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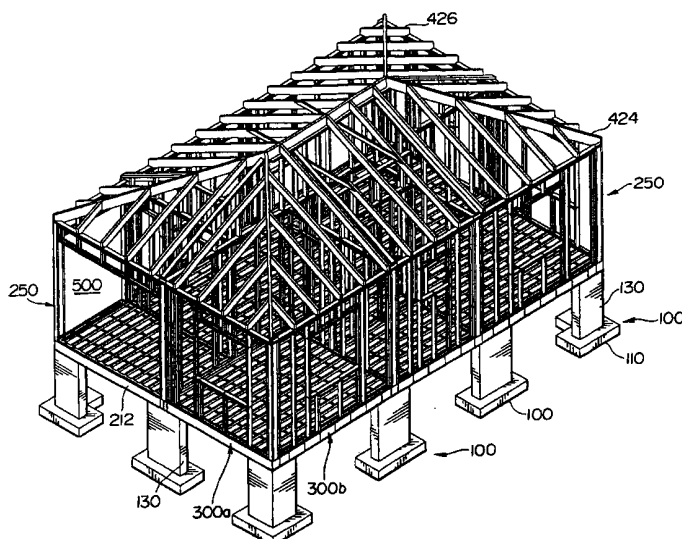
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(54) Title: SNAP-SCREW STEEL FRAME AND CONCRETE BUILDING SYSTEM



(57) **Abstract:** A building resistant to earthquakes, wind loads, fire, insects and rot includes a frame having multiple panels connected to form an outside wall and interior walls. The panels are constructed using formed coiled steel with "C" and/or "U" cross-section studs/rails that preferably include appropriately located notch pairs to form joints with other studs/rails. The building preferably also includes a flooring substrate having groupings of studs/rails to form floor panels that are covered with galvanized steel sheets, which supports a bed of concrete to form the floor. The building preferably rests upon a footing system to raise the building off the ground and thus provide an air barrier below the house. The panels and floor panels may be constructed either off-site or on-site. The building may include a variety of roofing material and structures that satisfied the requirements dictated by the environment in which the building is built.

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SNAP-SCREW STEEL FRAME AND CONCRETE BUILDING SYSTEM

I. Field of the Invention

This invention relates to frames for buildings and buildings constructed from such frames, and more particularly to high quality buildings that can be erected quickly and at low cost from studs and rails preferably made of steel.

II. Background of the Invention

Conventional building practice for residence housing relies primarily on wood frame construction in which the building frame is constructed on site from framing lumber cut to fit piece-by-piece individually. It is a labor intensive process and demands considerable skill from the carpenters to produce a structure that has level floors, perfectly upright walls, square corners and parallel door and window openings. Even when the building frame is constructed with the requisite care and skill, it can become skewed by warping of the lumber, especially modern low grade lumber produced on tree farms with hybrid fast-growth trees.

Although conventional wood frame buildings require very little equipment for construction, they have become quite costly to build. The labor component of the cost is substantial, partly because of the straight wages that must be paid for the long laborious process of constructing the frame, and partly because of the many government mandated extra costs such as workman's compensation and liability insurance, social security payments, medical insurance premiums, and the host of reports that must be made to the government by employers. Accordingly, employers now seek to minimize their work force by whatever means is available to minimize these burdensome costs.

Steel frame construction is commonly used on commercial buildings because of its greater strength, fire resistance and architectural design flexibility. The parts of such a steel frame are typically built to order in accordance with the architect's plans, then trucked to the building site and assembled piece-by-piece with the use of a portable crane. The building can be made precisely and as strong as needed, but the cost is relatively high because of the skilled crew and expensive equipment need to assemble the building. It is a construction technique generally considered unsuitable for single family residence building because the cost is high and the building walls are substantially thicker than those made using standard frame construction, so standard door and window units do not fit

properly and must be modified with special trim that rarely produces an aesthetic appearance.

Earthquake damage is becoming a matter of increasing concern among homeowners because of the publicity given to damage and loss of life in recent earthquakes around the world. Earthquake preparedness stories and advice abound, but an underlying unresolved concern is that conventional wood frame homes in the past were not built to tolerate the effects of an earthquake, neither in its ultimate load-bearing capability nor its serviceability limits. Modern building codes attempt to address this concern, but the measures they require merely add to the already high cost of a new home and may not always provide significantly improved resistance to earthquake damage, particularly with respect to after-quake serviceability.

Fire often follows an earthquake, as happened in the disastrous Kobe earthquake of 1994, and of course fire is a major threat to homes independent of earthquake. When fire breaks out in a conventional home, the wood frame fuels the fire and reduces the chances of successfully extinguishing it before the entire structure is destroyed. The major life saving advance in the recent past is the fire alarm which detects the fire and merely alerts the occupants that a fire has started so they may escape before burning up with the house, but significant improvements to the fire resistance of the home itself that would retard the spread of the fire would be desirable.

The other major catastrophic threat to homes is wind. Wind loads on wood frame homes have destroyed many homes, primarily because the roof is usually attached so weakly to the walls that the combination of lift, exerted upward on the roof by the Bernoulli effect of the wind flowing over the roof, and pressure under the eaves tending to lift the roof off the walls, wrenches the roof off the walls and allows the wind to carry the roof away like a big umbrella.

Termite and carpenter ant damage to wood frame homes is a major form of damage, costing many millions of dollars per year. Although the damage done by insects is rarely life threatening, it is actually more extensive in total than the combined effects of wind and earthquake, and it is an ever present danger in many parts of the world.

Thus, there exists an increasing need for a home building frame design that would enable the inexpensive construction of homes that are highly tolerant

of the effects of earthquakes, do not support combustion, are capable of withstanding high winds, are immune to damage from insects, and can use standard building components such as door and window units. Such a building frame concept would be even more commercially valuable if it were possible to
5 erect the building in a short time with a small crew and without heavy equipment, and the frame could be adapted to produce buildings of attractive building styles desired locally.

III. Summary of the Invention

This invention provides a building system for constructing homes
10 inexpensively while protecting the structure against the forces of nature.

An objective of the invention is to provide a snap-screw steel frame and concrete housing system preferably with steel reinforced concrete columns at the corners and between peripheral wall intersections.

Another objective of the invention is the flexibility of design allowed by the
15 building material and method of construction.

Another objective of the invention is the speed at which a house or building may be constructed.

Another objective of the invention is to provide a structure capable of withstanding high winds resulting from, for example, hurricanes, monsoons, and
20 tornados.

Another objective of the invention is the flexibility of assembly of wall panels off-site to further speed the construction of a structure or assembly of the entire structure on-site.

A further objective of the invention is to provide a structure built with a steel
25 frame thus reducing the cost of construction over traditional methods.

A further object of this invention is to provide a frame for a house that can be built to withstand severe earthquakes and high winds yet is inexpensive as compared to wood frame houses.

A still further object of this invention is to provide an improved process for
30 constructing a frame for a house that is less costly than conventional wood frame houses and substantially more resistant to damage from earthquakes and wind.

Yet another object of this invention is to provide a steel frame home having walls the same thickness as a conventional wood frame home so that standard door and window units can be used while providing a normal appearance and also

having a home that has the strength and fire resistant benefits of a steel frame building and costing less than conventional wood frame buildings.

An advantage of the invention is that a variety of roofing material may be used including galvanized steel sheets, tile, or shingles, for example.

5 Another advantage of the invention is that the footings are preferably positioned at intersections of the wall panels to complete a vertical tensile load path from the roof to the foundation for holding the roof down in high winds, and to secure the building frame to the foundation against lateral forces exerted by wind loads or earthquakes.

10 Another advantage of the invention is that preformed steel studs are provided thus avoiding the need to cut rectangular steel or wood to a correct size for use on-site.

Another advantage of the invention is the inexpensive materials used in construction, the decrease in labor costs to construct the building, and other cost savings that will become apparent based on this description.

15 Another advantage of the invention is the flexibility offered in the design of a home at a minimum that is equivalent to the flexibility offered by wood.

Given the following enabling description of the drawings, the apparatus should become evident to a person of ordinary skill in the art.

20 **IV. Brief Description of the Drawings**

The present invention is described with reference to the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally similar elements.

25 Figure 1 illustrates an exemplary assembled frame built according to the invention.

Figure 2 depicts an exploded view of the frame illustrated in Figure 1.

Figure 3 illustrates a cross-section of a footing and column structure of the invention.

Figure 4(a) depicts an embodiment of the floor panels of the invention.

30 Figure 4(b) depicts a cross-section of the floor of the invention.

Figure 5 illustrates an exploded view of a column in accordance with the invention.

Figure 6 illustrates an exploded view of wall structure in accordance with the invention.

Figures 7-20 depict different exemplary wall panels in accordance with the invention.

Figures 21(a)-(b) illustrate an embodiment for a roof structure in accordance with the invention.

5 Figures 22(a)-(b) depict an alternative embodiment for a roof structure in accordance with the invention.

Figures 23(a)-(b) illustrate external views of an exemplary house built according to the invention.

V. Best Modes for Carrying Out the Described Embodiments

10 Figures 1-20 illustrate an exemplary embodiment of the invention. Figures 1 and 2 more particularly show a frame for a home and an exploded view of that frame, respectively. Figures 7-20 illustrate the different wall sections used to assemble the frame illustrated in Figures 1 and 2.

15 The basic building components for the frame for this invention preferably are a "C" cross-section stud (hereinafter C stud), a "U" cross-section rail (hereinafter U rail), trapezoidal galvanized sheets, and/or flat sheets. The U rail preferably includes a main wall with two extending members that preferably are perpendicular to the main wall to form a U-shaped channel. The C stud preferably is a U rail with the addition of a flange extending from each of the two extending
20 members to form a channel with a "C" cross-section.

Preferably, these components are manufactured from flat steel stock, which may be delivered coiled to a fabrication site. More preferably, the steel ranges in thickness from 25g to 18g with a width of 7 inches to 17 inches to allow for the formation and creation of different widths of C studs and U rails.
25 Depending upon availability of coiled steel and other factors, the invention may be practiced using just C studs, just U rails, or some combination of the two. Most preferably, C studs are used throughout the building frame. Although wood studs may be used for the roof trusses.

One way to manufacture the C studs, U rails, and flat pieces is as follows.
30 The coiled steel is placed on a power decoiler that feeds a leveler (or straightener) that flattens the steel for manufacture of the components. The leveler removes coil-set, which is the bend that is induced into the steel during the coiling/unwinding process. The straightened steel then passes into a pneumatic feed control system and then on to a hydraulic unit. The feed control system is a

drive/measuring unit that indexes the steel so that the hydraulic unit is able to punch a hole as needed, create notch pairs as needed, and shear/cut the steel to appropriate lengths. The distance between punches/cuts in the steel is calculated based on instructions from a programmed controller to allow at least semi-automatic operation and manufacture of the steel components. Once the steel is punched at predetermined locations, punched to form notch pairs, and cut to the correct length, the steel (or blank as it is now known) passes onto an electrical transfer table to be lined up to pass through the rolling/forming mill, which is set up to produce the appropriate cross-sectional configuration for each piece. After being formed the piece exits the mill onto a run off table and is removed by a worker.

