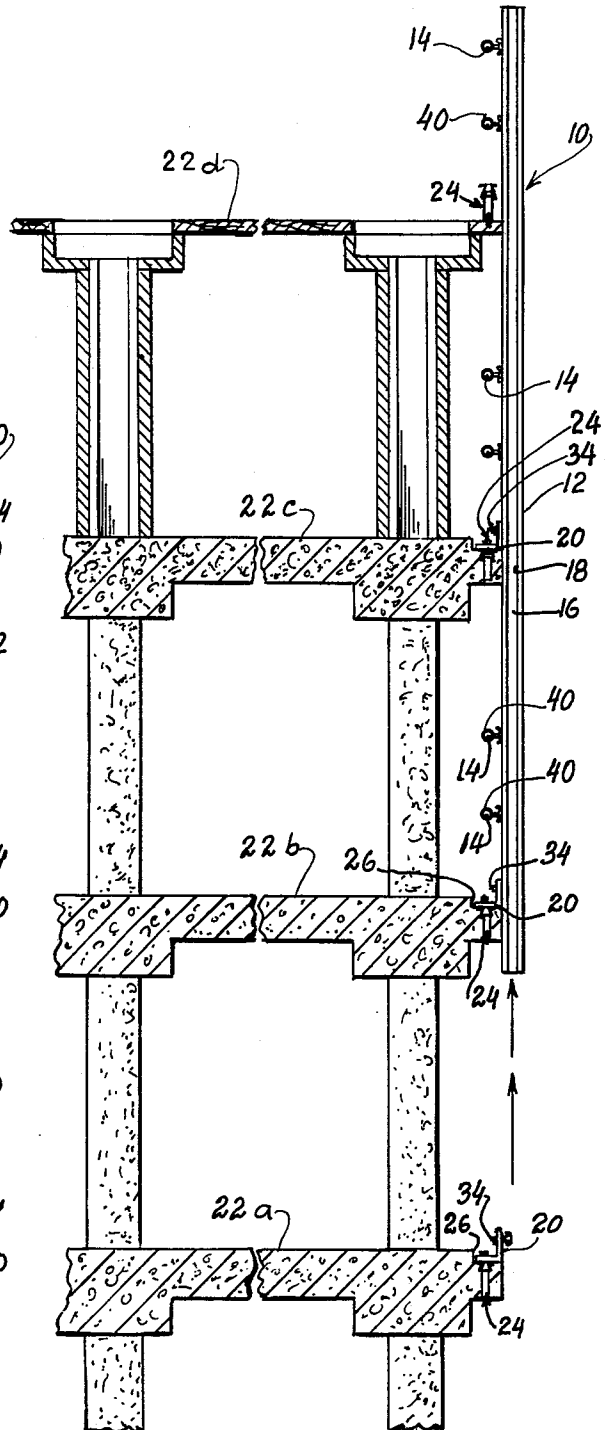


FIG. 4

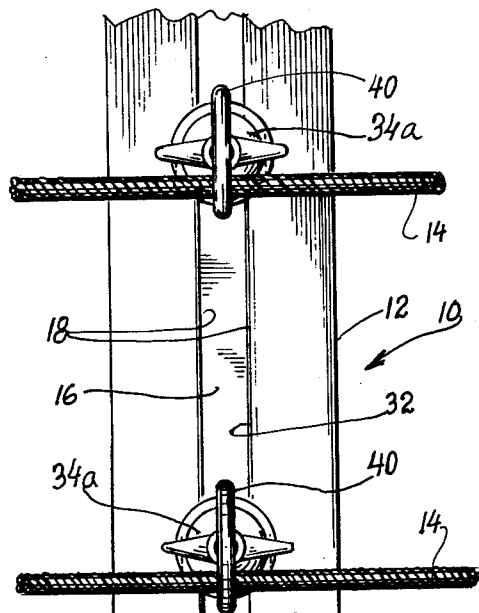


Fig. 5

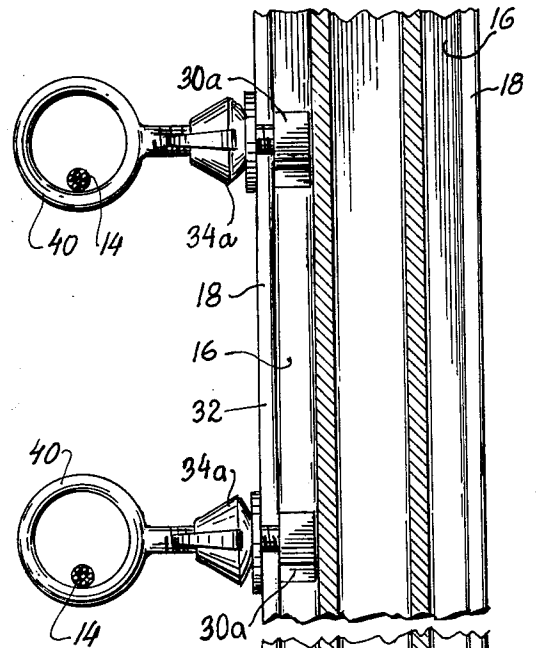
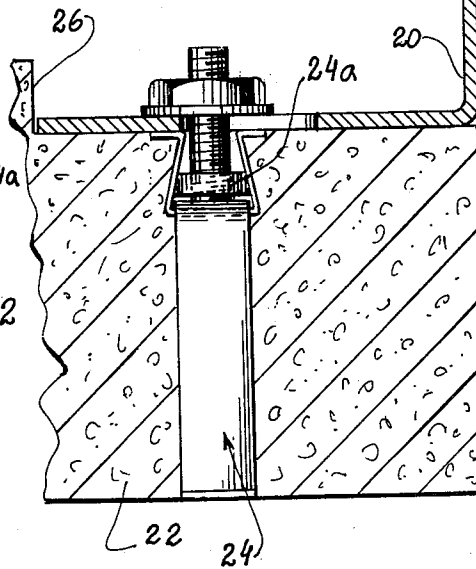
