

CORRECTED VERSION

(19) World Intellectual Property Organization International Bureau



(10) International Publication Number WO 2013/057464 A9

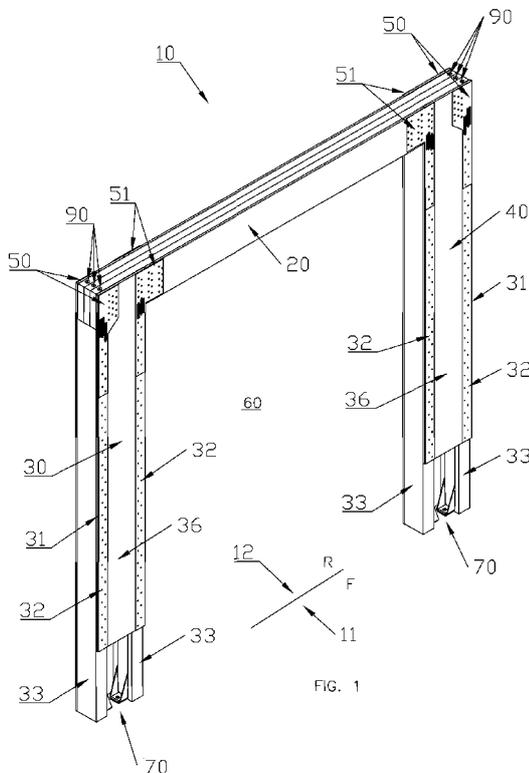
(43) International Publication Date 25 April 2013 (25.04.2013)

- (51) International Patent Classification: E04B 1/26 (2006.01) E04C 3/42 (2006.01)
(21) International Application Number: PCT/GB20 12/000794
(22) International Filing Date: 18 October 2012 (18.10.2012)
(25) Filing Language: English
(26) Publication Language: English
(30) Priority Data: 1117949.6 18 October 2011 (18.10.2011) GB
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,

[Continued on next page]

(54) Title: PORTAL FRAME



(57) Abstract: The present invention provides a portal frame comprising at least one header, at least a first column, at least one frame connector for rigidly connecting the at least first column to the at least one header, at least one header fastening means for fastening the frame connector to the at least one header and at least one column fastening means for fastening the frame connector to the at least first column. The at least first column is formed of wood or a wood-based/wood-derived material. The at least one frame connector comprises a lateral header connecting portion extending beyond a lateral edge of the first column in a direction towards the centre of the at least one header and a column connecting portion extending along at least a portion of the height of the at least first column. The lateral header connecting portion comprises at least one of the at least one header fastening means.

WO2013/057464 A9

KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,

LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

- (48) Date of publication of this corrected version: 20 June 2013

- (15) Information about Correction:  
see Notice of 20 June 2013

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## PORTAL FRAME

The present invention relates to a portal frame and, in particular, to a wooden portal frame.

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Portal frames are used in construction to frame openings in a panel or other wall-like structure, such as a door, window or garage door, for example. The portal frame must resist forces which result from lateral forces exerted on a building or structure, for example those occurring due to wind loading. The absence of structural materials in the portal opening necessitates a higher level of resistance to forces received or imposed on the portal frame when compared, for example, to a wall panel frame.

15

The use of steel portal frames in timber framed constructions is known. For example, US patent application no. 12/178,078 (published as US 2010/0018151 A1) describes a steel portal frame comprising a pair of steel shearwalls and a header. However, steel frames provide thermal bridges which conduct heat from a warmer side to a colder side, and therefore reduce the energy efficiency of a timber frame construction. Further, the steel components do not match the shrinkage of the timber components, giving rise to detrimental relative movements between respective steel and timber components. The use of steel portal frames also increases the cost of construction. Timber, on the other hand, can be sustainably sourced and provides aesthetic benefits. Timber is also more conducive to fixing methods used with timber frame constructions.

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The Simpson Strong-Tie "Wood Strong-Wall Garage Portal System" of the present applicant, and known in the art, comprises one or more shearwall panels and a header formed from timber. Lateral loads received on the building and experienced by the portal frame are designed to be resisted at the base of the column by holdowns and anchor bolts, i.e. a substantially rigid connection at the base between the columns and the supporting foundation. In order to provide sufficient resistance to the loading, the foundation on which the portal frame is supported must be of a bespoke construction, and one which differs from that commonly used for timber frame constructions. This adds complexity (and cost) since it is usual for strip foundations to be constructed as an entire entity for the building, prior to arrival on site of the timber frame, where there is no requirement for a length (or lengths) of specialised cross section in that foundation where a portal frame is envisaged.

US patent application no. 11/333,294 (published as US 2006/0193687 A1) describes a moment resisting connector for providing rigidity and resisting lateral loads in moment frames. This shape of connector requires fabrication (e.g. welding), has fixed dimensions, envelops the ends of the column and header and is fabricated from metal. As a result, the problem of thermal bridging again occurs, as does the problem of detrimental relative movements between respective steel and timber components. The use of metal also increases the cost of construction. The over-engineering of the connector (relative to the column) results in all force loading and movement being transferred to the header and columns, with a sudden transition zone

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from connector to header or column, and this can cause failure at points of force and bending concentrations, typically immediately adjacent to the openings of the connector which envelop the ends of the column and header.

5 Furthermore, the fixed dimensions of the fabricated section limit use of any one connector to the connection of a single size of header and column, increasing the range of different connector sizes which must be produced in order to accommodate different sizes of header and column, and/or  
10 compromising the structural integrity of a connection where the connector does not exactly fit the dimensions of each of the column and header.

US patent application no. 10/637,444 (published as US  
15 2004/0154258 A1) describes a structure comprising an "active" mechanism which is moved or deformed in response to loading of a frame. This does not provide for a rigid frame which resists loading in the manner of a portal frame.

20 The present invention addresses the above problems experienced in the art.

According to a first aspect, the present invention provides a portal frame comprising:

25 at least one header;  
at least a first column;  
.at least one frame connector for rigidly connecting the  
at least first column to the at least one header;  
at least one header fastening means for fastening the  
30 frame connector to the at least one header;  
at least one column fastening means for fastening the  
frame connector to the at least first column, wherein:

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the at least first column is formed of wood or a wood-based/wood-derived material, and

the at least one frame connector comprises:

5 a lateral header connecting portion extending beyond a lateral edge of the first column in a direction towards the centre of the at least one header; and

a column connecting portion extending along at least a portion of the height of the at least first column, wherein:

10 the lateral header connecting portion comprises at least one of the at least one header fastening means .

According to a second aspect, the present invention provides a column for use as the at least one first column and/or at least second column in a portal frame as set forth  
15 herein .

According to a third aspect, the present invention provides a method of forming a portal frame as set forth  
20 herein and comprising the step of:

fastening the at least first column to the at least one header using the frame connector.

According to a fourth aspect, the present invention  
25 provides a frame connector for use in a portal frame as set forth herein wherein the frame connector comprises:

a lateral header connecting portion extending in use beyond a lateral edge of the first column in a direction towards the centre of the at least one header; and

30 a column connecting portion extending in use along at least a portion of the height of the at least first column.

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

Figure 1 is a schematic perspective view of a portal frame according to a first preferred embodiment of the present invention;

Figure 2 is a schematic front elevation view of the portal frame of Figure 1;

Figures 3a to 3c are schematic perspective views of a header of the portal frame of Figure 1;

Figure 4 is a schematic perspective view of a first column of the portal frame of Figure 1;

Figure 5 is a schematic detailed front elevation view of the upper left hand end of the portal frame of Figure 1.

Figures 6a and 6b are schematic perspective views of respective outer and inner frame connectors of the portal frame of Figure 1;

Figure 6c is a schematic perspective view of an edging strip of the portal frame of Figure 1;

Figure 7a is a schematic detailed plan view from above of a right hand end of the portal frame of Figure 1;

Figure 7b is an enlarged schematic detailed plan view from above of a part of the right hand end of the portal frame shown in Figure 7a;

Figure 7c is an enlarged schematic detailed plan view from above of a part of the right hand end of the portal frame shown in Figure 7a;

Figures 8a and 8b are schematic detailed perspective views of a column connector of the portal frame of Figure 1;

Figures 9a and 9b are schematic detailed perspective views of a further embodiment of column connector according to the present invention;

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Figures 10a and 10b are schematic detailed perspective views of a yet further embodiment of column connector according to the present invention;

Figures 11a and 11b are schematic detailed perspective views of a further embodiment of column connector according to the present invention;

Figures 12a and 12b are schematic detailed perspective views of a yet further embodiment of column connector according to the present invention;

Figure 13 is a schematic perspective view of a portal frame according to a further preferred embodiment of the present invention;

Figure 14 is a schematic front elevation view of the portal frame of Figure 13;

Figure 15 is a schematic perspective view of a first column of the portal frame of Figure 13;

Figure 16 is a schematic perspective view of a portal frame according to a further preferred embodiment of the present invention;

Figure 17 is a schematic front elevation view of the portal frame of Figure 16;

Figure 18 is a schematic perspective view of a first column of the portal frame of Figure 16;

Figure 19 is a schematic detailed front elevation view of the upper left hand end of the portal frame of Figure 16;

Figure 20 is a schematic detailed plan view from above of a right hand end of the portal frame of Figure 16;

Figure 21 is a schematic perspective view of a portal frame according to a further preferred embodiment of the present invention;

Figure 22 is a schematic front elevation view of the portal frame of Figure 21;

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Figure 23 is a schematic perspective view of a first column of the portal frame of Figure 21;

Figure 24 is a schematic perspective view of a portal frame according to a further preferred embodiment of the present invention;

Figure 25 is a schematic front elevation view of the portal frame of Figure 24;

Figure 26 is a schematic perspective view of a first column of the portal frame of Figure 24;

Figure 27 is a schematic detailed front elevation view of the upper left hand end of the portal frame of Figure 24; and

Figure 28 is a schematic perspective view of a further preferred embodiment of outer and/or inner frame connector for use in the portal frame according to the present invention.

Referring first to Figures 1 to 7c, there is illustrated a portal frame 10 according to a first preferred embodiment of the present invention. The portal frame 10 comprises a header 20, supported by a first column 30 and a second column 40. The header 20, first column 30 and second column 40 define a portal opening 60. The portal frame 10 comprises a first face 11 (frontal F in the Figures) and a second face 12 (rear R in the Figures) .

The header 20, first column 30 and second column 40 are formed substantially of wood or a wood-based/wood-derived material (e.g. oriented strand board, wood composites, etc.). The header 20 preferably comprises a solid beam 21 and at least one wood or wood-based/wood-derived material panel 22. The solid beam 21 may be formed as a single piece or comprise a laminated structure (as shown) . Fasteners 90,

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preferably screws (as shown) , may be driven substantially vertically down into the header at or near each end (as shown in Figures 3a and 3b) to reinforce the header against splitting forces caused by use of the fasteners 45 described  
5 below.

The first column 30 is connected to the header 20 by means of at least one outer frame connector 50 and at least one inner frame connector 51. Preferably, the first column 30 may be connected to the header 20 by means of two outer  
10 frame connectors 50 and two inner frame connectors 51, one outer frame connector 50 and one inner frame connector 51 being affixed to the first face 11 and one outer frame connector 50 and one inner frame connector 51 being affixed to the second face 12.

15 The at least one outer frame connector 50 and at least one inner frame connector 51 are plate-like and/or do not envelop an end of the column and/or header.

Preferably, each of the at least one outer frame connector 50 and at least one inner frame connector 51 is  
20 adjacent to or only touches one of the first face 11 and the second face 12.

The first column 30 comprises at least one vertical stud 33 and at least one facing panel 31. Preferably, the first column 30 comprises two vertical studs 33 and two  
25 facing panels 31.

Each of the two facing panels 31 comprises a facing sheet 36 and at least one edging strip 32. Preferably, the facing sheet 36 is formed from wood or wood-based/wood-derived material and the edging strip 32 is formed from  
30 sheet metal. Preferably, the at least one edging strip 32 is shaped to enclose an edge of the at least one facing panel 31 (see Figure 6c and 7b). Preferably, the at least

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one facing panel 31 comprises one or a plurality of edging strips 32 arranged such that they enclose substantially the entire length of the lateral edges 38 of the facing sheet 36. Where two edging strips 32 are adjacent to each other  
5 along an edge (e.g. vertically, as shown in Figures 24 to 27) , they may be attached to each other by means of one or more splice plates 35.

Each of the two facing panels 31 extends beyond an upper end 37 of the two vertical studs 33 (see Figure 4 )  
10 such that, when the header 20 is supported by the column 30, each of the two facing panels 31 is in contact with a face 23, 24 of the header 20.

Each of the two outer frame connectors 50 and two inner frame connectors 51 comprises a plurality of apertures 52, 53, through which fasteners 54 may be passed to fix the two  
15 outer frame connectors 50 and two inner frame connectors 51 to the header 20 and the column 30. Each of the two outer frame connectors 50 and two inner frame connectors 51 may overlie at least a portion of the plurality of edging strips  
20 32 and/or splice plates 35. Preferably, an edging strip 32 may be integral to the at least one outer frame connector 50 and/or the at least one inner frame connector 51.

The two inner frame connectors 51 each comprise a column connecting portion 57 and a lateral header connecting  
25 portion 55 (as shown in Figure 6b) . The lateral header connecting portion 55 extends past a lateral edge of the column 30 and towards a centre of the header 20. The lateral header connecting portion 55 comprises at least one of the plurality of apertures 53 and the column connecting  
30 portion 57 comprises at least one of the plurality of apertures 53.

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The two outer frame connectors 50 each comprise a column connecting portion 58 and a header connecting portion 56, and a return flange 54 (as shown in Figure 6a) . The header connecting portion 56 extends towards a centre of the header 20. The header connecting portion 56 comprises at least one of the plurality of apertures 52 and the column connecting portion 58 comprises at least one of the plurality of apertures 52.

Embossments 80 are preferably provided in the region of each inner/outer frame connector 50, 51 where the lateral header 55 or header 56 connecting portion transitions to the column connecting portion 57, 58.

Further or alternative embossments may beneficially employed in place of or in addition to the embossments 80.

Fasteners 45 may be used as appropriate to connect the components which make up the portal frame 10. Preferably, at least one fastener 45 is used in at least one of the plurality of apertures 53 of the lateral header connecting portion 55, and at least one fastener 45 is used in one of the at least one of the plurality of apertures 53 of the column connecting portion 57. Preferably, at least one fastener 45 is used in at least one of the plurality of apertures 52 of the header connecting portion 56, and at least one fastener 45 is used in at least one of the plurality of apertures 52 of the column connecting portion 58. More preferably, fasteners 45 are used in a plurality of the apertures 52, 53. For certain applications, fasteners 45 may be used in every one of the plurality of apertures 52, 53.

Fasteners 45 may also be used as appropriate to connect the components which make up the facing panel 31. Preferably, apertures 59 in the plurality of edging strips

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32 are arranged to receive fasteners 45 such that they affix the edging strips 32 to the lateral edges 38 of the facing sheet 36.

Alternatively or additionally, adhesives may be  
5 beneficially employed in place of or as well as fasteners 45.

The second column 40 is preferably of substantially the same structure as the first column 30, save for handing (left/right) where necessary, and so like features are  
10 denoted by like reference numerals.

In use, moments generated under loading of the portal frame 10 due to lateral forces received by a building or other construction are resisted by the inner frame connector  
15 51 and the outer frame connector 50 as a result of the substantially rigid connection created by fasteners 45 inserted through the apertures 52 in the lateral header connecting portion 55 and the header connecting portion 56, and those inserted through the apertures in the column  
20 connecting portions 57, 58.

Preferably, a majority of the moments generated under loading of the portal frame 10 are resisted by the inner connector 51 and the outer connector 50 in the manner described above .

25 It will be appreciated, therefore, that in the portal frame 10 according to the present invention, moment forces are primarily dealt with and dissipated by the substantially rigid connections formed between the header 20 and the top of each column 30, 40. The term "rigid" used herein refers  
30 to the substantially rigid connection achieved between the header 20 and the top of each column 30, 40. As a result, there is little or no requirement for a rigid connection

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between the bottom of each column 30, 40 and the foundation or other supporting surface. Indeed, the columns 30, 40 may be free to rotate about the foundation or other supporting surface .

5

The portal frame 10 may further comprise at least one support connector 70 for attachment of the first column 30 and/or second column 40 to a foundation or supporting surface .

10

The support connector 70 may take any suitable form. For example, as illustrated in Figures 1, 2 and 4, the support connector 70 comprises two reinforced angle brackets 78, 79. Each angle bracket 78, 79 comprises an elongated back flange 172, 171 which may be fastened to the inner  
15 sides of the vertical studs 33, while a base flange 175 is provided for setting to a foundation or supporting surface.

An aperture 176 may be provided for receiving a bolt or other fastener for attachment of the first column 30 and/or second column 40 to a foundation or supporting surface.

20

Optionally, a washer or washer plate (not shown) may be provided above the base flange 175 to provide increased bearing capacity to resist lateral and uplift forces. Alternatively or additionally, the bearing capacity may be increased by way of doubling of material by the folding of  
25 an overlength base flange 175 back on itself.

Figures 8a, 8b, 9a, 9b, 10a, 10b, 11a, 11b, 12a and 12b illustrate alternative forms of support connector 70 for attachment of the first column 30 and/or second column 40 to a foundation or supporting surface.