The invention is preferably built using footings 100 as illustrated in Figure 1 to in part protect against high water, for example, from a flood or high tide. Preferably, the footings 100 include a base 110 and a pillar 130. The base 100 preferably is poured concrete, and more preferably the poured concrete includes at least one reinforced steel bar 112 within the base 110 to further strengthen it. The pillar 130 preferably is a column of reinforced concrete blocks 132, such as eight-inch block, that once stacked are filled with concrete. Preferably, a reinforcing bar(s) 134 runs from the base 110 up through the pillar 130 and out the top of the pillar 130. The reinforcing bar 134 may have a horizontal portion 1342 in the base 110 in addition to the vertical portion 1344 running up through the pillar 130.

The footings 100 preferably provide the surface upon which the flooring substrate 200 is placed. Preferably, the flooring substrate 200 is constructed out of groupings of C studs assembled into floor panels 210 as illustrated in Figure 4(a). Each floor panel 210 preferably includes two C studs as header joists 212 running the length of the floor panel 210. Each of these header joists 212 preferably will have notch pairs 214 spaced along its length. The header joists 212 preferably will be aligned with each other such that the respective ends and notch pairs of one header joist 212 lines up with the other header joist 212.

Each notch pair 214 preferably will receive a C stud crossing beam (or joist) 216. Preferably, each crossing beam 216 will be perpendicular to the header joist 212. The juncture of the header joist 212 and a crossing beam 216 preferably will be secured using self-tapping screws 150 (such as 5/8"), a weld,

bolts, or other similar securing means. The crossing beams 216 preferably will face the same way except for an end cap C stud 218, which will face the opposite direction as illustrated in Figure 4(a). The use of "floor beam 216" in this application will represent the header joist 212, crossing beam 216, and end cap

5 218 depending upon the location of the attachment and orientation of a particular floor panel.

Each floor panel 210 preferably provides a modular aspect to the size of the floor plan that may be created with this invention. Preferably, each floor panel 210 will then be attached and/or connected to neighboring floor panels 210.

10 Each floor panel 210 then preferably will be covered with a trapezoidal galvanized sheet 230 as illustrated in Figures 4(a)-(b) to keep cost down as compared to the alternative of plywood, which may be used instead. Depending upon the size of the floor panel 210 multiple trapezoidal sheets 230 may be required, alternatively the trapezoidal sheets 230 may overlap onto multiple floor

15 panels 210. Preferably, the trapezoidal sheet 230 will be held in place with self-tapping screws 150, a weld, or other similar securing item as spaced intervals across its surface. The flooring substrate 200 preferably is completed by providing a layer of cement 220, which preferably allows for at least 3000 pounds per square inch of pressure and/or is approximately four inches thick measured

20 from the floor beam 216, more preferably the concrete 220 is reinforced with a mesh 222.

Each floor panel 210 preferably will be attached to the footings 100 below it with a strap 140, which preferably is a galvanized strap (or other type of hurricane tie down) that more preferably is one inch wide. The strap 140 preferably is

25 inserted into the poured concrete prior to it setting within the pillar of concrete block 130 and extends out the top such that it may be looped preferably around the main wall of a floor beam 216 as illustrated in Figure 3.

Spaced along the peripheral floor beams 216 are columns 250 as illustrated in Figures 1 and 2, more preferably a column 250 will be above a

30 peripheral footing. Preferably, a column 250 separates wall panels 300 around the periphery of the building. A column 250 also preferably is at all corners of the periphery of the building. Figure 5 illustrates an exploded view of the preferred embodiment of the column 250 above a floor beam 216. Preferably, the column

250 is formed by two facing C studs (or U rails) 252, 252 and two flat stock steel pieces 254, 256.

The flat stock steel pieces 254, 256 are preferably of different lengths such that the outside piece 254 extends above and below the studs 252, 252 and the
5 inside piece 256 extends from the top of the studs 252, 252 down to a point along the studs 252, 252. The extra length at the bottom of the outside piece 254 overlaps with the main wall of the floor beam 216 (not illustrated in Figure 3) and as such preferably is attached using self-tapping screws 150 and/or a weld (not shown). More preferably, the overlap of the outside piece 254 is adjacent the
10 strap 140 and further holds the strap 140 against the floor beam 216. Preferably, the overlap is such that the outside piece 254 extends to the bottom of the main wall of the floor beam 216. The extra length at the top of the outside piece 254 preferably is for attachment to the roof structure.

Preferably, the flat stock pieces 254, 256 are held to the studs 252, 252
15 using either self-tapping screws 150 or welds preferably spaced at intervals along the height of the column 250, more preferably the self-tapping screws 150 are spaced at six inch intervals in horizontal pairs (one screw for each stud 252, 252 in the column 250). Once the column 250 is installed above the floor beam 216, preferably the column 250 is filled with concrete 258. Additionally, it is preferable
20 that the reinforcing bar 134 running up from the base 110 extends up through the floor beam 216 into the column 250. More preferably, at least one second reinforcing bar 136 extends from a top area of the concrete block pillar 130 through the floor beam 216 into the column 250. Most preferably, there are two second reinforcing bars 136 running through each column 250.

25 The wall panels 300(a-n) as illustrated, respectively, in Figures 7-20 are designed such that they can be assembled off-site, in which case preferably they will have the various connections welded together, or on-site, in which case preferably there will be self-tapping screws 150 used at the connection points/joints. Figures 7-20 illustrate a variety of exemplary wall panel
30 configurations that are also illustrated in Figures 1-2. Preferably, C studs are used throughout the wall panels such that the closed side of border studs (or border members) 320 for a wall panel abuts other building features like door frames, window frames, other wall modules, columns, floor beams, or the roof structure. The studs used in the wall panels preferably will have notches along

their respective lengths where other studs will intersect with them such that the notches nest the other intersecting studs. An example of this is Figure 6, which is a partial exploded view of the wall panel 300I, which also is illustrated in Figure 18, and shows the use of self-tapping screws 150 to secure the connections.

5 Figure 6 shows the wall panel floor (or floor member) 310 as having a series of notch pairs 312 to insert the border studs 320, vertical members 322, 324, and support member 326 that attach to the floor. The wall panel floor 310 preferably is attached to the floor beam 216 using self-tapping screws 150 spaced along its length, more preferably the self-tapping screws 150 are spaced at six
10 inch intervals. Likewise, preferably the border studs 320 will abut the neighboring panel, column 250, window unit, door unit, or space (e.g., if it is an open walkway) with its main wall. When the border studs 320 abut a neighboring panel or column 250, preferably a series of self-tapping screws 150 are spaced along the length of the end panel stud 320 to form a connection between the neighboring pieces,
15 more preferably the spacing for the self-tapping screws is six inches. The wall panel top (or ceiling member) 314, like the wall panel floor 310, preferably includes a series of notch pairs 312 that accept vertical studs. Alternatively, the wall panels 300 may also include vertical members 328 that run from the wall panel floor 310 up to the wall panel top 314 and have no other joints.

20 Preferably when a longer stud (like 322 or 324) that forms part of and continues through a joint 350 with another stud (like 342 or 344), the longer stud 322, 324 will have a pair of notches 312 formed to accept the other stud as illustrated in Figure 6. More particularly, vertical members 322, 322 each preferably include a notch pair 312 for accepting a horizontal member 342. These
25 three members and the wall panel floor 310 preferably form a frame for insertion of a door unit. To provide additional support to this frame, it is preferable to add a vertical support member 326' that will preferably fit into a notch pair 312 of the horizontal member 342 and a notch pair 312 of the wall panel top 314.

Also illustrated in Figure 6 is a preferred window frame for insertion of a
30 window unit. Vertical members 324, 324 each preferably include two notch pairs for accepting a first and second horizontal members 342', 344. Preferably, the first and second horizontal members 342', 344 include a notch pair 312 aligned with a notch pair 312 in the wall panel top 314 and the wall panel floor 310, respectively. A vertical support member 326 is preferably inserted between the

second horizontal member 344 and the wall panel floor 310 and thus into the respective notch pairs to provide additional support. A vertical support member 326' likewise preferably is inserted between the first horizontal member 342' and the wall panel top 314 and thus into the respective notch pairs to provide
5 additional support.

As shown in Figures 6-20, preferably all of the vertical studs will have at least one hole 360 lined up with other holes in other vertical studs such that electrical wiring, telephone wiring, or other utility conduit and/or wiring may pass through the studs and remain on the inside of the panel. These wall panels 300
10 can for example be covered with standard siding, T & G finish, or other material on the outside of the structure 510 and wall board on the interior walls.

As illustrated in Figures 7-20, the studs used in this invention can be arranged in a variety of patterns and arrangements. The wall panels 300g, 300h illustrated in Figures 13 and 14, respectively, are used to provide a structure for a
15 top border for the porch 500 illustrated in Figures 1 and 23(a). The wall panel 300j illustrated in Figure 16 is used for an interior walkway. The wall panels 300e, 300i, 300l, 300m, 300n illustrated in Figures 11, 15, 18, 19, and 20, respectively, include a space for the insertion of a standard door unit preferably using the stud structure as discussed above. The wall panels 300a, 300b, 300c, 300d, 300e,
20 300f, 300l illustrated in Figures 7-12 and 18, respectively, include a space for the insertion of a window unit preferably using the stud structure as discussed above.

Figures 21(a)-(b) illustrate the roof structure that may be made out of C studs, U rails, or wood. Preferably, the roof structure edge is flush with the peripheral wall of the structure.

Figures 21(a)-(b) more particularly illustrate an exemplary embodiment using wood. Figure 21(b) illustrates the interior roof support system that preferably includes 2" x 4" collar beams 410, 2" x 4" wallplates (or top plates) 412, and 2" x 4" studs (or king or queen posts) 414. The studs 414 preferably are spaced at intervals along the wallplates 412, more preferably they are spaced at
25 twenty-four inch intervals. Figure 21(a) shows the interior support system encompassed within an outer roof structure. The outer roof structure preferably includes a foundation of 2" x 4" wallplate 422 supporting 2" x 8" hip rafters 424 in the corners and 2" x 6" rafters 426 perpendicular to the wallplate 422. Most preferably the rafters 426 are spaced at twenty-four inch intervals. The hip rafters
30

424 and rafters 426, not intersecting hip rafters 424, preferably run from the wallplate 422 to a 2" x 8" ridge board 428 that preferably rests on top of a wallplate of the interior support system.

Alternatively, the roof could be constructed using C studs in place of the wood described in the previous paragraph or as follows. Preferably, a C stud of the same structure as the floor beams runs along the length of the house structure on each side. These roof C studs also preferably include a series of notch pairs for C stud rafters that ascend up to a central ridge C stud. Preferably, there is a C stud beam with its main wall abutting the top of the wall panels running down the center of the house. This central C stud beam preferably includes a series of notch pairs that are spaced, preferably at the same intervals as the side C studs, to nest king post C studs running up to the central ridge C stud, which has a notch pair for each king post.

