



(43) International Publication Date  
9 July 2015 (09.07.2015)

- (51) International Patent Classification:  
*E04B 1/18* (2006.01) *E04B 2/70* (2006.01)
- (21) International Application Number:  
PCT/EP2015/050015
- (22) International Filing Date:  
2 January 2015 (02.01.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
13/998,995 30 December 2013 (30.12.2013) US
- (72) Inventor; and
- (71) Applicant : STEIN, Alejandro [CH/CH]; CP90, CH-1297 Founex (CH).
- (74) Agent: LEEMING, John Gerard; J.A. Kemp & Co., 14 South Square, Gray's Inn, London, Greater London WC1R 5JJ (GB).

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, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, 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, SA, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

**Published:**

- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, — with international search report (Art. 21(3))

(54) Title: STIFFENERS FOR METALLIC LOGS STRUCTURES

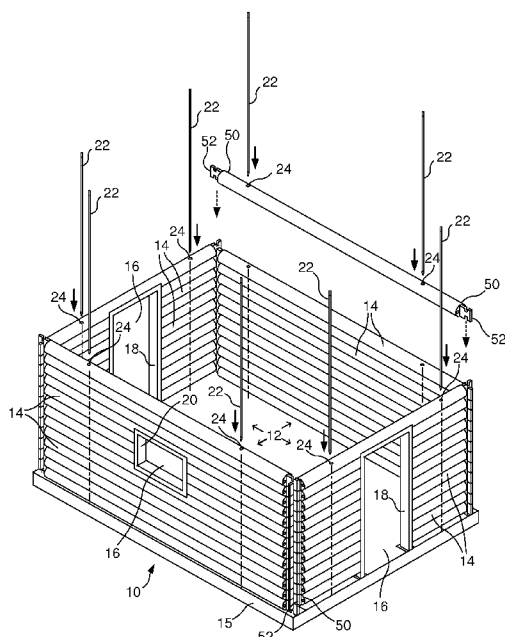


FIG. 1

(57) Abstract: A plurality of hollow metallic logs, also called metalogs, form a- freestanding wall or fence, or structure comprising walls, upper floors whenever applicable and/or roof of a building. Each metalog has an axis. A stiffener extends through a set of aligned holes in the metalogs at right angles to the axes. One or more additional stiffeners may similarly extend through one or more additional sets of aligned holes in the same metalogs. The stiffeners function to resist forces acting in a direction parallel to the axes of the metalogs and therefore enhance the stability of the structure and obviate otherwise required X-bracing.

## STIFFENERS FOR METALLIC LOGS STRUCTURES

## BACKGROUND OF THE INVENTION

## FIELD OF THE INVENTION

**[0001]** This invention relates to metalogs forming a-free-standing wall or fence, or a wall, upper floor or roof of a building, and more particularly to a novel and highly effective stiffener substructure and method for further stabilizing the metalogs so as to obviate otherwise required cross bracing ("X-bracing").

## DESCRIPTION OF THE PRIOR ART

**[0002]** One of the simplest and fastest methods of constructing freestanding walls and building structures uses hollow "logs". They can be made of various materials, including but not limited to plastic and cardboard, but are usually made of metal and are therefore commonly referred to as "metalogs". Metalogs can be custom-made almost anywhere by a mobile tube-forming machine, or "TFM", in which case the strip material to form the metalogs may be shipped in the form of coils, taking up relatively little volume. The strip can be longitudinally or spirally lock-formed into metalogs. The TFM can be installed on a trailer or barge to reach construction sites. An internal-combustion engine typically powers the TFM, so the metalog

fabrication can take place in locations with no infrastructure. This type of construction is ideally suited for employment in remote and rural areas, where requirements for fast-track construction of walls or fences, as well as of residential and non-residential buildings of a quality second to none for a same type of specifications, are often difficult to meet.

**[0003]** In this type of construction, connector elements fitted to the ends of the metalogs-interlock with each other at corners where two structural walls meet, thus providing basic stabilization for the walls. Although metalogs are foreseen to intersect most often on a right angle, there is no problem in varying the connector elements' shape so as to have metalogs intersect at different angles. Connector elements may also be used to connect metalogs forming a roof.

**[0004]** The present applicant is a leading developer of this type of construction, as exemplified by his prior US patents Nos. 4,619,089, 5,282,343, 8,074,413, 8,099,917, 8,122,657, 8,215,082, 8,555,575, and 8,567,139, plus numerous patents in other countries. The identified US patents and applications are incorporated herein by reference.

