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(54) FOLD-OUT PREFABRICATED STRUCTURE

(57) The invention relates to a fold-out prefabricated construction structure and method for the assembly thereof. The structure, having bays of desired width, length and shape, is made up of porticos formed by pillars and an upper structure (27). The method involves positioning the base (1) on a surface (28) and provisionally fixing at least one portion of said base. This allows opening the porticos with the help of auxiliary structures created for this purpose (14). The elements of the structure are fixed to one another, and to the surface of the portions of the base in their final position. Each of the porticos not yet fixed must be moved to their final position, in a successive manner and separately from the closest fixed portico, together with the rest of still free attached porticos, and suitably fixed to the surface.

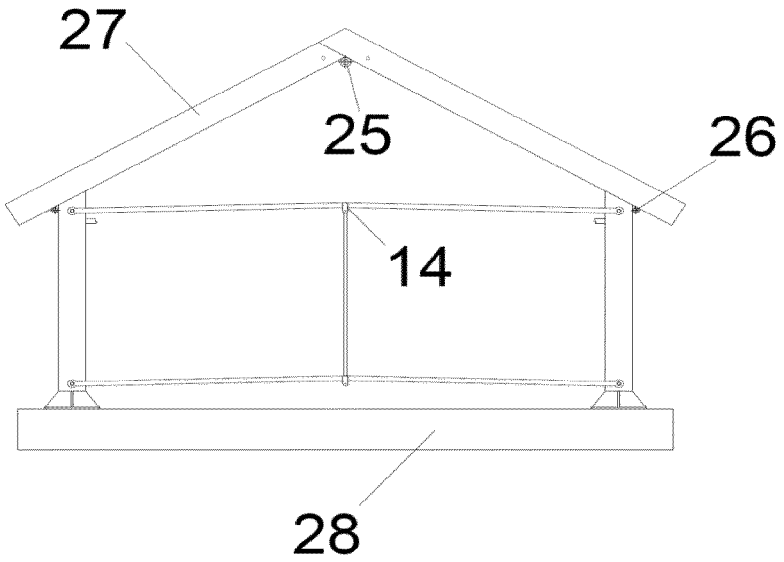

Figure 7

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Description

[0001] The present patent application is comprised in the sector of construction and the object thereof is a fold-out prefabricated structure and method for the assembly thereof. Once folded out, the structure acquires a fixed width, determined during the manufacturing phase, and the desired length and shape, to be formed during the folding out phase. It is made up of porticos that are independent from one another, formed by at least two pillars and an upper structure.

[0002] Such structures are known in the prior art, such as those described in patent documents US6499705, WO8303860, JPH0559821A, WO2013044301, DE212010000119U, ES2368539, JP2011179169A, which reflect the existing prior art, but have aspects that are susceptible to improvement.

[0003] To correctly fold out and subsequently use the structure there has to be a surface on which this can be done (28).

[0004] The parts forming the structure are:

[0005] A base built in one or several pieces, of materials and shape susceptible to being fixed to the surface, and prepared for being cut or separated into as many portions as there are pillars. Among its functions are that of maintaining the set of the structure attached at its lower part, forcing the pillars to remain erect and attached to same, allowing the entire folded up structure to be stood upright, allowing the pillars or sets of pillars to be moved on portions thereof and allowing all or portions of said base to be fixed to the surface, transmitting the stresses withstood by the pillars.

[0006] The pillars can have the height desired, even being able to go beyond the attachment point with the upper elements, and they are generally vertical, although it is possible to use any other arrangement, and can be of any section (circular, triangular, pentagonal, etc., or variable). The pillars can be different from one another in the same portico and between different porticos.

[0007] The upper structure can consist of any number of elements, which do not necessarily have to be identical to one another. Their final arrangement can form the desired angle, even being fixed by way of a horizontal beam, which makes it easier to create floor slabs. Furthermore, it is possible to determine whether or not the truss rafters will project out of the structure. This allows using the invention in pre-existing walls. Finally, the upper structures will generally be the same in all the porticos of one and the same structure, but they can have different shapes and compositions. The elements of the upper structure are attached to one another and to the pillars by means of articulations.

[0008] The structure is delivered folded up, taking up a smaller size than what it will take up once it is folded out.

[0009] With pillars of 267.00 cm in length and two truss rafters of 448.00 cm, a structure having three porticos would take up a total volume of 645.53 cm in length, 200.00 cm in width and 175.00 cm in depth (Figures 2, 3 and 4). The maximum weight can withstand significant oscillations due to the diversity of the construction materials and the variability of the dimensions of pillars and truss rafters. For example, a structure having three reinforced concrete porticos has a mass close to nine tons. A heavy duty vehicle would be necessary for moving this structure. The weight in wood or steel, for example, would be drastically less and would make the on-site deliver even easier.

[0010] Various techniques today allow making construction structures. The most common techniques involve the assembly of independent prefabricated pieces at their destination or the in situ construction thereof, requiring that workers and heavy machinery be available and travel for days or weeks, particularly if concrete is used. These needs entail higher costs for constructing any type of building and greatly limit any initiatives in this sense.

[0011] If the use of prefabricated elements is chosen, the stiff pieces (of steel, wood, ready-mix concrete or other similar materials) must be taken to the site independently and put in place one by one. This mechanism requires the presence of at least two operators on foot and an additional operator for operating the crane, the support of which will be necessary throughout the entire process. All this entails a high factory and site costs.

[0012] When prefabricated elements are not used, the reinforced concrete structures are made directly on site by at least two operators and a crane. To that end, it is necessary to use hand-crafted formworks with boards, props and other components. Due to the intrinsic progressiveness of the concrete hardening process, significant wait times must be accepted before being able to continue with the next element. For the same reason, all the elements withstanding bending (beams, slabs, etc.) cannot be under a load until 28 days after pouring the concrete. Therefore, this technique is particularly time-consuming as the dependent fragment hardening periods cannot overlap, and it is particularly material-consuming given the high number of phases, the loss of materials caused by bad weather, the limit to the number of uses of the formworks, the transport requirements given their high number, and taking into account that each concrete-pouring phase furthermore requires a concrete truck and a crane. As a consequence, it also demands a lot of manpower.

[0013] Unlike all these situations, the method for assembly object of invention enables concentrating resource consumption in the factory and reducing it at the construction site, where it is more expensive. The structure can be moved in a single trip and the need for crane is generally limited to the time required for the initial unloading, since after that activity no piece of the structure has to be lifted again, with the subsequent savings in energy, and enabling assembly by a single person. This invention is characterized by its folding out scalability and flexibility, such that it is possible to benefit from the savings generated in buildings of various shapes, sizes and

materials. In summary, the invention simplifies the creation of the structure required in the construction and restoration of homes, warehouses, garages, etc., with drastic savings in the purchasing price and in the need for mechanical and human resources.

[0014] A basic embodiment of a rectangular plan structure, with two rows of three identical porticos, having vertical pillars, two truss rafters per portico, having straight elements with a rectangular section, and folded out by means of auxiliary structures formed by metal bars, depicted in Figures 1 to 12 for better understanding thereof, and it will be described in detail below making reference to the attached drawings, in which:

Figure 1 is a schematic plan view of a surface prepared to be used by the structure object of invention, where locations 18, 19, 20, 21, 22 and 23 correspond with the final position of each of the pillars, whereas the point 24 represents the location prepared for the provisional fixing of the pillar 10.