Another alternative roof structure is to use roof panels 210b, which preferably are similar to the floor panels 210 where the end beam and crossing beams form the roof rafters 216b, 218b. This alternative embodiment preferably uses bent flashing along the outside roof edge (external wall flashing 280) and the inside roof edge (internal wall flashing 282) on both sides of the roof to join the panels to the wall panels 300 as illustrated in Figure 22(a). Also, the flashing preferably is used above (external ridge flashing 284) and below (internal ridge flashing 286) the roof ridge to join and secure the panels together as illustrated in Figure 22(b). The internal flashing preferably also connects to an internal ridge joist 212c, which preferably is a C stud with its channel directed towards the floor. The ridge joist 212c preferably forms the top portion of a support panel 210c running vertically down the center of the house above the interior wall panels. The support panel 210c preferably is of a similar construction to the floor panels 200 except for having the end caps running in the vertical direction to serve as king posts along with the other crossing beams 216c, 218c. The other difference is that the support panel 210c preferably is not as tall as the floor panel is wide. Preferably, the flashing 280, 282, 284, 286 is bolted, screwed or welded to the appropriate panels 300, 210b, 210c prior to installation of the roofing material.

Under either of the above alternative roof constructions or other similar structures, the galvanized steel sheets 230 used as part of the flooring may also be used as the roofing material as illustrated in Figures 23(a)-(b). Alternatively,

other types of roofing material may be used, which in turn will increase the cost of construction of the structure. This ability to select the type of roofing material is one of the advantages and flexibility offered by this invention.

5 An alternative embodiment is to eliminate the footings and floor substrate and instead begin with a concrete slab for the foundation. The wall panels and columns would then be attached to the concrete slab. Preferably in this alternative embodiment, the concrete slab would include the reinforcing bars and straps that connected the pillars of the footings through the floor beams to the columns.

10 VI. Industrial Applicability

The above-described invention may be used to construct buildings of various sizes and designs. Particularly, this invention provides an inexpensive construction cost to build homes that will withstand high winds that accompanying hurricanes, monsoons, and tornados along with any driving rain that may
15 accompanying these weather disturbances.

The design of the building materials using formed coiled steel increases the strength of the resulting building structure particularly when the studs are notched and combined with a concrete slab and the above-described columns provides unsurpassed price to strength ratio that is not possible with exclusively wood
20 framing, solid concrete structures, or rectangular steel framing.

If the wall and floor panels are built off-site the preferable way to secure the joints between studs is with welding. If the wall and floor panels are built on-site at the building construction worksite, then the preferable way to secure the joints is with self-tapping screws. In light of the foregoing description, one of ordinary
25 skill in the art will appreciate that there are other ways to secure these joints including bolting. Alternatively, bolting may be used to secure individual wall and/or floor panels to adjacent panels and/or columns.

Those skilled in the art will appreciate that various adaptations and modifications of the above-described preferred embodiments can be configured
30 without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

We claim:

1. A lightweight steel frame for a building comprising:

a plurality of footings each having a base and a column rising from said base;

at least one floor panel cover having

5 first and second header joists each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said first and second header joists being parallel to each other with the respective channels facing each other, said first and second header joists have a plurality of space notch pairs in respective flanges, and

10 a plurality of beams each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, each of said beams fits into a respective notch pair in said first and second header joists such that said beam is perpendicular to said header joists;

15 a plurality of columns having

two vertical members each having a main wall with two members extending from said main wall to form a U cross-section channel,

a first flat piece connected to each of said two vertical members such that the channels of said two vertical members face each other, said first flat piece extends below said vertical members to attach to said floor panel, and

20 a second flat piece connected to each of said vertical members such that a substantially rectangular channel is formed;

a plurality of wall panels each having

25 a floor member having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said floor member having a series of spaced notch pairs along its length including a notch pair at its ends,

30 two border members each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, each of said border members fits into one of said notch pairs at the end of said floor member and extend perpendicular to said floor member,

35 a ceiling member having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said ceiling member having a series of spaced notch pairs along its length including a notch pair at its ends for attaching a respective one of said border members, and

40 at least one vertical member having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said vertical member fits into a notch pair of said floor member and a notch pair of said ceiling member such that it is perpendicular to both and parallel to said two border members; and

a roof structure; and

45 wherein each of said pillars are covered by and attached to one of said at least one floor panels,

said wall panels form a peripheral wall and interior walls on said at least one floor panel,

at the junctions between said wall panels on the periphery of said building, a column is interposed between said wall panels, and

50 said roof structure is attached to said ceiling members of said wall panels on the periphery of said building and said columns.

2. The frame according to claim 1, further comprising:
at least one trapezoidal sheet laid over said at least one floor panel,
concrete formed along the top surface of said at least one trapezoidal sheet to form a floor for the building.

3. The frame according to claim 2, further comprising means for reinforcing the concrete floor.

4. The frame according to claim 2, further comprising a wire mesh within said concrete floor.

5. The frame according to claims 1, 2, 3, or 4, wherein each of said at least one column is filled with concrete.

6. The frame according to claim 5, wherein at least one reinforcing bar runs through said concrete in each of said at least one columns.

7. The frame according to claims 1, 2, 3, 4, 5, or 6, wherein at least one of said wall panels includes

at least a second vertical member running from said floor member to said ceiling member such that said channels of said two vertical members face each other, said two vertical members having at least one notch pair evenly spaced from said ceiling member,

a first horizontal member having a main wall with two members extending from said main wall to form a U cross-section channel, said first horizontal member running between a respective notch pair in said two vertical members such that it is parallel to said ceiling member and the channel of said first horizontal member faces said ceiling member; and

wherein a frame opening is formed below said first horizontal member and between said two vertical members.

8. The frame according to claim 7, wherein
said first horizontal member includes a notch pair,
said ceiling member includes another notch pair aligned with said notch pair in said first horizontal member, and

said wall panel having said first horizontal member includes a support vertical member to insert in said notch pair of said first horizontal member and said aligned notch pair of said ceiling member such that said support vertical member is perpendicular to said first horizontal member and said ceiling member.

9. The frame according to claim 7, wherein said wall panel further includes a second horizontal member parallel to said first horizontal member, said second horizontal member has a main wall with two members extending from said main wall to form a U cross-section channel, said first horizontal member running between a respective notch pair in said two vertical members, said channel of said second horizontal member faces said floor member such that a frame is formed for a window unit.

10. The frame according to claim 9, wherein
said second horizontal member includes a notch pair,
said floor member includes another notch pair aligned with said notch pair
in said second horizontal member, and

5 said wall panel having said second horizontal member includes a support
vertical member to insert in said notch pair of said second horizontal member and
said aligned notch pair of said floor member such that said support vertical
member is perpendicular to said second horizontal member and said floor
member.

10 11. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10, wherein
said roof structure includes

at least one support panel orientated perpendicular to said floor panels,
said support panel including

5 two header joists each having a main wall with two members
extending from said main wall with each member having a flange to form a C
cross-section channel, said header joists run parallel to each with the channels
facing each other, said header joists have a plurality of space notch pairs in
respective flanges, said header joists run parallel to said floor panels, said header
10 joist at the top of said support panel is a ridge joist,

a plurality of beams each having a main wall with two members extending
from said main wall with each member having a flange to form a C cross-section
channel, each of said beams fits into a respective notch pair in each of said
header joists such that said beam is perpendicular to said header joists, and

15 at least two rafter panels including

two header joists each having a main wall with two members
extending from said main wall with each member having a flange to form a C
cross-section channel, said header joists run parallel to each with the channels
facing each other, said header joists have a plurality of space notch pairs in
20 respective flanges, said header joists run parallel to said floor panels,

a plurality of beams each having a main wall with two members
extending from said main wall with each member having a flange to form a C
cross-section channel, each of said beams fits into a respective notch pair in each

of said header joists such that said beam is perpendicular to said header joists;
25 and

wherein said rafter panels are angled from at least one ceiling member of
at least one peripheral wall panel to at least one ridge joist.

12. The frame according to claim 11, further comprising:

internal ridge flashing running along and attached to the main wall of said
at least one ridge joists and along and attached to the bottom side of at least two
rafter panels,

5 external ridge flashing running along and attached to the top side of at least
two rafter panels,

external wall flashing running along and attached to an external side of at
least one peripheral wall panel and running along and attached to the top side of
at least one rafter panel, and

10 internal wall flashing running along and attached to an inside of at least one
peripheral wall panel and running along and attached to the bottom side of at least
one rafter panel.

13. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11,
wherein each of said footings includes

means for reinforcing said base, and

means for reinforcing said column.

14. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or
13, further comprising a plurality of reinforcing bars, one of said reinforcing bars
runs from a respective peripheral footing through the respective floor panel above
that footing into the respective wall panel.

15. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,
or 14, wherein said footings along the peripheral edge of said building include a
strap extending from said pillar such that said strap is attached to said floor panel
above said footing.

16. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, or 15, wherein each pillar of said footings is filled with concrete.

17. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, or 16, wherein a reinforcing bar runs from each peripheral footing through a respective floor panel through a respective wall panel into said roof structure.

18. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, or 17, further comprising:

self-tapping screws at each juncture of different pieces in said frame, and
self-tapping screws spaced along and attaching two pieces which abut for a predetermined length.

19. The frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, or 17, further comprising:

welds at each juncture of different pieces in said frame, and
welds spaced along and attaching two pieces that abut for a predetermined length.

20. A method for assembling a frame according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 or 19 comprising:

- assembling panels and columns off-site,
- shipping panels to a construction site,
- 5 fabricating the footings,
- attaching the floor panels to the footings,
- installing the wall panels and columns on the floor panels to form peripheral and interior walls including attaching them to neighboring panels and columns,
- installing and attaching the roof structure to the top of the wall panels and
- 10 columns,
- installing wiring and plumbing after installation of the wall panels,
- installing the trapezoidal sheets onto the floor panels,
- pouring a concrete floor over the trapezoidal sheets after installing the trapezoidal sheets, and

15 installation of window units and door units into the openings for same in the wall panels.

21. The method according to claim 20, further comprising attaching trapezoidal sheets to the roof structure.

22. A footing for use in building construction comprising:
a base of concrete with at least one reinforcing member entirely within said base,
a pillar of concrete block,
at least one second reinforcing member beginning in said base, passing through the center of said pillar, and extending out the top of said pillar, and
at least one third reinforcing member beginning in said pillar and extending out the top of said pillar.

23. A footing according to claim 22, wherein said pillar is filled with concrete to hold said second reinforcing member and said third reinforcing member, and
said footing further comprising a strap partially within said concrete that extends above said pillar.