**[0005]** Relatively small wall and building superstructures comprising metalogs can be assembled, start to finish, literally within minutes or hours using unskilled local labor. Larger wall and building structures can also be put together in particularly

short times, when comparing with alternative methods of construction. Typically galvanized, aluminized or pre-painted metallogs and other structural components render them impervious to rust, rot, fire and termites, while the combination of continuity and light weight of their structural surfaces renders them less susceptible than masonry and other conventional methods of construction to damage by high winds and earthquakes. A membrane impermeable to water may optionally be applied to the roof to shed rain. Otherwise, the hollow logs can disappear from view underneath internal and/or external cladding with or without thermal insulation incorporated into it.

**[0006]** These considerations have made this type of construction broadly acceptable in various countries for the construction of low-rise buildings and especially as a means of providing, on fast-track mode irrespective of location, free-standing walls and residential and non-residential buildings:

**[0007]** In order to make such free-standing walls and building structures sturdier and resistant to horizontal forces even in the absence of otherwise required X-bracing, there is a need for improvements in design and methods of construction.

## OBJECTS AND SUMMARY OF THE INVENTION

**[0008]** An object of the invention is to provide an improved means and method of stiffening metalog structures.

**[0009]** In more detail, objects of the invention include providing a series of stiffeners for an assembly of metalogs that:

- enables the metalogs to resist horizontal forces (due for example to wind) all or part of which act in a direction parallel to the axes of the metalogs;
- is readily adaptable to existing metalog technology;
- requires little expense for parts and labor; and
- has a mutual relation to the metalogs such that, while the stiffener itself is light and thin and as a standalone item has little resistance to lateral or compressive forces, it affords a surprising stiffness when actually crossing metalogs of a wall or other structure, especially as regards the capability of that wall or other structure to withstand forces having a component acting in a direction parallel to the plane in which it lies.

**[0010]** The foregoing and other objects of the invention are attained by providing, in a structure comprising a plurality of metalogs forming a-free-standing wall or fence, or a structure comprising walls, upper floors whenever applicable

and/or roof of a building, each metalog having an axis that is typically but not necessarily horizontal, the improvement wherein a stiffener extends through the metalogs to resist forces acting in a direction parallel to the axes of the metalogs, thereby further stabilizing the structure, even without X-bracing.

**[0011]** The stiffener preferably-comprises a rod or a tubular element of considerably smaller diameter than the diameter of the metalogs. The ratio of the diameter of the metalogs to the diameter of the rod or tubular element is at least 3 to 1 and preferably approximately 10 to 1. The stiffener is made of metal, wood, or a synthetic material and extends at right angles to the axes of the metalogs.

**[0012]** Connectors respectively support the ends of the metalogs, and the stiffener is spaced apart from the connectors. Depending on the length of the metalogs in a given structure, a plurality of stiffeners spaced apart from the connectors and from one another may be employed.

**[0013]** Each metalog is formed with a pair of spaced-apart holes, the holes of the several metalogs being aligned. The stiffener passes through the aligned holes. In any given metalog, the holes are preferably at diametrically opposite locations.

**[0014]** In an independent aspect of the invention, a method is provided, which comprises the steps of providing a set of metalogs, forming a pair of holes in each

metalog of the set, and arranging the metalogs to form at least a part of a free-standing wall or fence, or a wall, upper floor or roof of a building. The holes are aligned, and a stiffener is passed through the holes.

**[0015]** In this method, a rod or a tubular element is preferably employed as the stiffener, the metalogs have respective axes extending parallel to one another, and the stiffener is extended at right angles to the axes. The ends of the metalogs are supported by connectors, and the stiffener is spaced apart from the connectors. Where a plurality of stiffeners are employed, respective stiffeners are extended through the metalogs at locations that are spaced apart from the connectors and from one another. If a stiffener were to coincide with, or pass too near a corner column consisting of a sequence of connector elements, it would not contribute the desired resistance to horizontal forces.

**[0016]** In greater detail, the method comprises forming a plurality of sets of holes in each metalog of the set of metalogs, the holes of each set of holes being at diametrically opposite locations on the respective metalogs, providing first and second connecting means, employing the first connecting means to support the first ends and the second connecting means to support the second ends, spacing a first stiffener a first distance apart from the first connecting means and passing through a first set of aligned holes in the metalogs, and spacing a second stiffener a second

distance apart from the first stiffener on a side of the first stiffener opposite the first connecting means and passing through a second set of aligned holes in the metalogs, the second stiffener being a third distance apart from the second connecting means.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]** A better understanding of the objects, features, and advantages of the invention can be gained from a consideration of the following detailed description of preferred embodiments thereof in conjunction with the appended figures of the drawing, wherein:

**[0018]** FIG. 1 is an isometric perspective view showing the process of adding metalog stiffeners according to the invention to a metalog superstructure;