Figure 2 is an elevational view of the recently unloaded and still folded up structure, resting on the surface of Figure 1.

Figure 3 is a profile view of the structure in the same state as in Figure 2.

Figure 4 is a plan view of the folded up structure.

Figure 5 is a plan view of the piece forming the base depicting the portions where it will be divided throughout the assembly process.

Figure 6 is a profile view of a portico at an intermediate point of the process of it being opened.

Figure 7 is a profile view of a portico once it has been opened.

Figure 8 is a plan view of the structure and the surface once the porticos are finally open.

Figure 9 is an elevational view of the structure and the surface once the porticos are finally open, with the auxiliary structures prepared for moving the second and third porticos.

Figure 10 is an elevational view of the structure and the surface once the movement of the second and third porticos has ended.

Figure 11 is an elevational view of the structure and the surface once the movement of the second and third porticos has ended and the auxiliary structures have been placed for moving the third portico.

Figure 12 is an elevational view of the structure and the surface once the movement of the third portico has ended.

Figure 13 is a profile view of an example of a structure including a truss as reinforcement in the upper structure.

Figure 14 is a profile view of an example of a still folded up structure in which various porticos open out radially from a central pillar, where inner articulations and an upper structure by way of a horizontal beam have been used.

Figure 15 is a profile view of an example of a folded out structure in which various porticos open out radially from a central pillar, where inner articulations and an upper structure by way of a horizontal beam have been used.

Figure 16 is a plan view of an example of a structure in which various porticos open out radially from a central pillar.

Figure 17 is a profile view of an example of a structure in which an "upper structure-pillar" set is coupled to the portico formed by "pillar-upper structure-pillar", such that the intermediate pillar (34) is shared by two upper structures.

Figure 18 is a plan view of an example of a structure in which an "upper structure-pillar" set is coupled to the portico formed by "pillar-upper structure-pillar", such that the intermediate pillar (34) is shared by two upper structures.

Figure 19 is a schematic profile view of an example of a structure incorporating intermediate elements (31) for creating additional floors.

Figure 20 is a profile view of an example of a structure in which the upper structure is formed by a number of elements greater than two.

Figure 21 is a profile view of the structure of Figure 20, in an intermediate portico opening phase in which the elements of the upper structure that are placed against the pillars have reached their final folding out angle.

Figure 22 is a profile view of the structure of Figure 21 once the porticos are finally open.

Figure 23 is a profile view of an example of a structure designed with moved articulations in the pillars.

[0015] The process for folding out the mentioned structure having three porticos (Figures 2, 3 and 4), formed by two vertical pillars and two truss rafters, all of them

having a rectangular section and being straight, with a base that will be divided by means of cuts, will be described below. To illustrate all possible cases, first one of the side porticos must be fixed and the rest must move longitudinally. However, there is complete flexibility here because the number of porticos is irrelevant for the assembly technique and mechanism, and porticos can be acquired that are grouped together or separated, whichever is most appropriate in each case, because it is perfectly viable to use several structures for a single project.

[0016] Furthermore, for structures with more than 2 porticos, the most efficient process would begin by fixing one of the central porticos in its final position, followed by the movement of the remaining porticos in opposite directions, depending on the side of the already fixed portico on which they are located, such that movement stress is minimal. However, to avoid redundancies in the description, the process will begin at one of the ends.

[0017] The assembly begins with unloading the structure, at which time the pillar 8 must be placed in their final position (18), where their corresponding portion of the base (2) will be fixed by means of suitable techniques (welding, screws, bonding, etc.). After securing the first portion of the base, the current example requires a provisional fixing between the portion of the base (4) of the pillar (10) and the surface in position (24). This securing confers a static position to the first row of pillars and allows opening the second one to its final position without requiring a crane or heavy machinery. To that end, one or several auxiliary structures (14) must be assembled assuring the relative arrangement between sets of pillars while the opening takes place, and the suitable movement mechanism, for example, winches and cables, towing vehicles, jacks, wheels, etc., must be provided. When all these elements are in position, a longitudinal cut (17) is made dividing the base into two rows (Figure 5), and the stiffening elements between both rows (29) are cut. Only if all these elements are arranged is it possible to open the free row, which will remain erect as a result of the auxiliary structures (Figure 6), until both the pillar 11 and the articulations of the upper structure (25 and 26) reach their final position (Figures 7 and 8). The truss rafters of the present example (27) are prepared for reaching angles of 30° and 150° with respect to the horizontal. The portion of the base 5 of the pillar 11 will be fixed at point 21 and the portion 4 of the pillar 10 will be released from its provisional securing at 24. The articulations of all the porticos will also be immobilized either by fixing means for fixing same or by means of attaching the definitive elements of the structure to one another, since they will not require any mobility again.

[0018] There are a number of solutions for the upper part of the structure. Both the articulations attaching the pillars with the truss rafters and the truss rafters to one another, and the form of attachment of these points, are completely versatile, generating a wide range of possibilities in the finish of both roofs and floor slabs. Furthermore, when the upper part of the structure is made up of more than 2 elements, additional actions must be carried out to open it. Specifically, temporary fixing elements (32) reducing the movements of all those elements to standard protocol must be used. In such case, the porticos are opened in stages and the elements are gradually fixed as they reach the desired position. To complete the folding out, this activity must be performed in a successive manner until all the upper elements are fixed (Figures 20, 21 and 22).

[0019] The activities included in the following paragraph describe in detail the process of moving the porticos and must be performed n-2 times, where n is the number of porticos. This is because all the central porticos (i.e., those that are neither the first nor the last) share a single movement routine. Given that this invention exemplifies a structure having three porticos, the following routine is carried out just once.

[0020] The auxiliary structures (14) must be assembled between the pillars of the most recently fixed portico and the portico that is going to be moved next (Figure 9) and eliminating the attachment provided by the stiffening elements of the pillars and the truss rafters (29), as well as the attachment of the base (cut 15 of Figure 5) of both porticos to proceed to the uncoupling thereof. Therefore, the entire structure not yet fixed (porticos formed by pillars 9, 10, 12 and 13) still forms a single moving set, unlike the already secured porticos. Movement (Figure 10) and fixing of the following portico (pillars 9 and 12, through their respective portions of the base 3 and 6) are performed with the movement mechanism. This movement can be done in a single run if is a rectangular plan structure, i.e., if the final position of the porticos is parallel. If the final position of the porticos is not going to be parallel, separate movements for each pillar must be performed.

[0021] In order to move the last of the porticos, the remaining stiffening elements (29) must be removed, the auxiliary structures must be installed between the last and next to last porticos (Figure 11), the movement mechanism must be installed, the corresponding cut must be made in the base (16), and finally, it must be moved to the final position where the portions of the base 4 and 7 of the pillars 10 and 13 (Figure 12) are fixed.

[0022] Lastly, the auxiliary structures and the movement mechanism are disassembled.