30

In Figures 8a and 8b, the support connector 70 comprises an elongated strap which is bent so as to have upstanding side flanges 71, 72 which may be fastened to the

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inner sides of the vertical studs 33. The base flange portion 75 of the strap extending laterally between the upstanding side flanges 71, 72 bridges the gap between the inner sides of the vertical studs 33, and is provided for  
5 setting to a foundation or other supporting surface.

Optional channel section washer 77 is provided inside and above the base flange portion 75, thereby increasing the bearing capacity to resist lateral and uplift forces.

An aperture 76 may be provided for receiving a bolt or  
10 other fastener for attachment of the first column 30 and/or second column 40 to a foundation or supporting surface.

Optionally, a washer or washer plate (not shown) may be provided inside and/or underneath the channel section 75 to provide increased bearing capacity to resist lateral and  
15 uplift forces.

In Figures 9a and 9b, the support connector 70 is not provided with a channel section washer. Again, it is planar and can be formed from sheet material. Optional washer/washer plate 77 is provided underneath the base flange 75 to  
20 provide increased bearing capacity to resist lateral and uplift forces. Optional washer/washer plate 77 may extend laterally beyond the ends of the base flange 75 and on under the "foot" of each vertical stud 33, as shown.

In Figures 10a and 10b, the support connector 70  
25 bridges the gap between the vertical studs 33 and extends below, and is attachable to, the outer sides of the vertical studs 33. Optional washer/washer plate 77 is provided underneath the base flange 75 to provide increased bearing capacity to resist lateral and uplift forces.

30 In Figures 11a and 11b, the support connector 70 bridges the gap between, and is attachable to, the inner sides of the vertical studs 33. Optional washer/washer

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plate 77 is provided to overlie the base flange 75 to provide increased bearing capacity to resist lateral and uplift forces.

In Figures 12a and 12b, the support connector 70  
5 bridges the gap between the vertical studs 33 and extends below and is attachable to the outer sides of the vertical studs 33. Optional washer/ washer plate 77 is provided to overlie the base flange 75 between the vertical studs 33 to provide increased bearing capacity to resist lateral and  
10 uplift forces. Optionally, the washer/ washer plate 77 may be elongated with upturned ends which serve as flanges and may be fastened to the inner sides of the vertical studs 33 (not shown) .

In all embodiments, the at least one facing panel 31  
15 may stop short of the foot of the at least one vertical stud 33 (as shown) to allow access to the at least one support connector 70. In this case, a facing panel portion (not shown) may be provided to close the open area at the foot of the column 30, 40.

20 The columns 30, 40 will typically be hollow, and so insulation is provided (not shown) to increase the barrier to thermal and sound transmission. Where the at least one facing panel 31 stops short of the foot of the at least one vertical stud 33 to allow access to the at least one support  
25 connector 70, insulation may be provided as loose fill for retrofit filling, or may be attached to the inside of the closing facing panel portion.

In a further preferred embodiment, shown in Figures 13  
30 to 15, the first column 30 (and optionally second column 40) is/are connected to a foundation or other supporting surface using the support connector of Figures 8a and 8b. This

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further preferred embodiment is otherwise as described in the first preferred embodiment.

In a further preferred embodiment, shown in Figures 16  
5 to 20, the first column 30 (and optionally second column 40)  
is connected to the header 20 by means of at least one  
combined frame connector 150. Preferably, the first column  
30 (and optionally second column 40) may be connected to the  
header 20 by means of two combined frame connectors 150, one  
10 each being affixed to the first face 11 and the second face  
12 of the portal frame 10. "Dimpled" features 153 are  
provided on each combined frame connector 150 around the  
apertures 53 in the area spaced laterally of the column, in  
use, so as to take up the gap between the combined frame  
15 connector 150 and the header 20 (as can best be seen in  
Figure 20). This further preferred embodiment is otherwise  
as described in the first preferred embodiment.

In a further preferred embodiment, shown in Figures 21  
20 to 23, and similar to that shown in Figures 16 to 20, the  
first column 30 (and optionally second column 40) is  
connected to the header 20 by means of at least one combined  
frame connector 150. However, the first column 30 (and  
optionally second column 40) is/are connected to a  
25 foundation or other supporting surface using the support  
connector of Figures 8a and 8b. This further preferred  
embodiment is otherwise as described in the preferred  
embodiment of Figures 16 to 20.

30 In a further preferred embodiment, shown in Figures 21  
to 23, and similar to that shown in Figures 16 to 20, the  
first column 30 (and optionally second column 40) is

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connected to the header 20 by means of at least one combined frame connector 150. However, the edge strips are multi-part and a splice plate 35 is used to connect these (not shown on the right-hand column 40). This further preferred  
5 embodiment is otherwise as described in the preferred embodiment of Figures 16 to 20.

Figure 28 illustrates an alternative form of outer frame connector 50. As in the preferred embodiment describe  
10 above with reference to Figure 6a, the outer frame connector 50 comprises a column connecting portion 58 and a header connecting portion 56. However, in this alternative embodiment, no return flange is provided. The header connecting portion 56 comprises at least one of the  
15 plurality of apertures 52 and the column connecting portion 58 comprises at least one of the plurality of apertures 52. Embossments 80 are preferably provided in the region where the header connecting portion 56 transitions to the column connecting portion 58. Further or alternative embossments  
20 may beneficially employed in place of or in addition to the embossments 80.

In a further preferred embodiment (not shown), the header 20 comprises a solid beam as illustrated in Figure 2,  
25 but one not provided with a wood or wood-based/wood-derived material panel 22. Instead, the laterally extending portion of the lateral header connecting portion 55 or header connecting portion 56 may be bent out of the plane of the column connecting portion 57, 58 such that a face of the  
30 laterally extending portion is coplanar with a front face of the header 20.

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According to a yet further embodiment of the present invention (not shown), a portal frame as described in any preceding embodiment may further comprise at least one intermediate column. The header, first column, second  
5 column and at least one intermediate column define a plurality of portal openings.

It will be appreciated from the foregoing that the portal frame 10 according to the present invention is not  
10 limited to ground floor use, and may be beneficially employed also/instead in upper stories of a construction.

Whilst preferred embodiments of the present invention have been described above and illustrated in the drawings,  
15 these are by way of example only and non-limiting. It will be appreciated by those skilled in the art that many alternatives are possible within the ambit of the invention. For example, the header may alternatively be of hollow construction, and may comprise insulation in the hollow.  
20 The second column may differ in structure to the first column, for example the second column may comprise a solid strut. The various embodiments of frame connector (combined, inner and/or outer), edging strip and fasteners (and indeed all parts of the portal frame) may be optimised  
25 by reducing the number of discrete parts, such as by way of integrating the edging strip with the frame connector, for example. As such, the true scope of the invention is that as set out in the appended claims.

30 Each feature disclosed in this specification (including the accompanying claims and drawings), may be replaced by alternative features serving the same, equivalent or similar

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purpose, unless expressly stated otherwise, as set forth in the appended claims. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features, as set forth in the appended claims. In addition, all of the features disclosed in this specification (including the accompanying claims and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive, as set forth in the appended claims. Accordingly, while many different embodiments of the present invention have been described above, any one or more or all of the features described, illustrated and/or claimed in the appended claims may be used in isolation or in various combinations in any embodiment, as set forth in the appended claims. As such, any one or more feature may be removed, substituted and/or added to any of the feature combinations described, illustrated and/or claimed, as set forth in the appended claims. For the avoidance of doubt, any one or more of the features of any embodiment may be combined and/or used separately in a different embodiment with any other feature or features from any of the embodiments, as set forth in the appended claims.

## CLAIMS

1. A portal frame comprising:  
at least one header;  
5 at least a first column;  
at least one frame connector for rigidly connecting the  
at least first column to the at least one header;  
at least one header fastening means for fastening the  
frame connector to the at least one header;  
10 at least one column fastening means for fastening the  
frame connector to the at least first column, wherein.-  
the at least first column is formed of wood or a wood-  
based/wood-derived material, and  
the at least one frame connector comprises:  
15 a lateral header connecting portion extending  
beyond a lateral edge of the first column in a direction  
towards the centre of the at least one header; and  
a column connecting portion extending along at  
least a portion of the height of the at least first column,  
20 wherein:  
at least one of the at least one header fastening means  
is positioned in, or in the region of, the lateral header  
connecting portion.
- 25 2. A portal frame as claimed in claim 1 further  
comprising  
at least a second column;  
at least one frame connector for rigidly connecting the  
at least second column to the at least one header;  
30 at least one header fastening means for fastening the  
frame connector to the at least one header;

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at least one column fastening means for fastening the frame connector to the at least second column, wherein:

the at least second column is formed of wood or a wood-based/wood-derived material, and

5 the at least one frame connector comprises:

a lateral header connecting portion extending beyond a lateral edge of the second column in a direction towards the centre of the at least one header; and

10 a column connecting portion extending along at least a portion of the height of the at least second column, wherein :

the lateral header connecting portion comprises at least one of the at least one header fastening means.

15 3. A portal frame as claimed in claim 1 or claim 2 wherein the at least one frame connector is formed from sheet metal.

4. A portal frame as claimed in any one of the preceding claims wherein the at least one frame connector is plate-  
20 like.

5. A portal frame as claimed in any one of the preceding claims wherein the at least one frame connector does not envelop an end of the at least one header and/or the at  
25 least first or second column.

6. A portal frame as claimed in any one of the preceding claims wherein the at least one frame connector is adjacent to, or only touches one of, a front facing side or a rear  
30 facing side of the portal frame.

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7. A portal frame as claimed in any one of the preceding claims wherein the lateral header connecting portion is not coplanar with an adjacent section of the frame connector.

5 8. A portal frame as claimed in any one of the preceding claims wherein the at least first column comprises at least one vertical stud and at least one facing panel.

9. A portal frame as claimed in claim 8 wherein the at  
10 least one facing panel comprises a sheet of wood or wood-derived/wood-based material and at least one edging strip.

10. A portal frame as claimed in claim 9 wherein the at  
15 least one edging strip is shaped to enclose an edge of the at least one facing panel or sheet.

11. A portal frame as claimed in claim 9 or claim 10 wherein the at least one frame connector comprises the at least one edging strip.

20

12. A portal frame as claimed in any one of claims 8 to claim 11 wherein the at least one facing panel extends beyond an upper end of the at least one vertical stud.

25 13. A portal frame as claimed in any one of the preceding claims wherein the at least one header comprises a solid beam .

14. A portal frame as claimed in any one of claims 1 to 12  
30 wherein the at least one header is hollow and/or a composite structure .

- 22 -

15. A portal frame as claimed in claim 13 or claim 14 wherein the at least one header is formed of wood or a wood-based/wood-derived material.

5 16. A portal frame as claimed in any one of the preceding claims wherein the at least one header further comprises at least one wood or wood-derived/wood-based material panel.

10 17. A portal frame as claimed in any one of the preceding claims wherein the at least one header is part of another and/or existing structure.

15 18. A portal frame as claimed in any one of the preceding claims further comprising at least one support connector for attaching the at least first column to a foundation or other supporting surface.

20 19. A portal frame as claimed in any one of the preceding claims configured to resist moments generated under loading of the portal frame in use by substantially rigid connection of the at least one header to the at least first column using the at least one frame connector.

25 20. A portal frame as claimed in claim 19 configured to resist moments generated under loading of the portal frame in use by substantially rigid connection of the at least one header to the at least first column and the at least second column using a plurality of the at least one frame connector.

30

- 23 -

21. A portal frame as claimed in any one of the preceding claims comprising at least two frame connectors for rigidly connecting the column to the at least one header.

5 22. A portal frame as claimed in claim 21 wherein one of the at least two frame connectors is used on a front facing side of the portal frame and one of the at least two frame connectors is used on a rear facing side of the portal frame .

10

23. A portal frame as claimed in claim 21 or claim 22 wherein one of the at least two frame connectors is used at an inner edge of the column of the portal frame and one of the at least two frame connectors is used at an outer edge  
15 of the column of the portal frame.

24. A portal frame as claimed in claim 21 or claim 22 wherein one of the at least two frame connectors is of a different shape to that of the other or others of the at  
20 least two frame connectors.

25 25. A column for use as the at least one first column and/or at least second column in a portal frame as claimed in any one of the preceding claims .

25

26. A column for use in a portal frame as claimed in any one of claims 1 to 24 in combination with a frame connector for connecting the column to the at least one header.

30 27. A frame connector for use in a portal frame as claimed in any one of claims 1 to 24 wherein in frame connector comprises :

- 24 -

a lateral header connecting portion extending in use beyond a lateral edge of the first column in a direction towards the centre of the at least one header; and

a column connecting portion extending in use along at least a portion of the height of the at least first column.

28. A method of forming a portal frame as claimed in any one of claims 1 to 24 comprising the step of

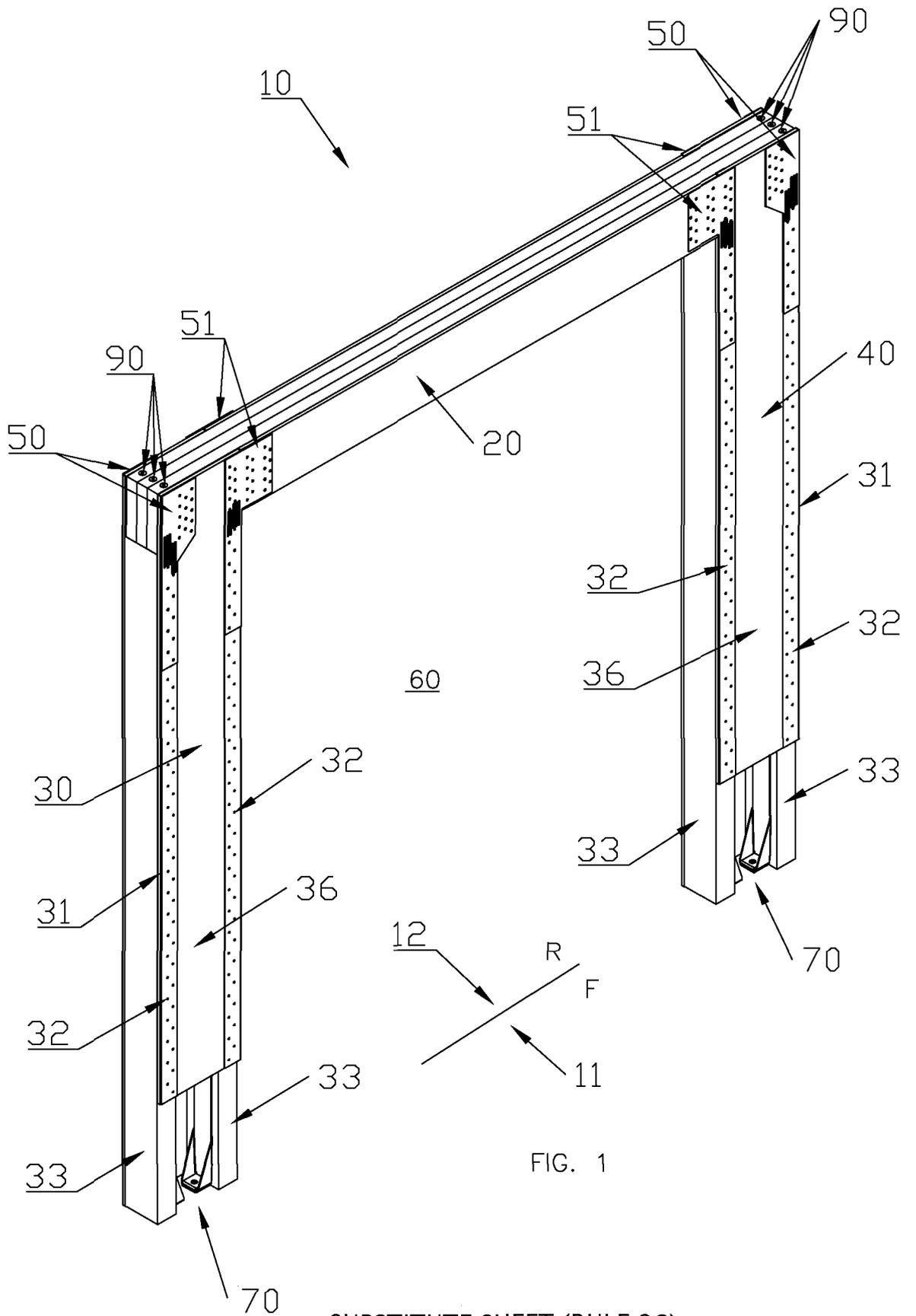
fastening the at least first column to the at least one header using the frame connector.

29. A portal frame substantially as hereinbefore described with reference to or as shown in the accompanying drawings.

30. A column for a portal frame substantially as hereinbefore described with reference to or as shown in the accompanying drawings .

31. A frame connector for a portal frame substantially as hereinbefore described with reference to or as shown in the accompanying drawings .

32. A method of forming a portal frame substantially as hereinbefore described with reference to or as shown in the accompanying drawings.