**[0019]** FIG. 2 is an isometric perspective view showing the metalog superstructure of FIG. 1 after the installation of the stiffeners;

**[0020]** FIG. 3 is an isometric perspective view showing the structure of a preferred embodiment of the lower end of a stiffener facilitating its insertion into holes formed in metalogs as explained below;



**[0021]** FIG. 4 is an isometric perspective view with a break indicating that a one-piece stiffener can optionally extend from top to bottom of a building superstructure wall;

**[0022]** FIG. 5 is an isometric perspective view showing the process of employing the structure of FIG. 3 as a bridge for adding an optional extension to the stiffener of FIG. 4;

**[0023]** FIG. 6 is an isometric perspective view showing the structure of FIG. 5 after the addition of the extension;

**[0024]** FIG. 7 is an end view of metalogs with a stiffener extending through holes arranged so that, on each metalog, the holes are at diametrically opposite positions, and the holes of one metalog are aligned with those of the others;

**[0025]** FIG. 8 is a top view of the structure of FIG. 7;

**[0026]** FIG. 9 is an end view of metalogs with a stiffener extending through holes arranged so that, on each metalog, the holes are displaced from diametrically opposite positions, and the holes of one metalog are aligned with those of the others; and

**[0027]** FIG. 10 is a top view of the structure of FIG. 9.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

**[0028]** FIGS. 1 and 2 show a building superstructure 10 comprising walls 12 formed of metalogs 14 mounted on an optional concrete slab 15. The axes of the metalogs 14 in a given wall 12 are horizontal and parallel to one another. Provision is made for openings 16 for one or more doors 18 and windows 20, plus vents, plumbing and electrical connections and any other required openings (not shown). In accordance with the invention, stiffeners 22 are provided. They are passed through a pair of holes 24 formed in each of the metalogs 14.

**[0029]** FIG. 2 shows the structure of FIG. 1 after installation of the stiffeners 22. Each stiffener 22 extends from the top 26 to the bottom 28 of a wall 12. The stiffeners 22 stiffen the walls 12 of the superstructure 10 as explained below and make it highly resistant to forces generated for example by wind having components parallel to the walls.

**[0030]** As FIG. 3 shows, the stiffeners 22 are preferably configured at the bottom to facilitate entry into the holes 24 formed in the metalogs 14 and speed their installation by unskilled labor. In the illustrated embodiment, the formation 30 resembles a battlement, with crenellations 32 alternating with structure analogous to merlons 34.

**[0031]** As FIG. 4 shows, the formation 30 tapers in towards its lower end 36. This facilitates its entry into the holes 24 shown in FIG. 1 while enabling a snug fit (i.e., a fit with little play) of the main portion 38 of the stiffener 22 within the holes 24.

**[0032]** FIG. 5 shows a link 40 connecting two sections 42 and 44 that together form a stiffener 22. The link 40 has a tapered battlement-like formation 30 as described above to facilitate its entry into the lower section 42. The link 40 protrudes well above the top 46 of the lower section 42 to provide good support for the upper section or extension 44. FIG. 6 shows the composite stiffener 22 after assembly of the upper and lower sections 42, 44 as described above.

**[0033]** A one-piece stiffener 22 as shown in FIG. 4 is preferred in most cases, but the structure of FIGS. 5 and 6 provides an alternative if the height of the wall 12 or other considerations recommend it.

**[0034]** Since the metalogs 24 are substantially cylindrical, they are substantially circular in cross section and, except for oval sections that are also possible, have a diameter in cross section corresponding to the diameter of a circle. (Oval sections have major and minor diameters plus other diametric chords.) FIG. 7 is an end view of metalogs 14 with a stiffener 22 extending through holes 24 arranged so that, on each metalog 14, the holes 24 are at diametrically opposite positions, and the holes

24 of one metalog 24 are aligned with those of the others. FIG. 8 shows the same structure as viewed from above.

**[0035]** The arrangement of FIGS. 7 and 8 is usually preferred, but the invention also extends to the case of FIGS. 9 and 10, where the stiffeners 22 extend through holes 24 arranged so that, on each metalog 14, the holes 24 are displaced from diametrically opposite positions. In the case of FIGS. 9 and 10, as in the case of FIGS. 7 and 8, the holes 24 accommodating a given stiffener 22 of one metalog 14 are aligned with those of the other metalogs 14 accommodating the same stiffener 22.

**[0036]** Each stiffener 22-comprises a rod or a tubular element of considerably smaller diameter than the diameter of the metalogs. The ratio ratio of the diameter of the metalogs to the diameter of the rod or tubular element is at least 3 and is preferably approximately 10 to 1.