Claims

1. A prefabricated construction structure having any number of porticos that allows obtaining a final structure of various shapes and dimensions, which is delivered folded-up, comprising a base (1) built in one or several pieces, susceptible to being fixed to the surface and prepared for being cut or separated into as many portions as there are pillars, said pillars (8, 9, 10, 11, 12, 13) having any dimensions, shape, section and inclination, attached to the base, which

can be different from one another, an upper structure (27) made up of elements of any length, shape and section, which can be different from one another, with finishes that allow fitting with others at the chosen angle, attached to one another and to the pillars by articulations or other moving elements (25, 26), which are delivered folded-up and expanded to their final position throughout the fold-out process, stiffening elements (29) providing strength to the conglomerate and allowing groups of structural elements to be opened and moved as a result of auxiliary structures (14) assuring the relative arrangement between sets of pillars during the required fold-out movements.

2. The prefabricated structure according to claim 1, **characterized in that** the base and the pillars form a single piece.

3. The prefabricated structure according to claim 1, **characterized in that** the high part of the pillars and the upper structure incorporate the elements required for configuring a truss (30).

4. The prefabricated structure according to claim 1, **characterized in that** various porticos open out from a single central pillar (33), having said pillar in common.

5. The prefabricated structure according to claim 1, **characterized in that** other "upper structure-pillar" sets are coupled to the portico formed by "pillar-upper structure-pillar", such that the intermediate pillars (34) are shared by two upper structures.

6. The prefabricated structure according to claim 1, **characterized in that** it incorporates intermediate structural elements (31) that allow creating additional floors.

7. The prefabricated structure according to claim 1, **characterized in that** the number of elements forming the upper structure is greater than two, where temporary fixing elements (32) are required for the sequential folding out of the elements.

8. The prefabricated structure according to claim 1, **characterized in that** the articulations are located at intermediate points of the elements of the structure, either the pillars or upper elements, by way of moved articulations (35).

9. A method for forming a structure according to claim 1, consisting of positioning the base (1) on a surface (28), provisionally fixing at least one portion of said base to the surface, opening the porticos by moving the non-fixed pillars (11, 12, 13) using a movement mechanism and one or several auxiliary structures (14) assuring the stability of the structure and the relative arrangement between both sets of pillars, definitively immobilizing the attachment of the upper elements to one another and to the pillars once they are completely opened, fixing the portions of base of the pillars that have acquired their final position on the surface, and for each of the porticos or pillars not yet fixed, in a successive manner, eliminating the stiffening elements (29), attaching it to the adjacent fixed portico, moving it to its final position, using the auxiliary structures, together with the rest of porticos yet to be fixed contiguous to same, if there are any, and fixing it by means of a method suitable for the surface.

10. The construction structure according to claim 1, folded out by means of the method for the assembly thereof according to claim 8.

11. The method for forming the structure according to claim 8, wherein the function of the auxiliary structures (14), of maintaining relative arrangement of the moved pillar, is undertaken by alternative solutions, such solutions being able to include the use of heavy machinery.