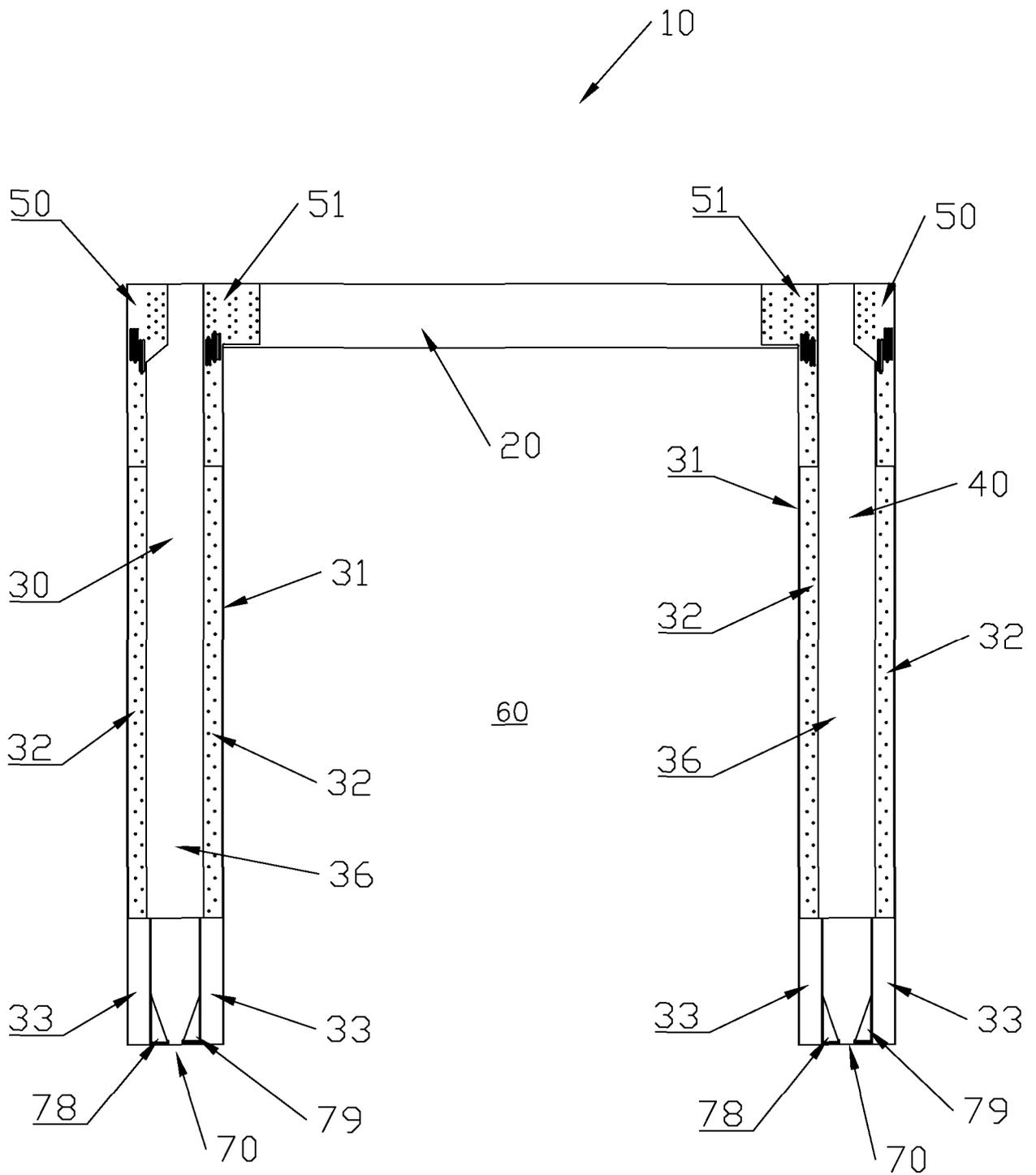
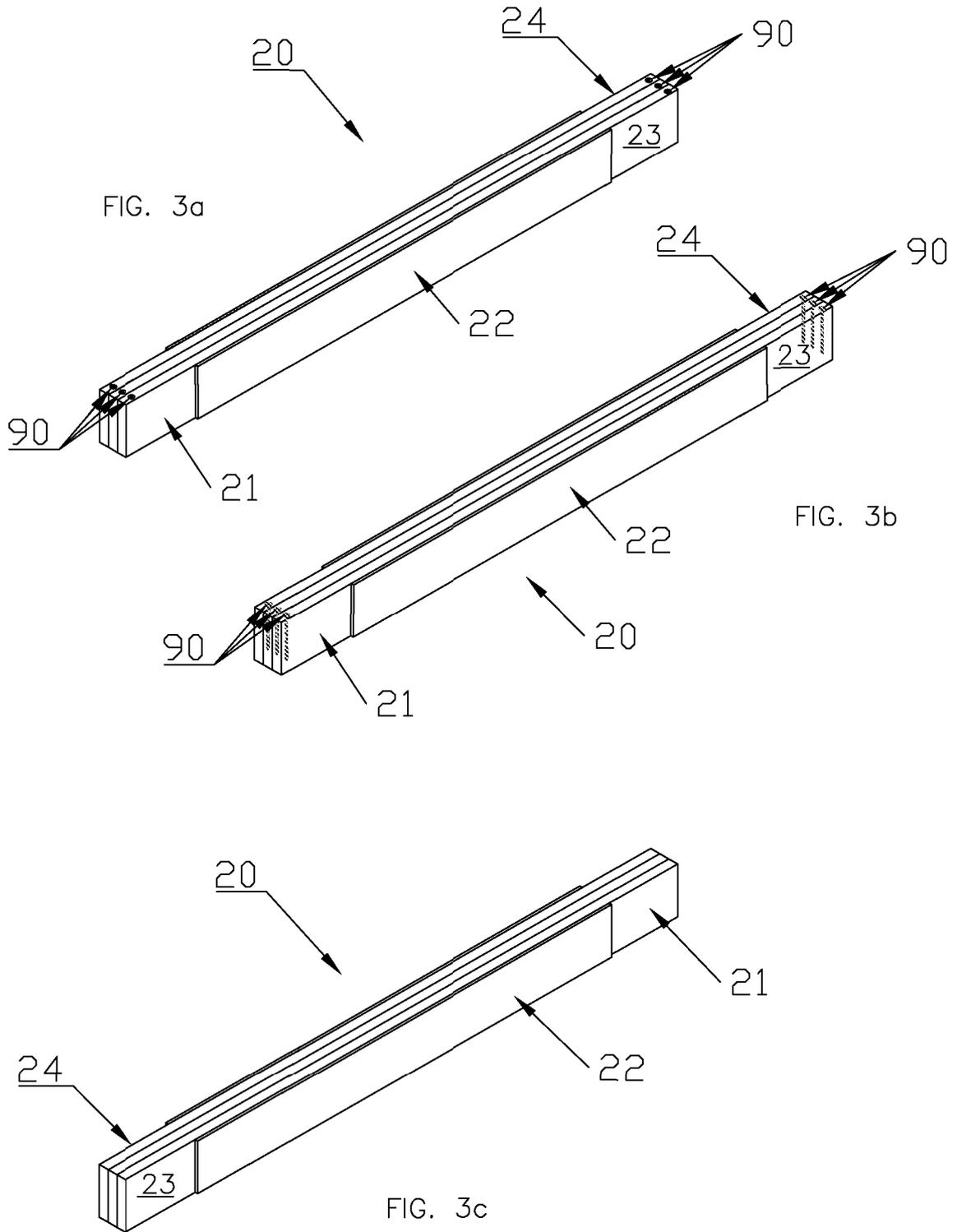


FIG. 2



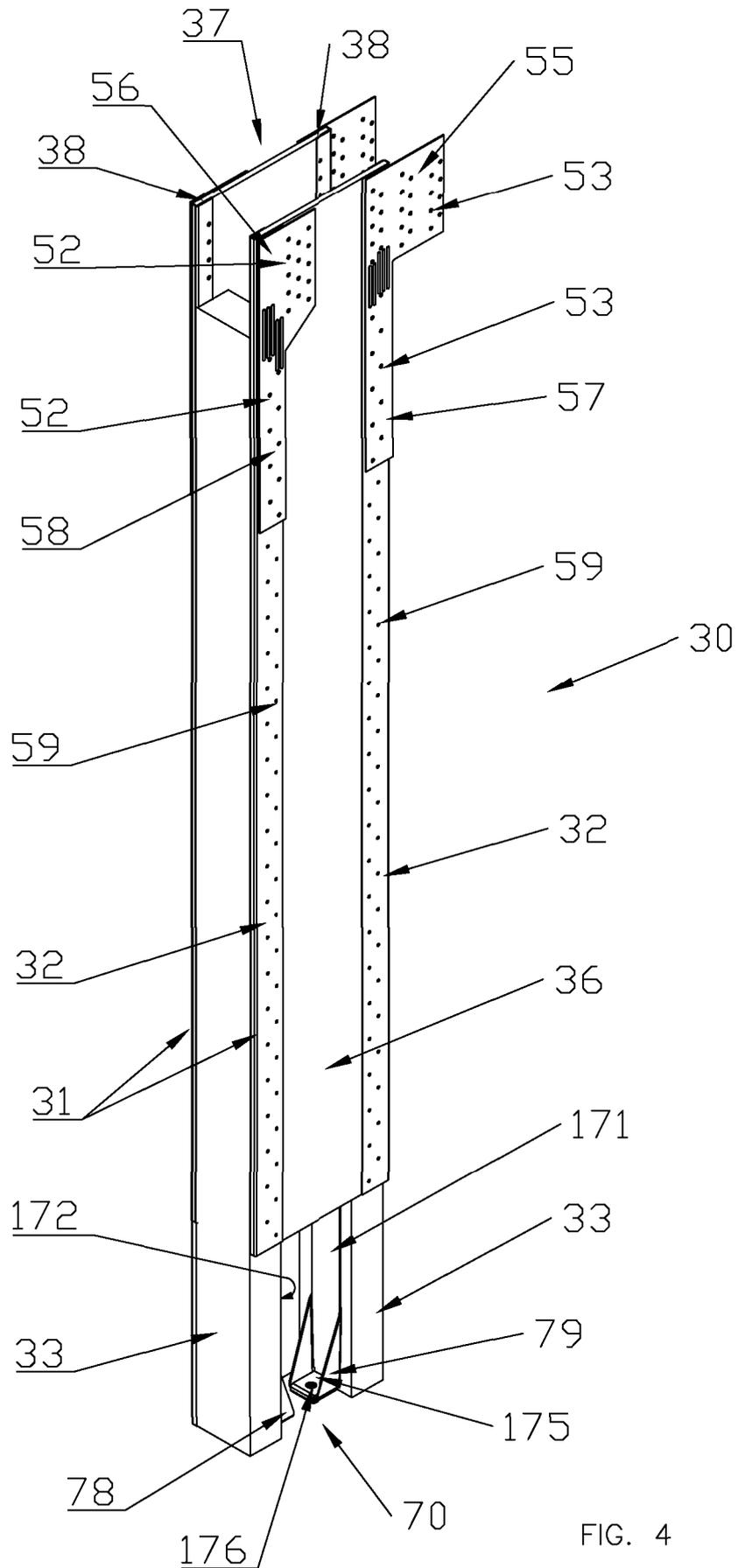
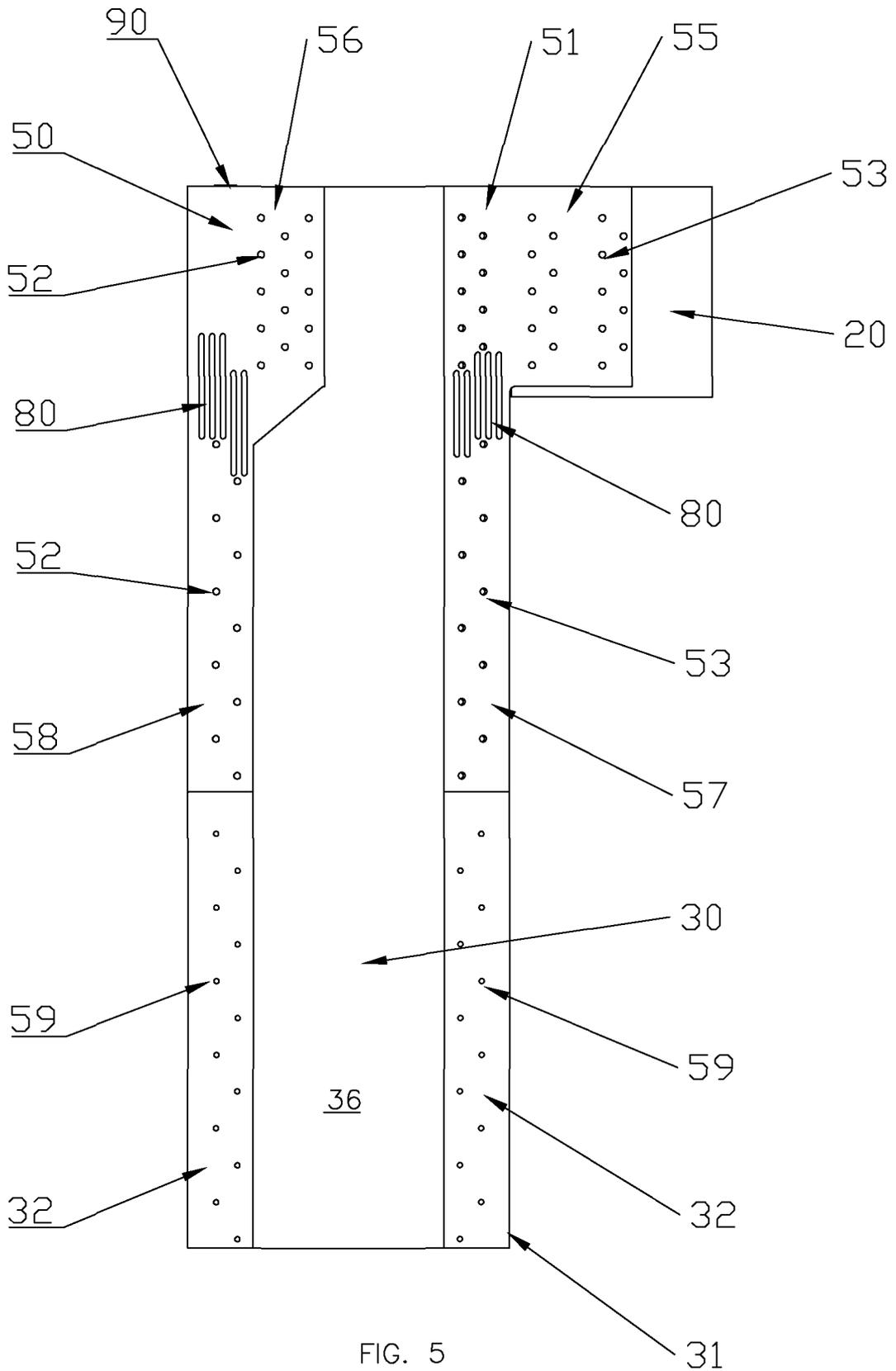


FIG. 4

SUBSTITUTE SHEET (RULE 26)