**[0037]** The stiffeners 22 are not subject to compressive loads and partly for that reason they can be made out of relatively thin material. Moreover, the stiffeners 22 do not even require a complete circular section. In other words, they may comprise strip material roll-formed on or off a construction site into tubes with a circular or oval section, without even requiring the longitudinal joint or gap to be closed.

**[0038]** Another reason the stiffeners can be made out of relatively thin material is that they are supported by the metalogs 14, even as they stiffen the structure formed by the metalogs 14. That is, if the metalogs 14 have a diameter of, say  $x$  cm, the stiffeners 22 are supported at intervals that do not exceed  $x$  cm in the embodiment of FIGS. 7 and 8 and that are even less in the embodiment of FIGS. 9 and 10. The stiffeners 22 when engaged with the metalogs 14 as described herein impart a stiffness to the structure formed by the metalogs 14 that is quite surprising and out of proportion to the light weight of the stiffeners 22.

**[0039]** The stiffeners 22 can be made of metal, wood, or a synthetic material and extend at right angles to the axes of the metalogs.

**[0040]** As FIGS. 1 and 2 show, the metalogs 14 have opposite ends 50. Corner connectors 52 respectively support the ends 50, and the stiffeners 22 are spaced apart from the ends 50 and connectors 52. Where multiple stiffeners 50 are employed in a given wall, as illustrated in FIGS. 1 and 2, the stiffeners 22 are spaced apart from the connectors 52 and from one another.

**[0041]** In greater detail, a method according to the invention comprises the steps of spacing a first stiffener a first distance apart from the first connecting means, as illustrated in the back wall in FIG. 2 by the separation between either stiffener 22, say the nearer one, and the nearest corner connectors 52, the first stiffener passing

through a first set of aligned holes 24 in the metalogs 14; and spacing a second stiffener a second distance apart from the first stiffener on a side of the first stiffener opposite the first connecting means, as illustrated in the back wall in FIG. 2 by the separation between the two stiffeners in that wall, the second stiffener passing through a second set of aligned holes in the metalogs and being a third distance apart from the second connecting means, as illustrated in the back wall in FIG. 2 by the separation between the second stiffener and the second connecting means (i.e., the corner connectors 52 in the far corner of FIG. 2).

**[0042]** Thus there is provided in accordance with the invention a novel and highly effective structure and method for further stabilizing metalogs so as to obviate X-bracing. The invention provides an improved means and method of stiffening metalog structures.

**[0043]** The invention provides a stiffener for an assembly of metalogs that enables the metalogs to resist forces (due for example to wind) that act in a direction parallel to the axes of the metalogs. It is readily adaptable to existing metalog technology and requires little expense for parts and labor. Moreover, it has a mutual relation to the metalogs such that, while the stiffener itself is light and thin and as a standalone item has little resistance to lateral or compressive forces, it affords a surprising stiffness to the wall or other structure comprising the metalogs,

especially as regards the ability of that structure to withstand forces having a component acting in a direction parallel to the plane in which it lies.

**[0044]** Many modifications of the preferred embodiments of the invention disclosed herein will readily occur to those having ordinary skill in the art. The invention extends to all embodiments thereof that are within the scope of the appended claims.

**CLAIMS**

1. A structure comprising a plurality of intersecting metalogs forming a freestanding wall or fence, or a wall, upper floor or roof of a building, each metalog having an axis, and a stiffener extending through the metalogs to resist forces acting in a direction parallel to the axes of the metalogs to enhance the stability of the structure.
2. A structure according to claim 1 wherein the stiffener comprises a rod or a tubular element of considerably smaller diameter than the diameter of the metalogs.
3. A structure according to claim 2 wherein the ratio of the diameter of the metalogs to the diameter of the rod or tubular element is at least 3 to 1.
4. A structure according to claim 3 wherein the ratio is approximately 10 to 1.
5. A structure according to claim 1, 2, 3 or 4 wherein the stiffener is made of metal, wood, or a synthetic material.
6. A structure according to any one of claims 1 to 5 wherein the axes of the metalogs are horizontal and the stiffener extends at right angles to the axes of the metalogs.



7. A structure according to any one of claims 1 to 6 wherein the metalogs have ends and comprising connectors respectively supporting the ends, wherein the stiffener is spaced apart from the connectors.

8. A structure according to any one of claims 1 to 7 wherein the metalogs have ends and comprising connectors respectively supporting the ends and a plurality of stiffeners spaced apart from the connectors and from one another.

9. A structure according to any one of claims 1 to 8 wherein each metalog is formed with a pair of spaced-apart holes, the holes of the several metalogs being aligned and the stiffener passing through the holes.

10. A structure according to any one of claims 1 to 9 wherein each metalog is formed with a pair of holes at diametrically opposite locations, the holes of the several metalogs being aligned and the stiffener passing through the holes.