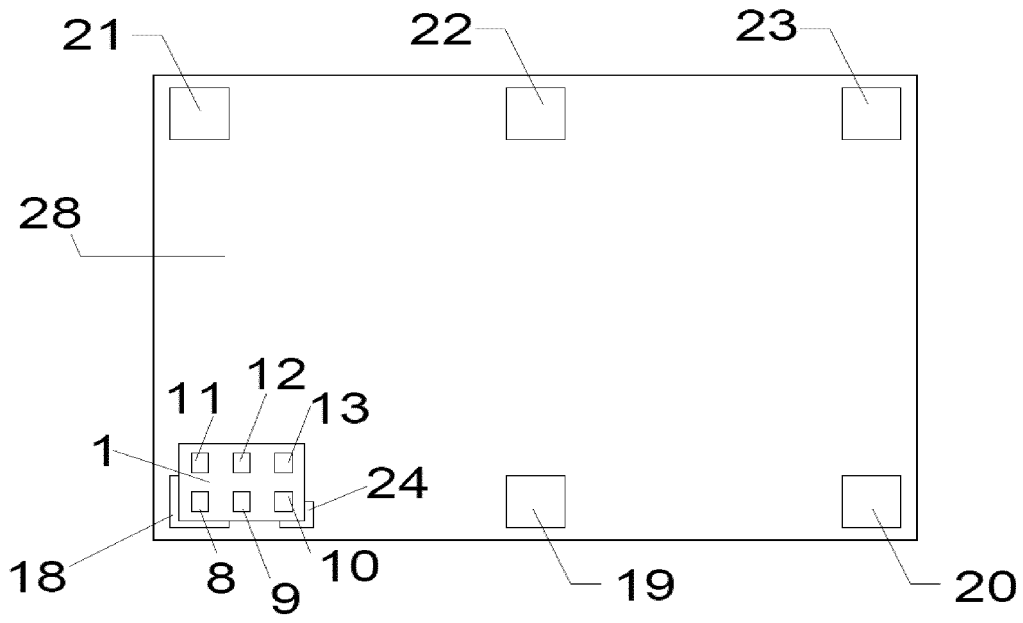


Figure 1

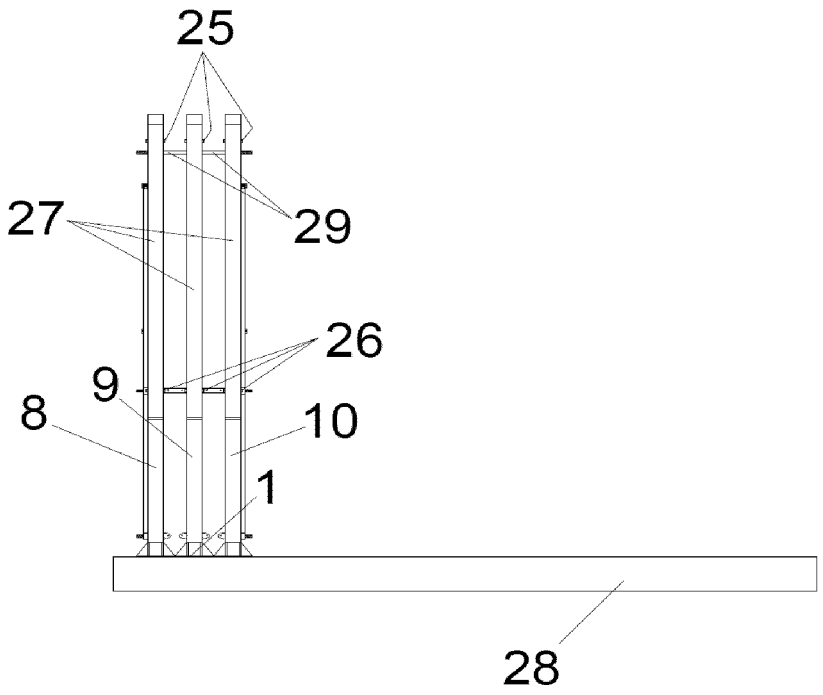


Figure 2

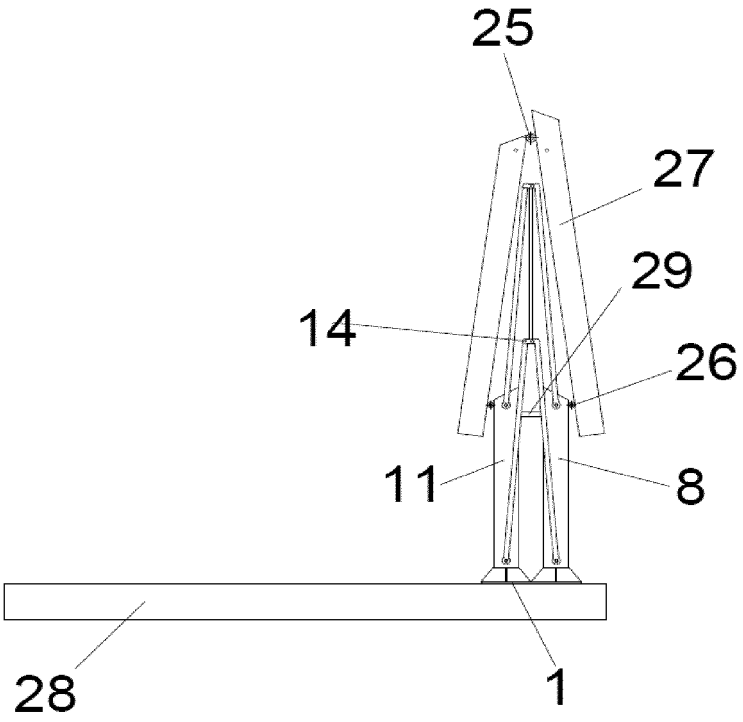


Figure 3

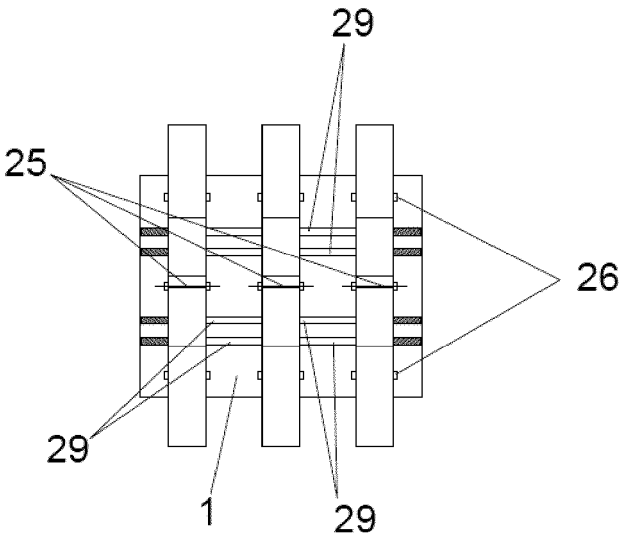


Figure 4

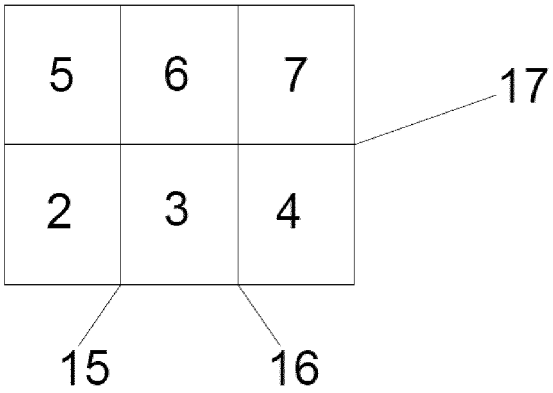


