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(71) Applicant *(for all designated States except US)*: **GRO-CON PTY LIMITED** [AU/AU]; 3 Albert Coates Lane, QV Building, Melbourne, Victoria 3000 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **SHAW, Graham William** [AU/AU]; 3 Albert Coates Lane, QV Building, Melbourne, Victoria 3000 (AU).

(74) Agent: **FREEHILLS PATENT & TRADE MARK ATTORNEYS**; Level 43, 101 Collins Street, Melbourne, Victoria 3000 (AU).

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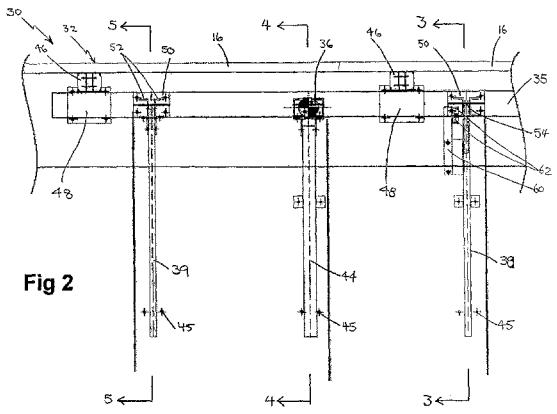


Fig 2

(57) **Abstract:** The invention provides a perimeter screening system for a multi-level building, that includes a screen assembly (32) including at least one perimeter screen (16), and lifting means (36) connected to the assembly and fitted with a first support member (44) detachably connectable to a floor of the building to provide a bearing point for lifting the screen assembly to another floor. A pair of second support members (38,39) is laterally spaced from the first support member and the second support members are detachably connectable to a floor for receiving the load of the screen assembly whilst the screen assembly is in a stationary position. At least one vertical guide column (50) is connected to the screen assembly and has a plurality of vertically spaced apart horizontal elements (54). Safety means (56) is fitted to at least one of the second support members and interacts with the at least one vertical guide column so as to allow the screen assembly and guide column to be lifted past but to receive the load of the screen assembly by engaging under one of the horizontal elements in the event of failure of the lifting means during lifting of the screen assembly. At least another of the second support members is retractable towards the screen assembly to travel with the screen assembly past a next floor during lifting of the screen assembly, and the first support member is retractable towards the lifting means to travel with the lifting means past a next floor as it is retracted upwardly.

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Perimeter screening system

Field of the invention

The present invention relates generally to a perimeter screening system for use during the construction of multi-level buildings, especially high-rise tower buildings.

Background of the invention

A major constraint on the construction of high-rise buildings is the strength of prevailing winds. Notwithstanding the installation of guardrails at the adjacent edge of a floor slab, there is a maximum wind speed above which the installation of cladding cannot be safely continued. The typical limiting wind speed for tower cladding installation is recognised as being about 10m/s.

To overcome this limitation and to additionally improve safety, perimeter screening systems are used to guard and protect the edges of the floors of buildings as the floors are being constructed. The perimeter screens usually extend over multiple floors, typically three or four. When a new floor is being built, the perimeter screens are moved up or "jumped" to the next floor.

Presently, to move perimeter screens between floors, each individual screen is lifted up to the next floor by a crane. A typical building may include around thirty to fifty perimeter screens. Pouring of a floor is carried out in zones so that perimeter screen lifting and form jacking can be carried out in one zone, while another zone is being poured and a third is drying. For each zone, there may be eighteen perimeter screens. Each perimeter screen will have two beams temporarily held to the floor by a large bolt at the inner end. The outer end is connected to the perimeter screen. These beams are termed "needles" in the building industry and take the weight of the screen. Prior to connecting the crane to the screens a second level of needles is located on the new floor level above. These needles are required to support the perimeter screens when

they are raised, therefore two levels of needles are required. Once the crane has taken the load of the perimeter screen, all of the needles on the lower level are unbolted and

removed by workers and manually transported to the next floor, two levels above prior to raising the screen. When moving a zone of eighteen screens, for example, thirty-six needles need to be manually removed, transported to the next floor and re-fixed.

The current system is manually laborious and can take around ten hours to move an entire zone of perimeter screens. The screens are typically moved up a floor every seven days or so. Another limitation of the current system is that cranes can only operate in wind speeds up to a set maximum, eg 21m/s, which can be somewhat limiting in areas of regularly higher wind speeds.

One attempt to eliminate the use of a crane involves the temporary installation of a mast between the building floors to be jumped. The mast includes a plurality of holes, spaced every 40mm or so along the mast. The perimeter screen is jumped up the mast between the holes in multiple stages. Such a system is laborious and time consuming, taking around four hours to jump one perimeter screen up to the next floor.

It is not admitted that any of the information in this specification is common general knowledge, or that the person skilled in the art could be reasonably expected to have ascertained, understood, regarded it as relevant or combined it in anyway at the priority date.

It is therefore an object of the present invention to provide a perimeter screening system that at least in part alleviates one of more of the problems associated with current systems.

Summary of the invention

The invention provides a perimeter screening system for a multi-level building, that includes a screen assembly including at least one perimeter screen, and lifting means connected to the assembly and fitted with a first support member detachably connectable to a floor of the building to provide a bearing point for lifting the screen

assembly to another floor. A pair of second support members is laterally spaced from the first support member and the second support members are detachably connectable to a floor for receiving the load of the screen assembly whilst the screen assembly is in a stationary position. At least one vertical guide column is connected to the screen assembly and has a plurality of vertically spaced apart horizontal elements. Safety means is fitted to at least one of the second support members and interacts with the at least one vertical guide column so as to allow the screen assembly and guide column to be lifted past but to receive the load of the screen assembly by engaging under one of the horizontal elements in the event of failure of the lifting means during lifting of the screen assembly. At least another of the second support members is retractable towards the screen assembly to travel with the screen assembly past a next floor during lifting of the screen assembly, and the first support member is retractable towards the lifting means to travel with the lifting means past a next floor as it is retracted upwardly.

Preferably the first support member is spaced from and between the second support members when viewed in plan.

The screen assembly may include multiple perimeter screens connected in series side by side. In this case there are at least two of the first support member, at least two of the guide columns, and at least two pairs of the second support members, and the first support members are between the second support members of the respective pairs when viewed in plan. Furthermore, the multiple perimeter screens may be connected in series side by side by at least one horizontal beam or truss assembly and the lifting means and guide column(s) may be affixed to the horizontal beam or truss assembly.

Preferably the retractable first and second support members are pivotally retractable.

The lifting means may be, for example, a hydraulic ram apparatus, or a screw jack.

Preferably the or each guide column slidably engages the respective second support members to prevent lateral movement of the screen assembly. This slidable engagement may include a roller mechanism at an end of the beam for preventing lateral movement of the screen assembly whilst stationary and whilst being raised from a first floor to a second floor.

The perimeter screening system may further include support props and/or braces associated with the first and first support members, that are retractable to travel with the screen assembly or lifting means, as applicable, as they travel upwardly.

In an embodiment wherein the or each guide column is a pair of spaced beams and said vertically spaced apart horizontal elements are bars extending across the space between the beams.

Preferably, two guide columns are provided, however there may be additional guide columns or other vertical support columns, such as I-beams.

The safety means may include a one-way rotational arm that is prevented from pivoting downwardly from a rest position but is capable of supporting the load of the screen assembly by engaging under one of the horizontal bars of the guide column, the arm being able to rotate upwardly such that, upon lifting of the screen assembly, the horizontal members are free to push past the arm. The bottom of the arm may include a chamfer to assist the horizontal bars to push past. If, whilst lifting, the lifting means fail, the arm will prevent the screen assembly falling past it as it engages under a respective horizontal bar.

Typically, the first support member is a needle beam, and the second support members are needle beams.

The invention also provides a method for lifting the screen assembly of the aforementioned perimeter screening system, comprising:

retracting said other of the second support members towards the screen assembly;

operating the lifting means to lift the screen assembly, while said safety means interacts with said guide column so as to receive the load of the screen assembly by engaging under one of the horizontal elements in the event of failure of said lifting means during lifting of the screen assembly;

retracting the first support member towards the lifting means; and

retracting the lifting means upwardly.

