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(54) Hangar door and hangar provided with such a hangar door

(57) A hangar door comprising at least one door panel (21, 22) provided with a door cover, intended to be included movably in a wall of a hangar (1). The door panel (21, 22) comprises at least one door panel segment (30) in which at least a part of the cover has been mounted movably and can assume an opened state. Thus it is possible to release in an opened state of the door an opening in the door panel thus to control actively the influence of the door on the air streams around the door. A hangar (1) provided with such a door comprises a mainly linear guide (11, 14) in which the door panel (21, 22) has been mounted linearly displaceable.

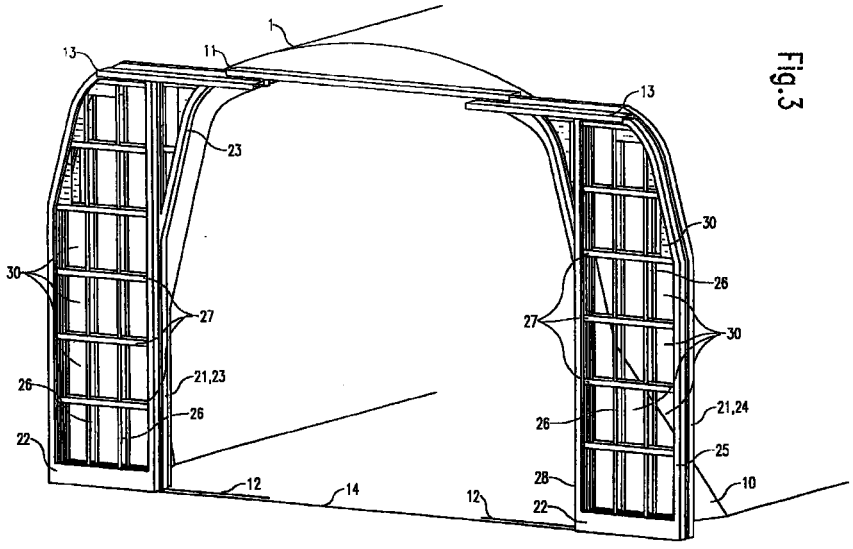

Fig.3

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Description

[0001] The present invention relates to a hangar door comprising at least a door panel provided with a door cover, intended to be taken up movably in a wall of a hangar, which door panel is able to close, in a first, closed position, at least a part of said wall and to release, in a second, opened position, at least in part an access opening to the hangar. The invention relates also to a hangar provided with a hangar door comprising at least one door panel provided with a door cover.

[0002] Although not exclusively the invention relates particularly to a hangar for the storage and manufacture of airships such as the renowned Zeppelin, named after count Ferdinand von Zeppelin who in 1900 as the first designed and built an airship retaining its form. At the outbreak of the first world war in 1914 many such airships were already built by him and the war itself gave an extra impulse for the building of such airships that were deployed for bombardments and reconnaissance flights. However, the development of airplanes for the aviation has made the further development of airships for an important part superfluous. Nevertheless a renewed demand seems to arise for airships and consequently for hangars in which these can be built and later stored.

[0003] An existing hangar for an airship is described in the journal Aeronautical Engineering Volume 54-22 at page 191 through 201. Here it concerns the manufacturing hall and storage shed of the Goodyear Zeppelin Corporation new to Akron, Ohio in the United States of America. This hangar comprises an elongated vaulted construction and is with a length of about 358 meter, a width of close to 100 meter and a height of about 64 meter at present the largest in its kind in the world. Except for the production of airships such a hangar also serves as storage when the airship is out of operation.

[0004] Concerning the sailing with an airship, bringing the airship into the hangar and bringing the airship out of the hangar is one of the most risky operations. Therefore it is of eminent importance that the hangar disturbs the normal wind velocities as little as possible so that the manoeuvring of or with the airship is not hampered further by transverse winds resulting from the building and the open standing doors. With the known hangar this has lead to a vaulted design, that has the form of a parabola in vertical cross section, and to a specially designed hangar door that is also parabolic in a vertical longitudinal section. The door comprises two door panels that can be best described according to the above article as a quarter of the peel of half an orange, which with the lower side of it is supported on a flat surface and of which the point at the upper side hinges about a vertical pin in the roof of the hangar. In closed state the door forms a spherical extension of the hangar that runs parabolically and is circular in a horizontal cross section. The door panels are at their lower side in a guide corresponding therewith in the form of a part of an arc of a circle. To open the hangar the door panels are turned away to the back about the hinge pin in the roof of the hangar to glide along a fixed part of the spherical extension.