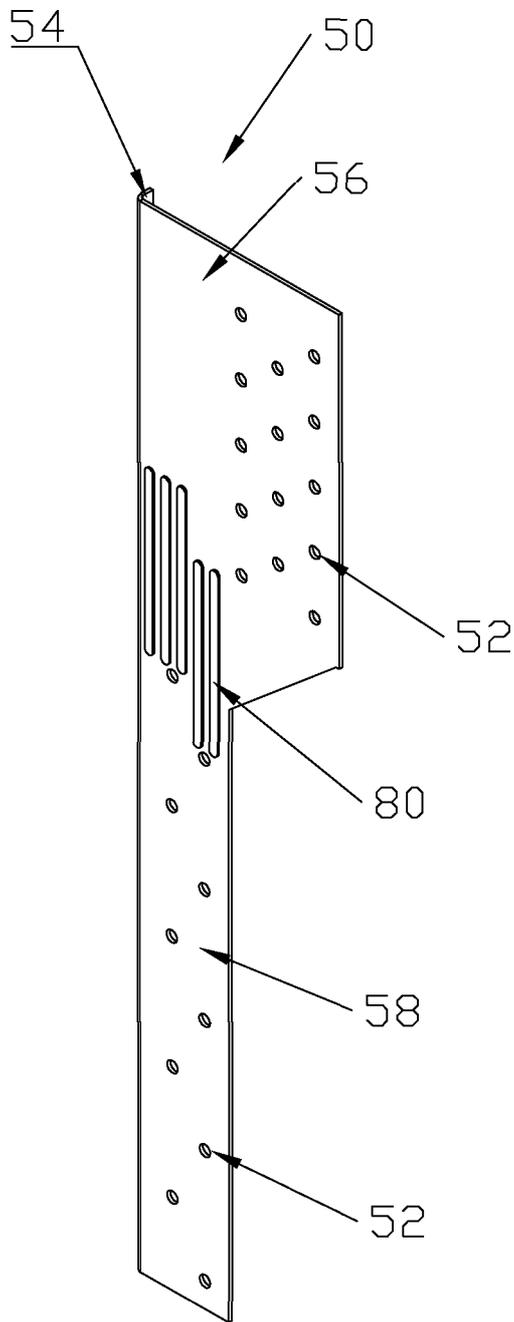


FIG. 6a

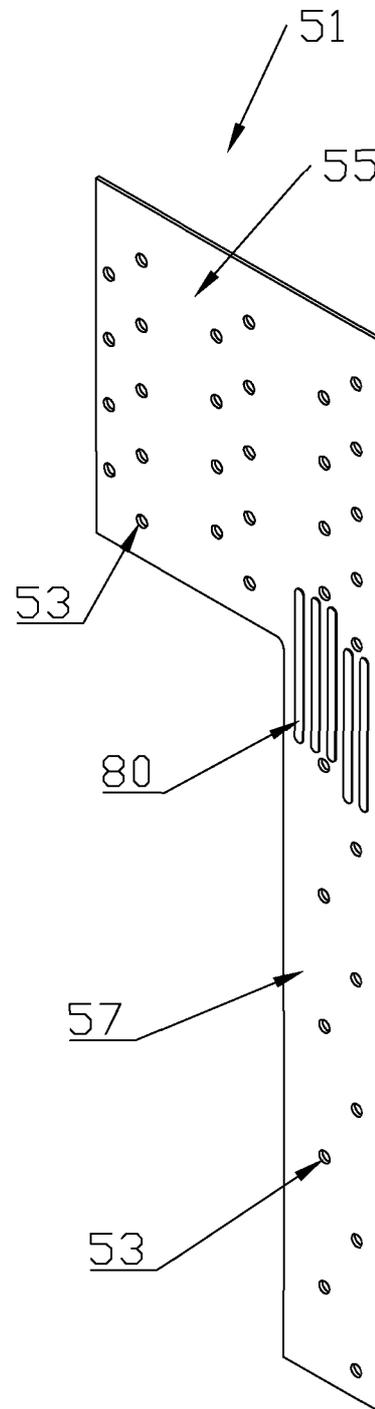


FIG. 6b

7 / 28

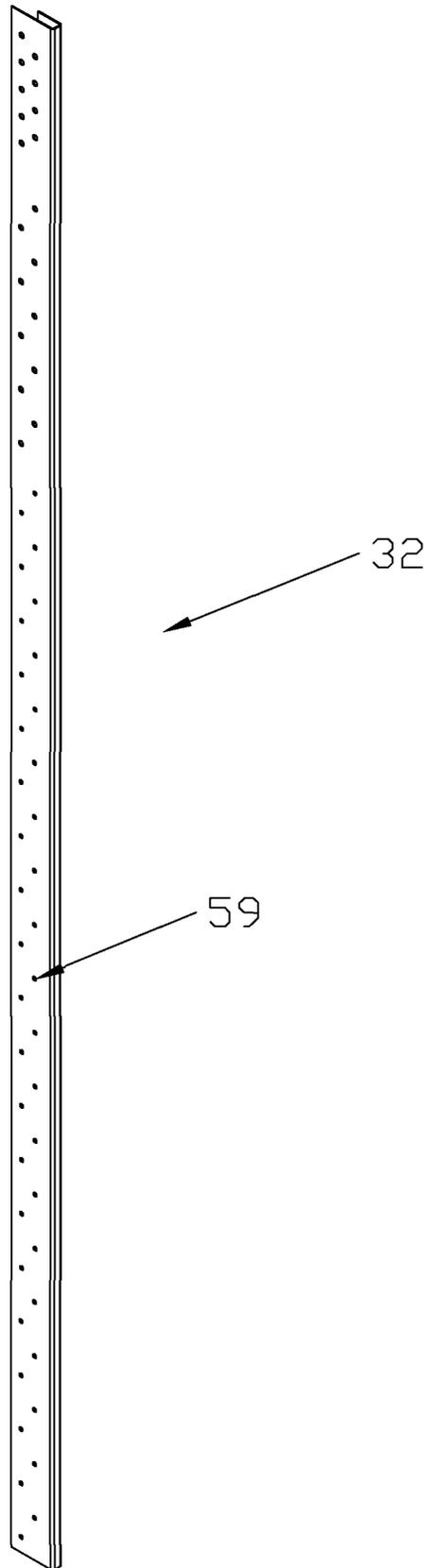


FIG. 6c  
SUBSTITUTE SHEET (RULE 26)

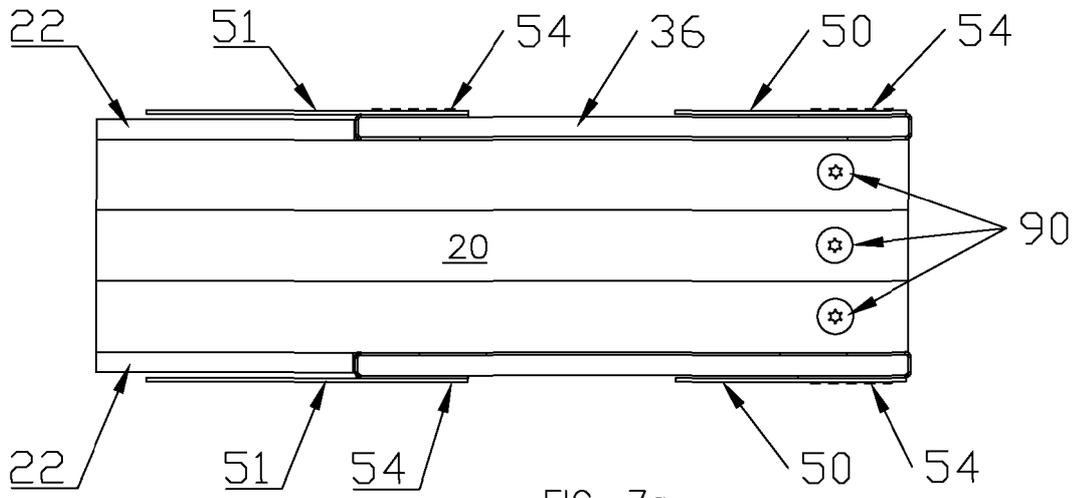


FIG. 7a

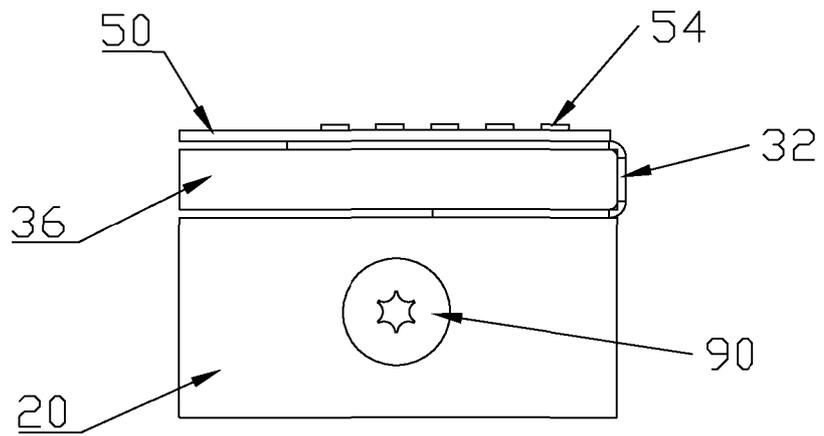


FIG. 7b

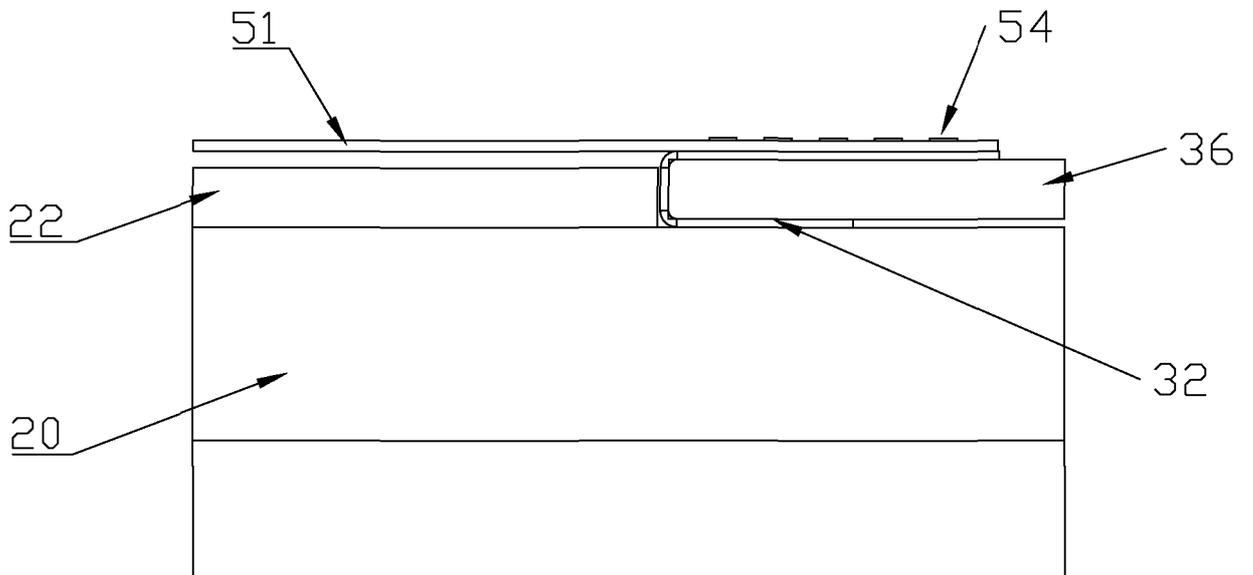


FIG. 7c  
SUBSTITUTE SHEET (RULE 26)

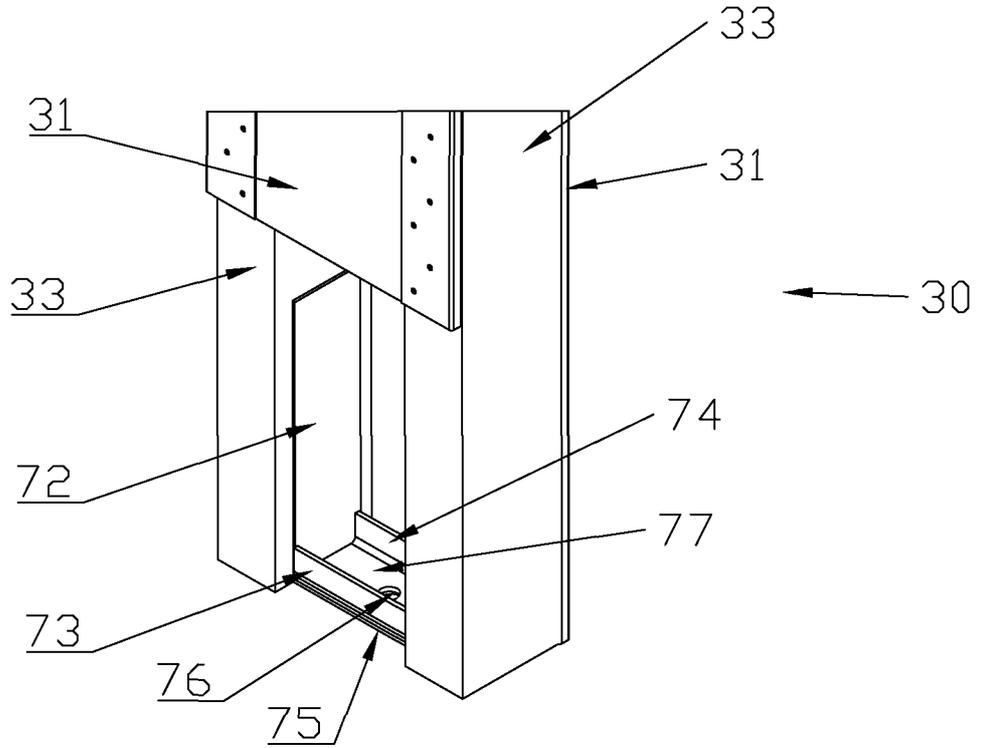


FIG. 8a

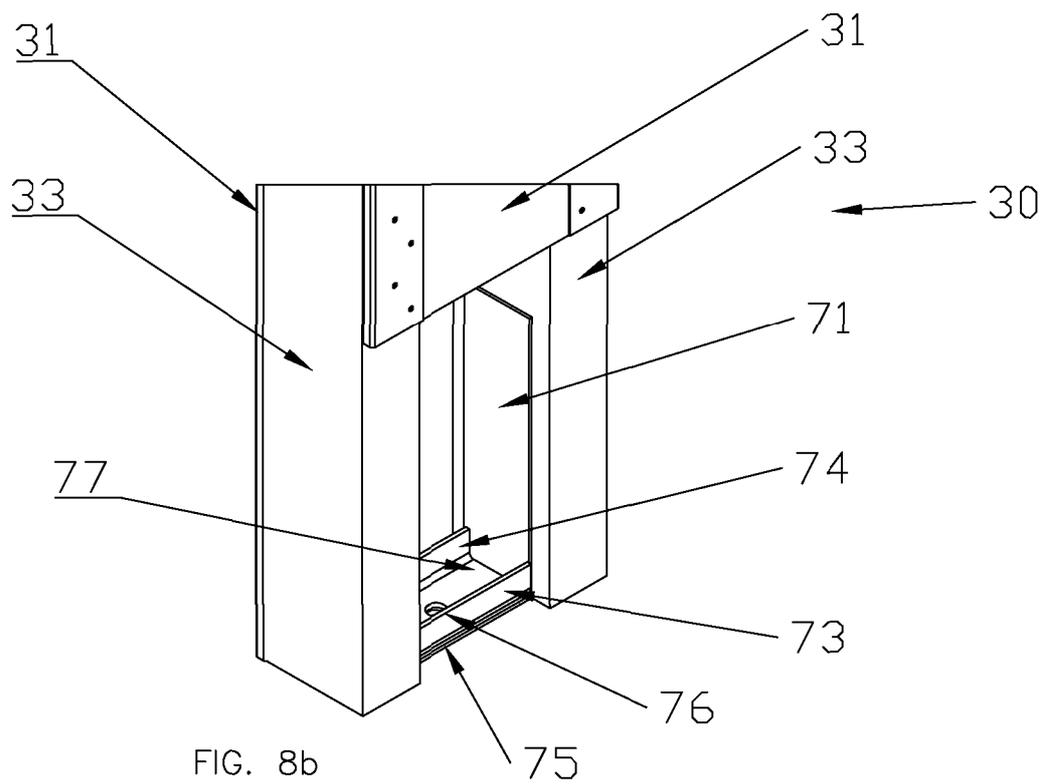


FIG. 8b  
SUBSTITUTE SHEET (RULE 26)

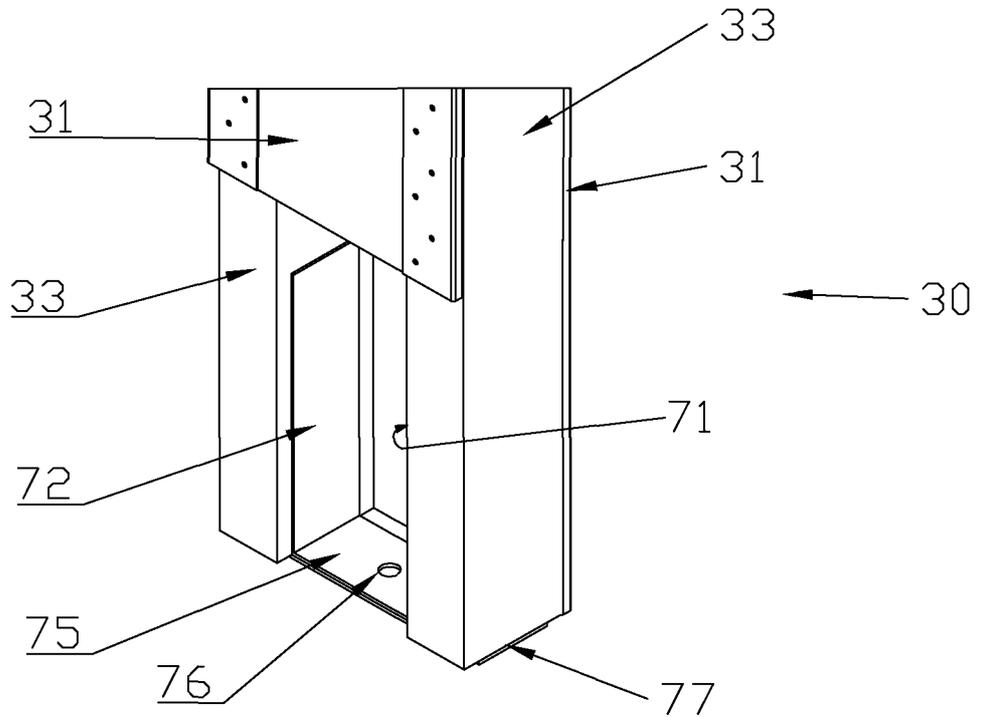


FIG. 9a

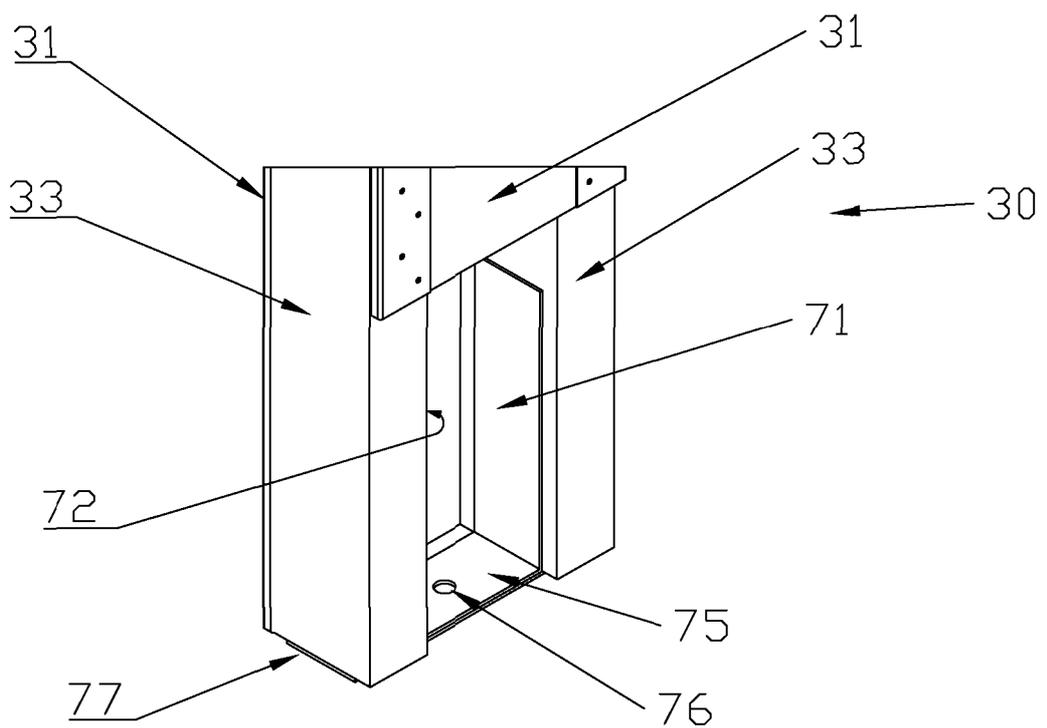


FIG. 9b  
SUBSTITUTE SHEET (RULE 26)