According to another aspect of the invention, there is provided a support and guidance assembly for a screen assembly including at least one perimeter screen for a multi-level building, the screen assembly being moveable from a first floor to a second floor, the assembly including:

a longitudinal beam having a first end and a second end;

connection means at or adjacent the first end for detachably connecting the beam to said first floor with the beam extending across the floor to the screen assembly beyond the edge of the floor;

a roller mechanism at the second end of the beam for preventing lateral movement of the screen assembly whilst stationary and whilst being raised from the first floor to the second floor; and

support means at the second end of the beam for supporting the weight of the screen assembly whilst stationary, the support means being further capable of receiving the load of the screen assembly in the event of a failure of a lifting means during movement of the screen assembly from the first floor to the second floor.

Advantageously, whilst lifting of the screen assembly is occurring, safety means is provided that is capable of receiving the load of the screen assembly in the event of failure of the lifting means during lifting. The safety means allows the screen assembly to be lifted past and may be provided by the support beam.

Preferably, the screen assembly includes multiple perimeter screens connected in series side by side.

As used herein, except where the context requires otherwise the term "comprise" and variations of the term, such as "comprising", "comprises" and "comprised", are not intended to exclude other additives, components, integers or steps.

Brief description of the drawings

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a floor plan of a typical building using a perimeter screening system according to the present invention;

Figure 2 is a plan view of a section of the perimeter screening system according to the present invention;

Figure 3 is a sectional side elevation of the perimeter screening system at a guide beam location through line 3-3 of Figure 2;

Figure 4 is a sectional side elevation similar to Figure 3 of the perimeter screening system at a hydraulic ram location through line 4-4 of Figure 2;

Figure 5 is a sectional side elevation of the perimeter screening system at a guide beam location through line 5-5 of Figure 2;

Figure 6 is a sectional side elevation of the perimeter screening system similar to Figure 3 prior to lifting;

Figure 7 is a partial sectional side view corresponding to Figure 3;

Figure 8 is a partial sectional side view corresponding to Figure 4;

Figure 9 is a partial sectional side view corresponding to Figure 5;

Figure 10 is a partial sectional side view corresponding to Figure 6;

Figure 11 is a sectional side elevation of a portion of the upper I-beam and vertical column connection with the support beam; and

Figure 12 is a sectional side elevation of a portion of the lower I-beam and vertical column.

Detailed description of the embodiments

Figure 1 shows a floor plan of a multi-level building 10 that is under construction. The concrete floor 12 is poured in zones 1, 2, and 3, the boundaries of which are shown by dashed line 14. Zone 1 has been poured and has now set, zone 2 is currently drying and zone 3 has just been poured.

Perimeter screens 16 are located around the perimeter of the floor to enclose the working area for safety and to protect workers and equipment against wind loads. The perimeter screens 16 extend above to the next floor 18 where the concrete floor is currently being poured, in corresponding zone 1, and to one or two floors below 20, 22, where workers are still constructing the floor including the installation of wall cladding, which then negates the need for perimeter screens. When zone 1 on the next floor 18 has set, the perimeter screens 16 are lifted up a floor to protect the new floors being constructed.

The present invention provides a perimeter screening system 30 that includes a screen assembly 32. The screen assembly 32 includes at least one perimeter screen 16. In the embodiment illustrated in the drawings the screen assembly 32 includes multiple perimeter screens 16, between three and five, connected together in series side by side, as shown in Figures 1 and 2. The perimeter screens 16 are connected together by horizontal beams 34, 35.

Lifting means, such as hydraulic rams 36, are connected to the screen assembly 32 to lift the screen assembly from the first floor 12 to the second floor 18. It will be appreciated that alternate lifting means, such as an electric screw jack, may be used.

The perimeter screening system 30, as shown in Figures 1 and 2, includes support members in the form of beams, respectively ram support beams 44 comprising first support members, and inner beams 38 and outer beams 39 comprising second support members. Beams 38,39 are fitted in spaced pairs toward either end of the screen assembly 32. These beams 38, 39, functionally known as needle beams, are detachably mounted at a first end 40 and extend along the floor 12 to connect with the screen assembly 32 at a second end 42. The beams 38, 39 support the weight of the screen assembly 32 whilst stationary. Each ram support beam 44 is pivotally connected to a ram 36, is detachably connectable to the first floor 12 and provides a bearing point for lifting the screen assembly 32 from the first floor 12 to the second floor 18. Two rams 36 and ram support beams 44 are provided in the illustrated embodiment, and are spaced from and located between the pairs of support beams 38, 39, when viewed in plan as shown in Figure 2. The support beams 38, 39 and the ram support beams 44 are detachably connected via tie down brackets 45 into the concrete floor 12. Beams 39 are pivotally retractable towards screen assembly 32, and each beam 44 is pivotably retractable towards its ram 36.

It will be appreciated that a single lifting means may be provided, however it is preferable to provide at least two to ensure stability.

The perimeter screens 16 are connected to upright members 46 which have upper and lower right angle brackets 48 attached thereto. Connected to the right angle brackets 48 are the horizontal beams 34, 35. The horizontal beams 34, 35, best shown in Figures 11 and 12, are transverse I-beams. Extending between the upper and lower horizontal beams 34, 35 are four vertically extending guide columns 50. Each guide column 50 aligns with a support beam 38. It will be appreciate that only two guide columns may be present, those aligning with the inner support beams 38. Vertical support columns, such as I-beams may be provided to align with the outer support beams 39.

The guide columns 50 are pairs of spaced beams, such as back-to-back channels 52, and include a plurality of vertically spaced apart horizontal elements, in this case bars 54, extending across the space between the channels 52: this can be seen in Figure 2. The second end 42 of the support beam 38, 39 includes a one-way rotational arm 56

that is prevented from pivoting downwardly and therefore is capable of supporting the load of the screen assembly 32 by engaging under one of the horizontal bars 54 on the guide column 50. The arm 56 includes a hooked portion 58 to positively receive the horizontal bars 54.

The one-way rotational arm 56 also provides a safety means. As the arm 56 is able to rotate upwardly, as the screen assembly 32 is lifted, the horizontal bars 54 on the guide column push past the arm 56. A chamfer 64 on the underside of the arm assists this. Some or all of the support beams 38, 39 may therefore be left in place during lifting of the screen assembly 32 to provide a secondary support should the ram 36 fail during lifting. If the ram 36 fails, the screen assembly will fall until the rotational arm 56 catches under the next horizontal bar 54. As the horizontal bars 54 are preferably spaced approximately 300mm apart, the furthest the screen assembly 32 will fall is 300mm.

The second end 42 of the support beam 38, 39 also includes a roller mechanism 60 with two rollers 62 that engage around the edge of one of the channels 52 of the guide column 50, shown best in Figures 2 and 11. The roller mechanisms 60 prevent lateral movement of the screen assembly 32 and the screen assembly is guided by the rollers 62 as it is lifted. The roller mechanism 60 removes the drag effect of other types of connections.

The hydraulic ram 36 includes a first component 66, which is detachably connected to the first floor 12 via the ram support beam 44, and a second component 68 that is slidably received in the first component 66. The second component 68 is connected to the screen assembly 32 by being fixed to the upper horizontal beam 35. A diagonal brace 74 is provided between the ram 36 and the floor 12 to provide additional support, particularly whilst lifting. Push/pull diagonal props 75 are also provided in line with the support beams 38, 39.

Under strong wind conditions, the screen assembly is prevented from inward movement by a bumper arrangement 70 that abuts against the lower floor 22. Also at floor 22, a pair of temporary tie rods 72 are clipped into place to prevent the screen being blown

out from the building. It will be appreciated that the tie rods may be both tensile and compressive and therefore the bumper arrangement 70 will not be required.

Figures 3 and 7 show the configuration of the assembly when stationary and in use for screening floor 12. When the perimeter screens are to be lifted or "jumped" to the next floor 18, two additional support beams 76 are fitted to the floor 18, as shown in Figures 6 and 10. These beams 76 are positioned over the inner two beams 38 of the screen assembly 32. The tie rods 72 on floor 22 are released and the outer push/pull props 75 are released and folded against the guide columns 50. The ram 36 is loaded with sufficient pressure to take the load off the support beams 38, 39. The two outer support beams 39 are folded up against the guide beam 50 and fixed into place so they are able to move with the screen assembly 32, as shown in Figures 5 and 9. The two inner beams 38 are left in place on floor 12. The two inner push/pull props are then released.