24. A wall panel for use in framing a house comprising:
a floor member having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said floor member having a series of spaced notch pairs along its length including
5 a notch pair at its ends,
two border members each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, each of said border members fits into one of said notch pairs at the end of said floor member and extend perpendicular to said floor member,
10 a ceiling member having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said ceiling member having a series of spaced notch pairs along its

length including a notch pair at its ends for attaching a respective one of said border members, and

15 at least one vertical member having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said vertical member fits into a notch pair of said floor member and a notch pair of said ceiling member such that it is perpendicular to both and parallel to said two border members; and

20 wherein self-tapping screws are used at the joints between said floor member and said border members and said at least one vertical member, between said ceiling member and said border members and said at least one vertical member.

25. A floor structure for use in building comprising:

at least one floor panel cover having

first and second header joists each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said first and second header joists being parallel to each other with the respective channels facing each other, said first and second header joists have a plurality of space notch pairs in respective flanges, and

5 a plurality of beams each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, each of said beams fits into a respective notch pair in said first and second header joists such that said beam is perpendicular to said header joists;

at least one trapezoidal sheet laid over said at least one floor panel;

concrete formed along the top surface of said at least one trapezoidal sheet to form a floor for the building; and

15 a reinforcing structure within said concrete.

26. A roof structure for use in a building comprising:

at least one support panel orientated perpendicular to said floor panels, said support panel including

two header joists each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said header joists run parallel to each with the channels

facing each other, said header joists have a plurality of space notch pairs in respective flanges, said header joists run parallel to said floor panels, said header joist at the top of said support panel is a ridge joist, and

10 a plurality of beams each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, each of said beams fits into a respective notch pair in each of said header joists such that said beam is perpendicular to said header joists;

 at least two rafter panels including

15 two header joists each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, said header joists run parallel to each with the channels facing each other, said header joists have a plurality of space notch pairs in respective flanges, said header joists run parallel to said floor panels, and

20 a plurality of beams each having a main wall with two members extending from said main wall with each member having a flange to form a C cross-section channel, each of said beams fits into a respective notch pair in each of said header joists such that said beam is perpendicular to said header joists;

 internal ridge flashing running along and attached to the main wall of said

25 at least one ridge joists and along and attached to the bottom side of at least two rafter panels;

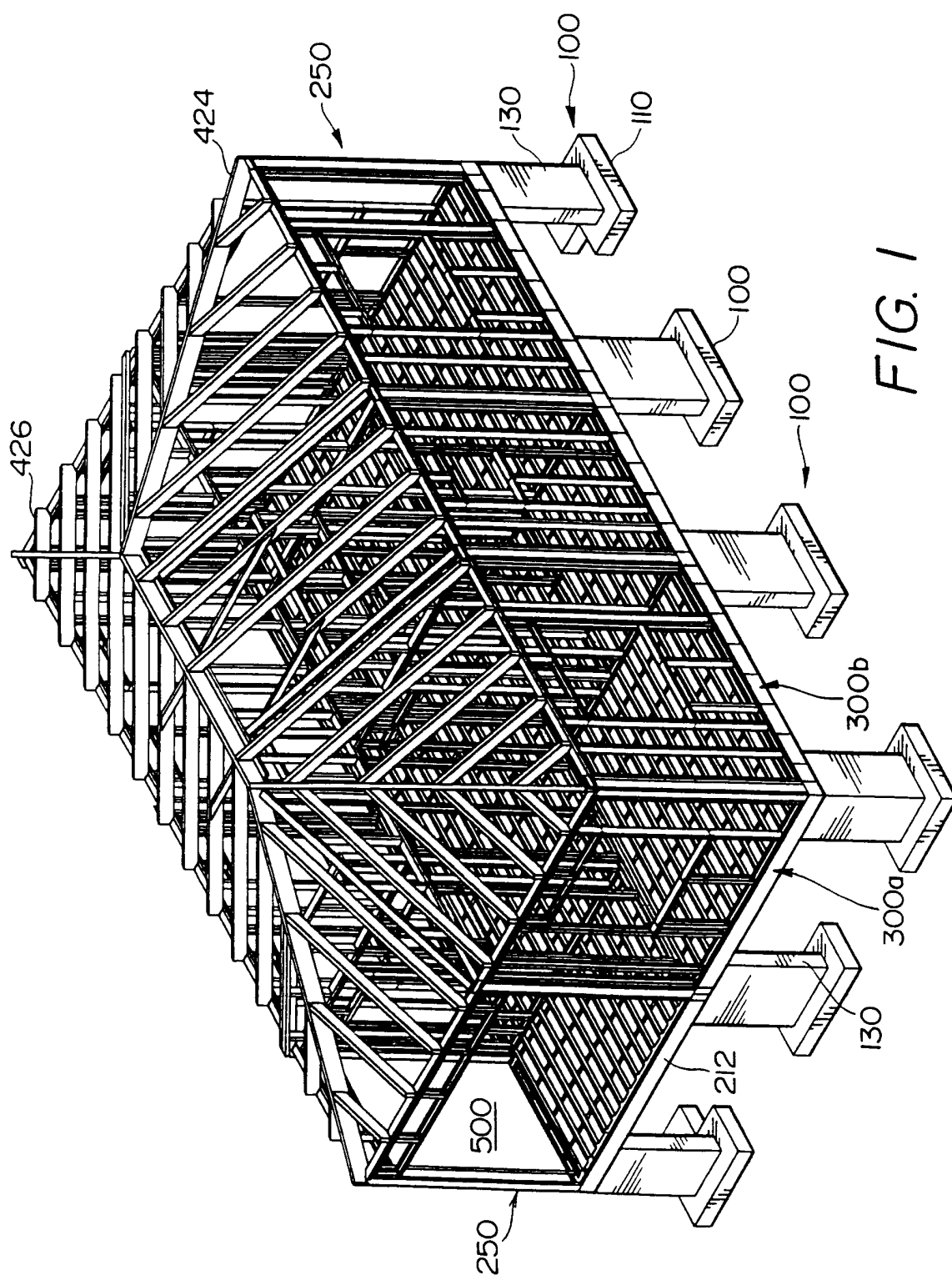
 external ridge flashing running along and attached to the top side of at least two rafter panels;

30 external wall flashing running along and attached to an external side of at least one peripheral wall panel and running along and attached to the top side of at least one rafter panel; and

 internal wall flashing running along and attached to an inside of at least one peripheral wall panel and running along and attached to the bottom side of at least one rafter panel; and

35 wherein said rafter panels are angled from at least one ceiling member of at least one peripheral wall panel to at least one ridge joist.

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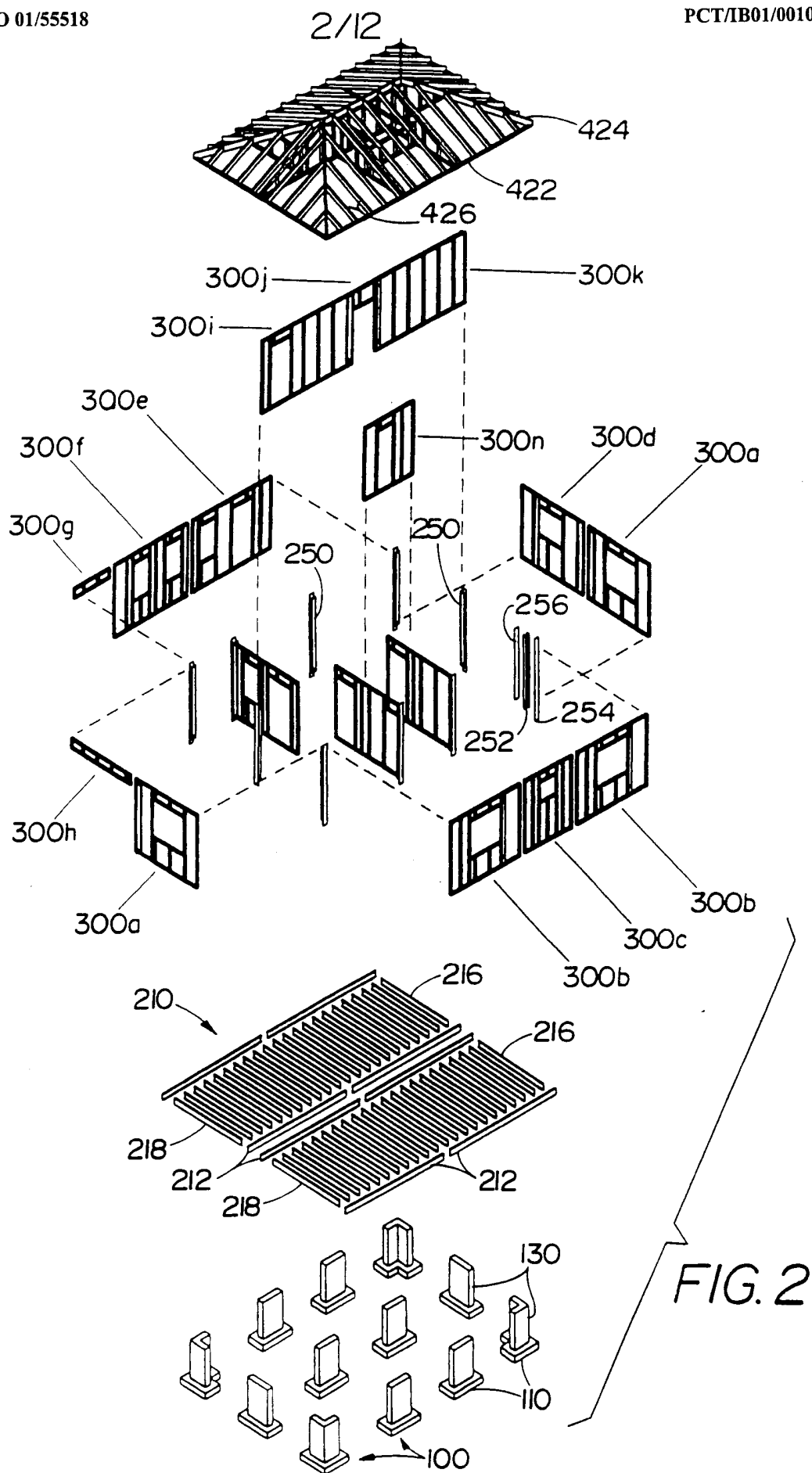