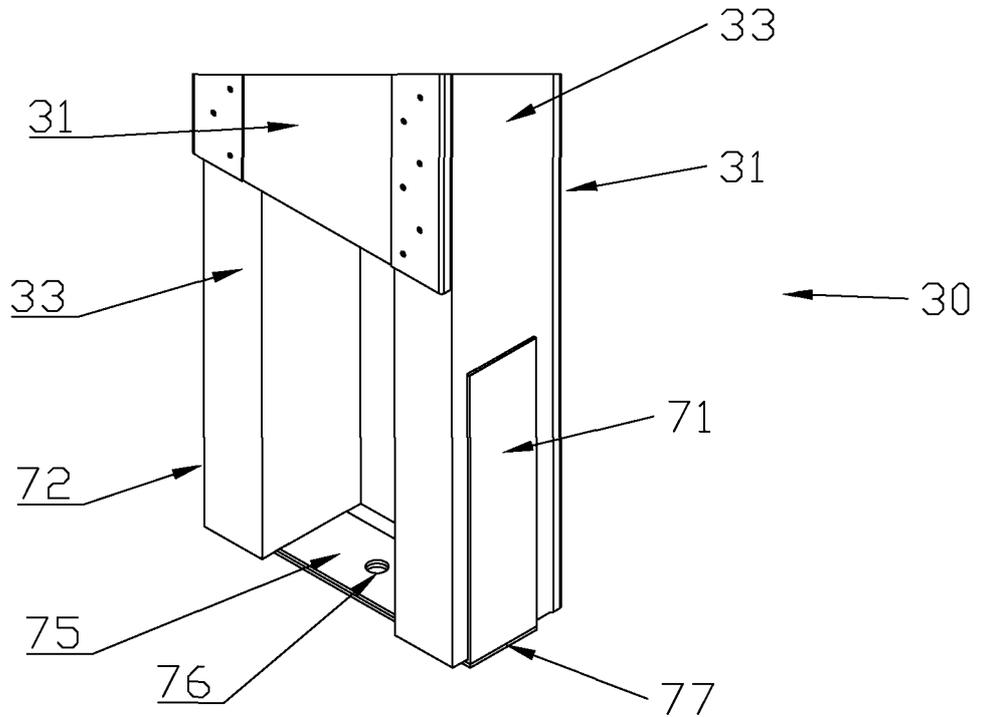


FIG. 10a

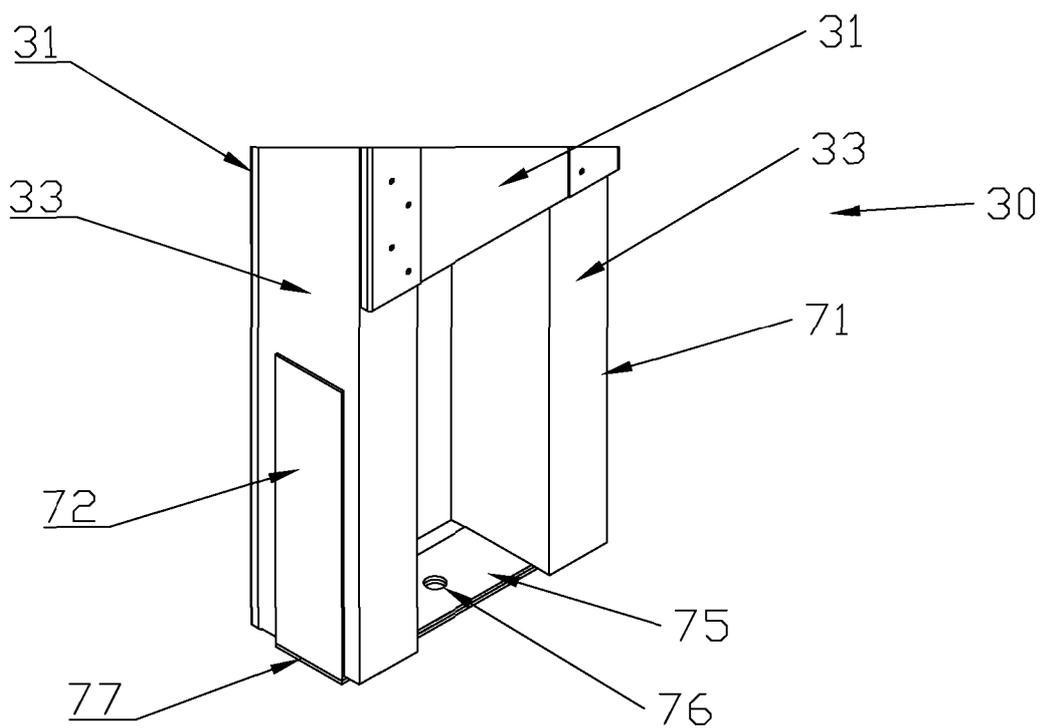


FIG. 10b  
SUBSTITUTE SHEET (RULE 26)

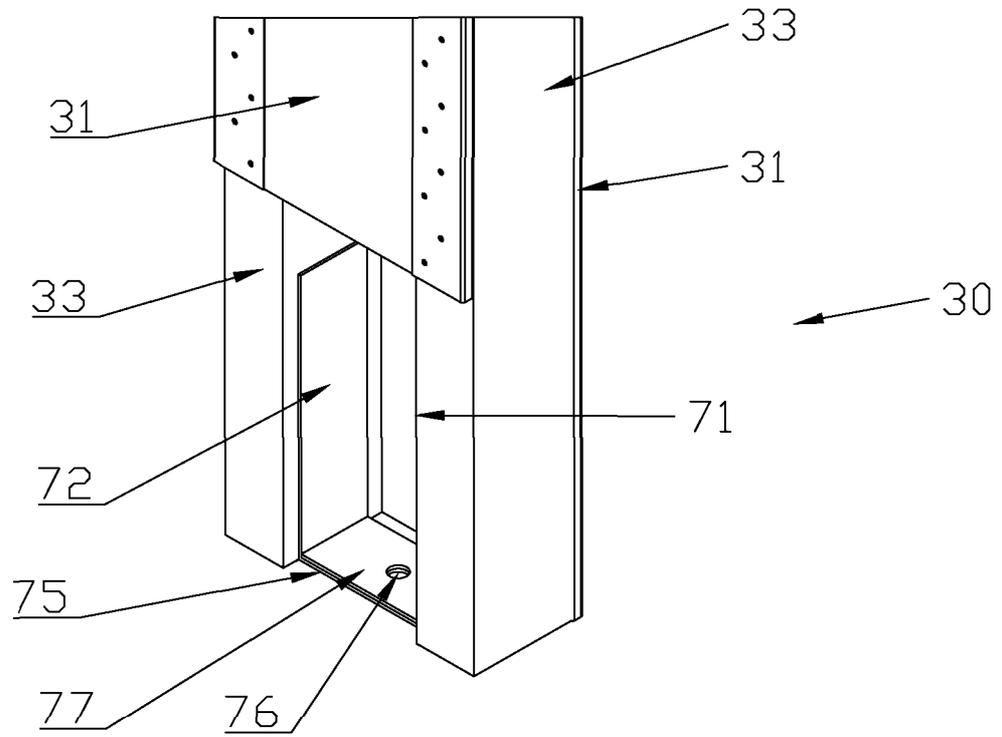


FIG. 11a

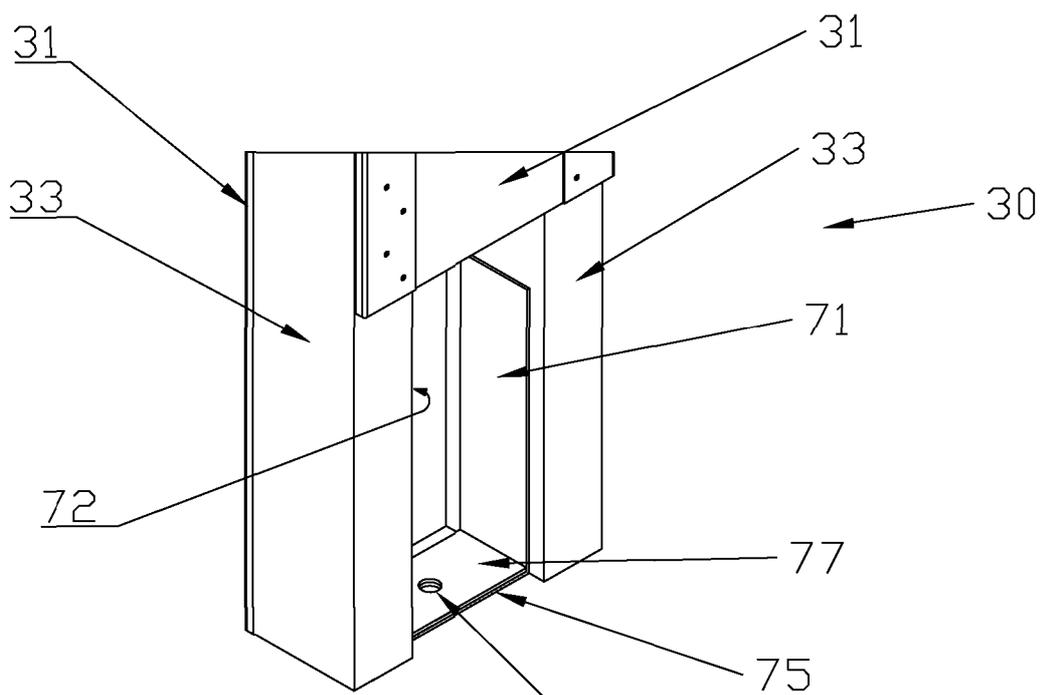


FIG. 11b  
SUBSTITUTE SHEET (RULE 26)

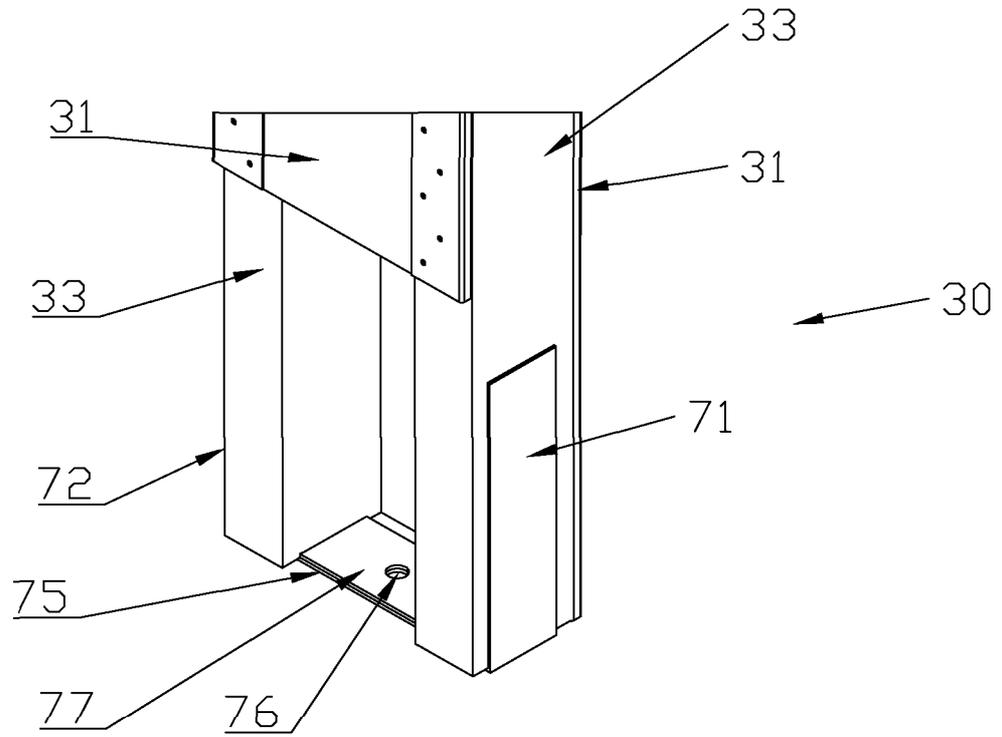


FIG. 12a

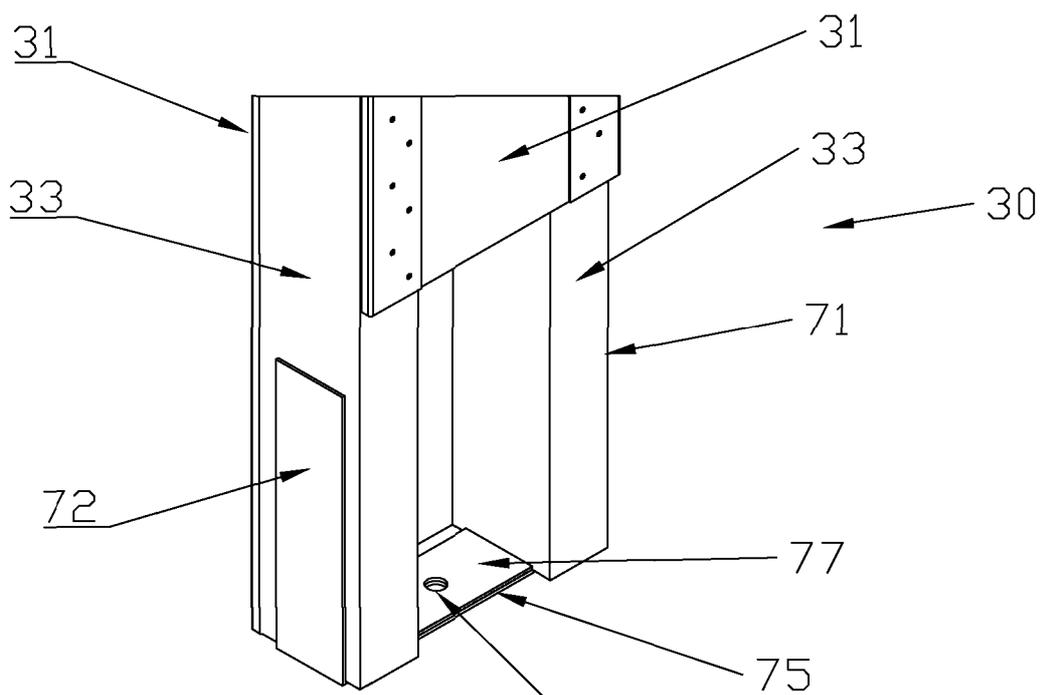


FIG. 12b  
SUBSTITUTE SHEET (RULE 26)