Figure 5

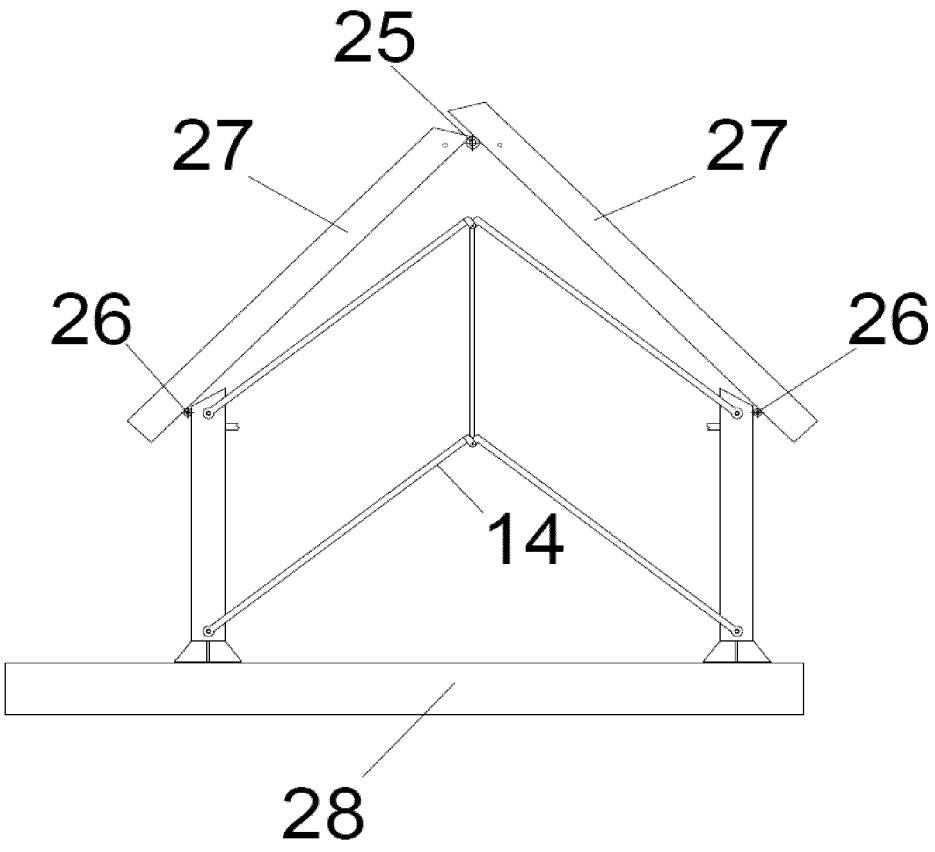


Figure 6

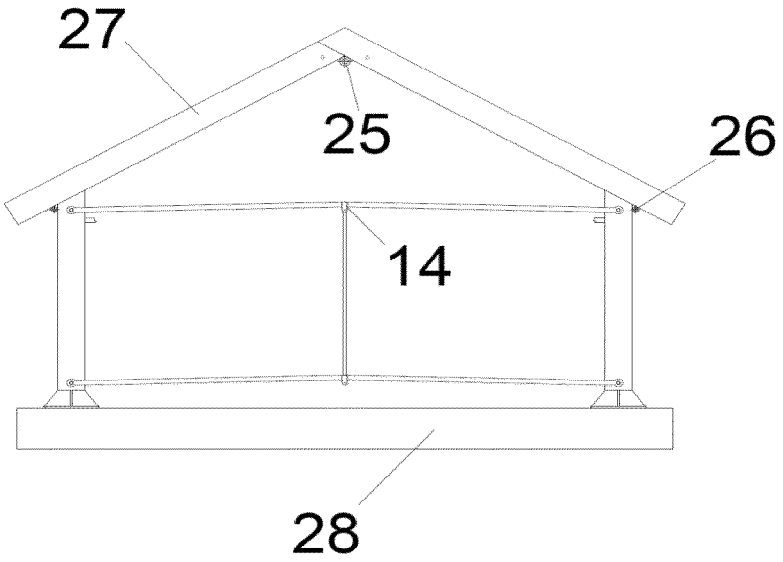
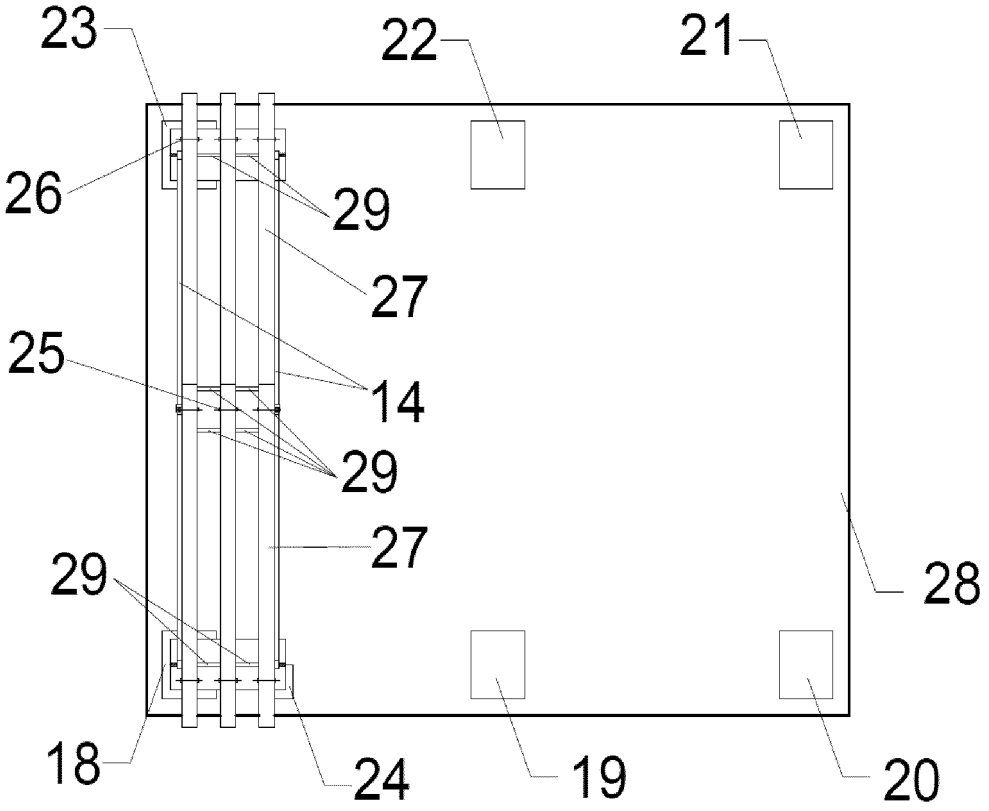


Figure 7



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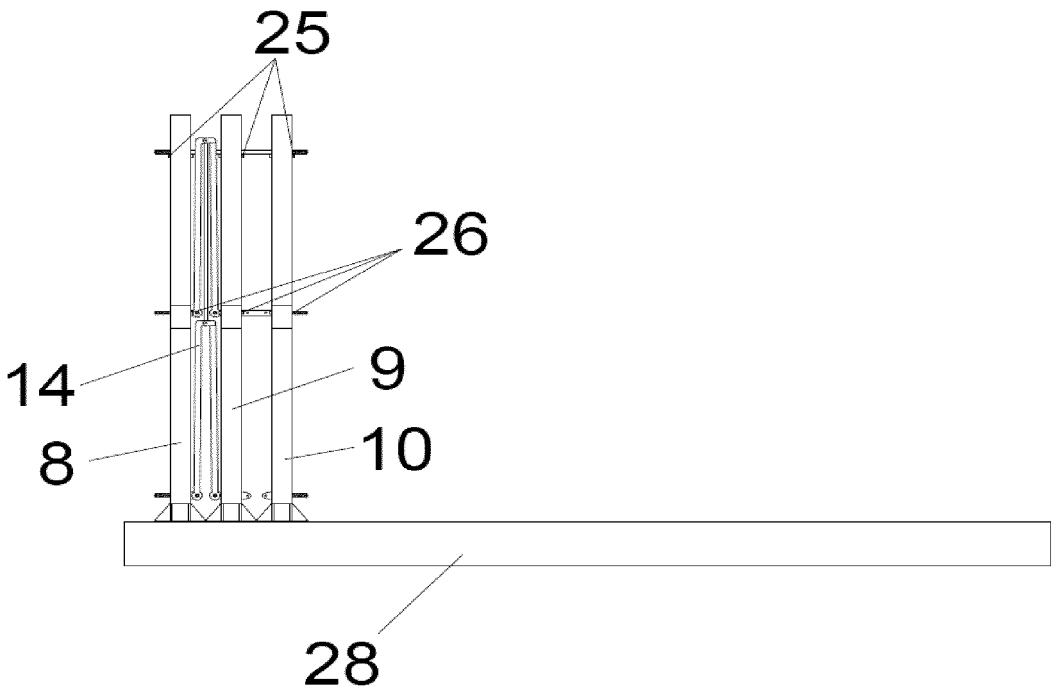