FIG. 7

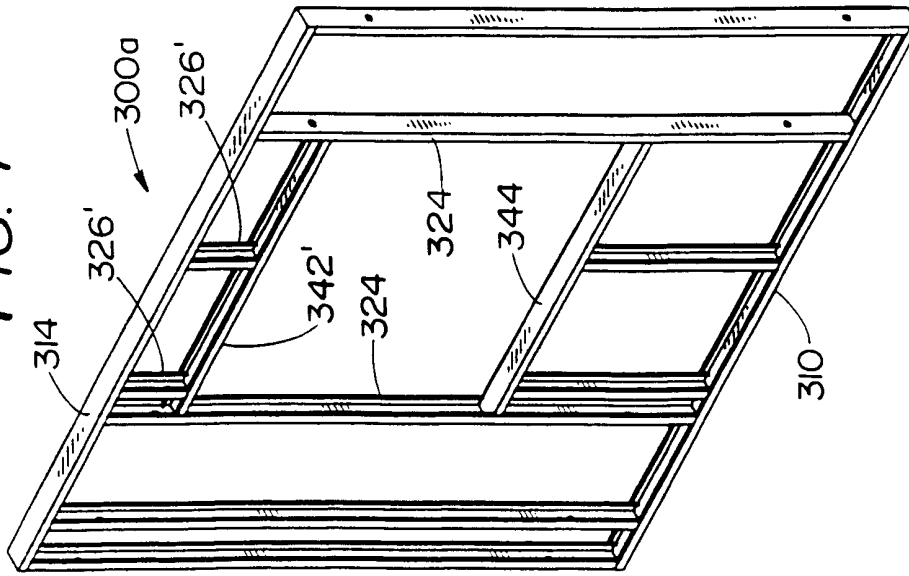


FIG. 5

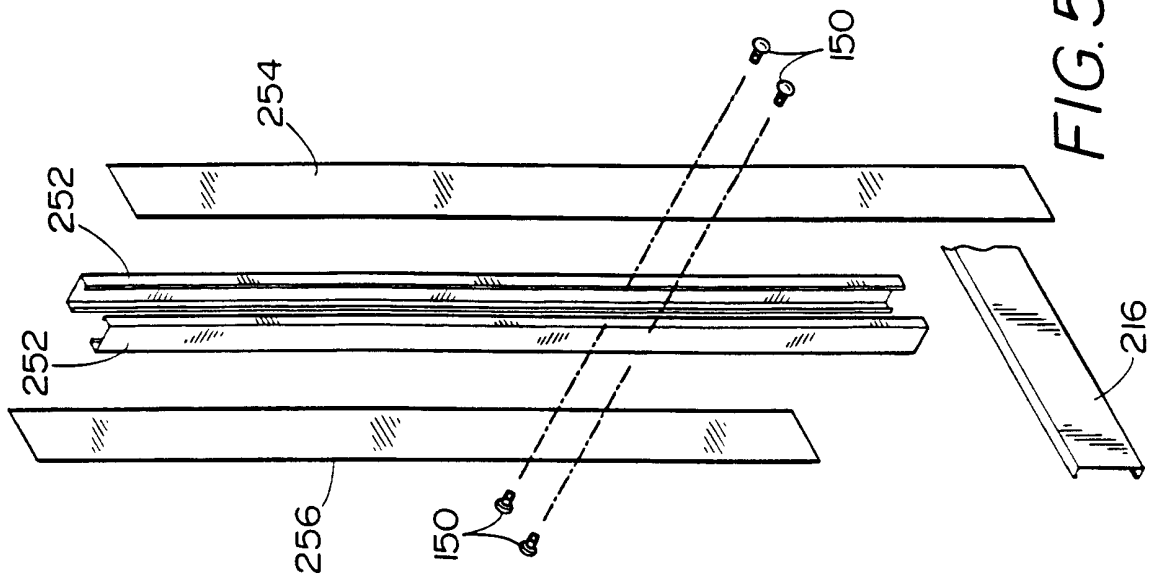
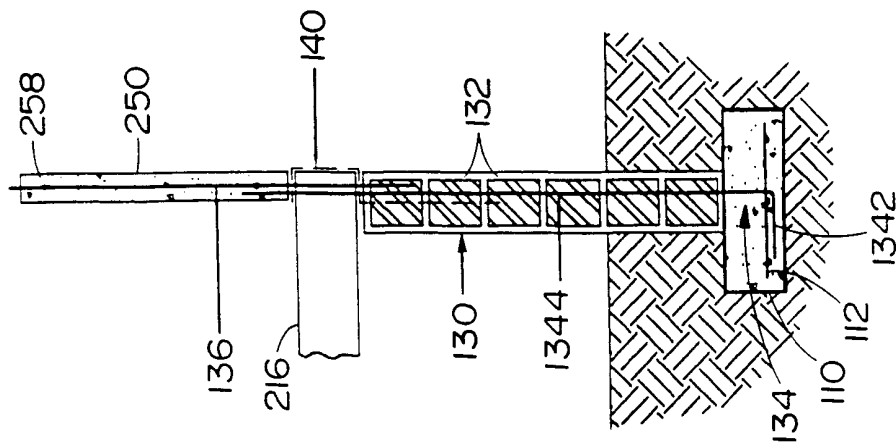
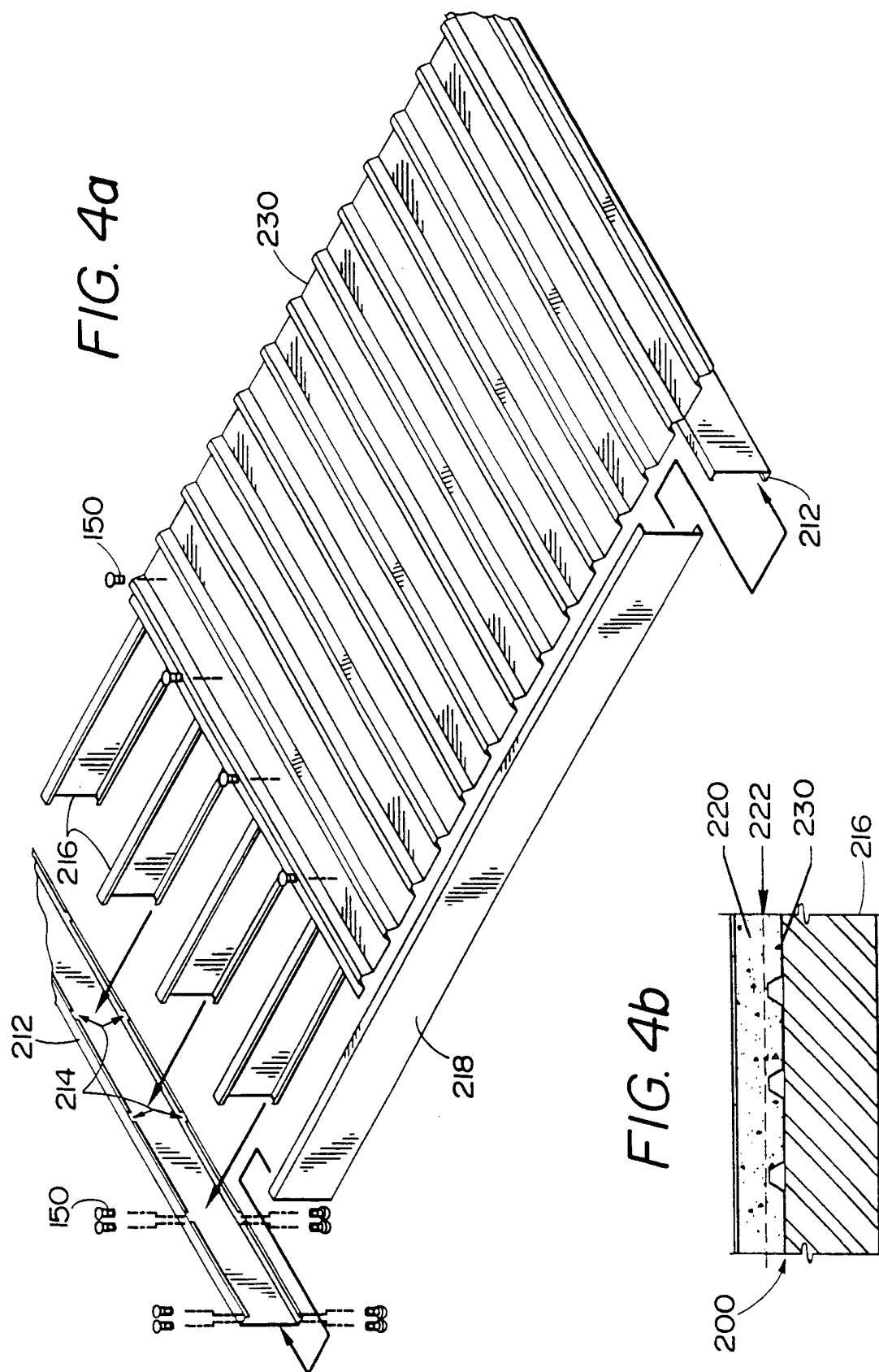
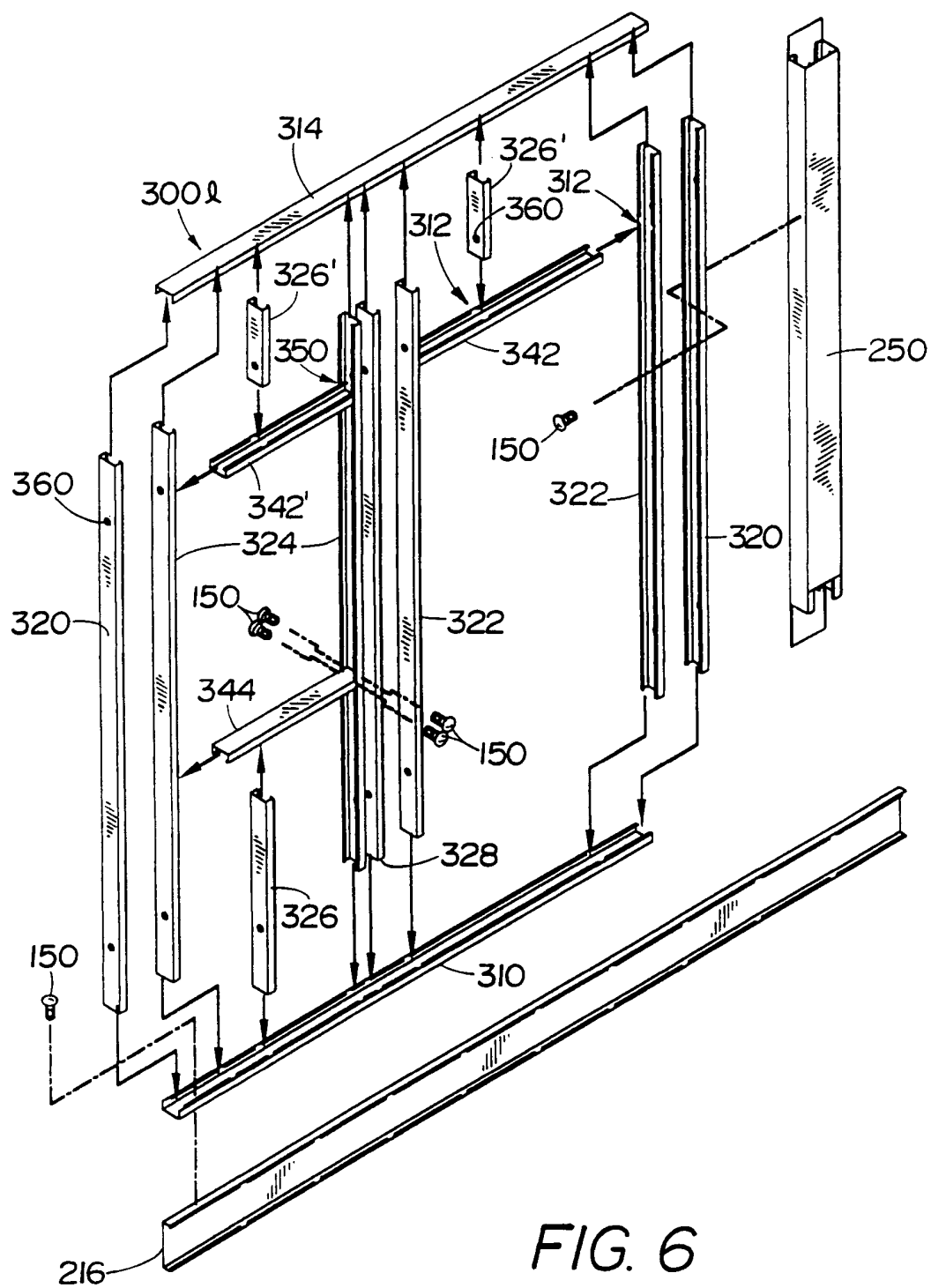