11. A method comprising the steps of:

providing a set of metalogs,

forming a pair of holes in each metalog of the set,

arranging the metalogs to form at least a part of a free-standing wall or fence, or a wall, upper floor or roof of a building,

aligning the holes, and

passing a stiffener through the holes.

12. A method according to claim 11 comprising the step of employing a rod or a tubular element as the stiffener.

13. A method according to claim 11 comprising the step of employing a metal rod or a metal tubular element as the stiffener.

14. A method according to claim 11, 12 or 13 wherein the metalogs have respective axes extending parallel to one another, comprising the step of extending the stiffener at right angles to the axes.

15. A method according to claim 11, 12, 13 or 14 wherein the metalogs have ends and comprising the step of providing connectors, employing the connectors to support the ends, and spacing the stiffener apart from the connectors.

16. A method according to any one of claims 11 to 15 wherein the metalogs have ends and comprising the step of providing connectors, employing the connectors to support the ends, providing a plurality of stiffeners, and extending respective stiffeners through the metalogs at locations that are spaced apart from the connectors and from one another.

17. A method according to any one of claims 11 to 16 comprising the step of forming a plurality of sets of holes in each metalog of the set of metalogs, the holes of each set of holes being at diametrically opposite locations on the respective metalogs, wherein the metalogs have first and second ends, providing first and second connecting means, employing the first connecting means to support the first ends and the second connecting means to support the second ends, spacing a first stiffener a first distance apart from the first connecting means and passing through a first set of aligned holes in the metalogs, spacing a second stiffener a second distance apart from the first stiffener on a side of the first stiffener opposite the first connecting means and passing through a second set of aligned holes in the metalogs, the second stiffener being a third distance apart from the second connecting means.