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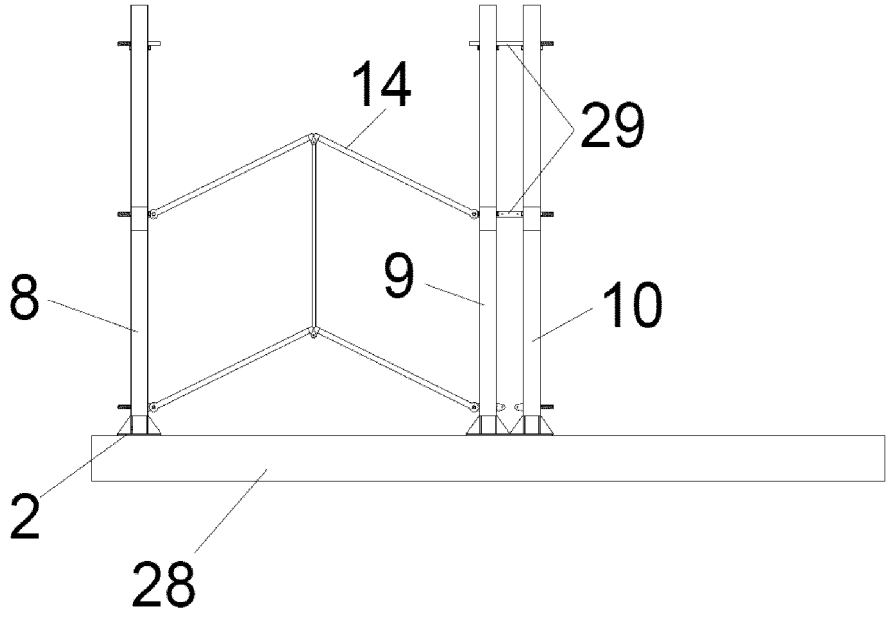
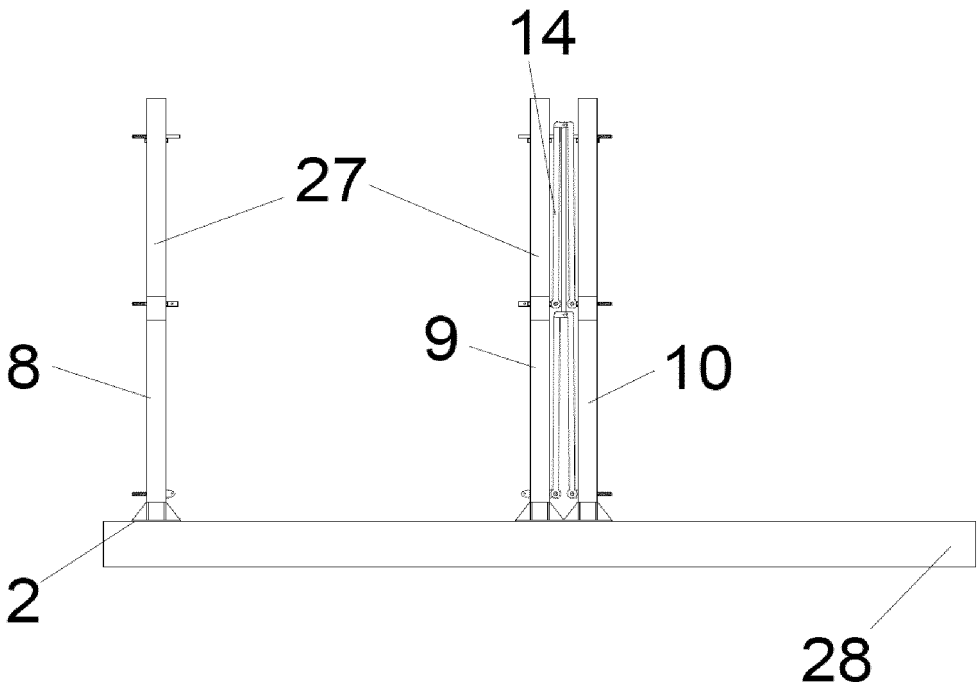


Figure 10



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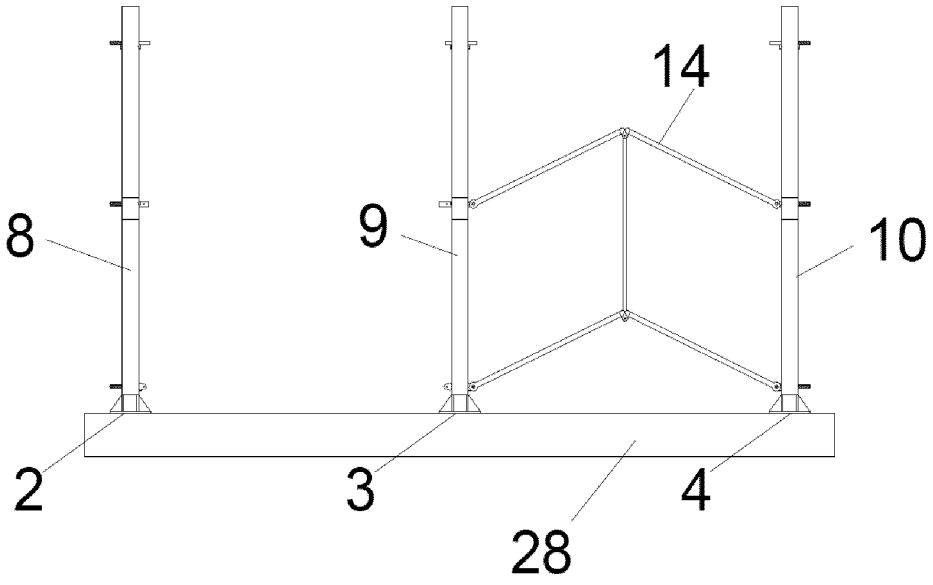