FIG. 3





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FIG. 8

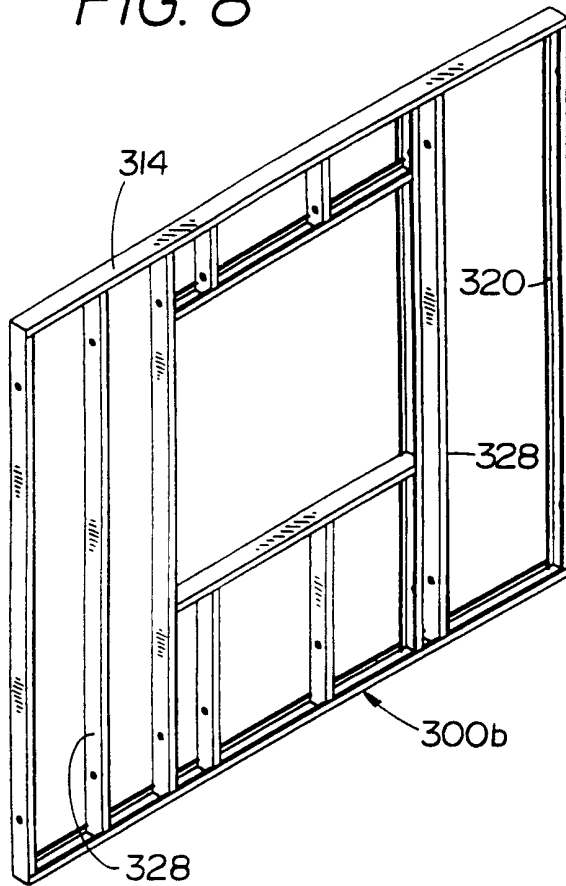


FIG. 9

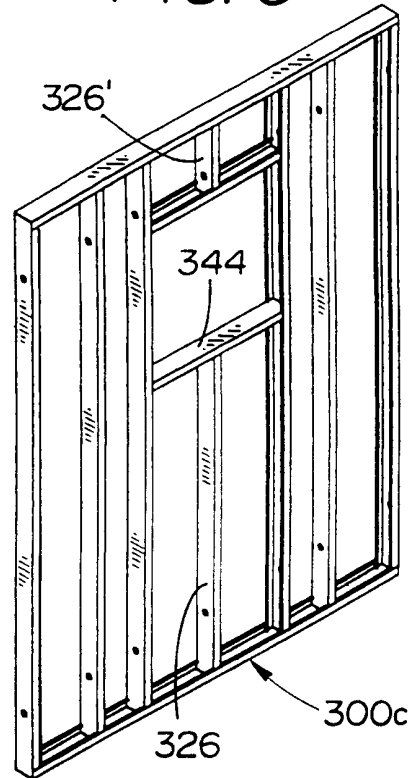


FIG. 10

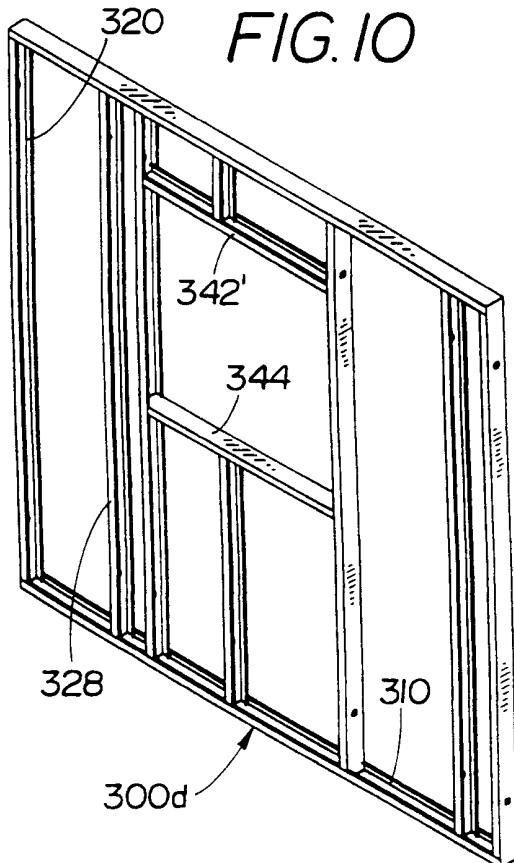
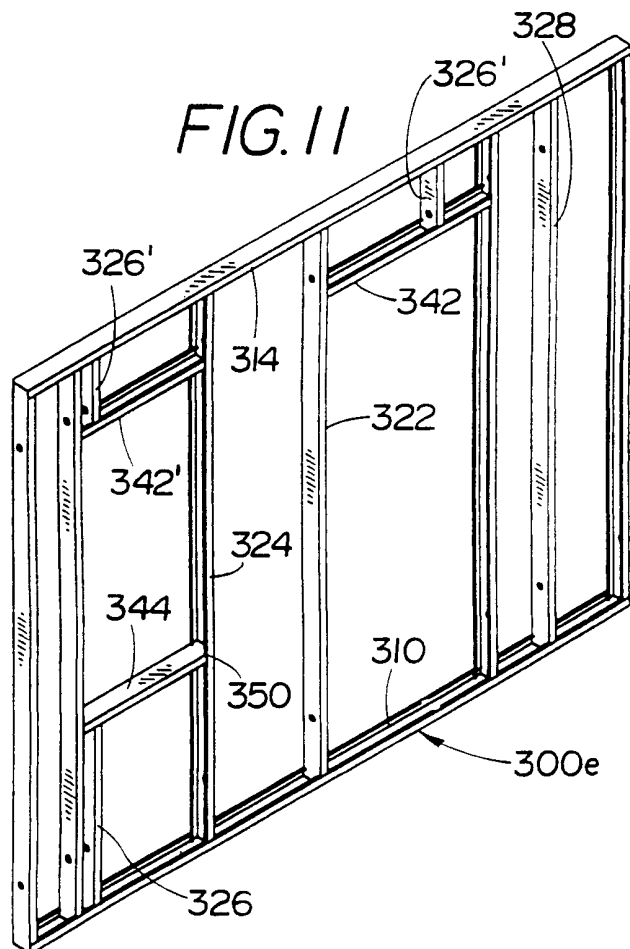


FIG. 11



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FIG. 12

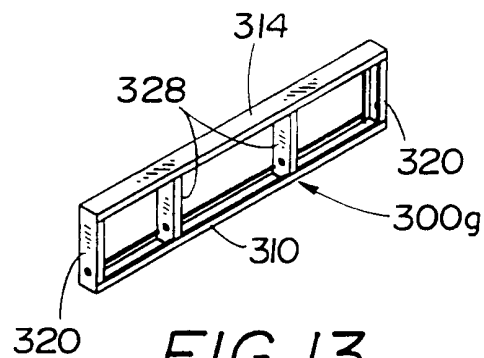
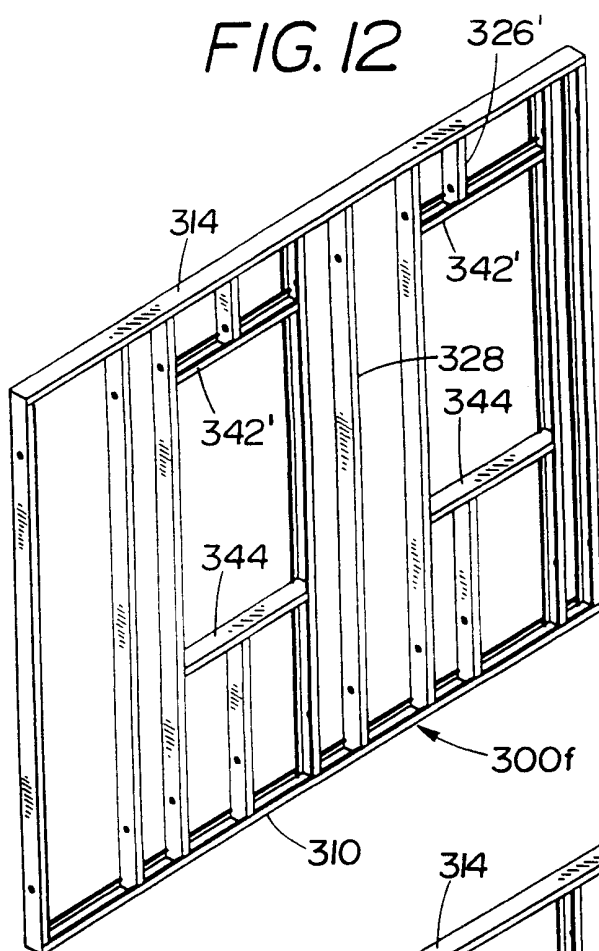