1 / 4

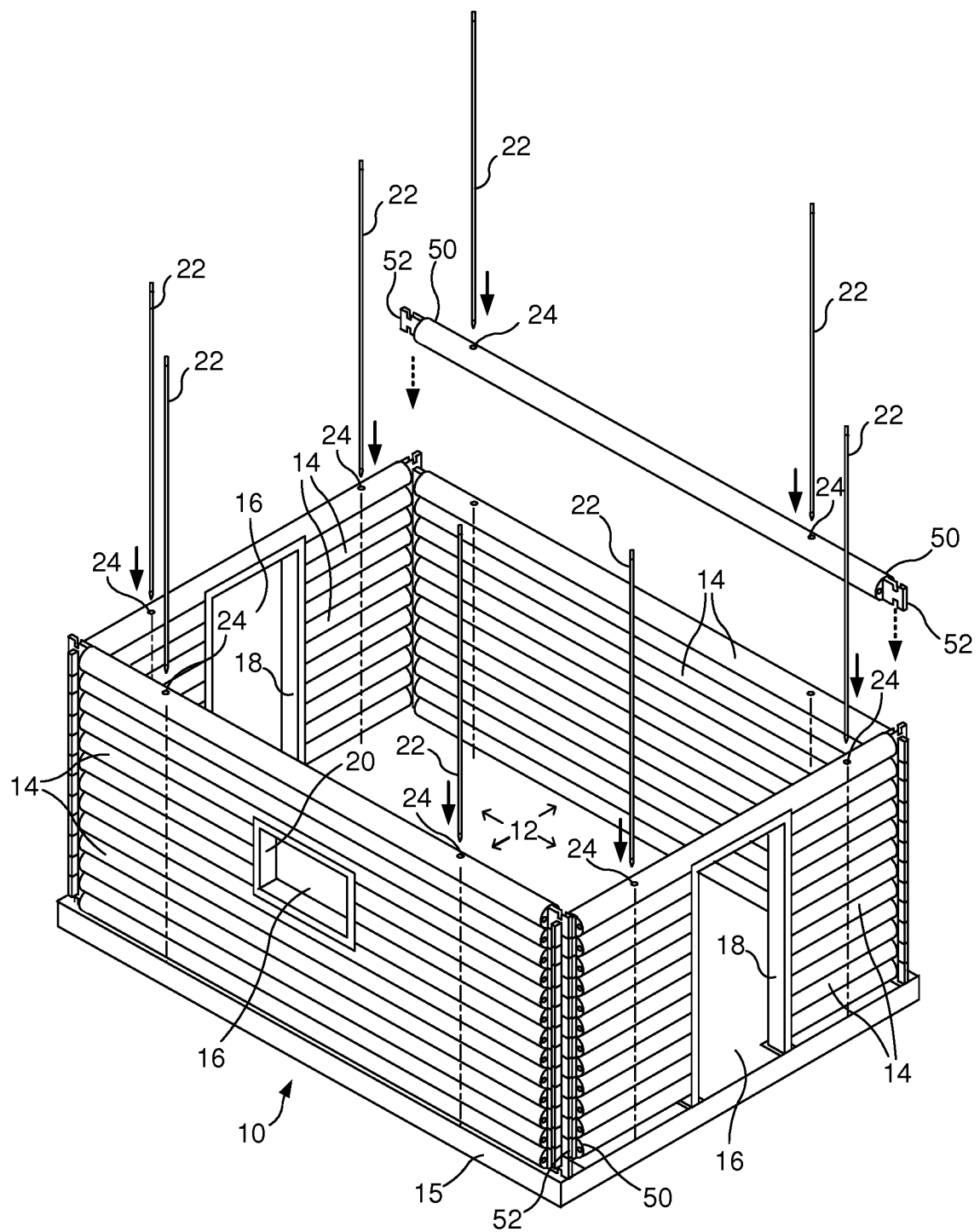


FIG. 1

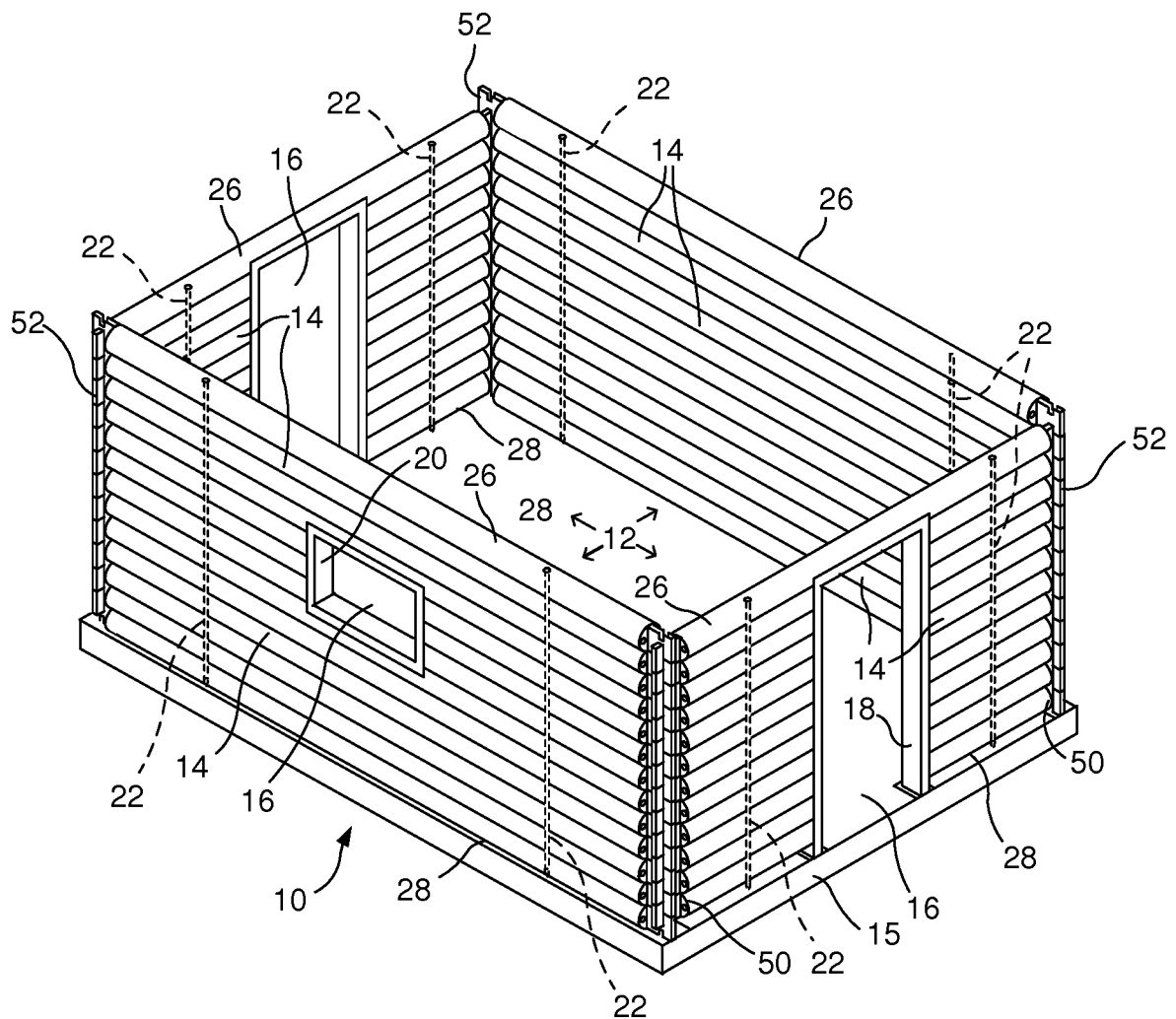


FIG. 2

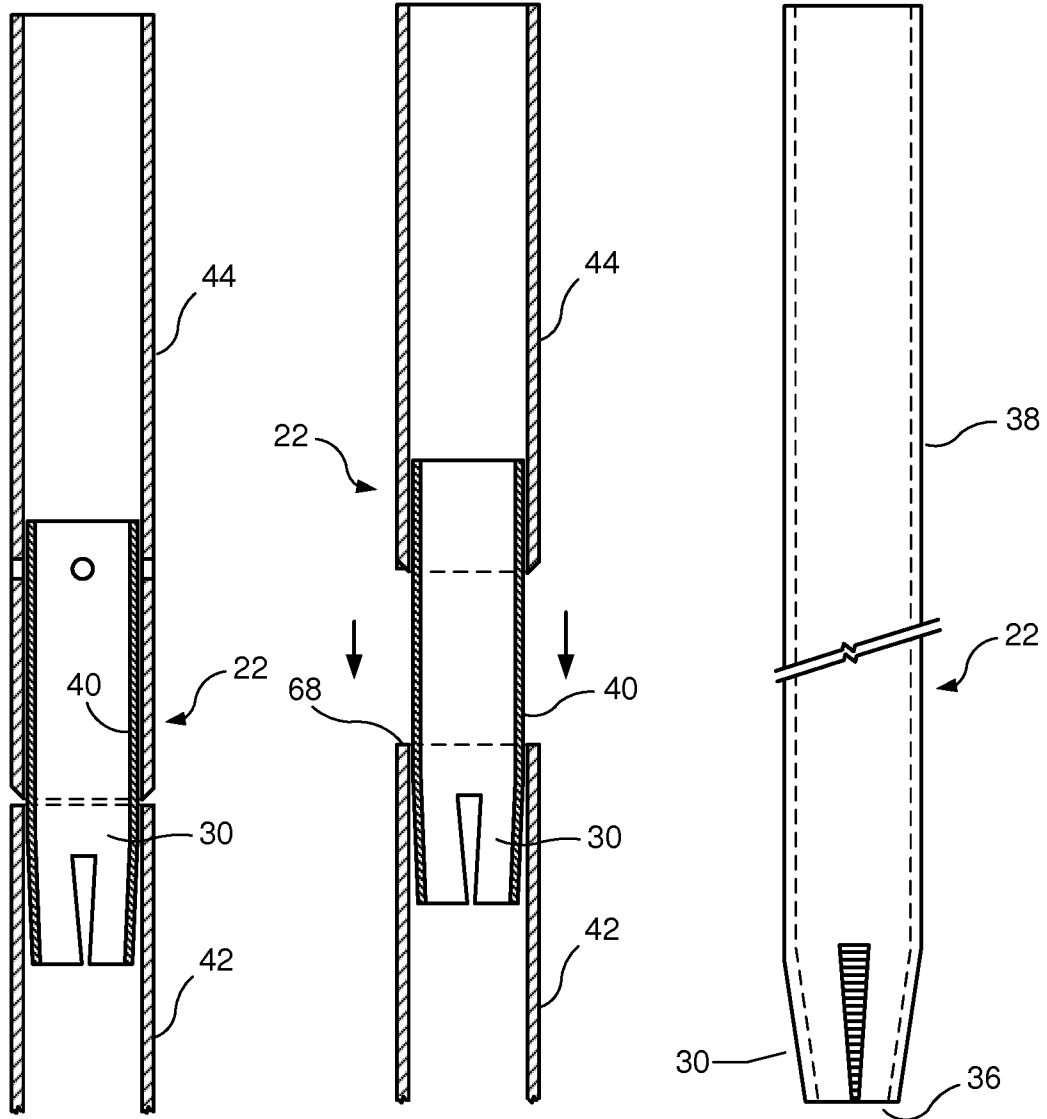


FIG. 6

FIG. 5

FIG. 4

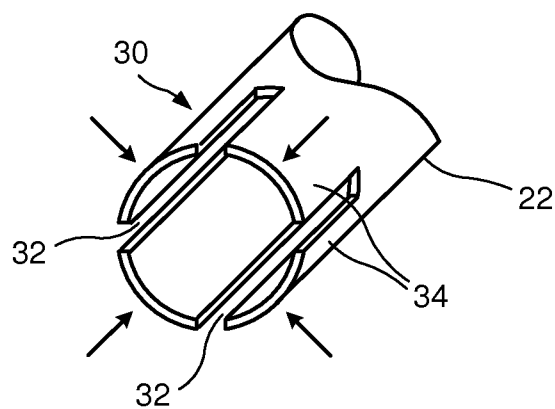


FIG. 3

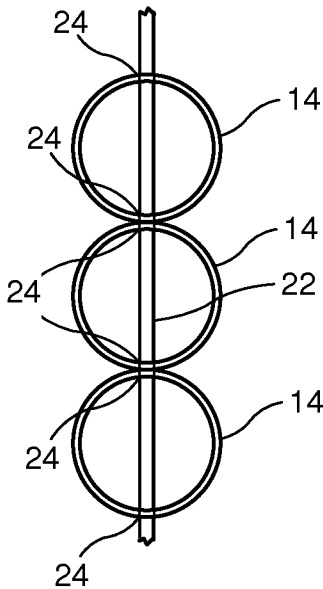


FIG. 7

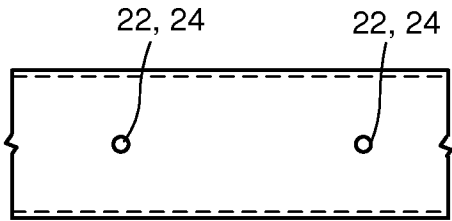


FIG. 8

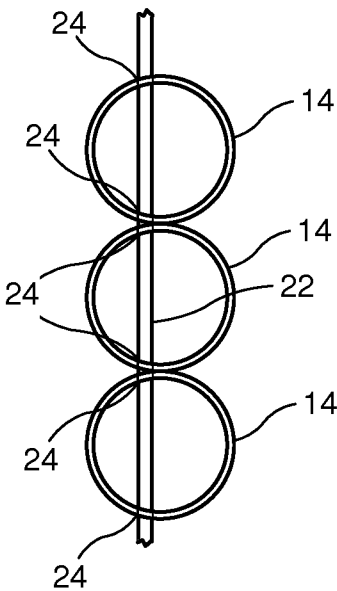


FIG. 9

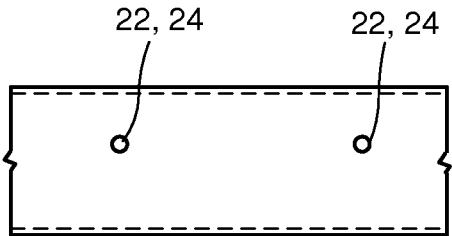


FIG. 10

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2015/050015

A. CLASSIFICATION OF SUBJECT MATTER  
INV. E04B1/18 E04B2/70  
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

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	US 5 253 458 A (CHRISTIAN DEAN [US]) 19 October 1993 (1993-10-19) column 3, lines 26-68; figure 1 -----	1-17