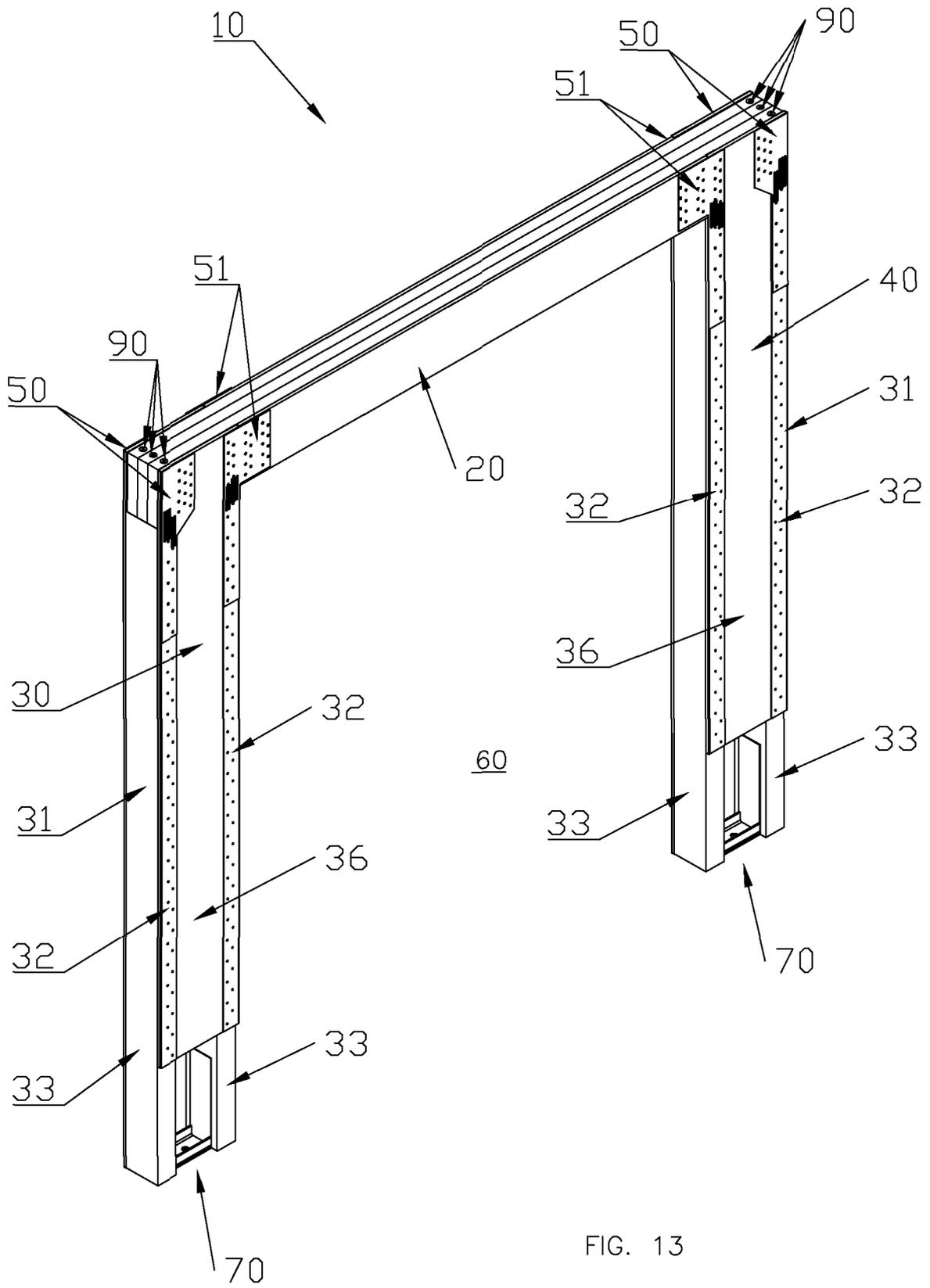


FIG. 13

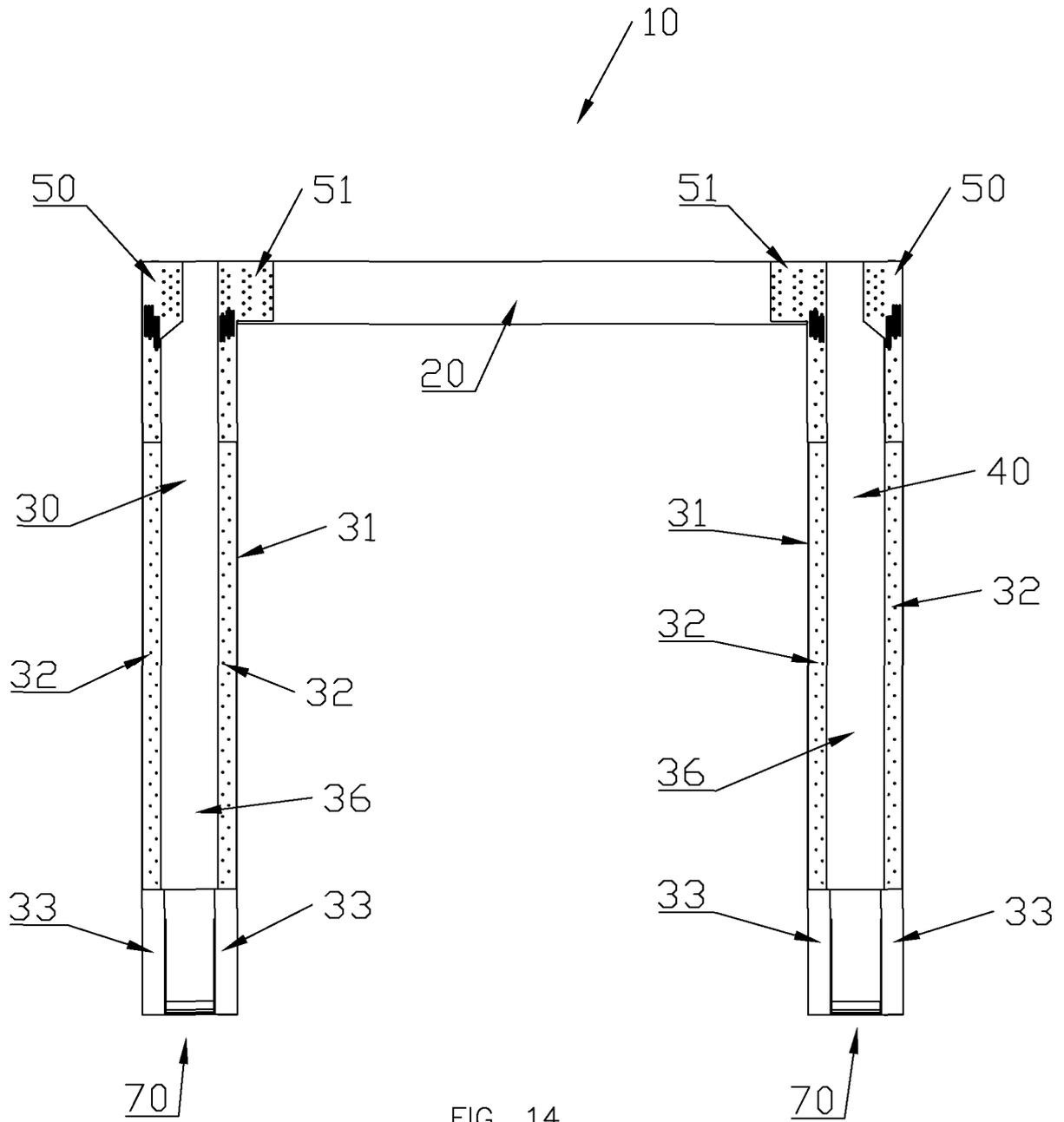
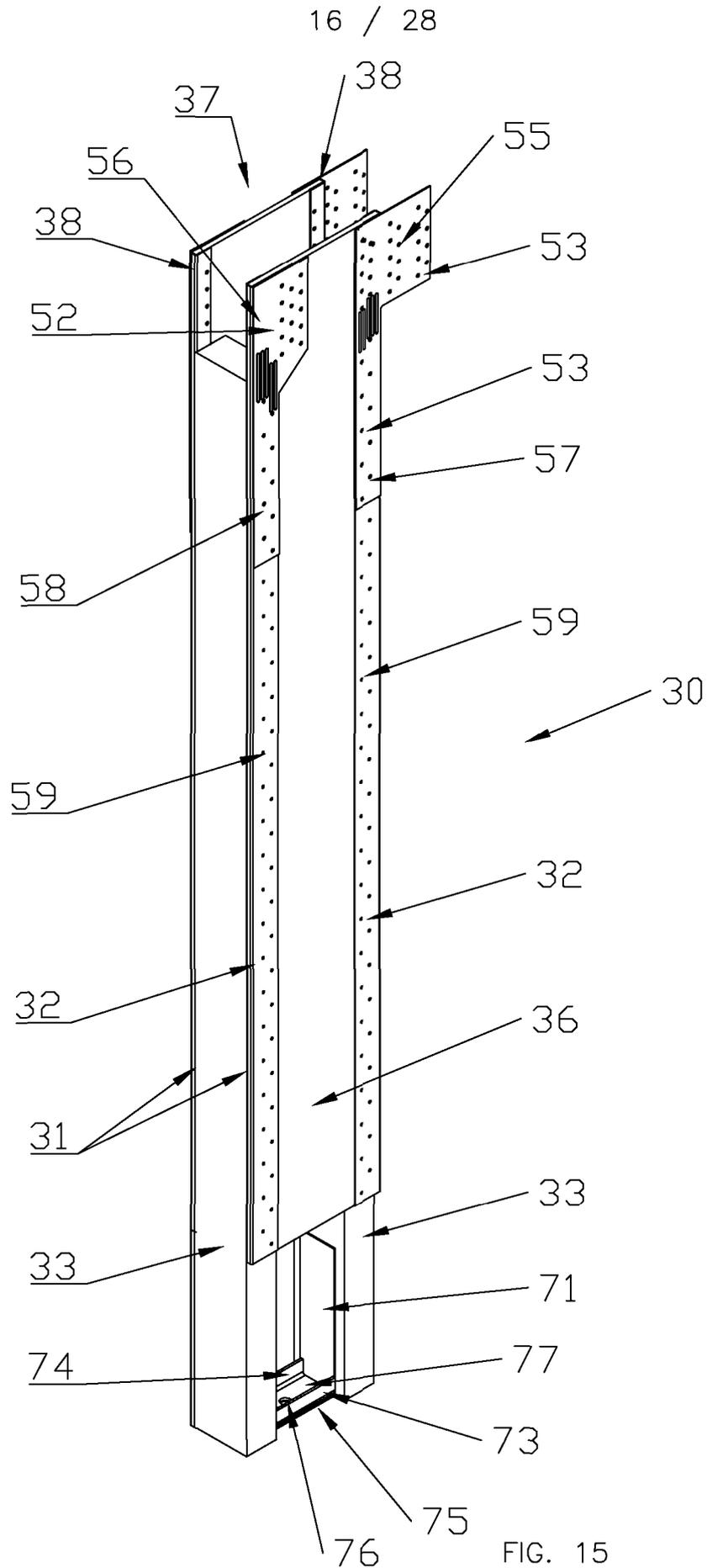


FIG. 14



SUBSTITUTE SHEET (RULE 26)