FIG. 13

FIG. 14

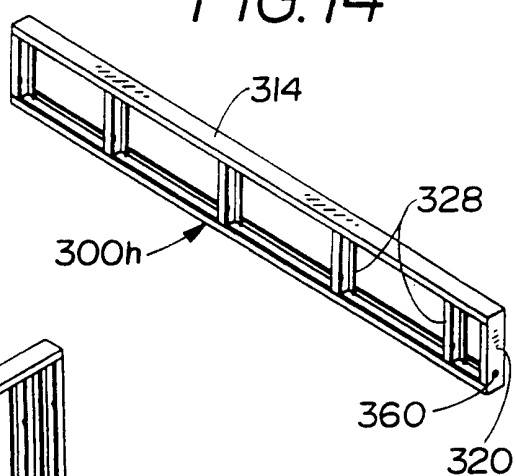


FIG. 16

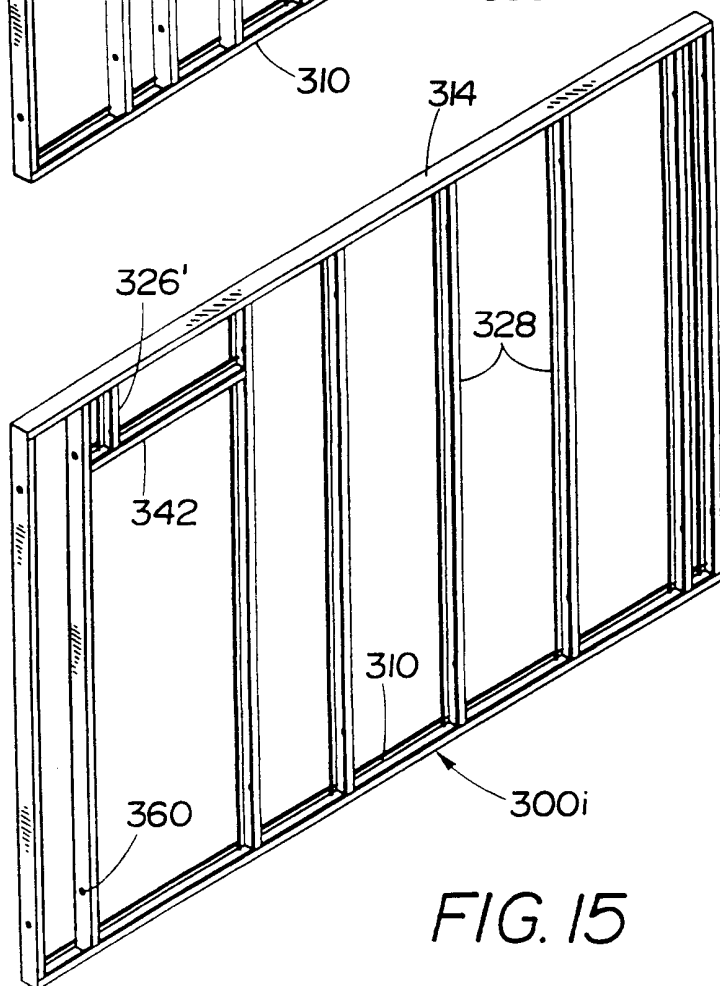
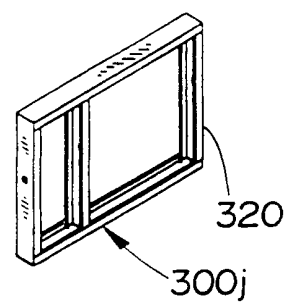


FIG. 15

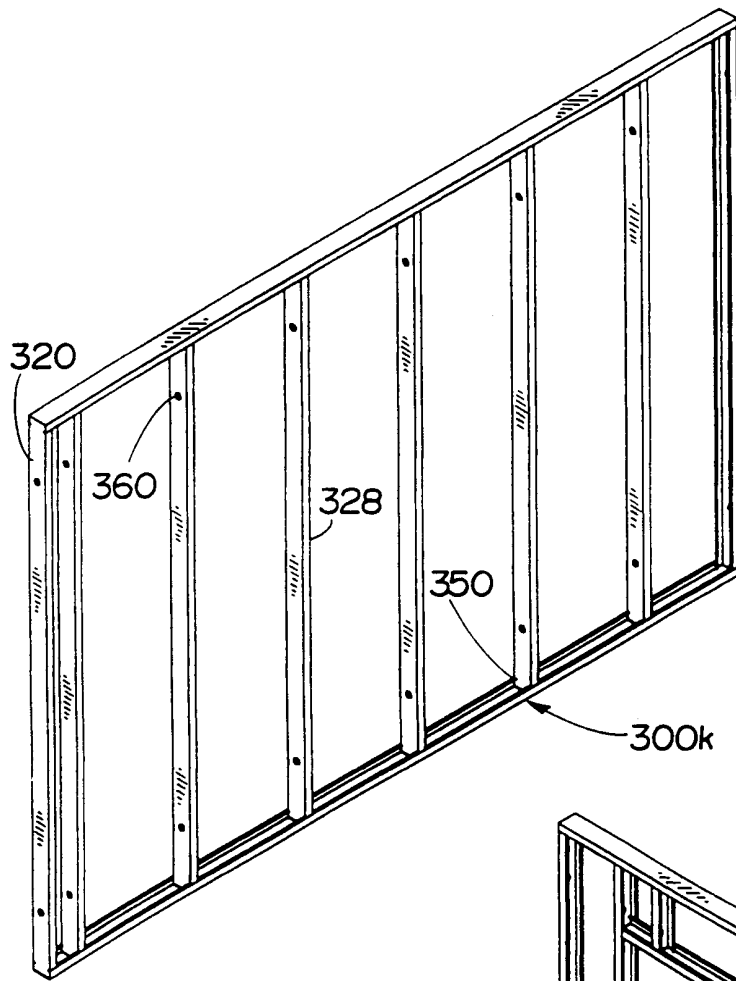


FIG. 17

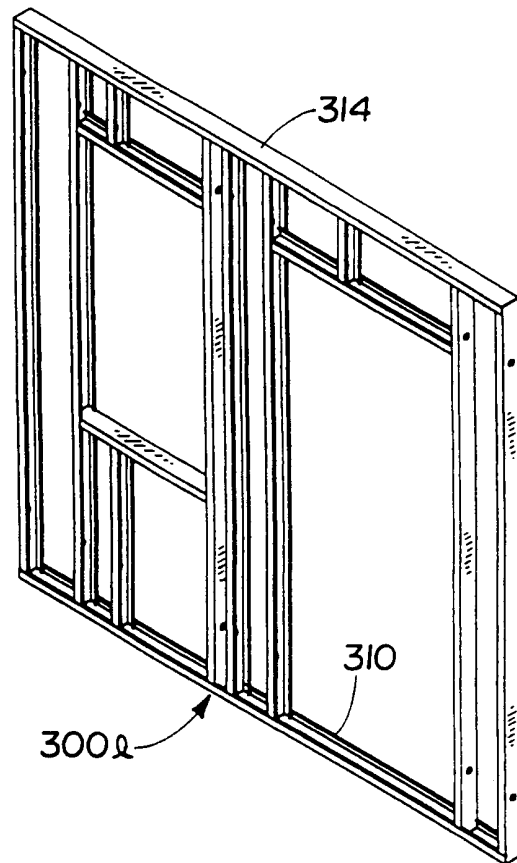


FIG. 18

FIG. 19

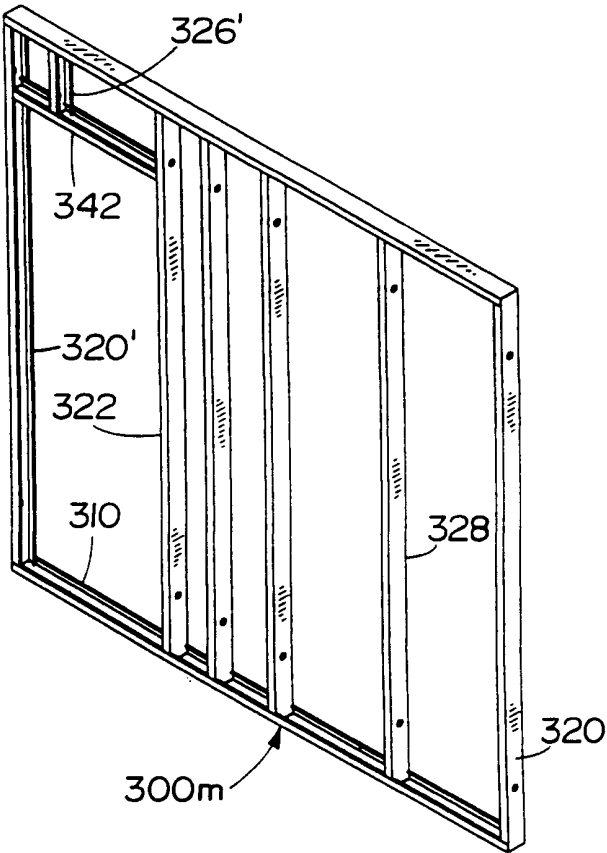
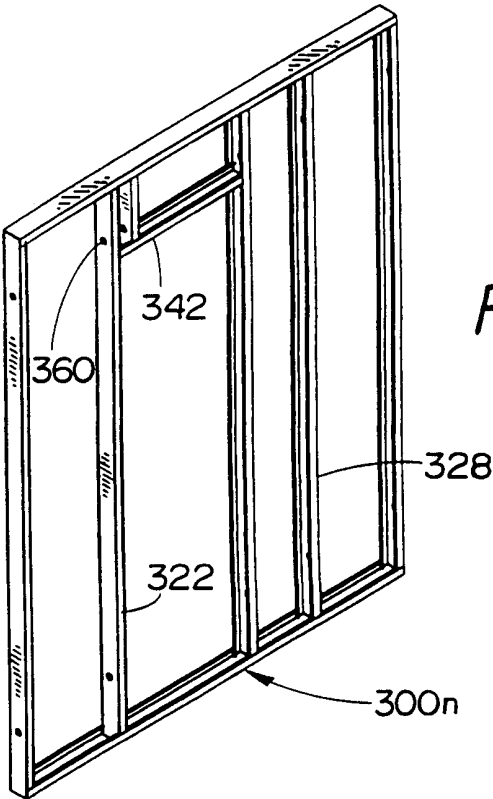
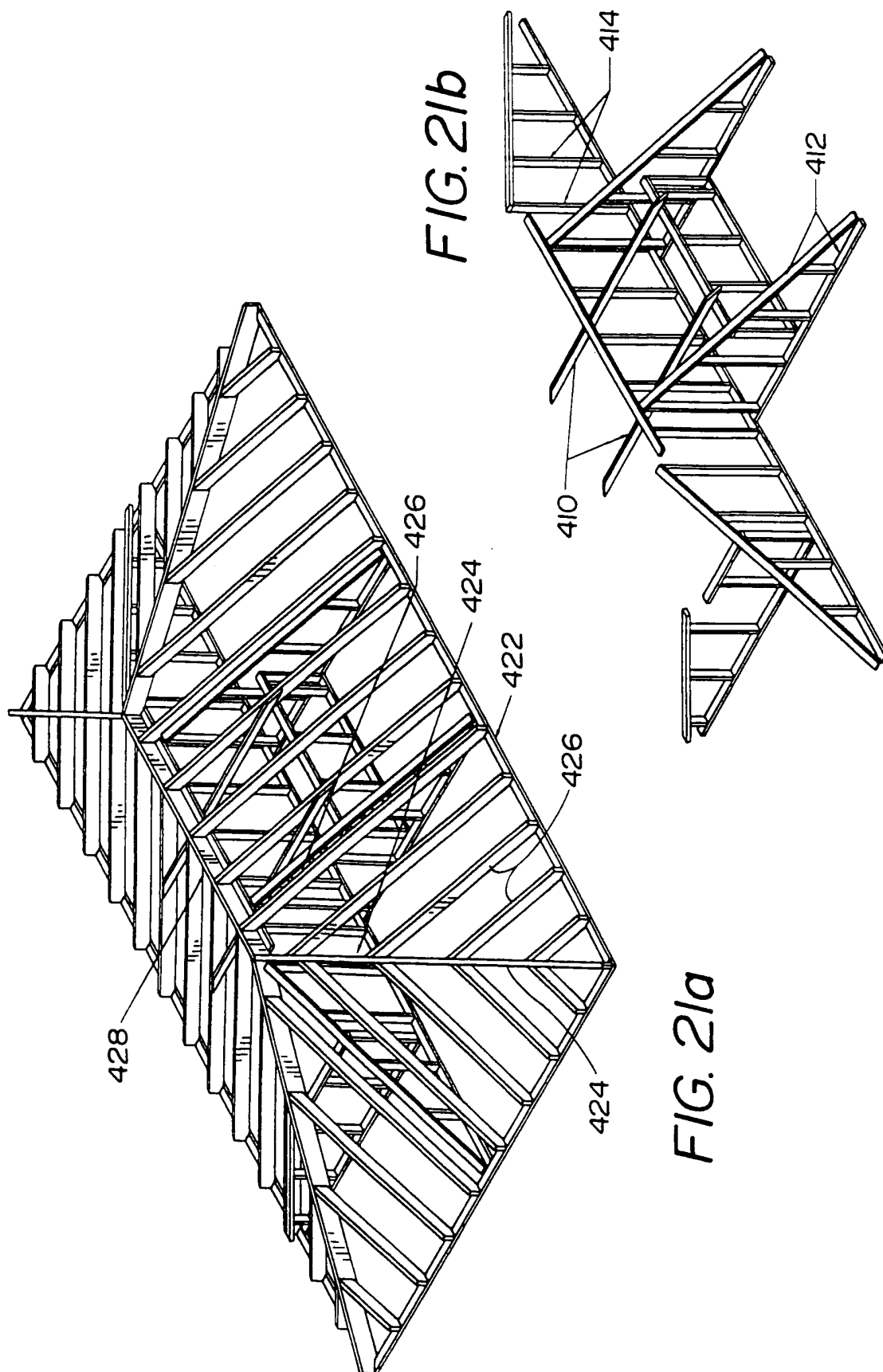