X	US 6 931 803 B1 (DAVIS GARY [US] ET AL) 23 August 2005 (2005-08-23) column 4, line 54 - column 6, line 32; figures 1, 9, 13B -----	1-17
A	US 4 619 089 A (STEIN ALEJANDRO [VE]) 28 October 1986 (1986-10-28) cited in the application the whole document -----	1-17
A	US 2009/293390 A1 (ANDERSON RICHARD T [US]) 3 December 2009 (2009-12-03) abstract; figures 1, 2 ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

3 March 2015

Date of mailing of the international search report

11/03/2015

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

Couprie, Brice



## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2015/050015

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/133345 A1 (WRIGHTMAN ROBERT A [CA]) 28 May 2009 (2009-05-28) abstract; figures 1, 2 -----	1
A	US 2008/083177 A1 (TIBERI SYLVAIN [CA] ET AL) 10 April 2008 (2008-04-10) abstract; figures 1, 2 -----	1
A	US 2004/187411 A1 (CLEGG JAMES D [US]) 30 September 2004 (2004-09-30) abstract; figure 4 -----	1
A	US 4 823 528 A (FAW GARLAND [US]) 25 April 1989 (1989-04-25) abstract; figures 1, 2 -----	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/050015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5253458	A	19-10-1993	NONE
US 6931803	B1	23-08-2005	NONE
US 4619089	A	28-10-1986	NONE
US 2009293390	A1	03-12-2009	US 7596916 B1 06-10-2009 US 2009293390 A1 03-12-2009
US 2009133345	A1	28-05-2009	CA 2639518 A1 13-03-2009 US 2009133345 A1 28-05-2009
US 2008083177	A1	10-04-2008	CA 2645468 A1 30-05-2009 CH 698215 A2 15-06-2009 FR 2924449 A1 05-06-2009 US 2008083177 A1 10-04-2008
US 2004187411	A1	30-09-2004	NONE
US 4823528	A	25-04-1989	NONE