Figure 12

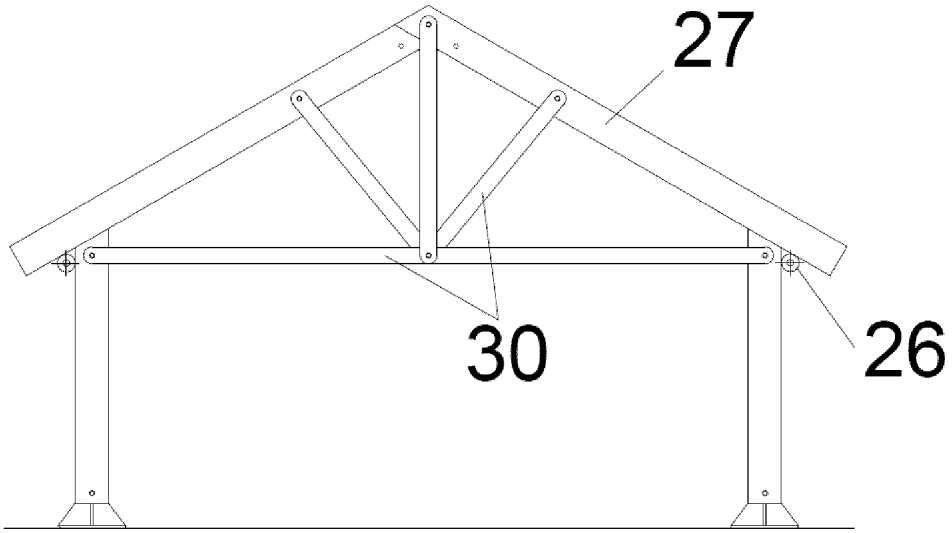


Figure 13

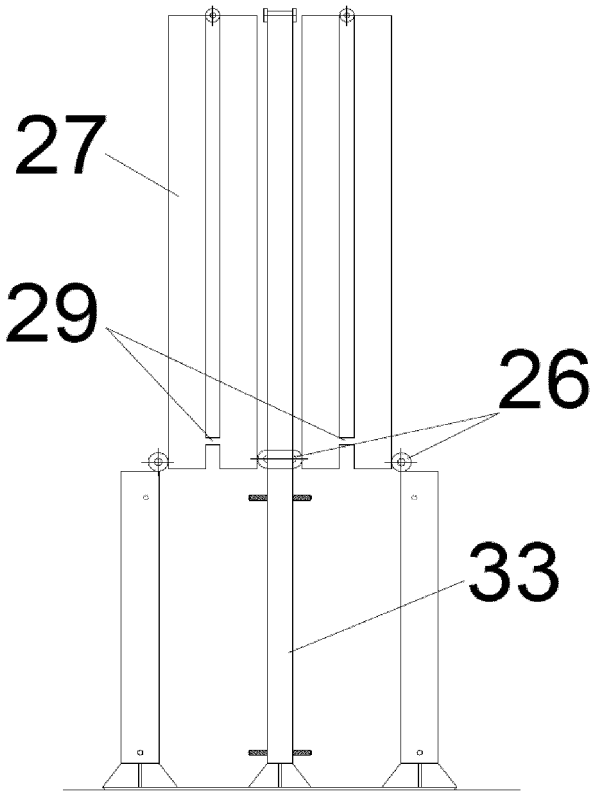
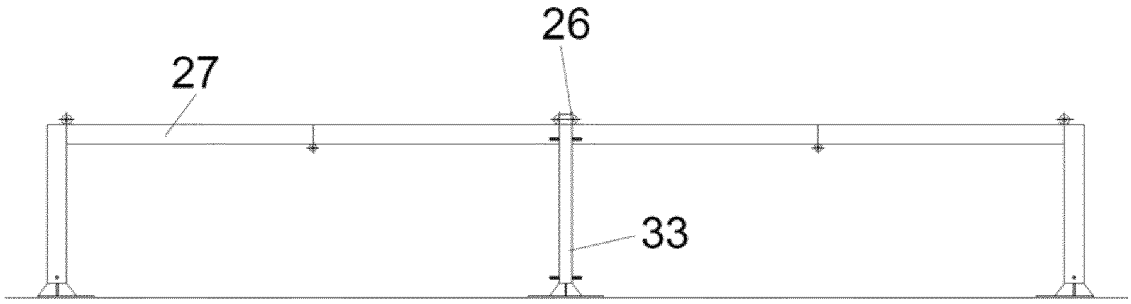


Figure 14



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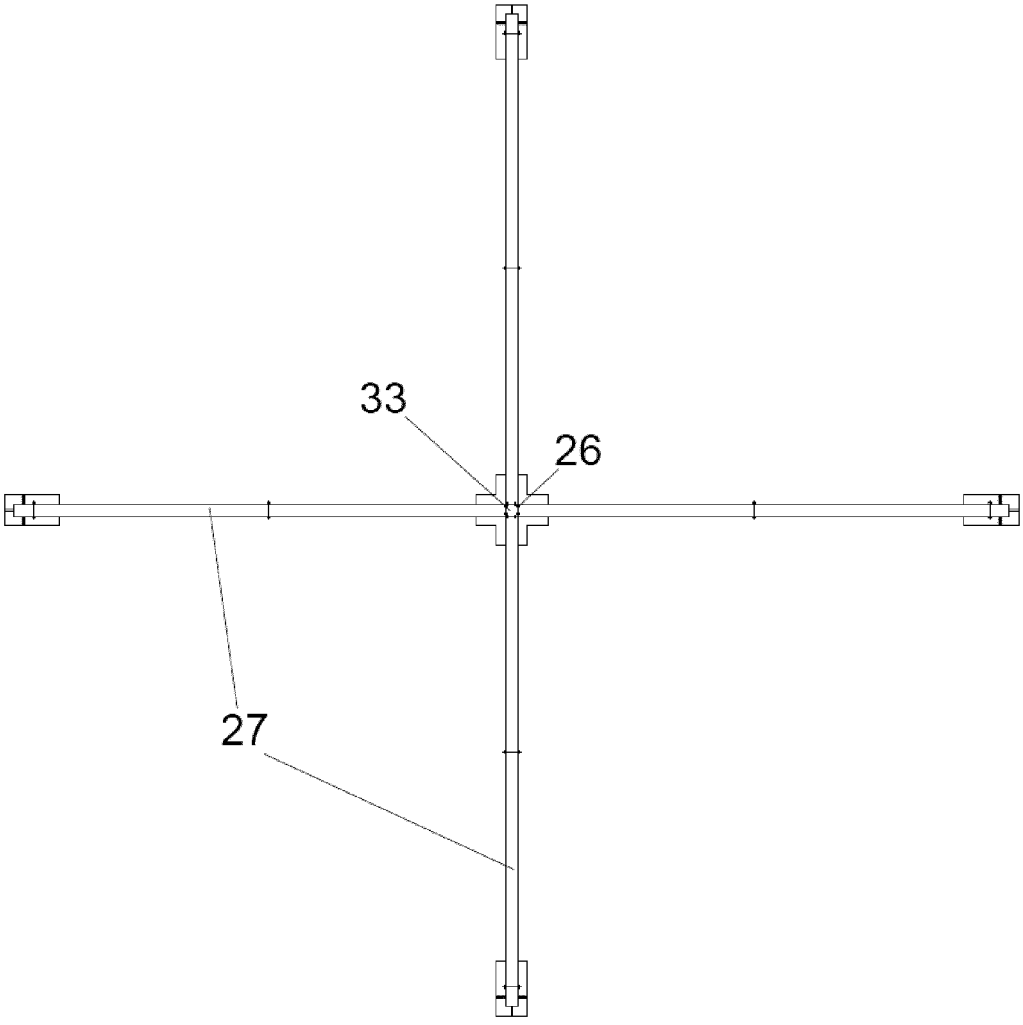

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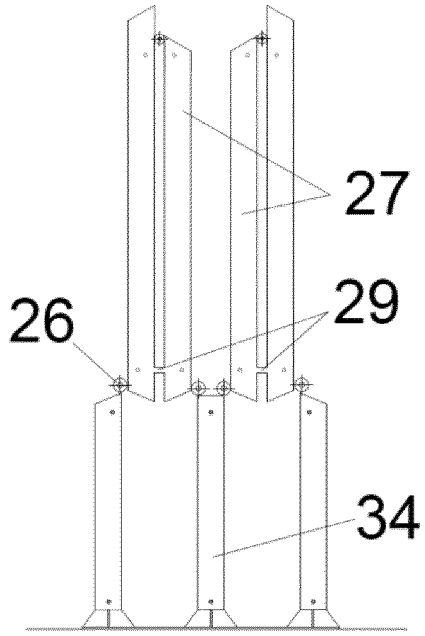

Figure 17

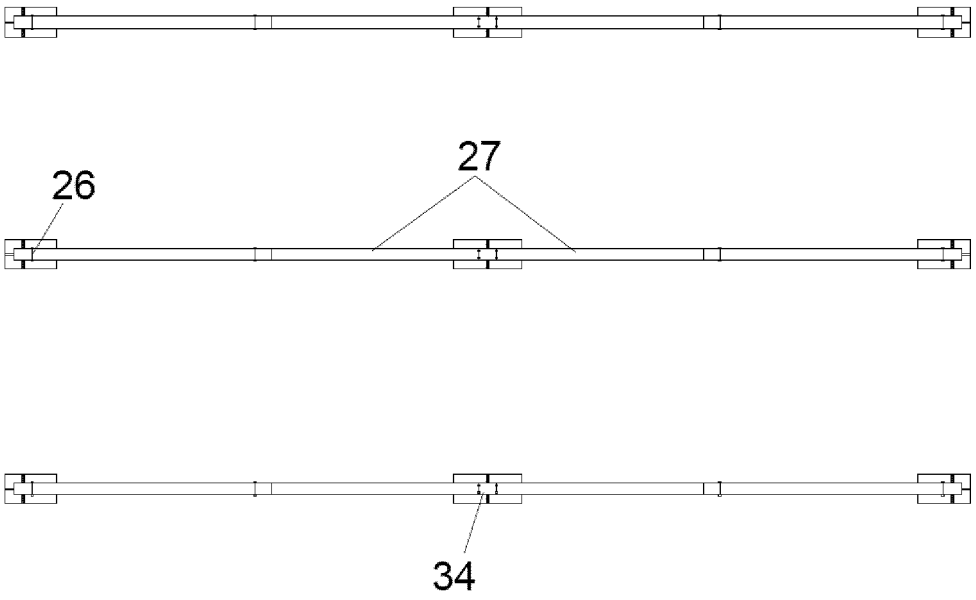

Figure 18

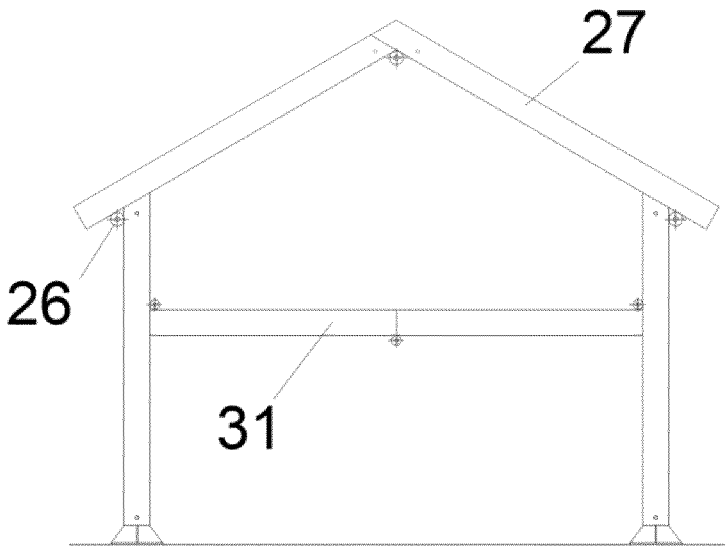

Figure 19

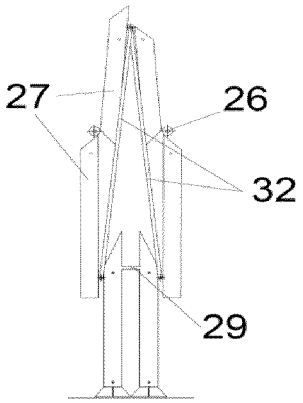

Figure 20

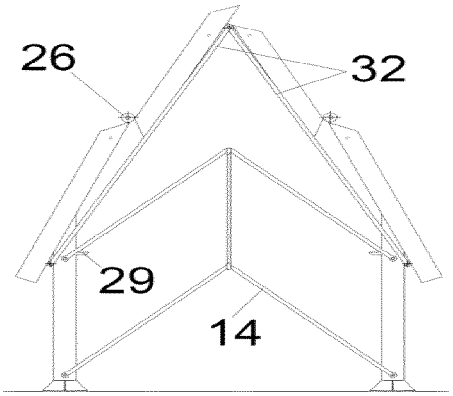

Figure 21

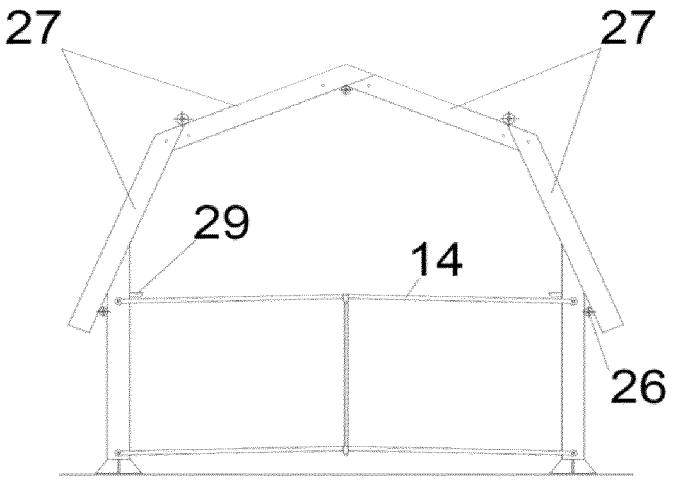

Figure 22

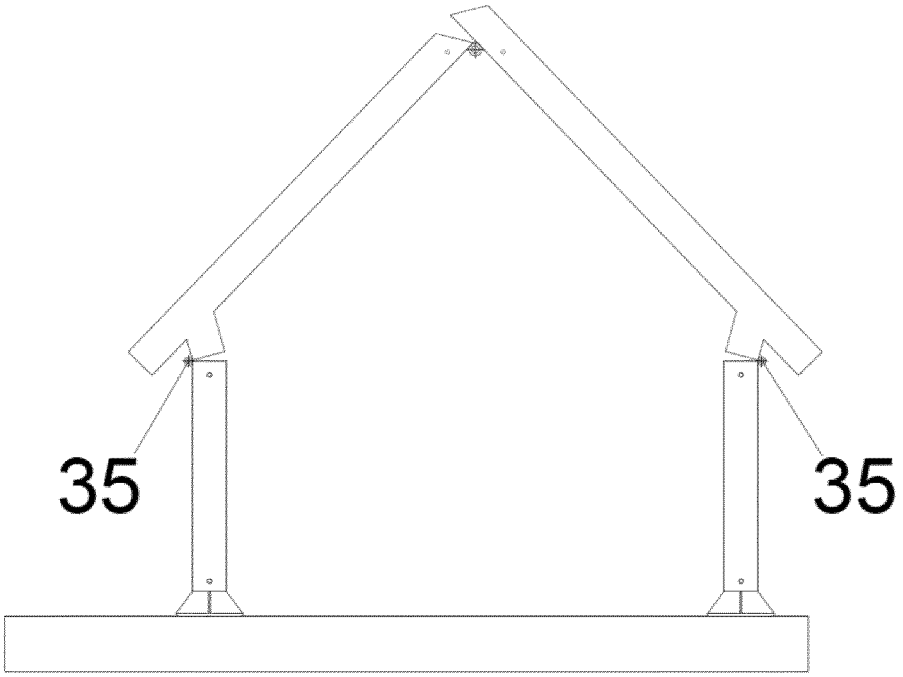

Figure 23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2015/070034

A. CLASSIFICATION OF SUBJECT MATTER

E04B1/344 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6499705 B1 (TSAI MING-LIANG) 31/12/2002, column 2, line 7 - column 3, line 34; figures.	1,2,4,5,9
A	US RE31641E E (DAVID.L. DERUS) 07/08/1984, column 3, line 19 - column 8, line 63; figures.	1,4,5,9
A	WO 8303860 A1 (MARTIN MARIETTA CORP) 10/11/1983, page 4, line 1 - page 10, line 15; figures.	1,2,4,5
A	JP H0559821 A (TAISEI CORP) 09/03/1993, Abstract from DataBase EPODOC. Retrieved from EPOQUE; AN JP-21992291-A	1,6

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

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Date of the actual completion of the international search	Date of mailing of the international search report
24/09/2015	**(25/09/2015)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer M. Hernández Agusti Telephone No. 91 3495553

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2015/070034

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