FIG. 20





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FIG. 22a

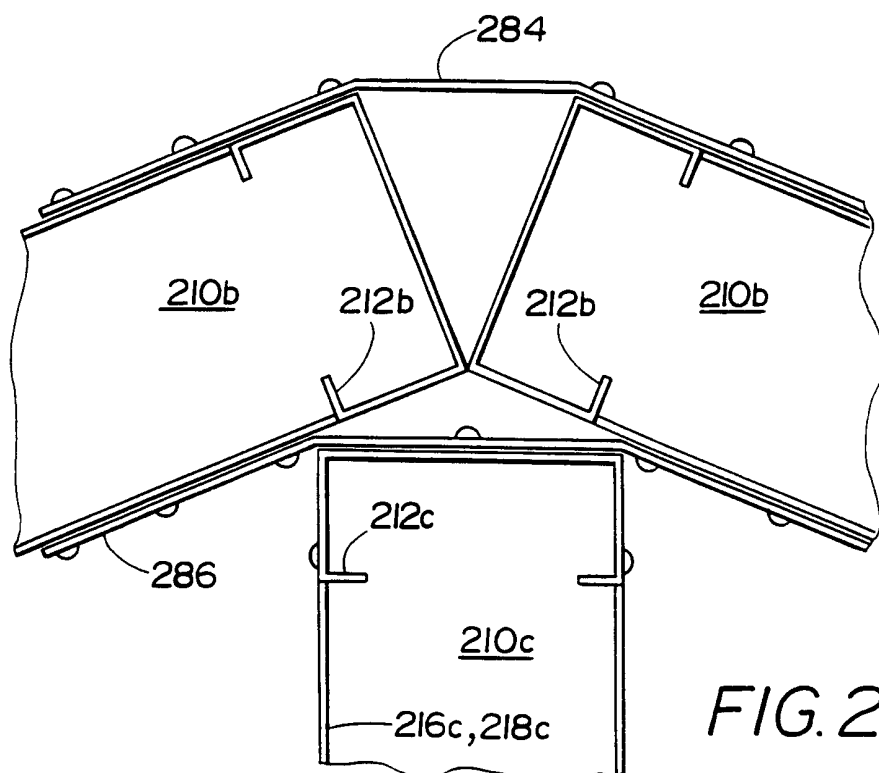
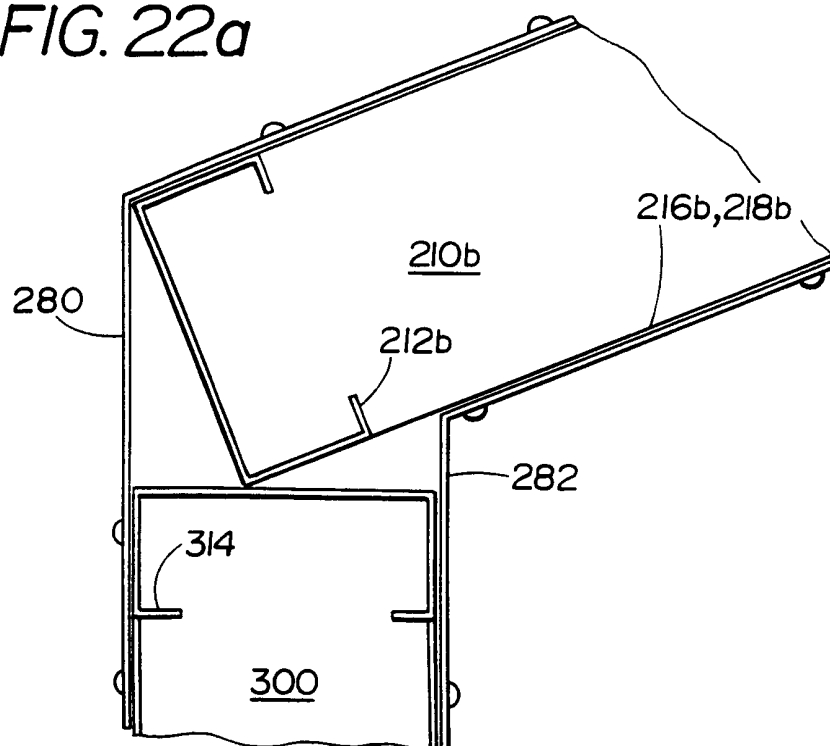
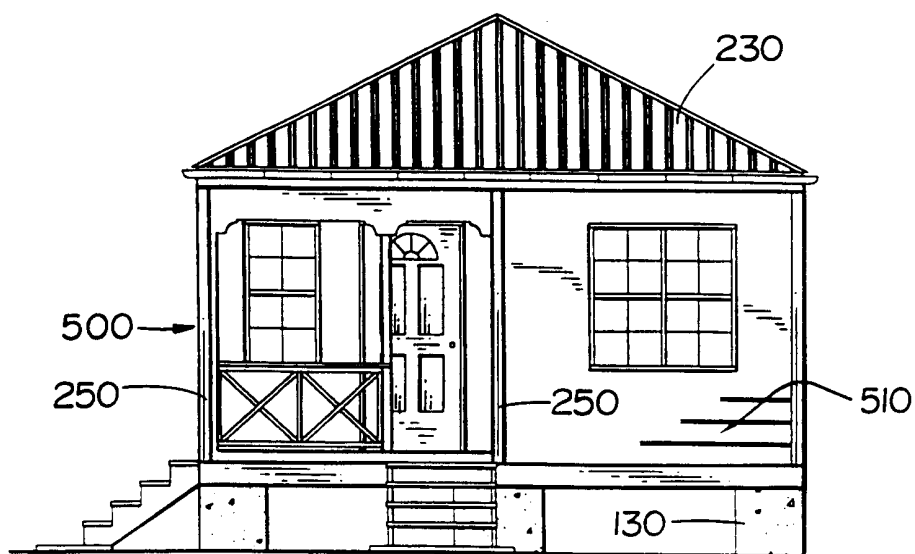
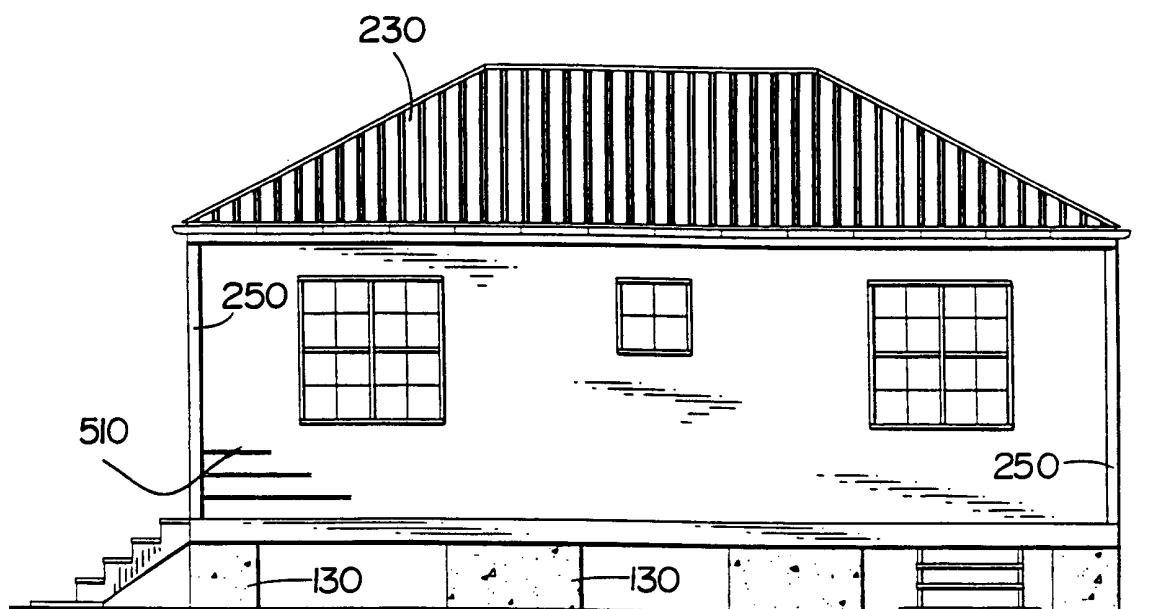


FIG. 22b

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*FIG. 23a**FIG. 23b*

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/00102

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E04B1/24

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)

IPC 7 E04B E04D

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	GB 587 047 A (ALBERT HENRY THOMAS BRODERICK) 11 April 1947 (1947-04-11)	1,7-11, 18,19,24
Y	the whole document	2-6, 12-17, 25,26 20
A	----	
Y	US 4 333 280 A (MORTON VIRGIL R) 8 June 1982 (1982-06-08)	2-4,25
A	the whole document	21
Y	US 3 971 172 A (GENTIL ROBERT) 27 July 1976 (1976-07-27) column 1, line 4 - line 15 column 5, line 7 - line 20; figures 1-9	5,6
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

18 May 2001

Date of mailing of the international search report

28/05/2001

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Zuurveld, G

INTERNATIONAL SEARCH REPORT

Inter. Appl. No.
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	the whole document	13,14, 16,17
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