Full pressure is then applied to the ram 36 and the second component 68 is extended away from the first component 66, with the load being borne by the ram support beam 44 through to the first floor 12. As the screen assembly is lifted, the one-way pivoting arms 56 on the remaining support beams 38 swing upwardly and drop back to their horizontal position as the horizontal bars 54 on the guide column 50 move past. Whilst lifting, the guide column 50 is guided by the roller mechanism 60 preventing lateral movement of the screen assembly 32.

When the screen assembly 32 reaches its new position it is slightly above the required level. The screen assembly will settle down onto the next horizontal bars 54. The two outer support beams 39 carried by the screen assembly 32 are swung down and bolted into place on the newly poured floor 18. The push/pull props 75 are refitted, as are the tie rods 72.

As shown in Figures 4 and 8, the ram support beams 44 are pivotally connected to the ram 36 so that they can be folded up and fixed against the first component 66 of the ram 36. The diagonal brace 74 is released and is preferably also fixed against the first component 66. Once the screen assembly 32 is fully secured to the floor 18, the first component 66 is retracted to the second component 68 lifting the ram support beam 44

and the diagonal brace 74 with it. These are then fixed to the new floor 18 before re-jumping to a floor above.

At leisure, the workers can unbolt and remove the two support beams 38 from floor 12 and carry them up two floors for installation prior to the next jumping operation. This can be done once all of the screen assemblies on floor 12 have been jumped up to the next floor, resulting in twenty support beams 38 on floor 12 being manually carried. This is in contrast to the seventy-four that would have needed to be manually carried for the illustrated floor by the prior art system.

As a perimeter screen is typically raised every five to seven days, the reduction in manual labour and time taken to the lift the perimeter screens on a floor is significant. Instead of jumping one perimeter screen in an hour, a screen assembly of multiple perimeter screens, such as five, can be jumped in the same time. Given that a floor may include around over thirty perimeter screens, the time saved is substantial.

It will be understood that the invention disclosed and defined in this specification extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of these different combinations constitute various alternative aspects of the invention.

CLAIMS

1. A perimeter screening system for a multi-level building, comprising:

a screen assembly including at least one perimeter screen;

lifting means connected to the assembly and fitted with a first support member detachably connectable to a floor of the building to provide a bearing point for lifting the screen assembly to another floor;

a pair of second support members laterally spaced from the first support member and each detachably connectable to a floor for receiving the load of the screen assembly whilst the screen assembly is in a stationary position;

at least one vertical guide column connected to the screen assembly and having a plurality of vertically spaced apart horizontal elements; and

safety means fitted to at least one of the second support members and interacting with said at least one vertical guide column so as to allow the screen assembly and guide column to be lifted past but to receive the load of the screen assembly by engaging under one of the horizontal elements in the event of failure of said lifting means during said lifting of the screen assembly;

wherein at least another of the second support members is retractable towards the screen assembly to travel with the screen assembly past a next floor during said lifting of the screen assembly, and said first support member is retractable towards the lifting means to travel with the lifting means past a next floor as it is retracted upwardly.

2. A perimeter screening system according to claim 1 wherein the first support member is spaced from and between the second support members when viewed in plan.

3. A perimeter screening system according to claim 1 wherein the screen assembly includes multiple perimeter screens connected in series side by side.

4. A perimeter screening system according to claim 3 wherein there are at least two of said first support member, at least two of said guide columns, and at least two pairs of said second support members, and wherein the first support members are between the second support members of the respective pairs when viewed in plan.

5. A perimeter screening system according to any one of claims 1 to 4 wherein said retractable first and second support members are pivotally retractable.

6. A perimeter screening system according to any one of claims 1 to 5 wherein said lifting means is a hydraulic ram apparatus.

7. A perimeter screening system according to any one of claims 1 to 5 wherein said lifting means is a screw jack.

8. A perimeter screening system according to any one of claims 1 to 7 wherein the or each guide column slidably engages the respective second support members to prevent lateral movement of the screen assembly.

9. A perimeter screening system according to claim 8 wherein the slidable engagement includes a roller mechanism at an end of the beam for preventing lateral movement of the screen assembly whilst stationary and whilst being raised from a first floor to a second floor.

10. A perimeter screening system according to any one of claims 1 to 9 further including support props and/or braces associated with the first and first support members, which props and/or braces are retractable to travel with the screen assembly or lifting means, as applicable, as they travel upwardly.

11. A perimeter screening system according to any one of claims 1 to 10 wherein the screen assembly includes multiple perimeter screens connected in series side by side by at least one horizontal beam or truss assembly and wherein said lifting means and guide column(s) are affixed to said at least horizontal beam or truss assembly.

12. A perimeter screening system according to any one of claims 1 to 11 wherein the or each guide column is a pair of spaced beams and said vertically spaced apart horizontal elements are bars extending across the space between the beams.

13. A perimeter screening system according to any one of claims 1 to 12 wherein said safety means includes a one-way rotational arm that is prevented from pivoting downwardly from a rest position but is capable of supporting the load of the screen assembly by engaging under one of the horizontal bars of the guide column, the arm being able to rotate upwardly such that, upon lifting of the screen assembly, said horizontal members are free to push past the arm.

14. A perimeter screening system according to any one of claims 1 13 wherein said first support member is a needle beam.

15. A perimeter screening system according to any one of claims 1 to 14 wherein said second support members are needle beams.

16. A method for lifting the screen assembly of the perimeter screening system of any one of claims 1 to 15, comprising:

retracting said other of the second support members towards the screen assembly;

operating the lifting means to lift the screen assembly, while said safety means interacts with said guide column so as to receive the load of the screen assembly by engaging under one of the horizontal elements in the event of failure of said lifting means during lifting of the screen assembly;

retracting the first support member towards the lifting means; and

retracting the lifting means upwardly.