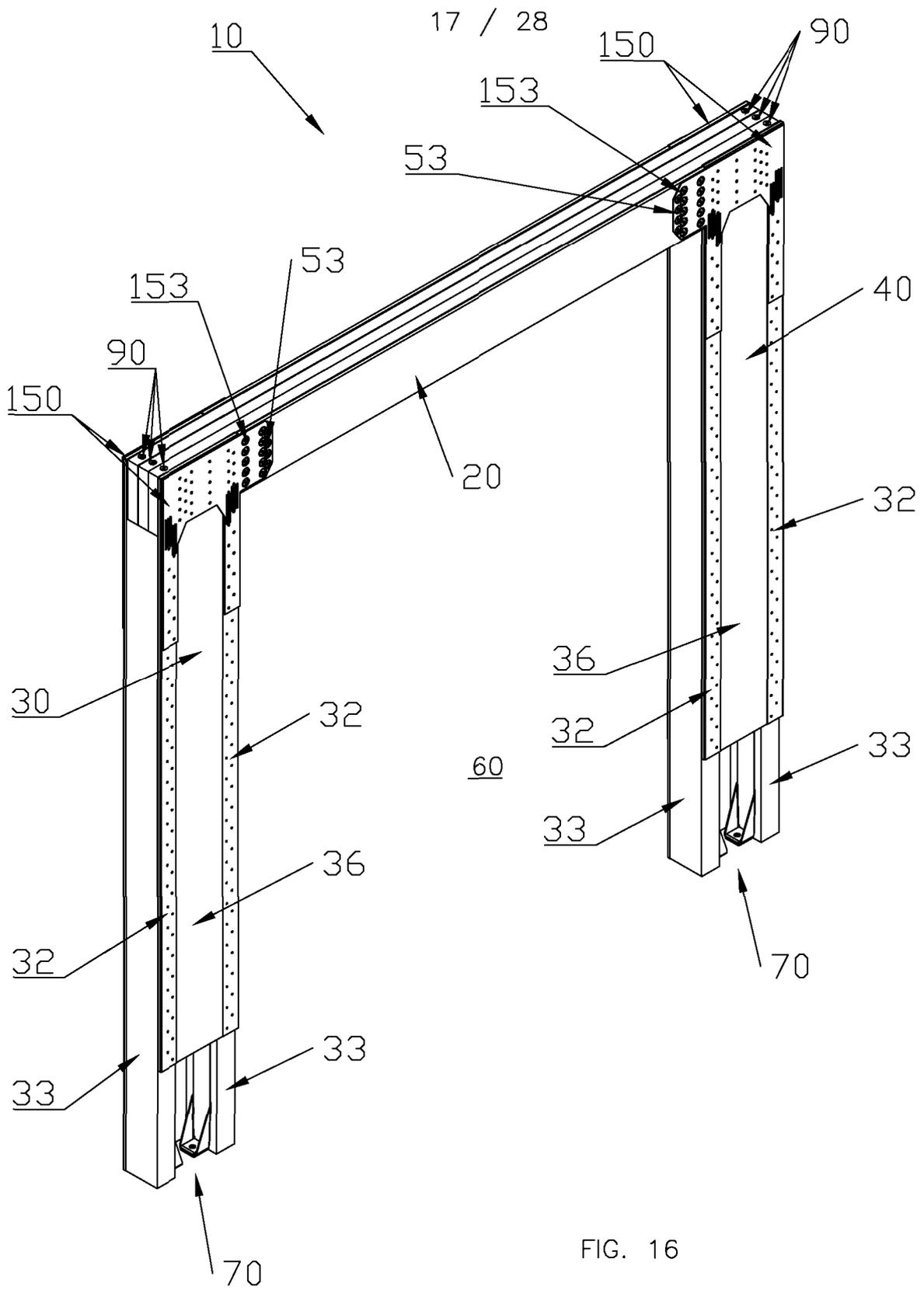


FIG. 16

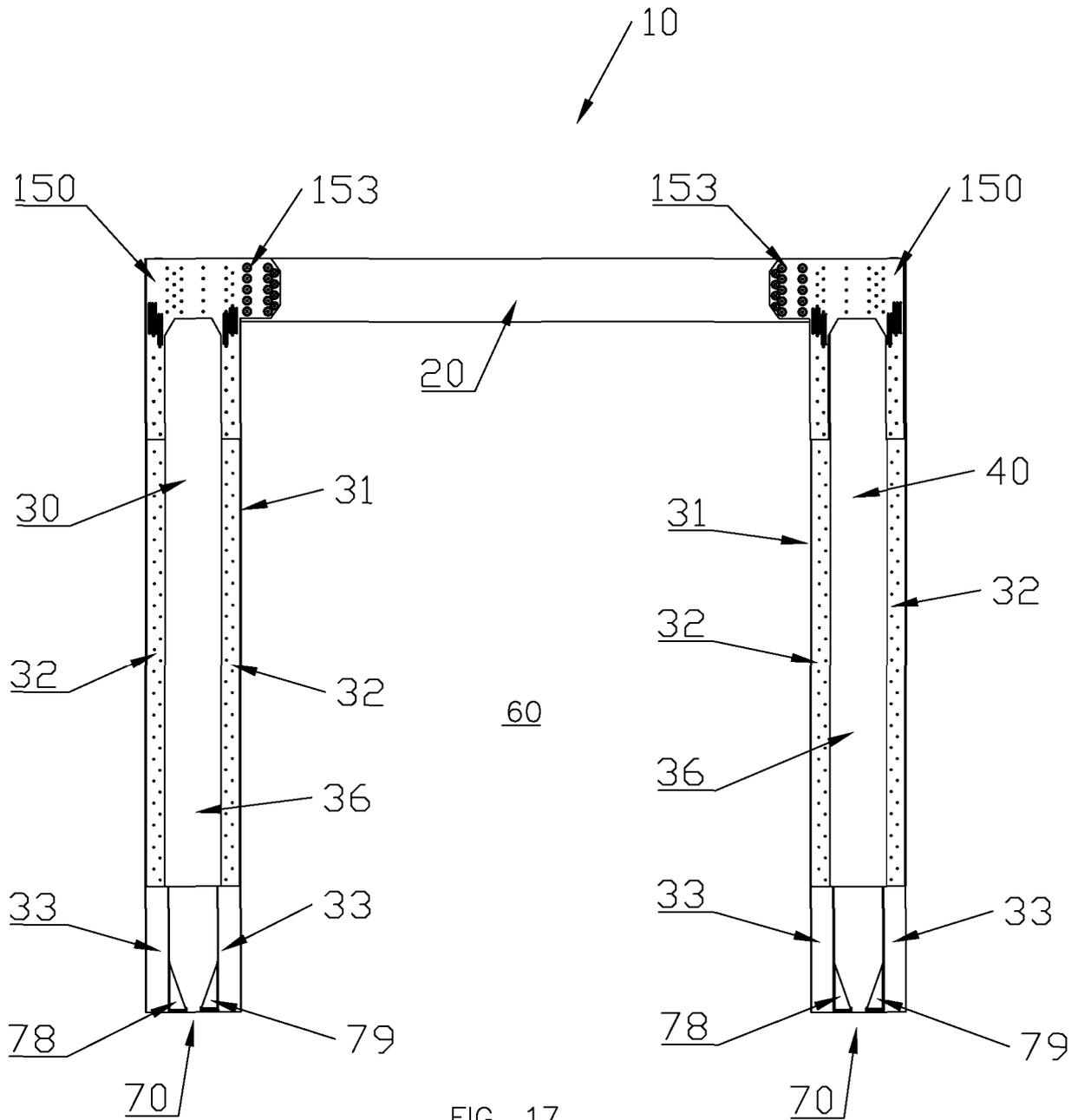


FIG. 17

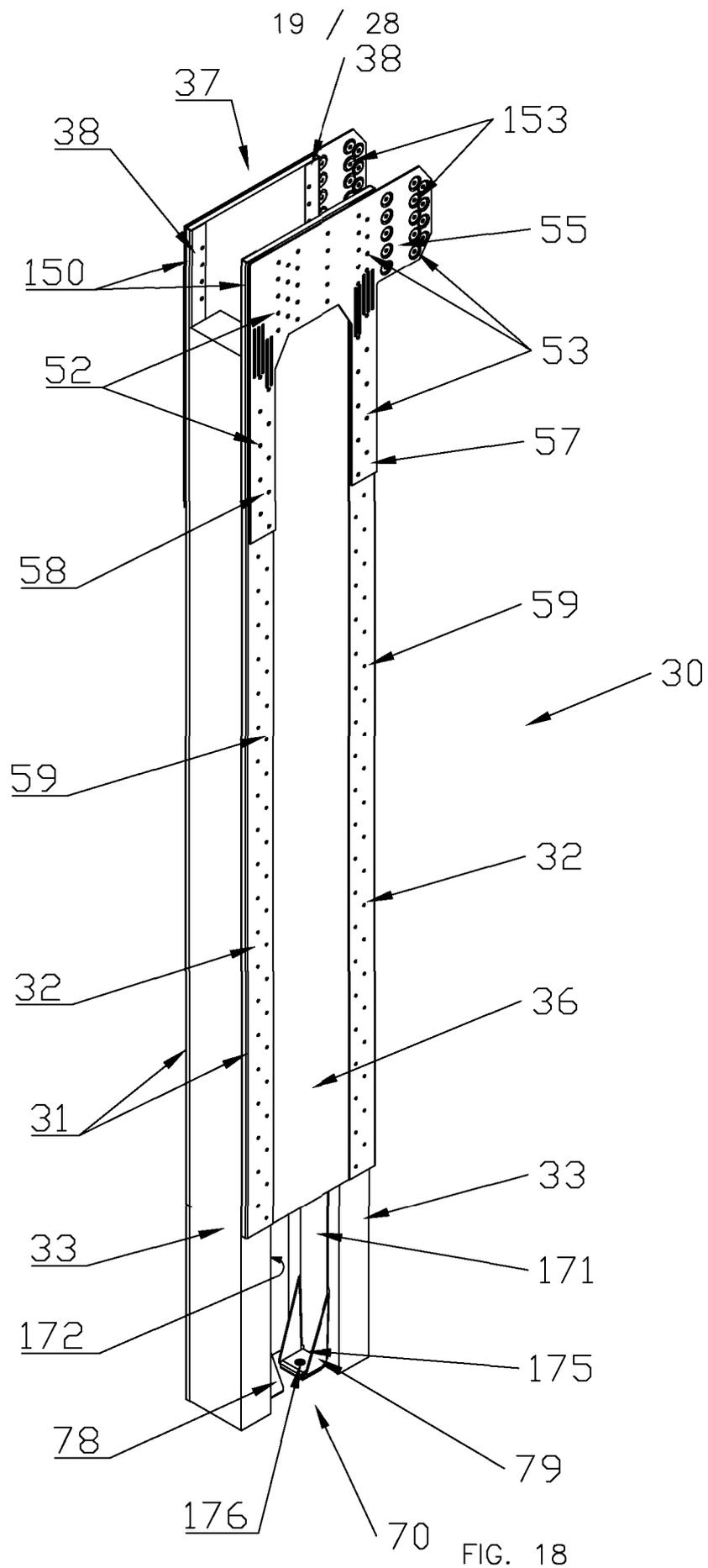


FIG. 18

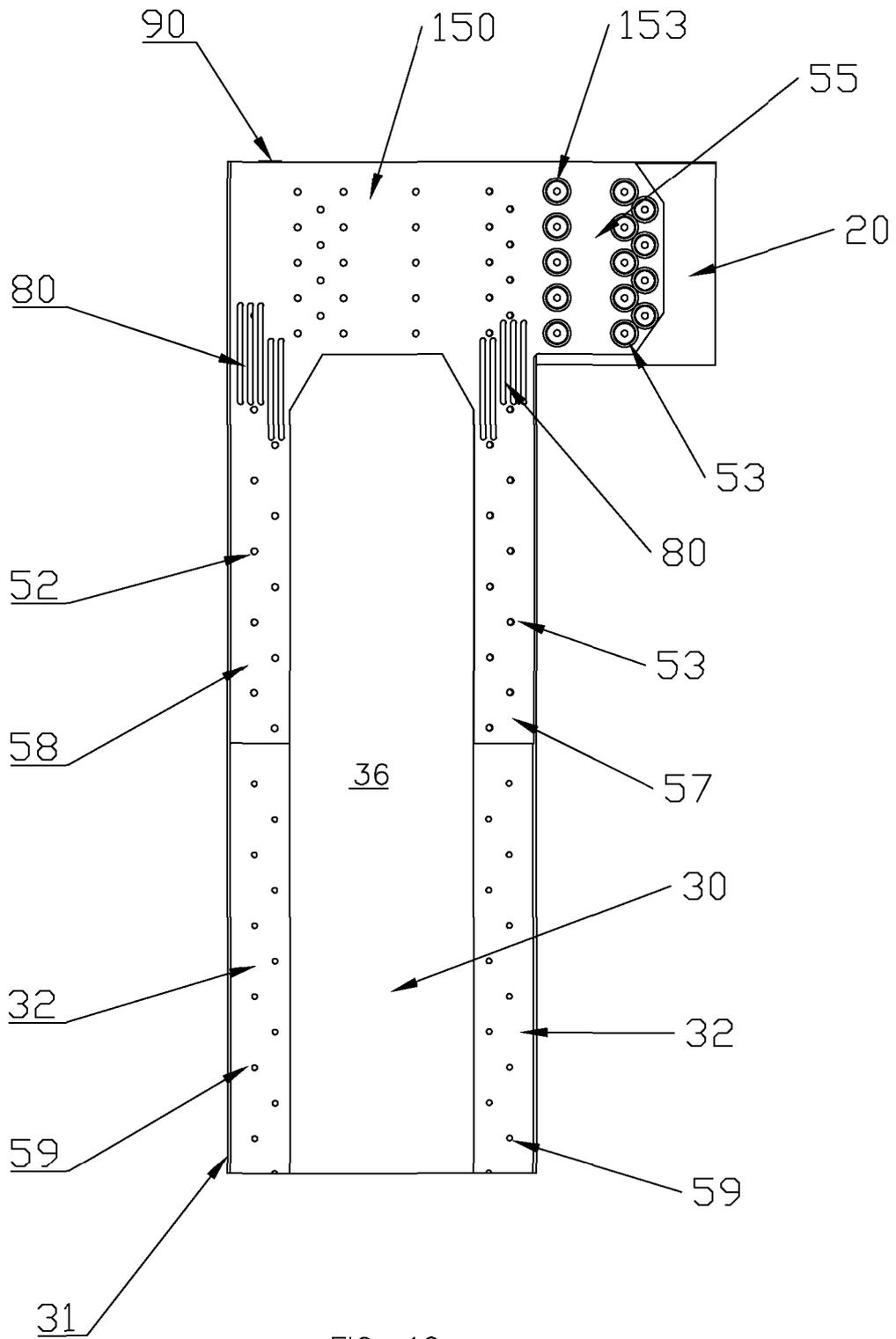


FIG. 19

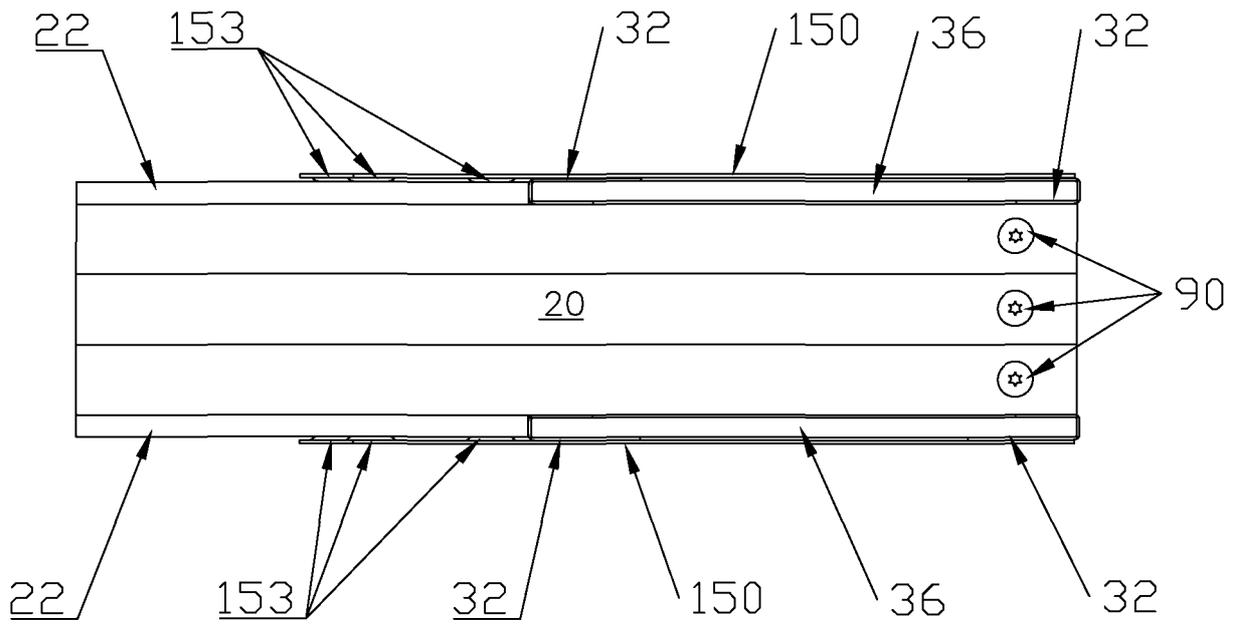


FIG. 20

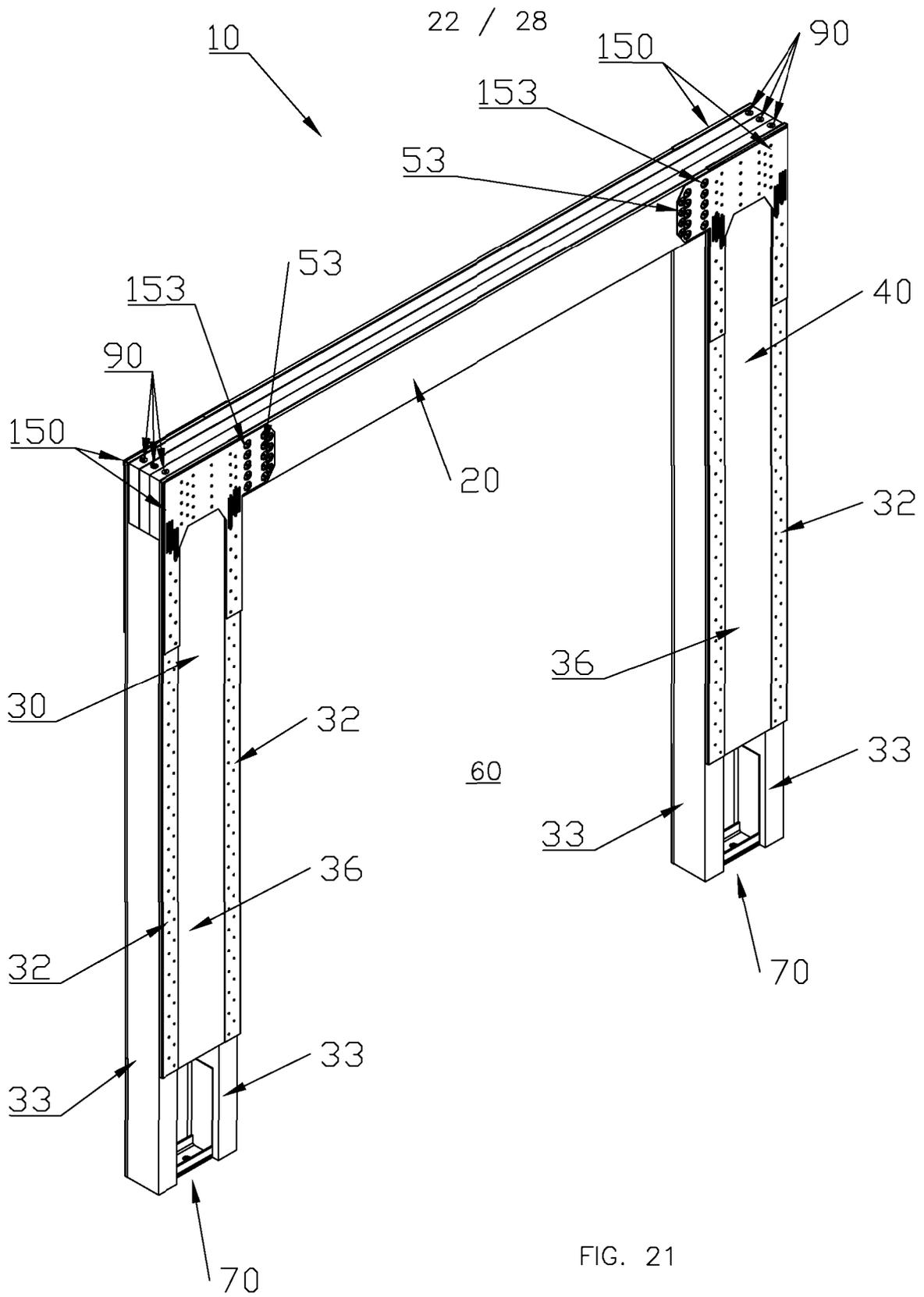


FIG. 21

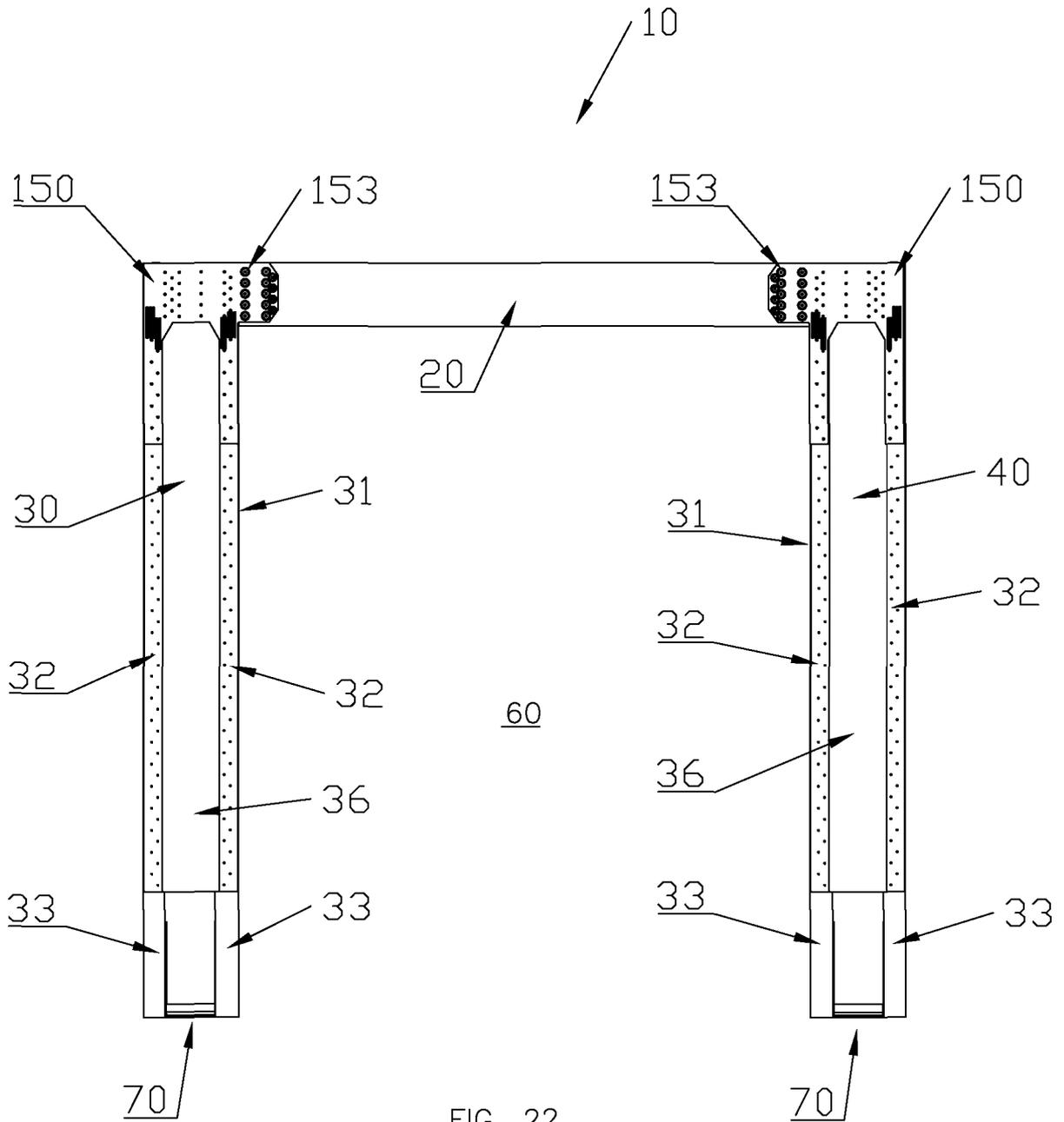


FIG. 22

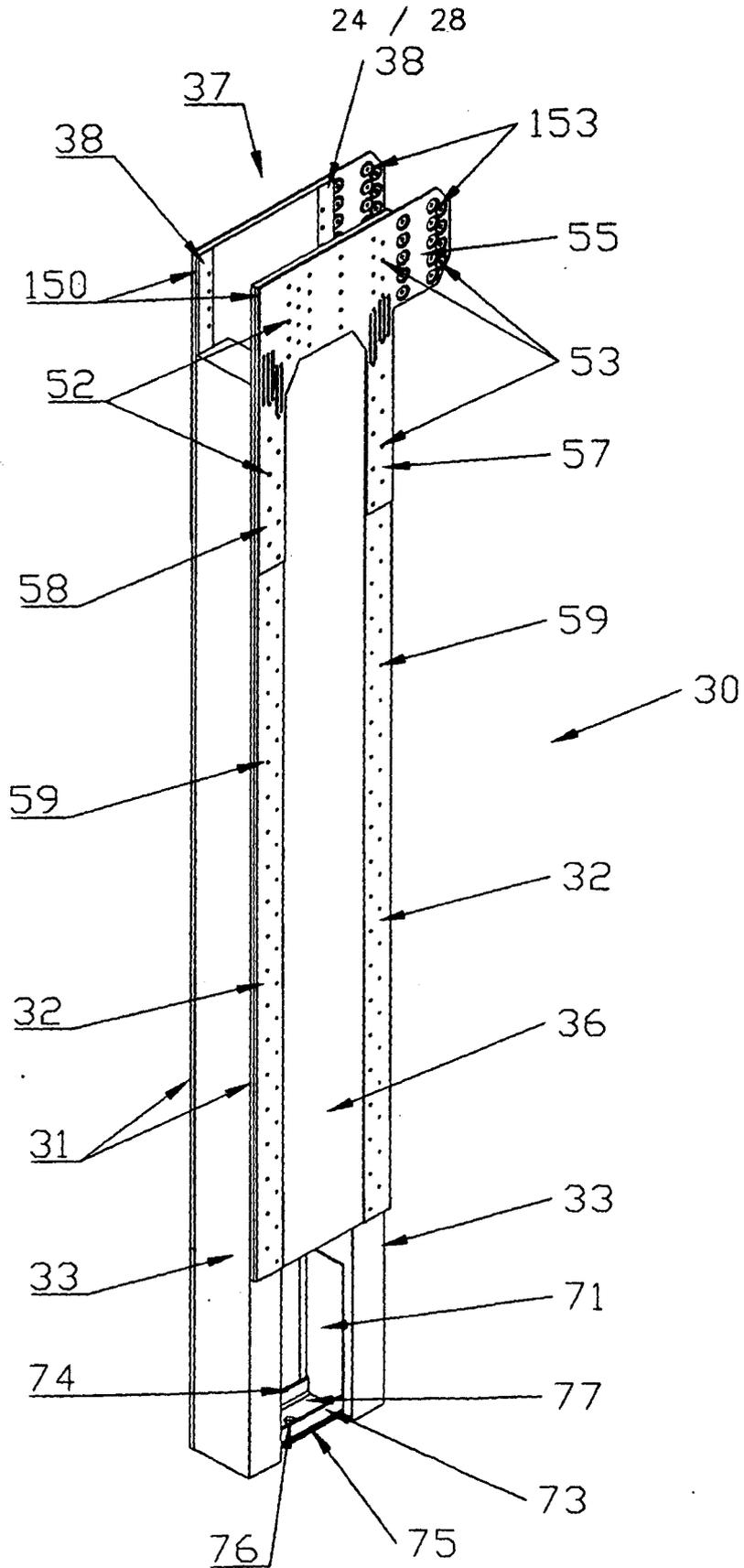


FIG. 23



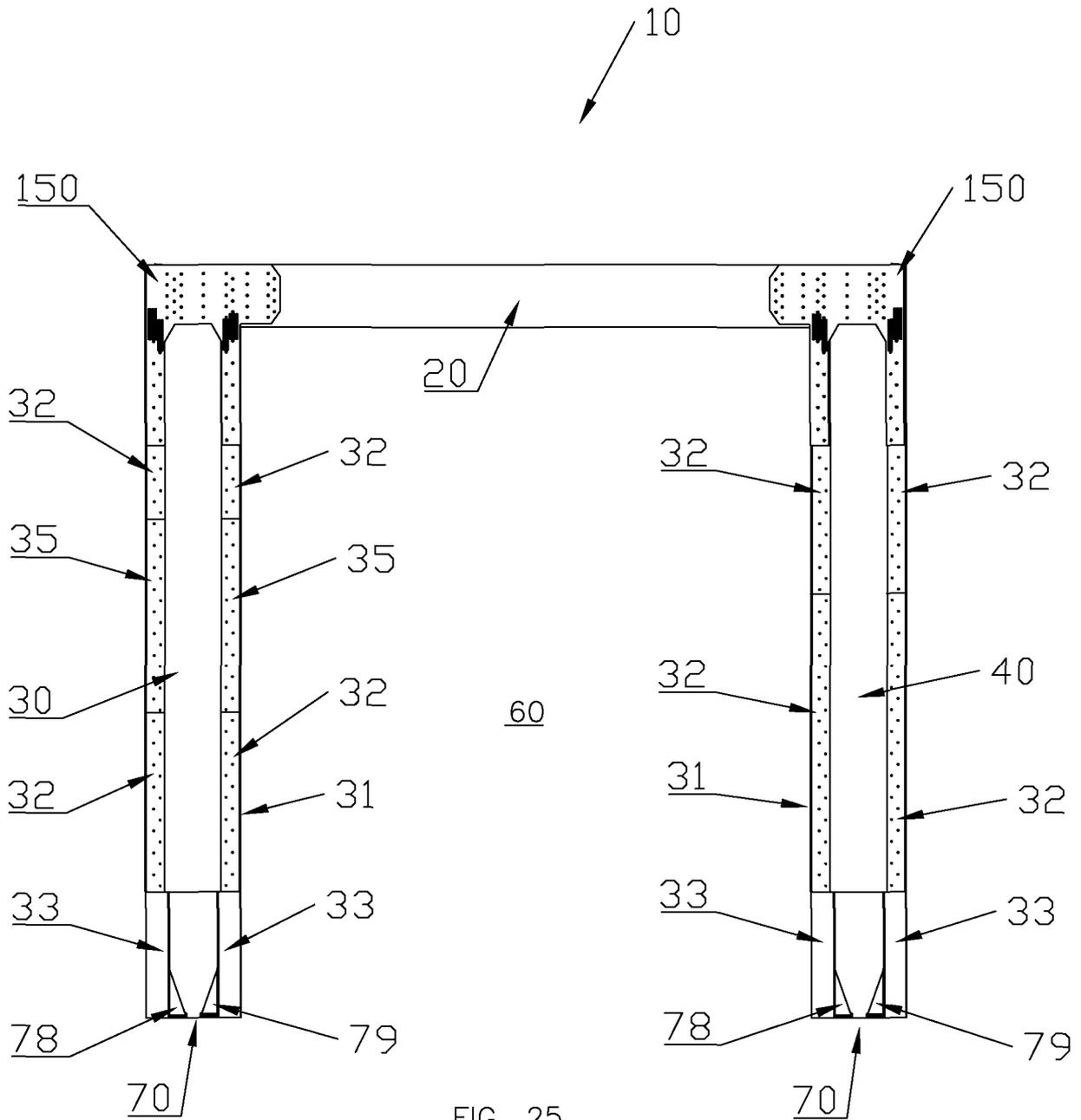
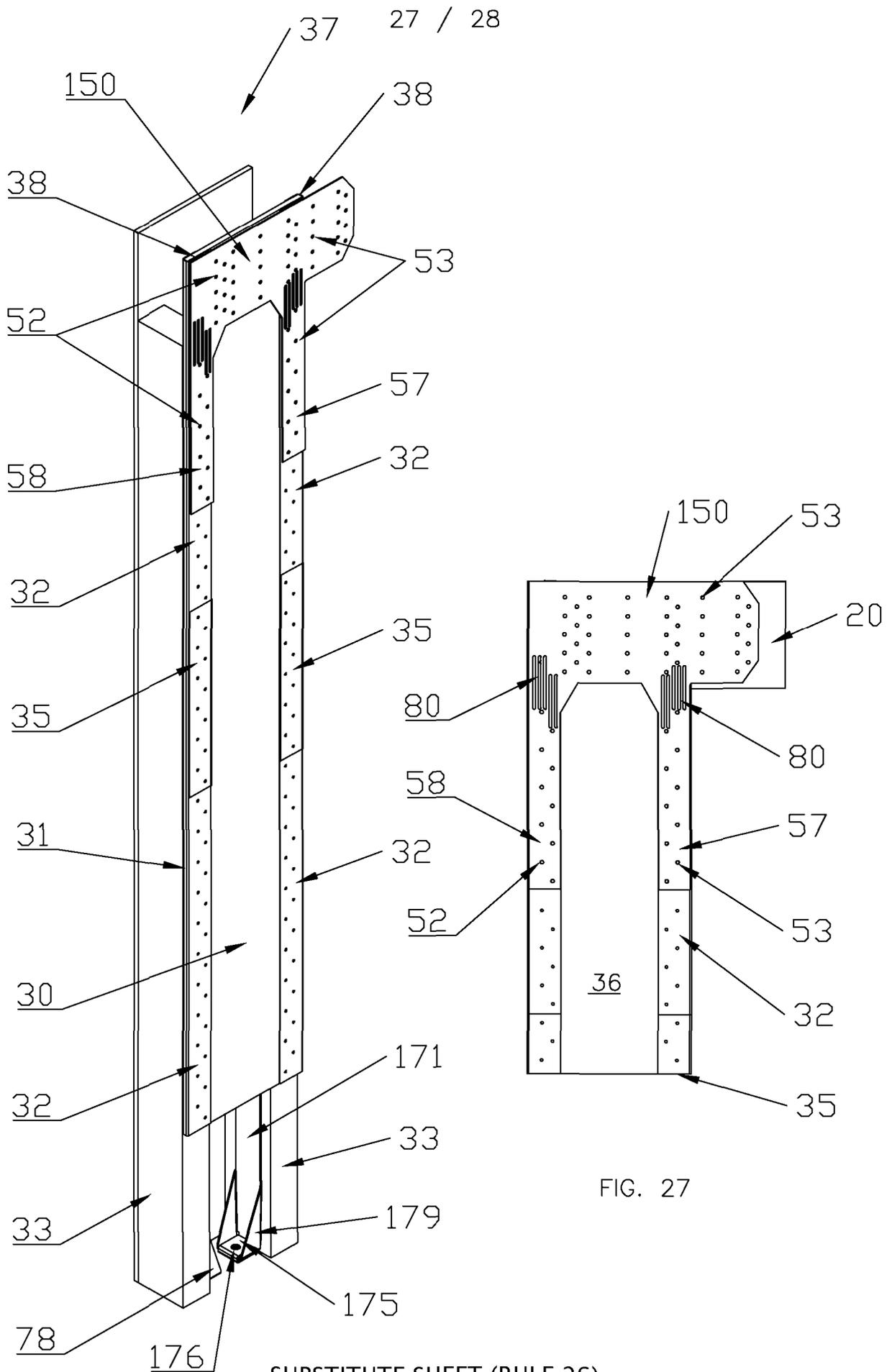


FIG. 25



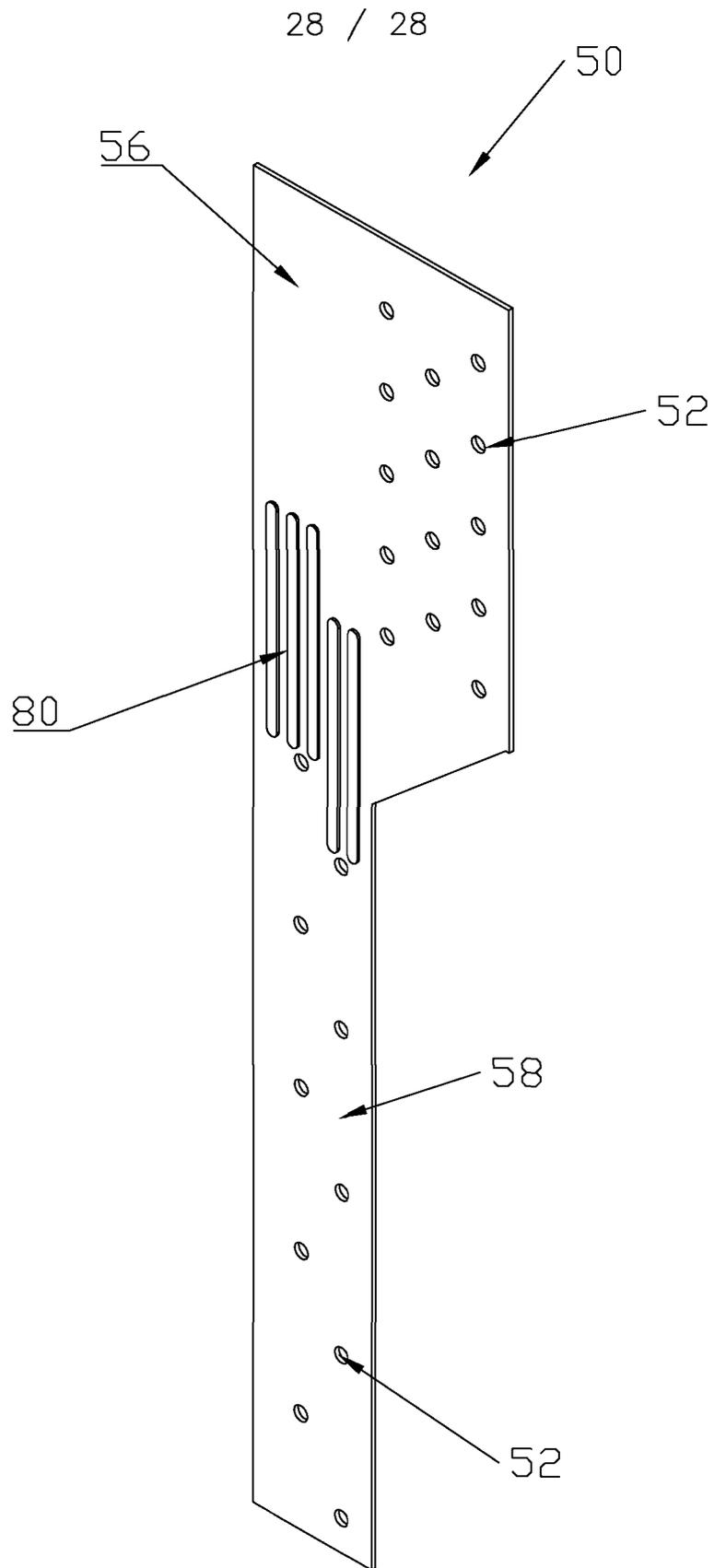


FIG. 28

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/GB2012/000794

A. CLASSIFICATION OF SUBJECT MATTER  
**INV. E04B1/26 E04C3/42**  
 ADD.  
 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)  
**E04B E04C**

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)  
**EPO-Internal , WPI Data**

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"WOOD STRONG-WALL : Garage Portal Systems on Concrete Foundations", C-SW07, 1 January 2007 (2007-01-01) , pages 47-49 , XP055048207 , Retrieved from the Internet: URL: <a href="http://www.buidesign.com/pdf/simpsonstrongtie/Wood-Strong-Wall-1-Shearwall-1-Product-Data-307376.pdf">http://www.buidesign.com/pdf/simpsonstrongtie/Wood-Strong-Wall-1-Shearwall-1-Product-Data-307376.pdf</a> [retrieved on 2012-12-18] the whole document	1-28
X	----- GB 2 026 124 A (MOEHLNPAH WALTER GEORGE) 30 January 1980 (1980-01-30)	27
A	page 1, line 93 - line 115; figures 1,2 -----	1-26,28
X	US 5 697 725 A (BALLASH EVON M C [US] ET AL) 16 December 1997 (1997-12-16)	27
A	column 2, line 2 - line 56; figures 1, 5-7 -----	1-26,28

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	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search <b>29 January 2013</b>	Date of mailing of the international search report <b>04/02/2013</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Galanti , Flavi o</b>
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2012/00Q794

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: 29-32  
because they relate to subject matter not required to be searched by this Authority, namely:  

The claims must not, in respect of the technical features of the invention, rely on references to the description or drawings "except where absolutely necessary." See PCT Rule 6.2(a) and PCT Guidelines 5.10
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos. :
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2012/000794

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2026124	A	30-01-1980	
		AU 4880779 A	24-01-1980
		CA 1097020 AI	10-03-1981
		DE 2928459 AI	31-01-1980
		FR 2431631 AI	15-02-1980
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		SE 7905997 A	18-01-1980
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		ZA 7903356 A	24-09-1980
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US 5697725	A	16-12-1997	NONE
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