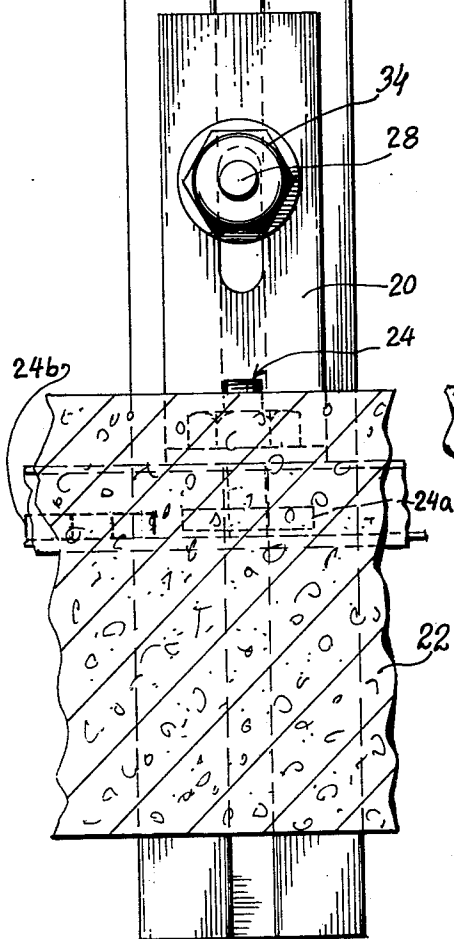
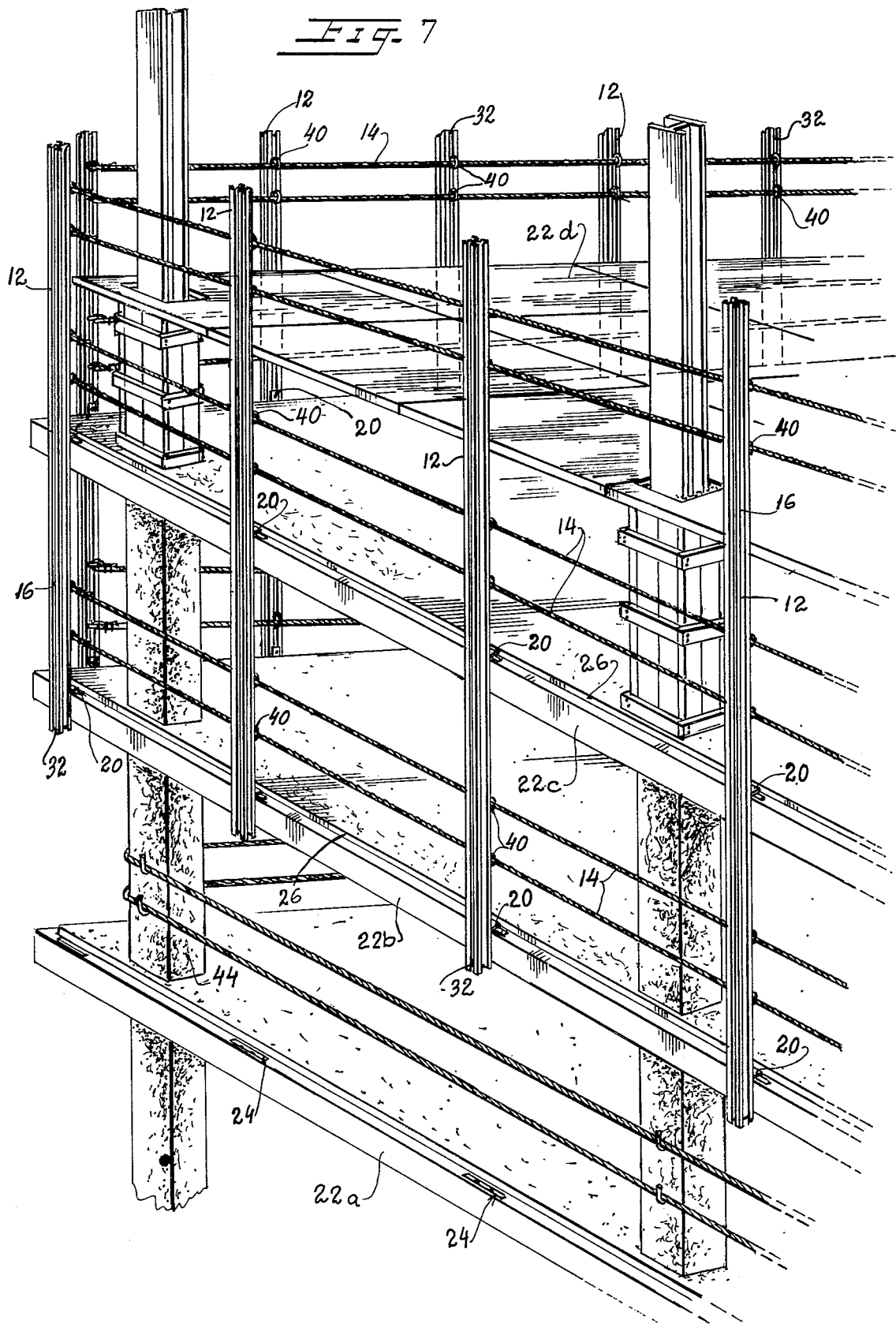
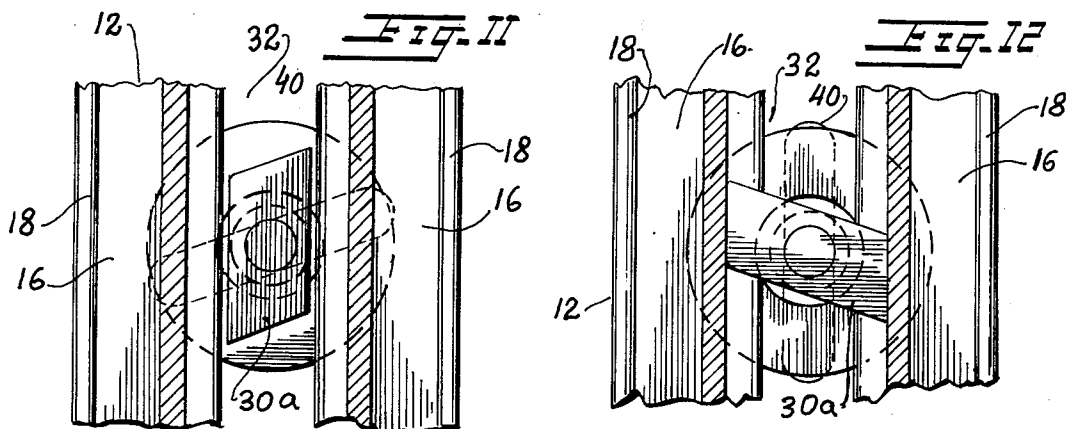
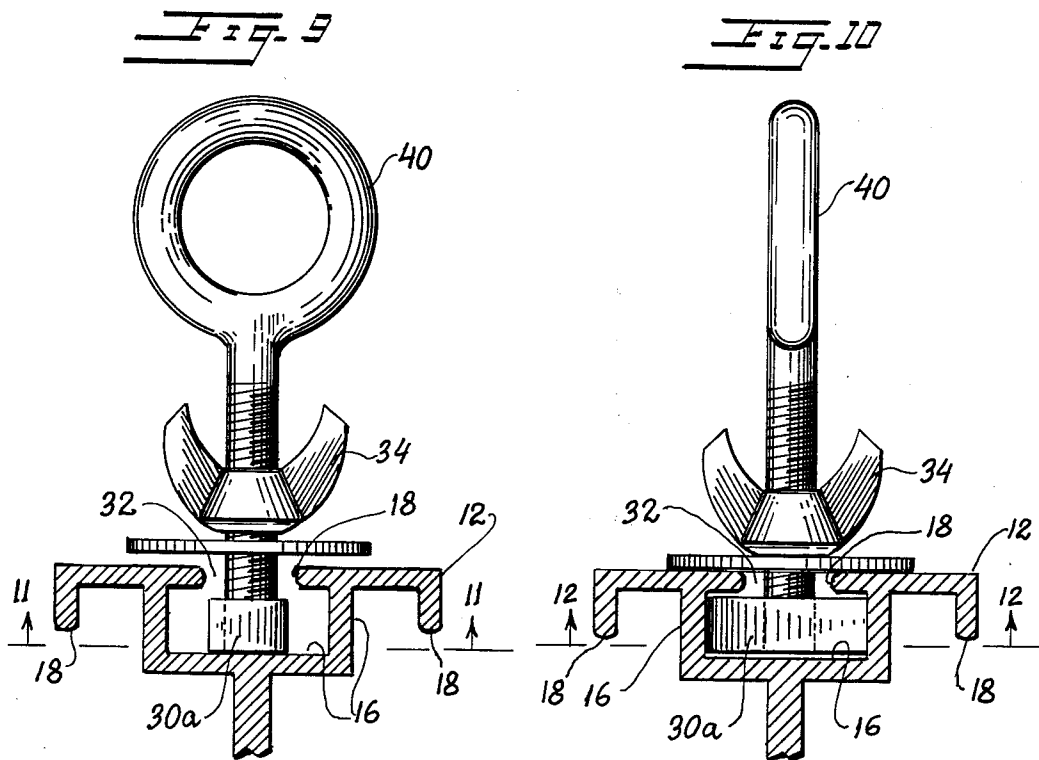
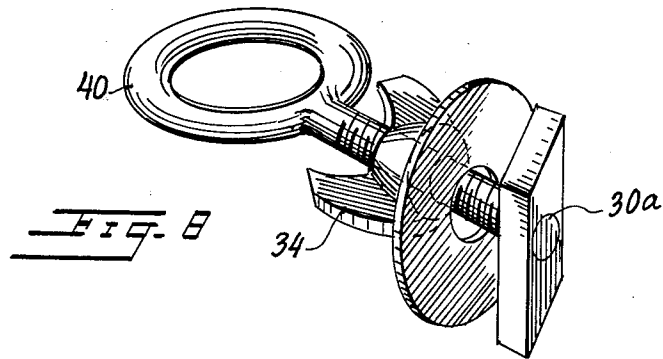


Fig. 6







ELEVATING PERIMETER RAILING

BACKGROUND OF THE INVENTION

While conventional multi-story high-rise construction has provided for the safety of workmen by the use of temporary railings or the like around the edges of floors which have not yet been closed in, the use of such devices has been limited to floors already occupied by workmen. This has been a necessity because workmen were required to install such railings on each floor. This was a practical method of operation but presented the problem of permitting workmen access to floors which had no perimeter protection in order to install such protective railings.

Enactment of the Federal Occupational Safety and Health Act (OSHA) has restricted such practices in that it is prohibited by law to allow workmen unrestricted general access to any floor which does not have an approved perimeter railing. Unfortunately, this provision of law has been honored more in the breach since no method has hereto been devised for placing a perimeter railing about a floor with the minimum number of workmen legally permitted on the floor to set up and secure such a railing.

SUMMARY OF THE INVENTION

It is an object of the present invention to permit erection of a temporary perimeter railing about a newly formed floor during construction of a high-rise building without the necessity of placing workmen on the floor.

It is another object of the invention to provide an apparatus which places a perimeter railing about an upper floor by action of workmen located on a lower floor, without the necessity for any workman to occupy the upper floor before the railing is positioned.

Briefly but not by way of limitation the present invention provides a plurality of vertical stanchions which extend more than two stories in height, said stanchions being vertically slidably secured to the lower two of a group of three floors while extending unfastened above the top of the uppermost of the three floors a sufficient distance to provide a safety railing. The upper of the three floors is accordingly protected by a perimeter railing secured cantilever-like from the next below two floors. As building construction progresses upwardly the stanchions are slid vertically upwardly to protect additional floors as they are formed, with the stanchions being secured to the two floors next below the floor just formed.

In the preferred embodiment the stanchions are channel extrusions having uniform cross-sections throughout their respective lengths. Bolt clamps are secured in the channels to hold floor brackets or safety cable eye bolts. Each stanchion may be moved relative to a floor bracket by loosening the bolt clamp and sliding the stanchion vertically, and then retighten the bolt clamp to hold the stanchion in position.

While it is not necessary to place workmen on the upper floor before the temporary perimeter railing is secured, the presence of a minimum number of workmen on the upper floor to assist in positioning the railing may be helpful and may expedite matters.

DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary front view of three floors of a multi-story building, showing the stanchions extending from two lower floors to a safety railing height

above the third and uppermost floor, with horizontal safety cables interconnecting the stanchions. It may be seen in this figure that at least three floors are provided with perimeter safety railings secured by the same stanchions.

FIG. 2 is a top view of the stanchions and building shown in FIG. 1. The stanchions and brackets have been enlarged to show detail.

FIG. 3 is a side view of the stanchions and the floors of a building under construction. The floors are shown in cross-section. It will be seen that three floors have been completed and are protected by the perimeter railing in the manner shown in FIG. 1. A fourth, upper, floor is about to be formed.

FIG. 4 is a view similar to that of FIG. 3, but showing the uppermost floor under construction and the perimeter railing raised into place about the uppermost floor. Although it would appear from this figure that the lowermost floor is now unprotected, by this stage in construction that floor would have been closed in or otherwise provided with more permanent perimeter protection.

FIG. 5 is an enlarged fragmentary back view of a stanchion in accordance with the invention, showing the floor bracket and two safety cable brackets.

FIG. 6 is a side view, partly in cross-section, of the stanchion shown in FIG. 5. The dovetail insert, originally nailed to the floor form, is now imbedded in the concrete.

FIG. 7 is a perspective view of a corner of a multi-story building showing the temporary perimeter railing of the invention in use, on upper floors, and more permanent perimeter railing on a lower floor.

FIG. 8 is a perspective view of the eyebolt showing the parallelogram nut.

FIG. 9 is a top view of the eyebolt shown ready for insertion in or removal from a stanchion.

FIG. 10 is a view similar to that of FIG. 9 with the eyebolt and nut secured to the stanchion.

Fig. 11 is a front view of the eyebolt and stanchion of FIG. 9.

FIG. 12 is a front view of the eyebolt and stanchion of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, a temporary perimeter railing 10 of the present invention comprises a plurality of vertical stanchions 12 interconnected by a plurality of horizontal cables 14. In the preferred embodiment horizontal cables 14 are aircraft-type steel cables having sufficient strength to meet OSHA requirements. While rope, netting, wire mesh, fence fabric or any other suitable safety guard may be used, it has been found that aircraft cable provides the highest strength, longest lived and least stealable material applicable to heavy duty construction site use.

Each stanchion 12 is a channel having a uniform substantially rectangular cross-section configuration throughout its length. In the preferred embodiment each stanchion is an aluminum extrusion for high strength with light weight. The preferred embodiment provides an extrusion with four flanged U-shaped channels in back-to-back relationship, one on each face of the stanchion, and extending longitudinally for the full length of each stanchion, forming what is essentially a flanged I-beam having high resistance to bending mo-

ments in all directions. Each such flanged U-channel is denominated as channel 16 having flanged 18 at the opening of the U. Such a configuration is provided on each of the faces of the stanchion and permits brackets or other equipment to be fastened, in the manner to be described, on any face of any stanchion throughout its length. Flanges 18 of each U-channel 16 are turned inwardly of and define a channel opening 32. Each U-channel 16 has two such flanges 18, oppositely disposed on either side of channel opening 32, and each U-channel, its flanges and its opening extend longitudinally of the stanchion.

Floor brackets 20 are provided to secure a stanchion to a floor 22 of a building under construction. Each floor bracket 20 is an angle bracket secured to floor 22 in any conventional manner, preferably by a dovetail insert 24, having two nuts 24a and 24b, in the concrete of the floor at a recess 26 provided for the purpose. The vertical portion of floor bracket 20 is secured to stanchion 12 by means of a bolt 28 having a parallelogram shaped head 30 the major dimension of which is larger than the U-channel opening 32 at its place. The minor dimension of head 30 is smaller than U-channel opening 32 for ease of insertion and removed at any position along the stanchion. Tightening a nut 34 onto bolt 28 will secure floor bracket 20 to stanchion 12 by means of pressure exerted against flanges 18 of the U-channel facing fastening the floor bracket. It is clear that a loosening of nut 34 will permit stanchion 12 to slide with respect to bolt 28 for the entire length of the stanchion. Bolt 28 and head 30 may slide out of the bottom of the stanchion if the stanchion is moved far enough. With two floor brackets 20 secured vertically, one above the other on two adjacent floors, it will be seen that a stanchion secured to each of those floor bracket is constrained to slide vertically while engaged with both of those brackets.

Extending horizontally from stanchion to stanchion for whatever length and number of stanchions may be convenient from the point of view of construction and configuration of the floors to be protected are a plurality of horizontal cables 14 which are joined to or pass through eye bolts 40 secured to stanchions 12 for the purpose. Each of the eye bolts 40 is secured in U-channel opening 32 by means of head 30a similar to head 30 and a wing nut 34a which acts in a manner similar to nut 34 whereby each eye bolt 40 is slidably secured to its stanchion 12 by pressure exerted on flanges 18 of channel 32. The purpose of a wing nut is simply to permit ease of re-location of eye bolt by hand rather than by wrench, but any suitable fastener may be used.

Eye bolts 40 are secured to the stanchions at such locations and in such number that the spaces between each of the floors 22 are provided with a suitable number of horizontal safety cables 14. As shown in the drawing, two such cables are provided for each such space, but additional cables can easily be added as may be necessary.

At the end of each horizontal cable run, the cables are secured to eye bolts 40 of the end stanchion 12 by any conventional securing operation. The cables may run through intermediate eye bolts of intermediate stanchions without the necessity for securing the cable at each eye bolt. Obviously, the stronger the cable, the longer a horizontal run is possible. Conversely, the longer the horizontal run the more cumbersome will it be to raise the stanchion since all stanchions in a given

run must be raised simultaneously or the cables loosened to permit individual raising of the stanchions. Because of this high strength of the stanchions and the means for fastening the stanchions to the floor, the cables can be stretched taut and be maintained under considerable tension.

The operation of the temporary perimeter railing 10 of the present invention should be clear, particularly with reference to FIGS. 3, 4, and 7 of the drawing. Starting from a given position as in FIG. 3 wherein a multi-story building is under construction, three floors, 22a, 22b 22c, are shown as having been completed. Temporary perimeter railing 10 comprising a plurality of vertical stanchions 12 interconnected by a horizontal run of cables 14 and secured to each of the three floors, stands on the perimeter of each floor as protection against workmen falling off. The protection afforded to workmen on each of these floors is so easily attained, and so effective, that in fact it is not necessary to move the temporary perimeter railing 10 until construction has progressed to the point at which each of these three floors is closed in by more permanent perimeter protection as shown near the bottom of FIG. 7. This is, however, not the purpose of the invention. The purpose is to permit the railings to "climb" with continued upward construction of the building to provide safety railings at each of the upper floors and particularly on the uppermost floor, without the necessity for workmen to first climb onto an unprotected floor.

As shown in FIG. 4, a fourth floor 22d is under construction. Before workmen are permitted general unrestricted access to floor 22d it is necessary, under OSHA, to provide safety rails at floor edge. This is quickly and easily accomplished by loosening each nut 34 holding floor mounting brackets 20 and sliding stanchions 12 vertically upwardly a sufficient distance to provide the space above floor 22d with perimeter railing protection. Nuts 34 are tightened to secure the stanchion in its new position. If, as in the preferred embodiment and as shown in the drawing, the stanchions are of a sufficient length to extend three floors in height, only two nuts 34 will remain in a position to secure floor brackets 20 to each stanchion, these being at floors 22b and 22c which are the two floors next below newly formed floors 22d.

It will be seen from FIG. 4 that each stanchion 12 extends in cantilever fashion up past uppermost floor 22d without being fastened thereto, securement of each stanchion 12 at floors 22b and 22c being entirely sufficient. Thus, it will be seen that the stanchions may be manually raised by workmen standing on completed floors 22b or 22c, which floors having a safety railing, and no workman is necessary to be positioned on unprotected floor 22d until the railing is in place, although a minimum number of workmen can be used on floor 22d to assist. The remaining floor bracket 20 at bottom floor 22a is no longer necessary to temporary railing 10 and may be removed or used for another purpose. While it may appear from FIG. 4 that floor 22a is now unprotected by a safety railing, by this point in construction that floor will have been provided with more permanent protection, such as cables fastened to building columns 44.

The use of a double-nut dovetail insert 24 permits attachment of additional equipment, or personal safety harness, to the floor while a floor bracket is in place.

The temporary perimeter railing 10 of the present invention has been tested by an independent testing laboratory on a building under construction to determine whether the invention meets the OSHA requirements for a 200-pound horizontal load. The text report is excerpted as follows:

TEST LOCATION: Building number 4 — 18th floor southwest perimeter. Clients evaluation of vertical supports for horizontal open wall perimeter safety barriers. Re: OSHA, Part II, Vol.37, Nos. 2 and 3, Dec. 16, 1972, "Floor Openings to Outside."

TEST AREA: Vertical support assembly and its anchorage.

TEST REQUESTED: Apply rapid thrust force to support assembly right angle clip.

DESCRIPTION OF TEST AREA: The vertical member of this safety barrier is a 23-foot T5 aluminum (60-63) mullion [stanchion 12]. This mullion is supported by an iron right angle clip [floor bracket 20] ($6 \times 9 \times \frac{1}{4}$ inch). The right angle clip is fastened to a previously installed dovetail concrete insert [24] which is located $3\frac{1}{2}$ inches from the floor perimeter in a brick shelf [recess 26]. The dovetail is nailed to the concrete floor form prior to concreting. During concreting the concrete is placed around the dovetail embedding it into the concrete floor. The right angle clip is fastened to the dovetail by a wing nut which fastens to a 2 inch socket screw extending from the dovetail insert.

TEST EQUIPMENT: 10 tons hydraulic jack with an effective ram area of 2,236 square inches. $\frac{4}{8}$ inch face 0-1000 PSI certified and calibrated marsh line pressure gauge.

METHOD OF TEST: The jack cylinder was placed horizontally along floor with ram placed at a right angle and flush against the vertical portion of right angle clip. The base of the jack was braced against a wall column. The ensure correct seating a preload of 100 psi line pressure was applied before conducting test. Thrust was applied rapidly. The following indicates the time which the indicated pressures were reached.

TIME seconds	TOTAL LINE PRESSURE psi	CORRECTED LINE PRESSURE FOR PRELOADING psi	POUND THRUST psi
1	350	250	559
2	450	350	783
5	700	600	1342

At 1342 psi thrust (corrected) line pressure fell off to 350 (559 psi thrust) and tensile cracking of the concrete became apparent. Total failure did not occur however and 10 minutes elapsed without further loss (indicating no further deflection) in line pressure. The test was discontinued at this time.

The dovetail was imbedded in 4000 psi stone concrete that had been placed 29 hours prior to the test. Concrete test cyliners obtained from the placement area and cured on the floor over night indicated an average 24 hour compressive strength of 928 psi. It should be noted that curing conditions over night were adverse with marginal temperatures and high winds.

It will be seen from the above test report that horizontal thrust as high as 600 psi were attained before failure occurred, and even then failure was to the concrete, and no to the stanchions or fastening members

of the invention. Thus the 200-pound OSHA requirement was easily met and exceeded.

It will thus be seen that the invention provides a railing which is temporary only insofar as it is not intended to remain permanently a part of the building structure. The present invention provides a railing which "climbs" the building to follow construction thereof, and constantly and continuously protect the uppermost floor and floors immediately below the uppermost floor in the manner required by OSHA. While the foregoing has described a preferred embodiment of the invention it is clear that other embodiments may be had within the teachings hereof. For example, the cross-sectional configuration for each stanchion 12 in the preferred embodiment constitutes the four back-to-back flanged U-channels as shown and described. That configuration however may be modified to meet particular requirements.

What is claimed is:

1. A temporary perimeter railing for multi-story building construction, comprising:

- a plurality of stanchions, each stanchion being of a length at least sufficient to extend past three adjacent floors of the building under construction;
- a plurality of floor brackets adapted to slidably secure said stanchions to the floors of the building under construction, at least two of said floor brackets being vertically disposed adjacent the edges of adjacent floors for each of said stanchions whereby each stanchion is vertically slidably constrained such that each stanchion may be raised to extend above an upper floor and to be secured by said floor brackets disposed on at least two lower floors; and
- safety guards extending from stanchion to stanchion and secured thereto.

2. A temporary perimeter railing for multi-story building construction in accordance with claim 1, wherein:

each of said stanchions comprises a beam having at least one flanged U-channel extending longitudinally thereof.

3. A temporary perimeter railing for multi-story building construction in accordance with claim 1, wherein:

each of said stanchions comprises four flanged U-channels disposed in back-to-back relationship, each extending longitudinally thereof.

4. A temporary perimeter railing for multi-story building construction in accordance with claim 1, wherein:

said safety guards comprise a plurality of cables extending horizontally from stanchion to stanchion, the ends of each cable being secured to stanchions adjacent said ends, each cable passing through an eye bolt slidably secured to stanchions intermediate its ends.

5. A temporary perimeter railing for multi-story building construction in accordance with claim 1, wherein:

each of said floor brackets comprises an angle bracket one flange of which is secured to a floor and the other flange of which is securable to a stanchion by means of a bolt which engages a flanged channel provided in the stanchion for the purpose.

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