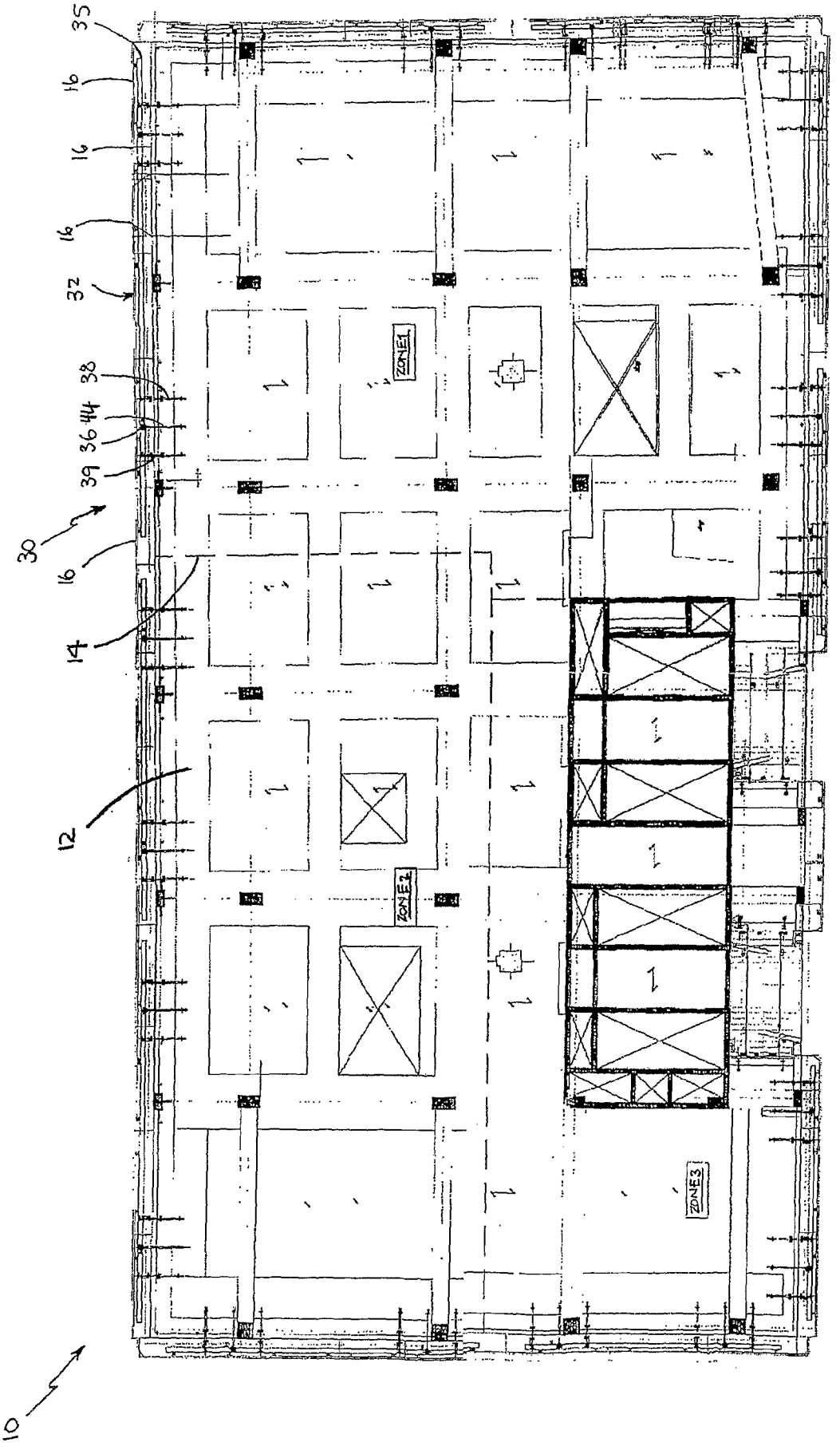


Fig 1

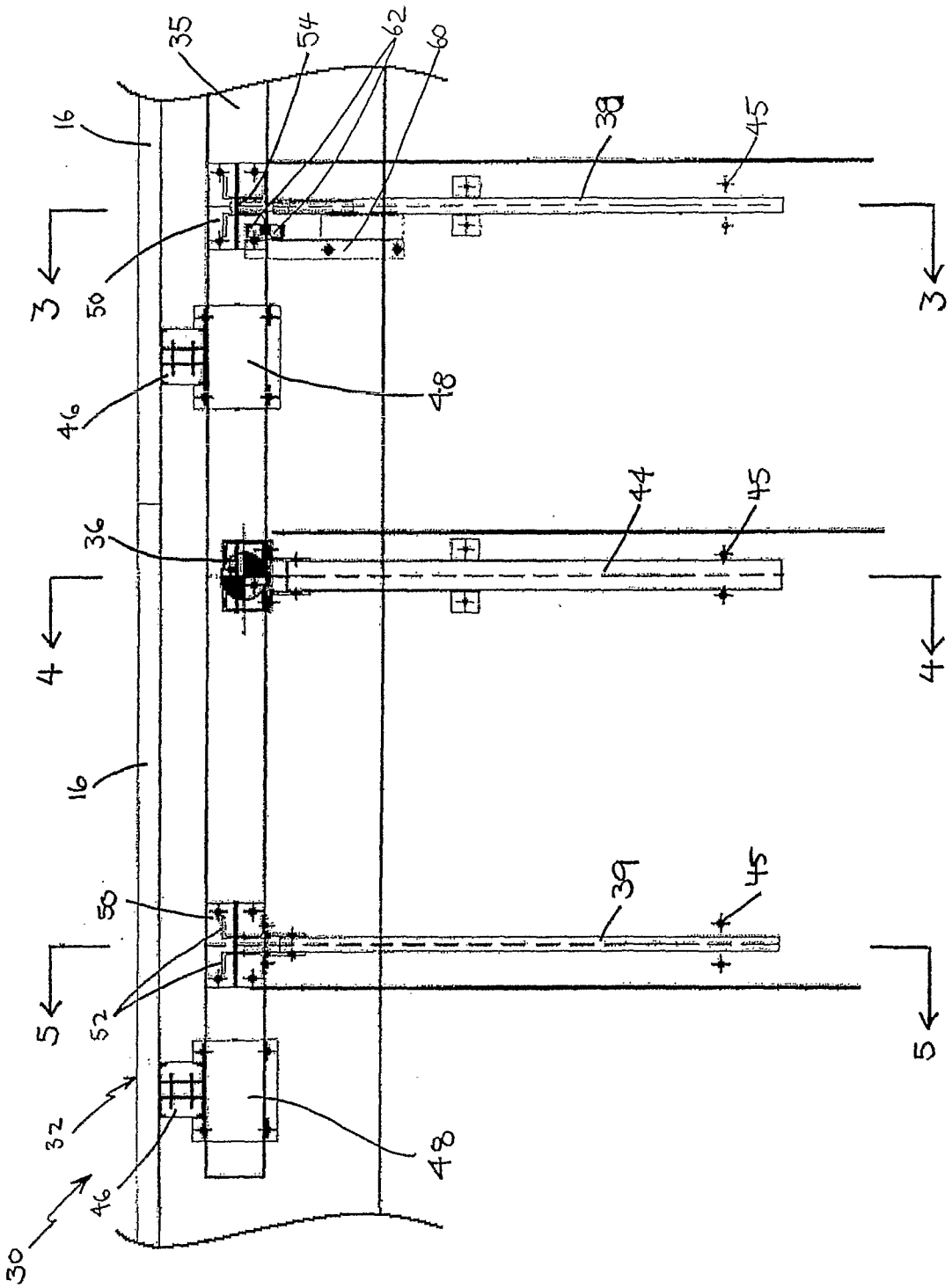

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Fig 2

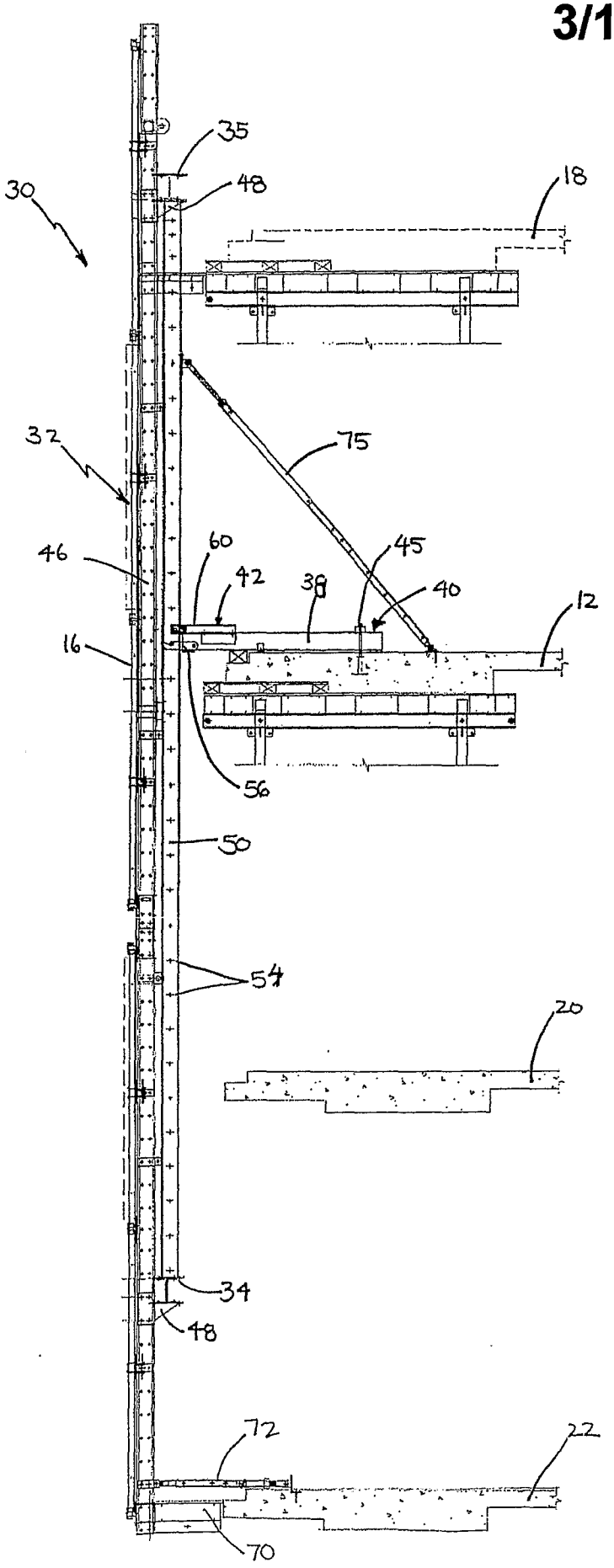


Fig 3

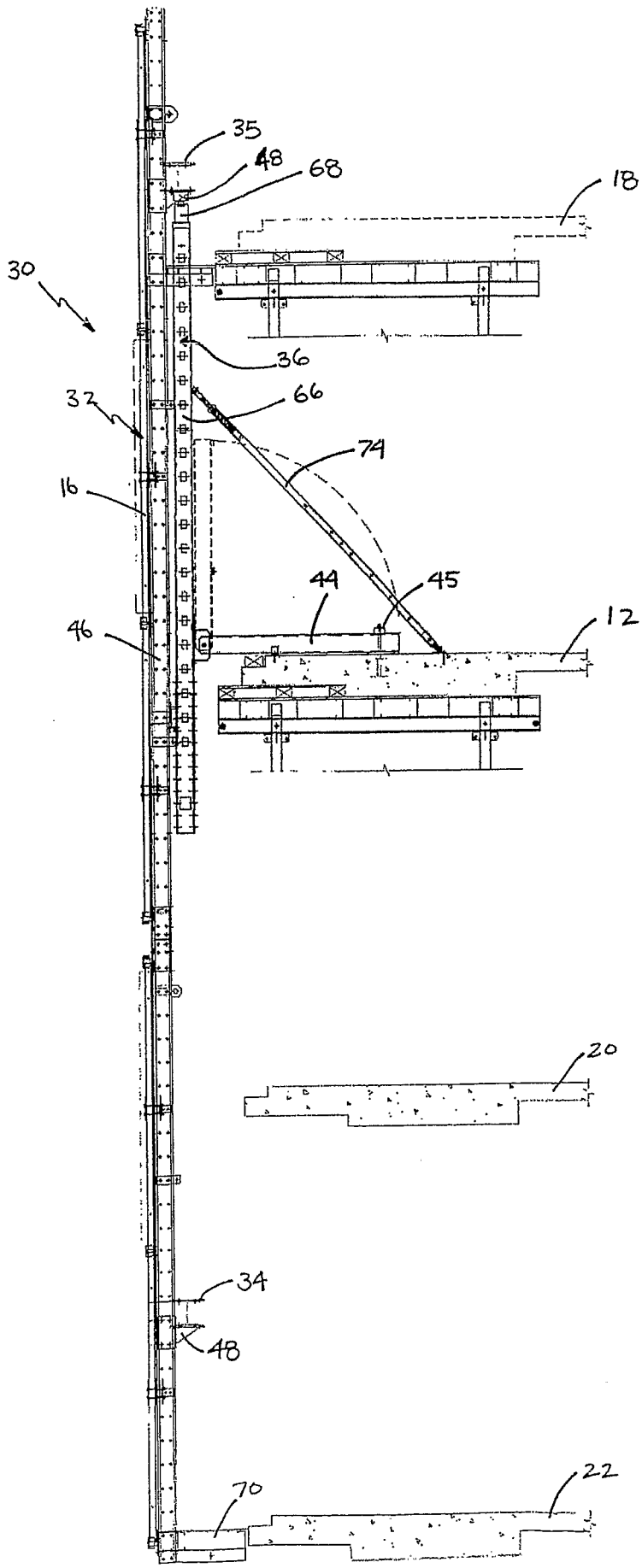


Fig 4

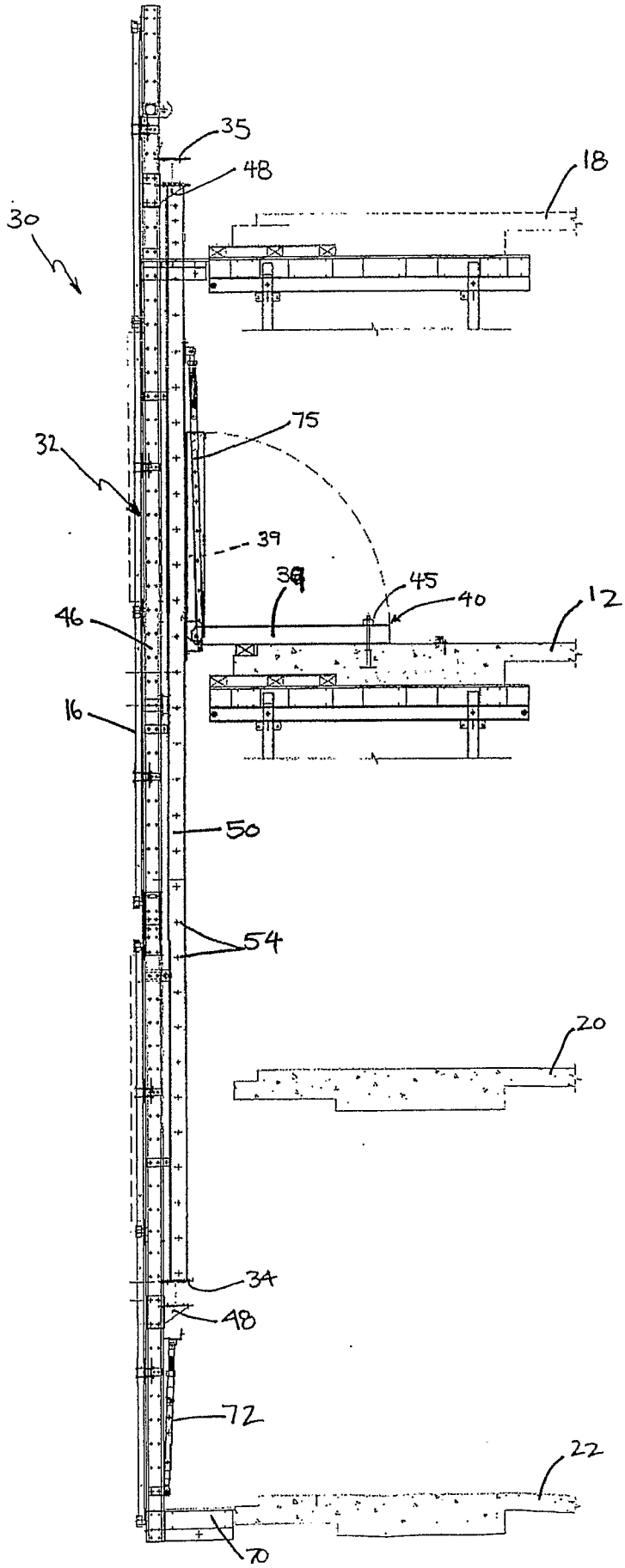


Fig 5

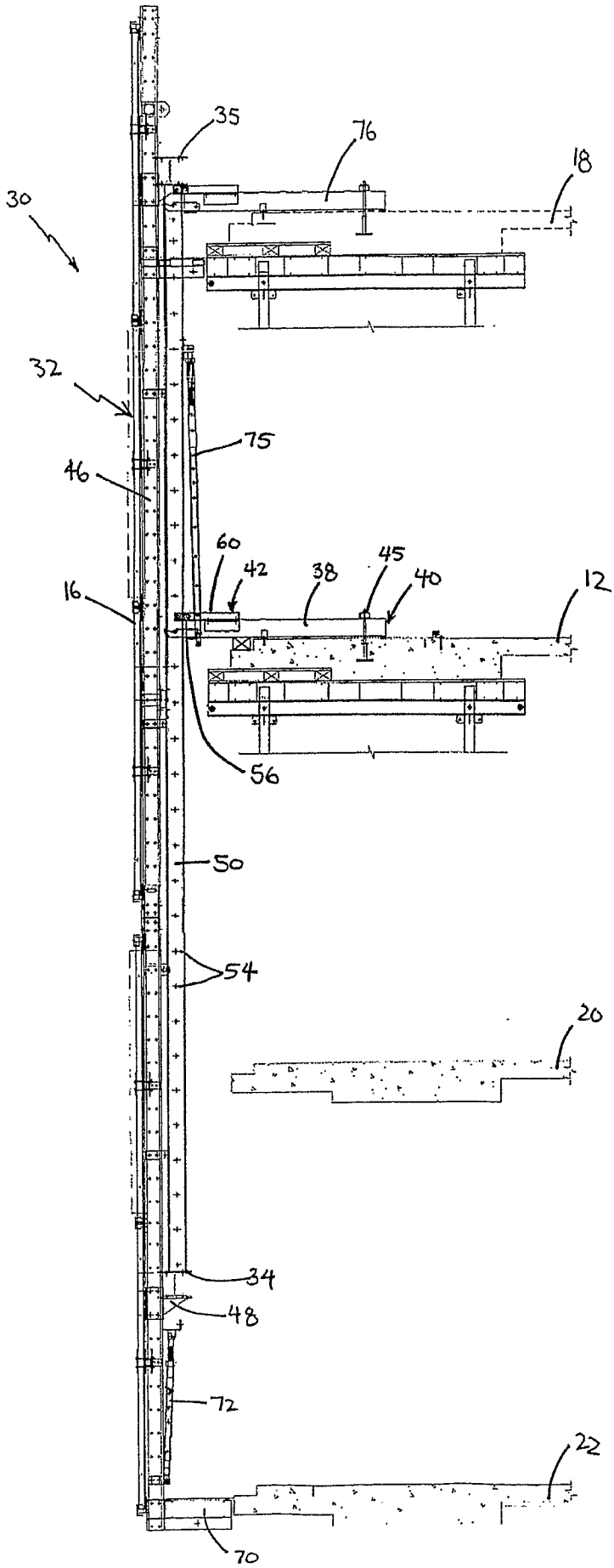


Fig 6