[0005] The advantage of this known construction is that in closed as well as in opened state the hangar has no protruding parts so that wind currents are being disturbed as little as possible by it in both states of the door. Thus especially close to the door opening wind accelerations and turbulences are prevented by it. However, a drawback of the known construction is the relatively heavy and complicated construction of the special door panels. Additionally the spherical extensions at both ends of the hangar are not usable optimally for manufacturing of and maintenance to the airship. Namely, these activities take place for an important part using hoisting hooks and from platforms that are mounted on wheels to the hangar roof. These aids cannot run through the spherical extensions of the known hangar, because of which an appreciable part of the hangar cannot be utilized optimally.

[0006] With the present invention it is intended to provide doors and a hangar of the kind mentioned in the introduction, of which at least almost the complete surface is at least almost fully usable for manufacturing and maintenance activities, while in opened state the doors have no influence whatsoever on the normal air streams around the building.

[0007] To reach the intended goal a hangar door of the kind mentioned in the introduction of the invention has as characteristic that the door panel comprises at least one door panel segment in which at least a part of the cover is mounted movably and can take an opened state to release in the second position of the door panel an opening therein. If such a door in opened state results in an adverse disturbance of the air streams around said door panel segment, it offers the possibility to put open said door panel segment of the door panel thus to reduce the disturbance of the air streams around the building or to have these almost completely disappear. The last is especially the case in a preferred embodiment of the hangar door of the invention characterized in that the door panel comprises an arrangement of stands and rails that are mutually connected to a framework and that the framework includes a number of essentially rectangular door panel segments in which the cover is installed movably. Such a construction offers the possibility to build up the complete door panel from movable segments so that in opened state, apart from the framework, the door panel can be put open and restricts a possible disturbance of the air stream around the building to a minimum.

[0008] In a special embodiment the hangar door of the invention has as characteristic that at the position of the door panel segment the cover can be rolled up and is connected with the door panel on one end rotating around an axis. The door panel segment concerned can thereby be put open totally or partly by rolling up the

cover to a greater or lesser degree. A comparable possibility offers a further special embodiment of the hangar door of the invention that is characterized in that the cover at the position of the door panel segment can be folded up or slid in whether or not telescopically.

[0009] In a further special embodiment the hangar door of the invention is characterized in that the cover at the position of the door panel segment comprises a number of parallel strips that are each installed rotating around an own longitudinal axis. The strips can, if desired, either each separately be operated, or be coupled to joint operating means. Other than a rollable or linearly displaceable door panel segment these strips additionally offer the possibility to vary the angle under which the strips stand relative to a through going air stream, so that the air streams around the door can be controlled very meticulously.

[0010] The door segment on its own can be operated by hand, but according to the invention a further preferable embodiment of the hangar door has as feature that the cover at the place of the door panel segment is provided with mechanical operating means. The operating means can be for instance of a hydraulic or pneumatic kind or be driven directly via a motor. Therefore manpower is superfluous and everything can be controlled remotely and possibly fully automatically. This is particularly preferential if the door comprises a (large) number of movable door panel segments. To be able to fine tune as well as possible the influence of the door on the natural air streams around the door a further special embodiment of the hangar door has as characteristic that the door panel comprises a number of segments in which the cover has been installed movably and that the segments are operable independently of each other. By this independent operation more or less or only specific segments can be put open to create the most favourable wind conditions around the door.

[0011] If desired separate mechanical operating means can be coupled to the various segments that are being controlled from a central control unit to realise in this way an active air stream control around the hangar door, in which one can anticipate to changing weather conditions, and especially a changing wind situation, either by opening or closing specific door panel segments or by varying the degree of opening thereof. Through this the manoeuvring of an airship into and out of a hangar that is equipped with such a door the ideal wind situation for the hangar can be created at least approximately. Therefore the control unit can be coupled to the meteorological station of the hangar which is present in most cases.

[0012] According to the invention a hangar provided with a hangar door comprising at least one door panel provided with a door cover has as characteristic that a mainly linear guide of the hangar receives the door panel movable and can assume an opened state to release an opening in it in an opened state of the door panel. Other than with the known, previously described hangar the hangar of the invention comprises a linear door guide and ditto door panels. These can, with an equal door opening, be produced considerably lighter and less complicated than the curved door panels of the known hangar and are less sensitive to deformation under the influence of wind and temperature variations. Thanks to the invention an adverse influence on the aerodynamics of the hangar through the doors can be counteracted at least to an important extent by completely or partly putting open de opened door panels themselves.

[0013] In a preferential embodiment the hangar of the invention has as characteristic that the hangar door comprises an arrangement of at least a first and a second door panel, that the guide of the hangar receives the first door panel movably, that a primarily linear upper guide is mounted to the first door panel to movably receive therein the second door panel and that at least one of both door panels comprises at least one door panel segment in which at least a part of the door cover has been movably installed and can assume an opened state to release in an opened state of the door panel an opening therein. Because the first door panel thus forms an upper guide for the second door panel, an upper guide that, in closed state of the door, extends itself outside the hangar can be avoided, which contributes in an important way to the aesthetic content of the hangar as a whole.

[0014] In a further embodiment the hangar of the invention has as characteristic that the hangar has an oblong, vaulted form in a direction transverse to the hangar door, and that the door panels of the arrangement have an outer post that is mainly parallel to a similar part of an outer rim of the hangar. Such a vaulted form is clearly preferred from an aerodynamic viewpoint. By adapting the form of the door panels to the design of the hangar, not only a smaller size of the doors in opened state is reached, but in the same state also an aesthetically fine aspect is reached, in which the outer posts of the door panels harmonise with the outer rim of the hangar.

[0015] According to the invention a special embodiment of the hangar has therewith as characteristic that the first door panel of the arrangement has an inner post that runs mainly parallel to the similar part of an outer rim of the hangar. In an opened state of the door this inner post fits to the outer wall of the hangar, through which a gap or such thing will be avoided at the spot, which is advantageous not only from an aesthetical viewpoint but also for the aerodynamics.

[0016] A further special embodiment of the hangar of the invention has as characteristic that at least in an opened state of the door the second door panel is connected pivotally around a mainly vertical axis with the first door panel. This ability to pivot offers additional possibilities to control the air streams around the hangar. Just like the first door panel the second door panel can be carried out with one or more segments in which the

cover has been mounted movably, but a further embodiment of the hangar of the invention has as characteristic that the second door panel comprises at least almost completely a fixed cover and that the second door panel can be pivoted over an angle of at least about 90 degrees. By this ability to pivot of the second door panel the position thereof relative to the actual wind direction can be varied in order to be able to limit the influence on the air stream in that way. It is also possible to place the second door panel just in more or less degree transverse to the wind to offer in this way as much lee as possible for the door opening.

[0017] The invention will now be clarified using two working examples and an accompanying drawing. In the drawing:

figure 1 shows a working example of a hangar of the invention provided with a first embodiment of a hangar door of the invention in a first, closed state;
figures 2 and 3 show the hangar of figure 1 with the hangar door in a second, opened state; and
figure 4 shows the hangar of figure 1 provided with a second embodiment of a hangar door of the invention in an opened state.

The drawings are presented purely schematically and not to scale. Notably because of the clarity some dimensions have been drawn in exaggeration. As much as possible similar parts have been indicated in the figures with the same referral figure.

[0018] The hangar 1 of figure 1 has an oblong, vaulted form that is fully self-supporting. A cross-section of the hangar is at least approximately parabolic, which is beneficial not only from a constructive viewpoint but also from an aerodynamic viewpoint because a crosswind can be lead over it relatively gradually. The hangar is intended for manufacturing and maintenance of airships and also offers the possibility to store a ready airship in it as long as it is out of commission. At present the largest hangar of the world for this purpose has a length of about 358 meters, a width of close to 100 meters and a height of about 64 meters, in which the height is measured in the middle. An even substantially larger hangar is being built and will be ready still this year in Germany.

[0019] On at least one of both crosscut ends the hangar is provided with a hangar door 2, that here comprises two arrangements of two door panels 21, 22 each. A first door panel 21 of both arrangements has been taken up movably in a linear guide of the hangar 1. This guide is formed by an upper rail 11, that is mounted firmly to the crosscut end of the hangar 1 and in which the door panel 21 is supported predominantly sideways, together with an lower rail 12, that has been mounted in front of the hangar in the pavement, over which the door panel 21 can roll. The second door panel 22 of each arrangement in its turn runs in a similar guide in the form of an upper rail 13 to guide therein the door panel 22 on the upper side and a lower rail 14 over which the door panel 22 rolls at the lower side. The upper rail 13 is firmly mounted to the first door panel 21 and thus slides inwards and outwards together with the first door panel 21. In this way a separate upper guide for the second door part 22, that should extend itself outside the hangar in closed state of the door, can be avoided. Because an inner post 23 of the first door panels 21 runs inside mainly parallel to a similar part of the outer rim of the hangar, the second guide 13 can be mounted firmly with the first door panels 21 concerned about almost its entire length, which enables a solid construction.

[0020] Both door panels have an outer post 24, 25 that runs at least almost parallel to a similar part of the outer rim of the hangar. By this harmony of the door panels 21, 22 to the design of the hangar the hangar 1 has door parts that do not or hardly protrude. Both door panels are provided in a conventional way with wheels running in bearings, though not visible in the drawing. The door can open and close fully independently by a motor drive of the door panels.

[0021] Figure 2 depicts a hangar of figure 1 in a state in which the door 2 is opened completely. Thanks to the course of the inner post 23 of the first door part 21 the first door part 21 fits in this state closely to the outer circumference of the hangar at the inner side to thus avoid an opening in that place. The last is especially important from an aerodynamic viewpoint. Because both door panels additionally have an outer post 24, 25 that runs mainly parallel to the outer rim of the hangar the view of the hangar in opened state of the door is being mainly maintained, which is aesthetically nice, and is the operative cross section of the opened doors thus smaller than that of rectangular door panels of the same height, which benefits the aerodynamic properties.

[0022] Especially with a wind direction oblique to the crosscut side of the hangar the wind will be forced up to the open standing doors in such a way that with a small wind strength an airship will not be able any more to leave or enter the hangar safely. To avoid this the door panels 21, 22 of this working example comprise a support construction of a number of stands 26 and rails 27 that are mutually connected to form a framework and enclose therefore a large number of rectangular segments 30 in which the cover of the door panel has been mounted movably. Thus these segments 30 can assume an opened state to release in that way an opening in the door panel corresponding to them. This is shown in figure 3.

[0023] The door panel segments 30 comprise in this example a cover that can be rolled up and at the upper side of them can be rotated around a horizontal axis in the framework have been hanged up. The segments 30 can be operated by means of separate operation motors that have been mounted in or close to the respective segments, but have not been shown further

in the figure. For the cover that can be rolled up one can resort to commercially available rolling doors such as are used as full admission doors in buildings of considerably smaller size than the present hangar. By putting all or almost all segments 30 open such as has been shown in figure 3 a particularly airy construction arises that will not or hardly be an obstacle for local air streams. Therefore there will be no question of a forcing up with an oblique wind direction at the head of the hangar, as shown herein before. At all other wind directions the segments can be opened or closed at will to create a wind situation as favourable as possible for the door opening. Thus for instance the segments 30 can be fully closed with a wind that comes from behind thus to offer a certain lee for the door opening. The hangar door of the invention always offers the possibility, given a certain wind direction and strength, to create experimentally or not the most favourable situation for the door opening.

[0024] Instead of rolling doors also other types of doors can be applied with a displaceable door panel though, such as a hoisting door that can or cannot be slid in telescopically, a folding door or even a swing-up door. Also a construction can be applied that comprises per segment 30 a number of parallel strips, that are mounted to be turned around an own longitudinal axis and are or are not operable together. What is important is that the cover at the place of the segments 30 can be manipulated in such a way that at that place an airy door construction can or cannot be obtained that does not or hardly interfere with the natural air streams around the hangar or even influences them in a positive sense. Therewith the cover can be opened after the doors have been slid open, but it is also possible to put open the cover already before sliding the door panels away to reduce the wind load on the door panels from the outset.

[0025] To avoid that the wind streaming through the door panels 21, 22 is being forced up behind it against the crosscut side of the hangar 1, thus to annul partly the effect of the invention, the hangar 1 has close to its crosscut end on the lower side bevelled sides 10. These sides 10 continue inside up to about the position of the inner posts 23, 28 of the door panels 21, 22 in their fully opened position to give the wind behind door panels 21, 22 free reign.

[0026] Additional possibilities to influence in favourable sense the air streams around the hangar are being offered by a second embodiment of the hangar door of the invention that is shown in figure 4. This door construction is mainly comparable to that of the first working example, albeit that in this case the second door panel 22 is not only linearly movable, but also, at least in opened state, connected pivoting around a vertical axis 15 with the first door panel 21. In the state shown in figure 4 both door panels 22 are turned to the front about 90 degrees, but if desired the door panels 22 can also be set out over a lesser angle. Thus the position of the second door panels 22 can be tuned to the local wind direction to effect a wind situation as favourable as possible. Therewith a variable cover can be used in the second door panels 22, as in this example, so that a fine tuning is possible, but if desired one can also start from a fixed cover, with which the most ideal situation is being set purely by the pivoting of the door panel.

[0027] Although hereinabove the invention was clarified based on a number of specific working examples, it will be clear that the invention is in no way limited to the given examples. On the contrary there are for the expert in the field many variations, manifestations and application fields imaginable without going beyond the scope of the invention. Thus the invention can also be used with advantage with a hangar other that for an airship, whereby thanks to the invention the wind load on the door in the opened state can be drastically reduced, so that a lighter construction can be employed. Also the structure of the door construction can be realised otherwise and at the place of the segments a foldable or rollable cloth, provided or not with strengthening ribs, can be applied instead of a relatively firm, segmental roll door panel.

Claims

1. Hangar door comprising at least one door panel provided with a door cover, intended to be included movably in a wall of a hangar, which door panel can close off in a first, closed position at least a part of said wall and can at least partly release in a second, opened position an admission opening to the hangar, characterised in that the door panel comprises at least one door panel segment in which at least a part of the cover has been mounted movably and can assume an opened state to release in the second position of the door panel an opening therein.

2. Hangar door according to claim 1, characterised in that the door panel comprises an arrangement of stands and rails that are mutually connected to form a framework and that the framework includes a number of mainly rectangular door panel segments in which the cover has been mounted movably.

3. Hangar door according to claim 1 or 2, characterised in that at the position of the door panel segment the cover can be rolled up and is pivotally connected on one end with the door panel.

4. Hangar door according to claim 1 or 2, characterised in that at the position of the door panel segment the cover can be folded up or slid in whether or not telescopically.

5. Hangar door according to claim 1 or 2, characterised in that the cover at the position of the door

panel segment comprises a number of parallel strips that have been mounted each pivotally around an own longitudinal axis.

6. Hangar door according to one of the preceding claims, characterised in that the cover at the position of the door panel segment is provided with mechanical operating means.

7. Hangar door according to one of the preceding claims, characterised in that the door panel comprises a number of door panel segments in which the cover has been mounted movably and that the door panel segments can be operated independently from each other.

8. Hangar provided with a hangar door comprising at least one door panel provided with a door cover characterised in that a mainly linear guide of the hangar receives the door panel movably and that the door panel comprises at least one door panel segment in which at least a part of the door cover has been mounted movably and can assume an opened state to release in an opened position of the door panel an opening therein.

9. Hangar according to claim 8, characterised in that the hangar door comprises an arrangement of at least a first and a second door panel, that the guide of the hangar receives the first door panel movably, that a mainly linear upper guide has been mounted on the first door panel to receive therein the second door panel movably and that at least one of both door panels comprises at least one door panel segment in which at least a part of the door cover has been mounted movably and can assume an opened state to release in an opened position of the door panel an opening therein.

10. Hangar according to claim 9, characterised in that the hangar has an oblong, vaulted form in a direction transverse to the hangar door, and that the door panels of the arrangement have an outer post that runs mainly parallel to a similar part of an outer rim of the hangar.

11. Hangar according to claim 9 or 10, characterised in that the first door panel of the arrangement has an inner post that runs mainly parallel to a similar part of an outer rim of the hangar.

12. Hangar according to claims 9, 10 or 11, characterised in that the second door panel, at least in an opened position of the door, is connected pivotally around a mainly vertical axis with the first door panel.

13. Hangar according to claim 12, characterised in that the second door panel comprises at least almost completely a fixed cover and that the second door panel can be pivoted over an angle of at least about 90 degrees.

Fig. 1

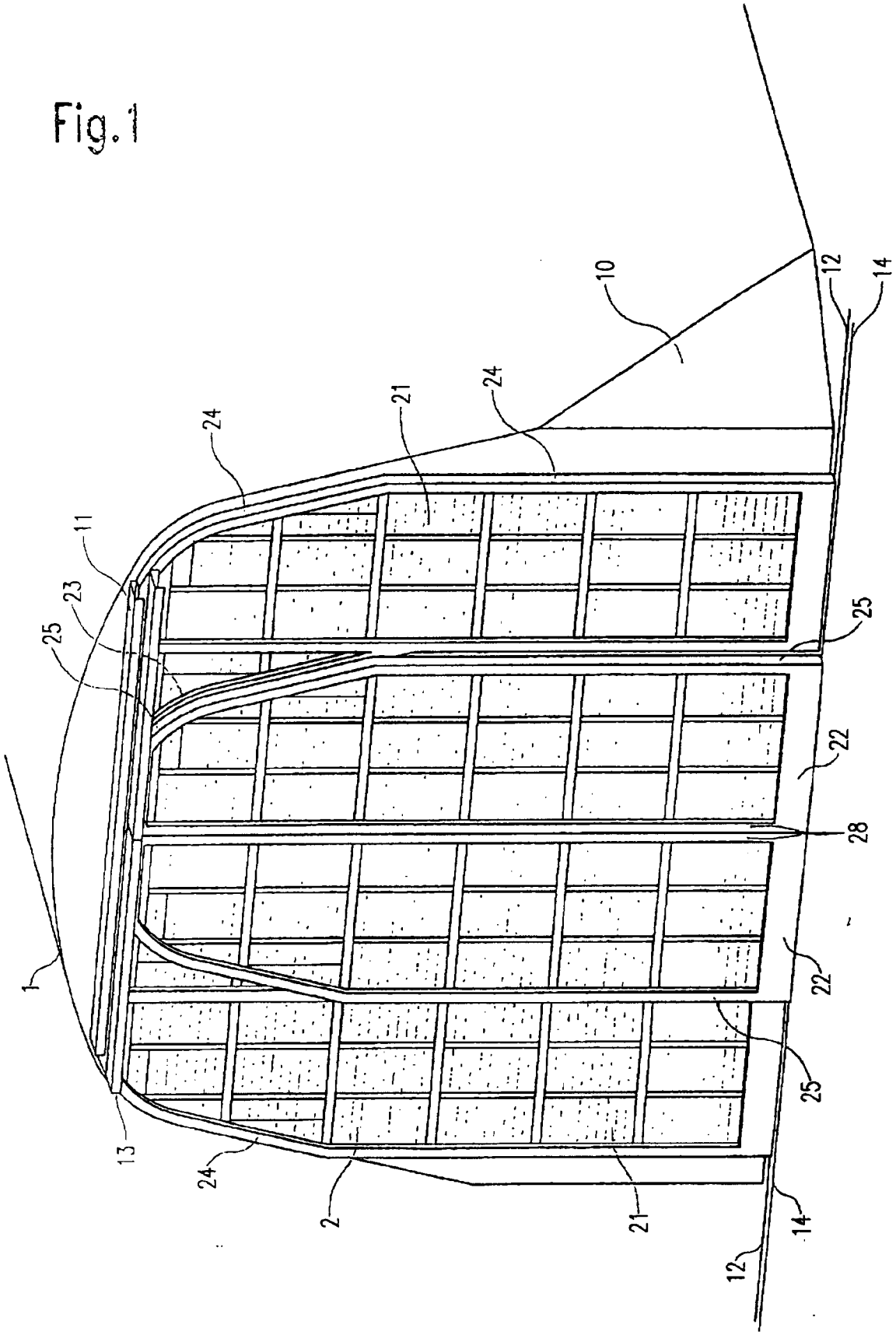

Fig.2

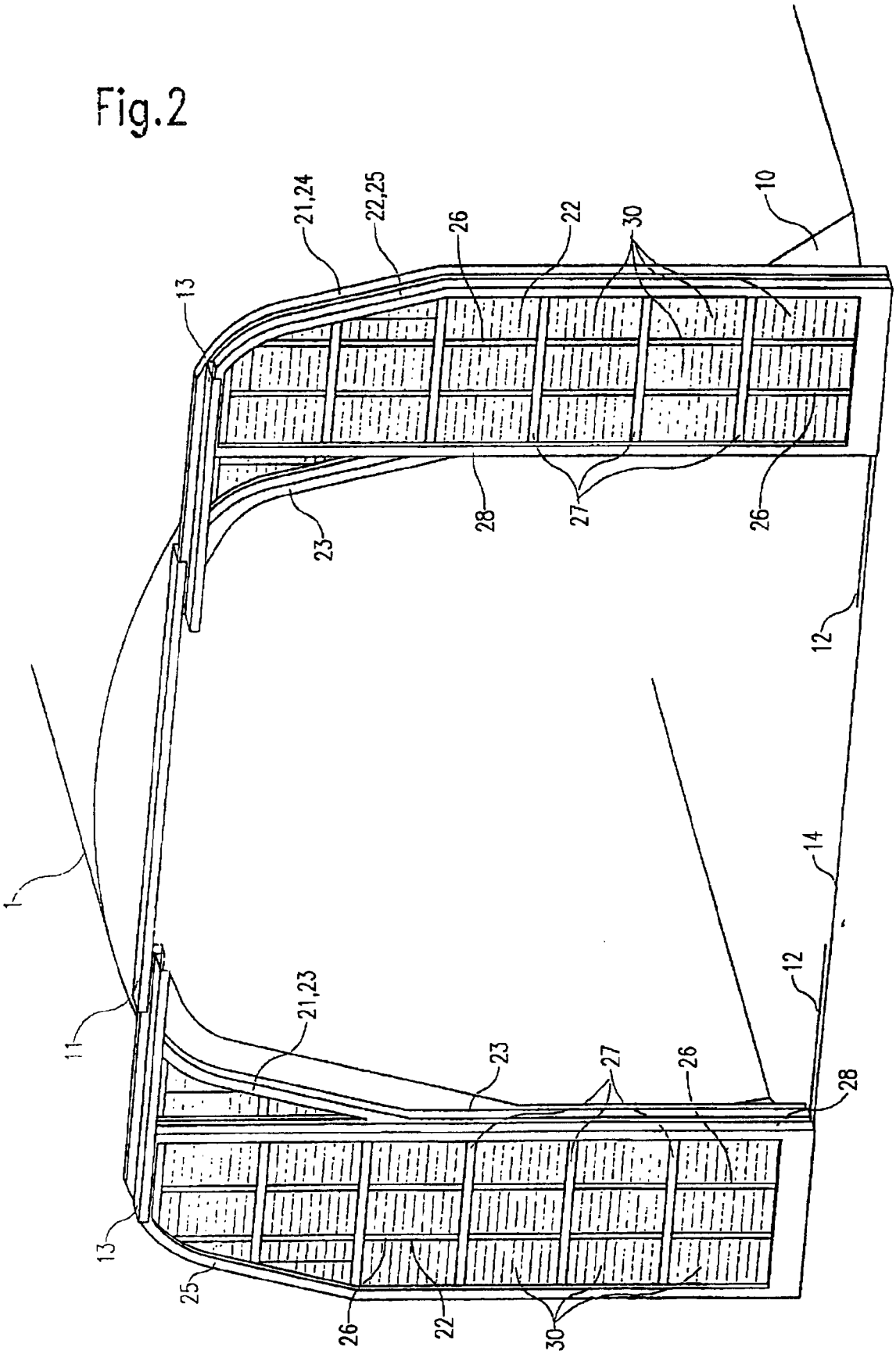
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Fig.3

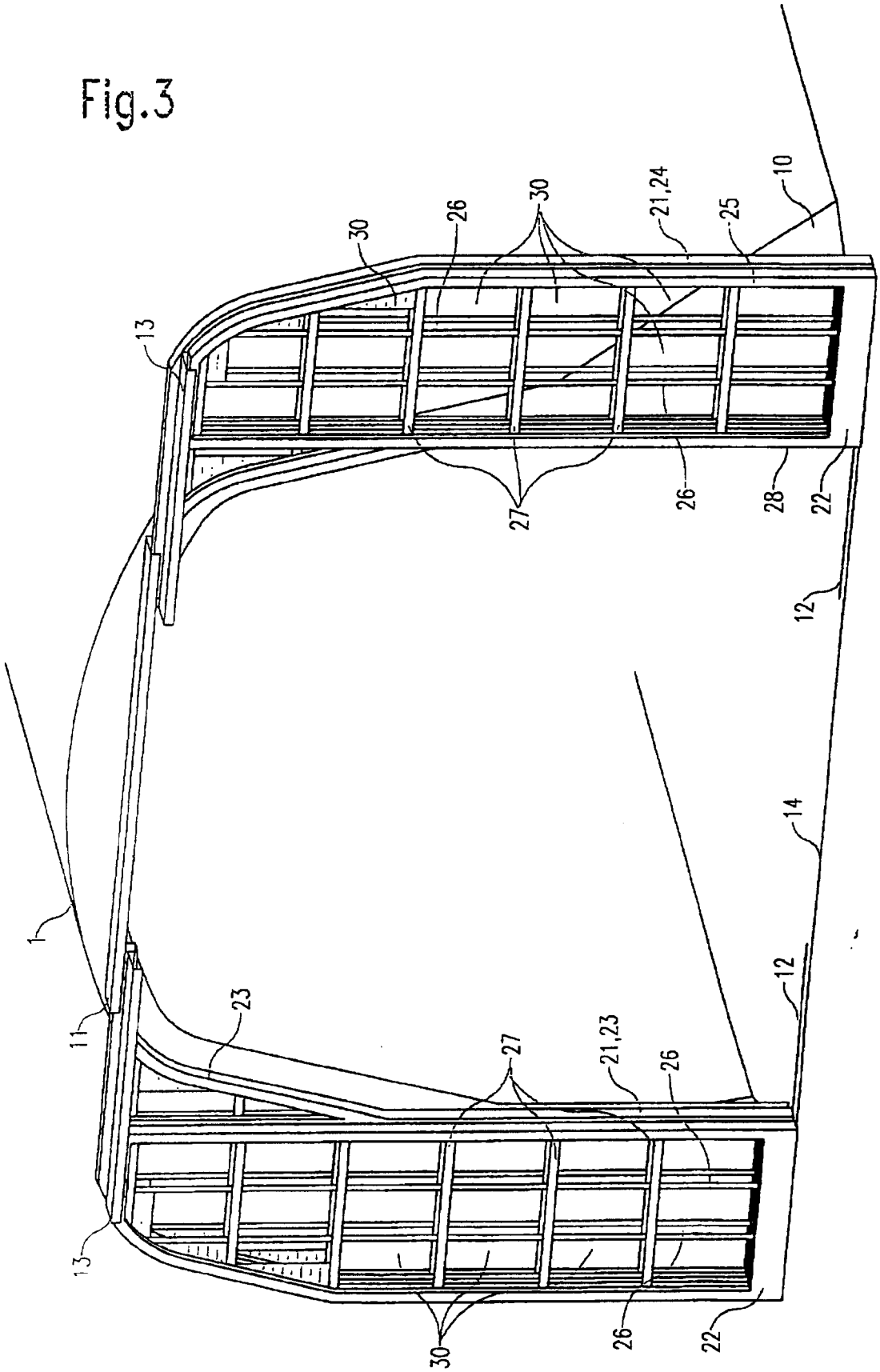
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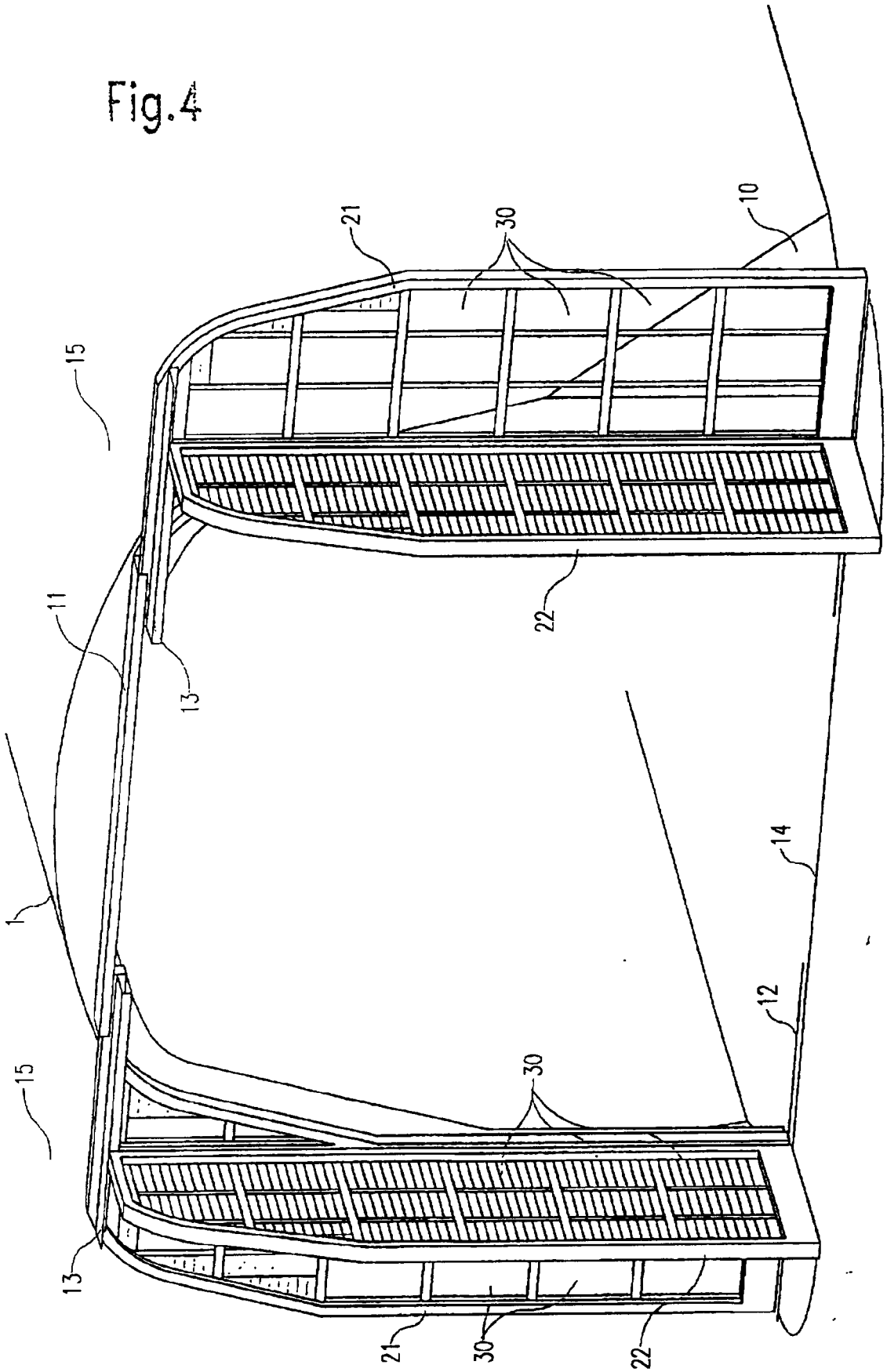
Fig.4



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EUROPEAN SEARCH REPORT

Application Number
EP 00 20 2006

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 300 332 C (BALLONHALLENBAU G.M.B.H.) 6 September 1917 (1917-09-06) * the whole document *	1,2,5-7	E06B3/01
A	FR 541 742 A (LUFTSCHIFFBAU ZEPPELIN) 1 August 1922 (1922-08-01) * the whole document *	8	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E06B
E04H
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 October 2000	Verdonck, B

CATEGORY OF CITED DOCUMENTS

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23-10-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 300332 C		NONE	
FR 541742 A	01-08-1922	NONE	

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