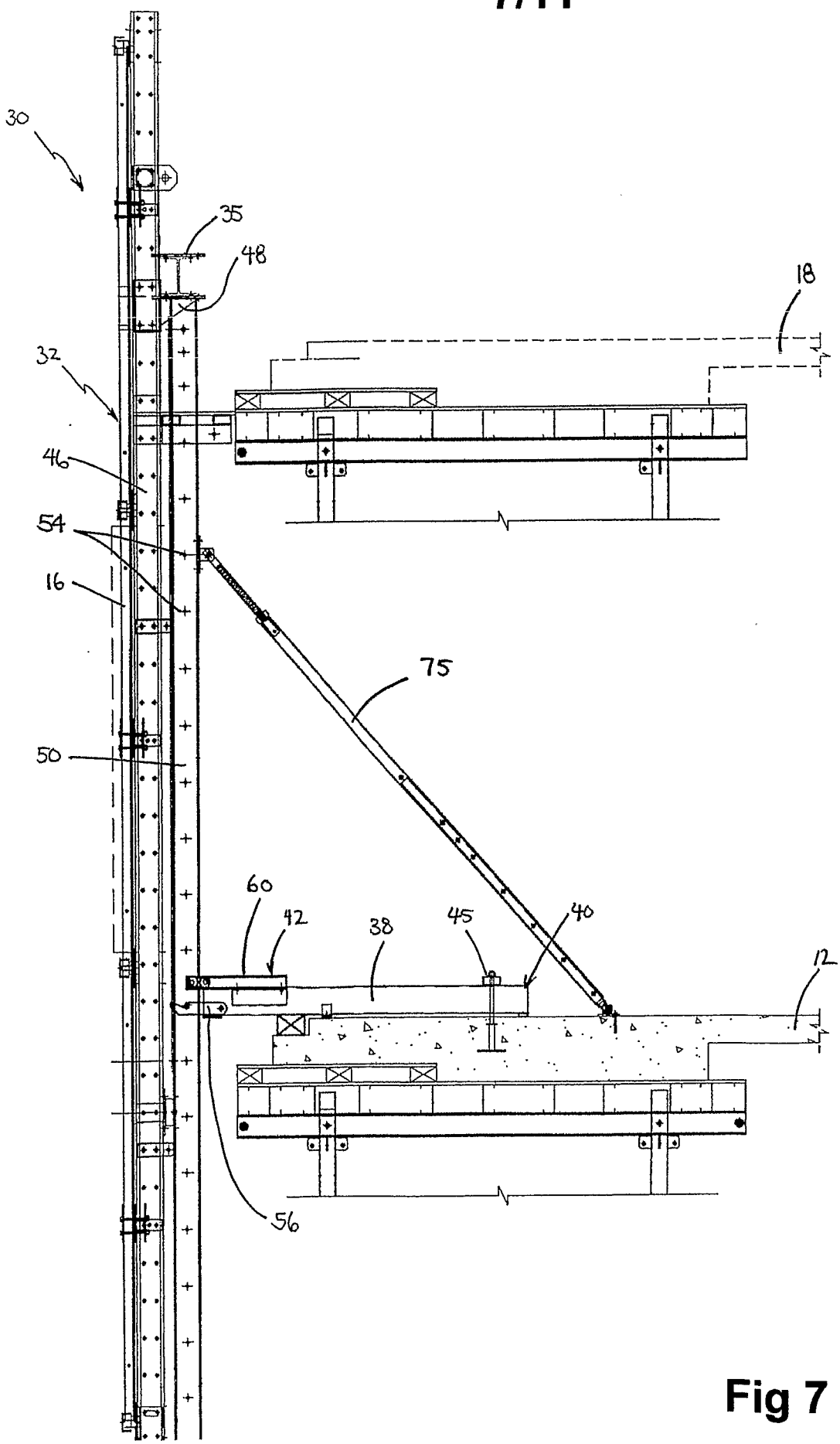


Fig 7

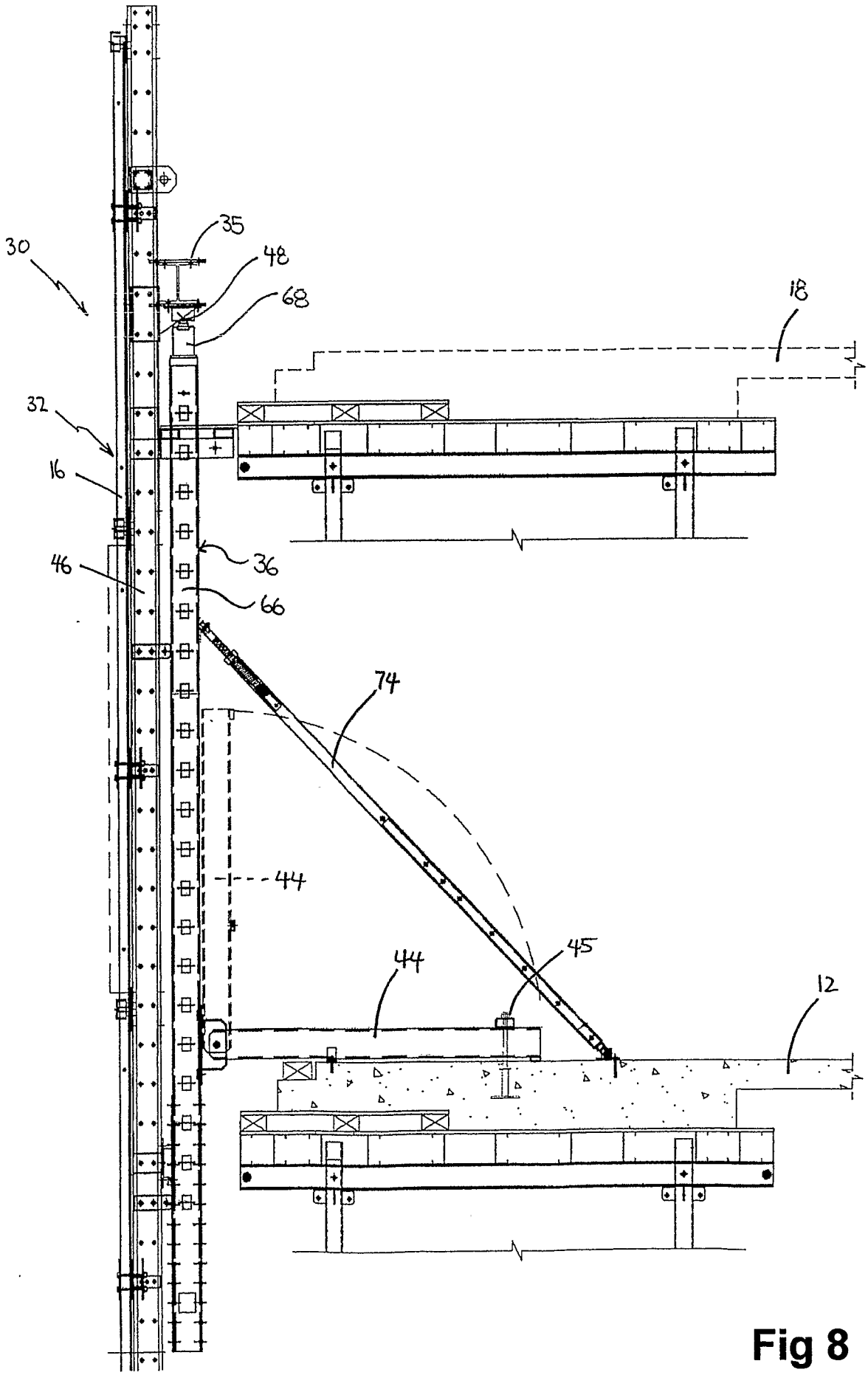


Fig 8

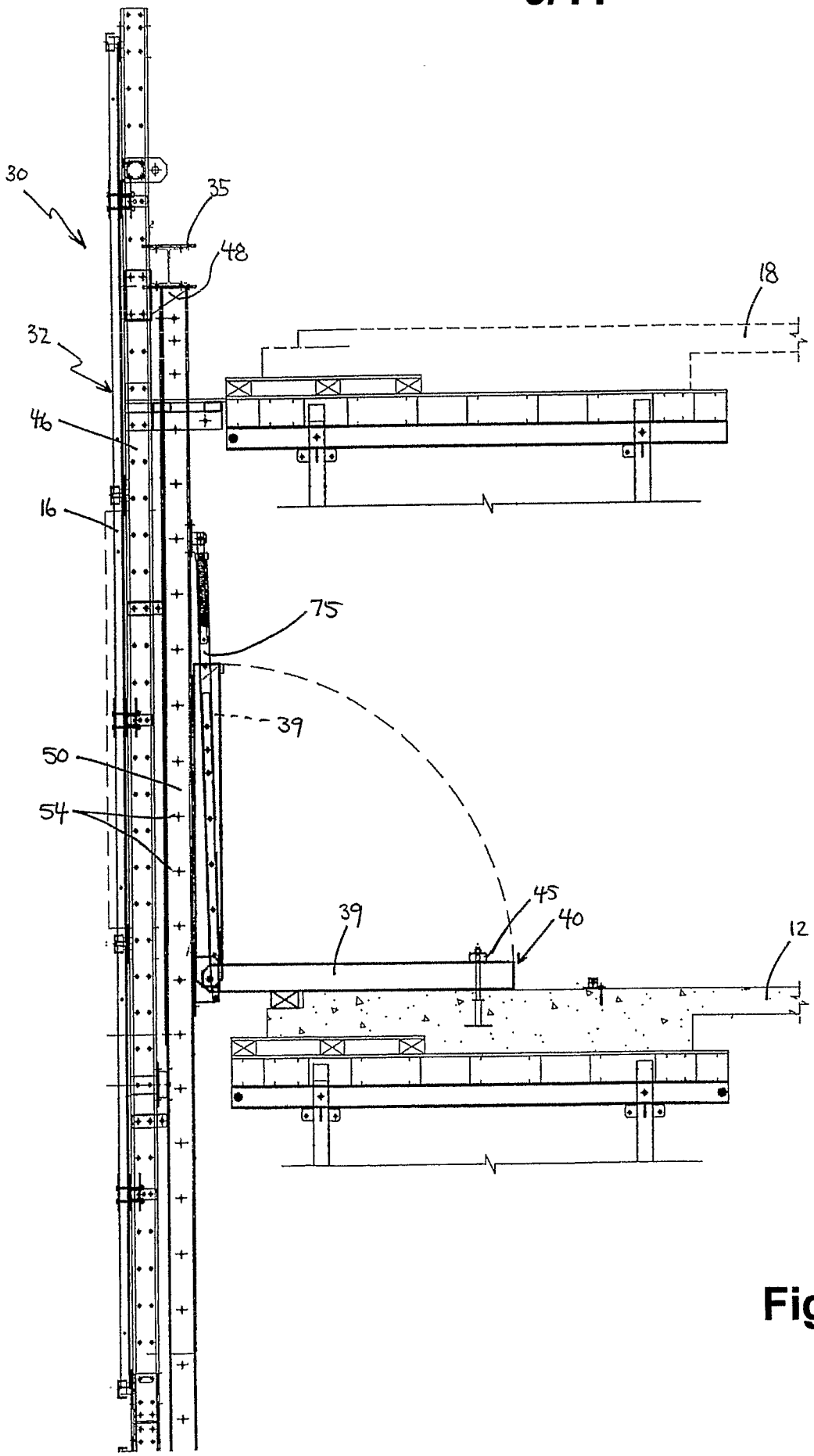


Fig 9

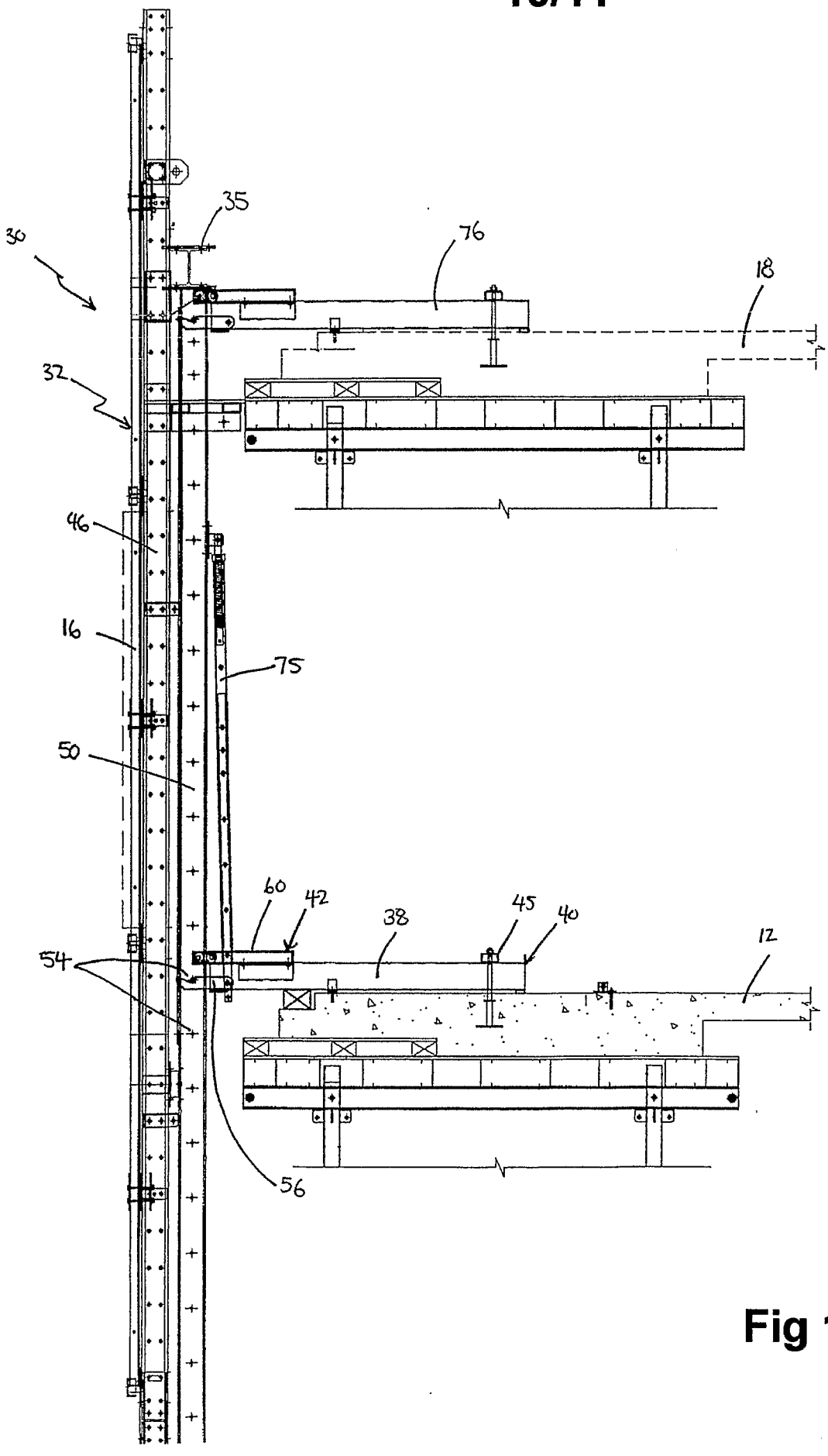


Fig 10

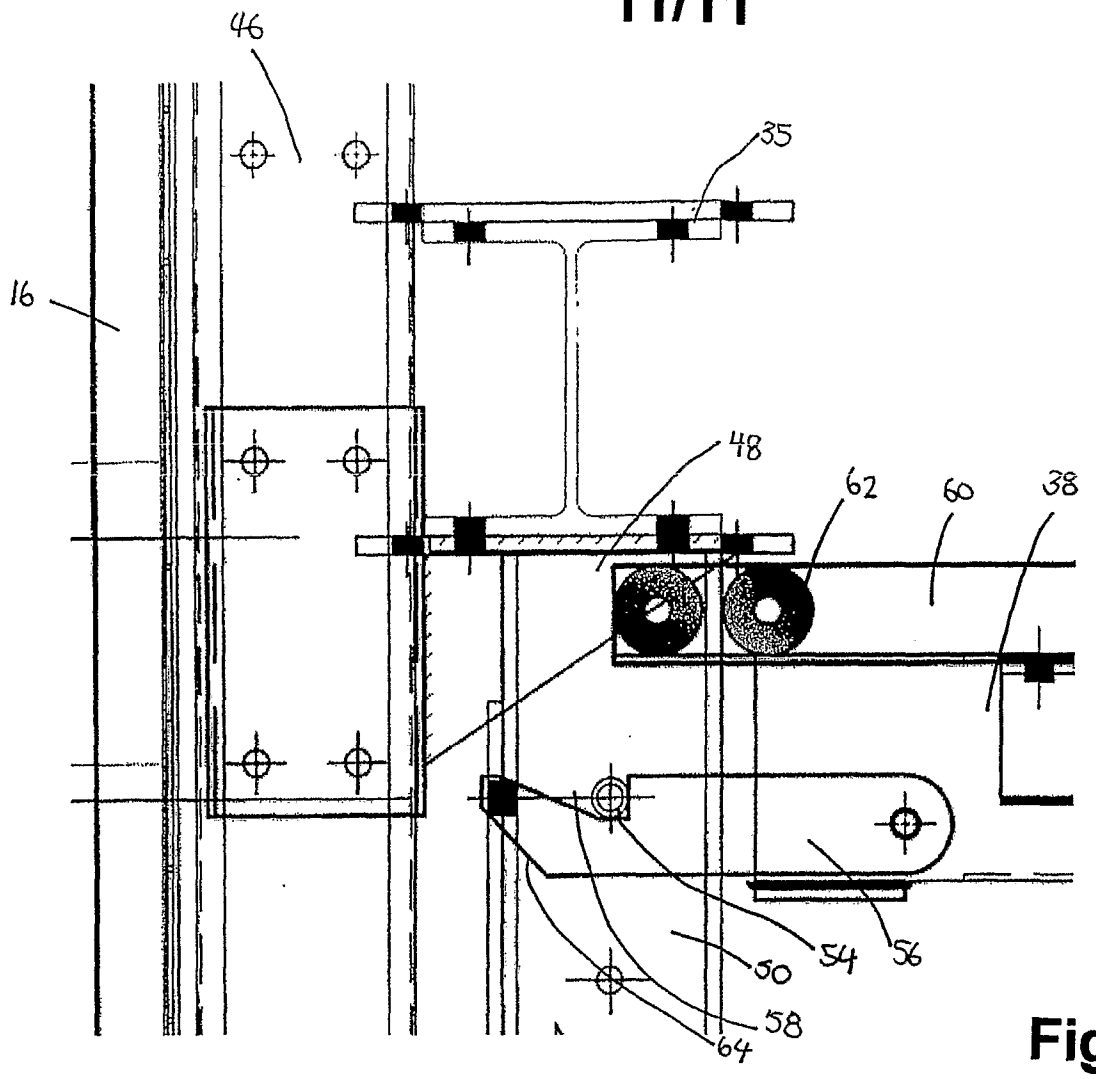


Fig 11

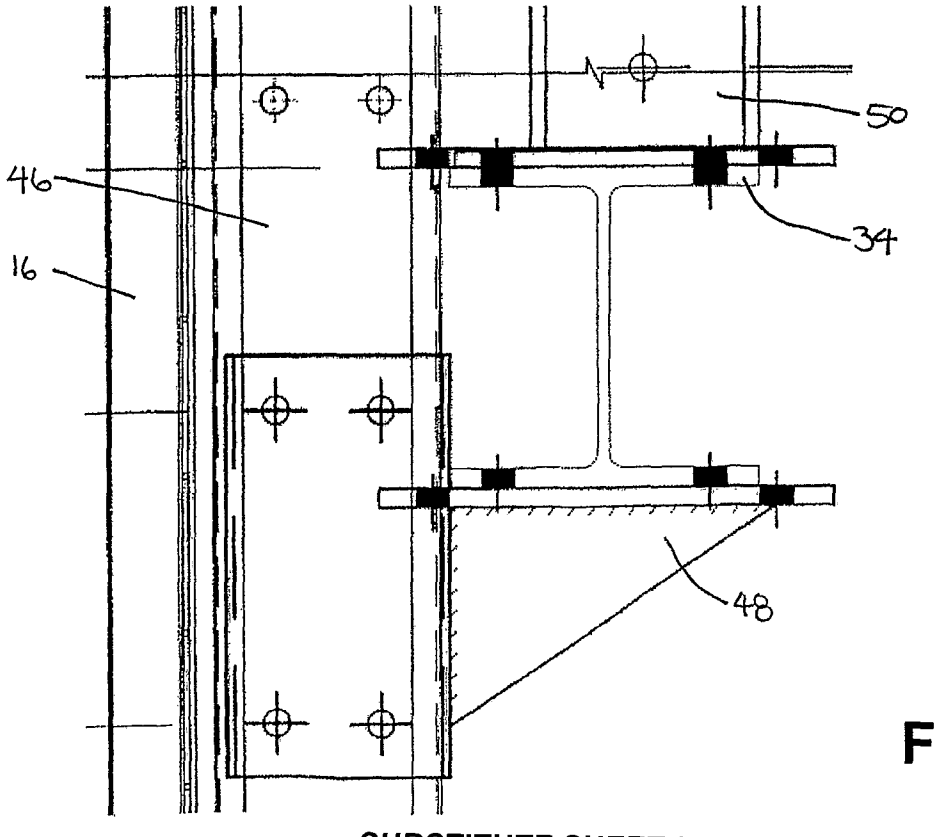


Fig 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/001683

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

E04G 21/32 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI, EPODOC: E04G5/ic/ec, E04G21/ic/ec and keywords, screen or similar, lift or raise or hydraulic or jack or similar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	AU 2003254411 B2 (FORMULA ONE SELF DRIVING SCREENS P/L) 29 July 2004 See page 4/lines 11-16, 21-27, page 8/lines 1-13 and the figures	1-16
Y	US 4962828 A (DUNCAN) 16 October 1990 See figure 20	1-16
A	US 4129197 A (PRESTON) 12 December 1978 See the figures	

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 November 2008	16 DEC 2008
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **OWEN ANDREWS** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2885

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2008/001683

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
AU	2003254411	WO	2004020766				
US	4962828	AU	41774/89	AU	64540/90	CA	2025679
		US	4892169				
US	4129197	NONE					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX