Aug. 14, 1934. J. I. BYRNE 1,970,222

DOOR

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Fig. 1.

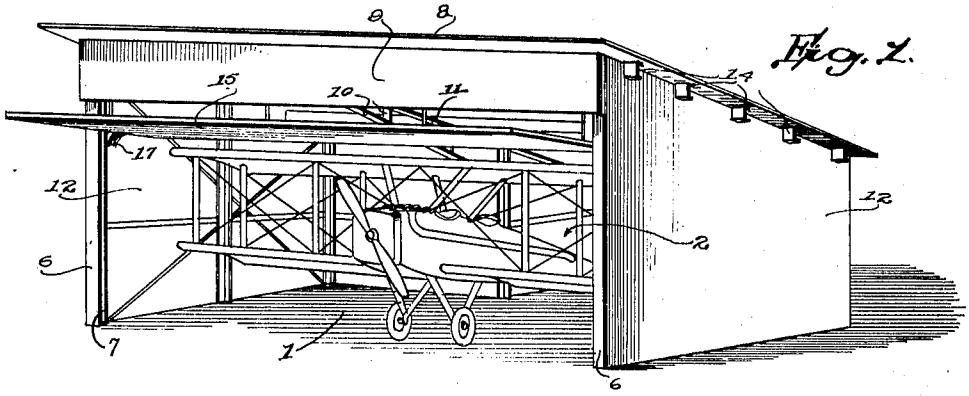

Fig. 2.

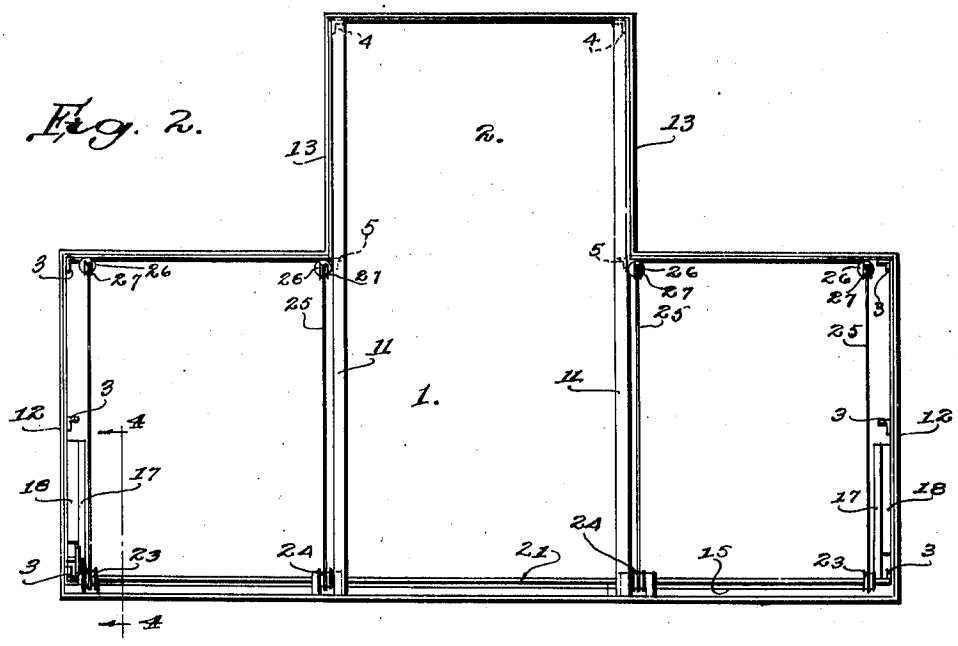

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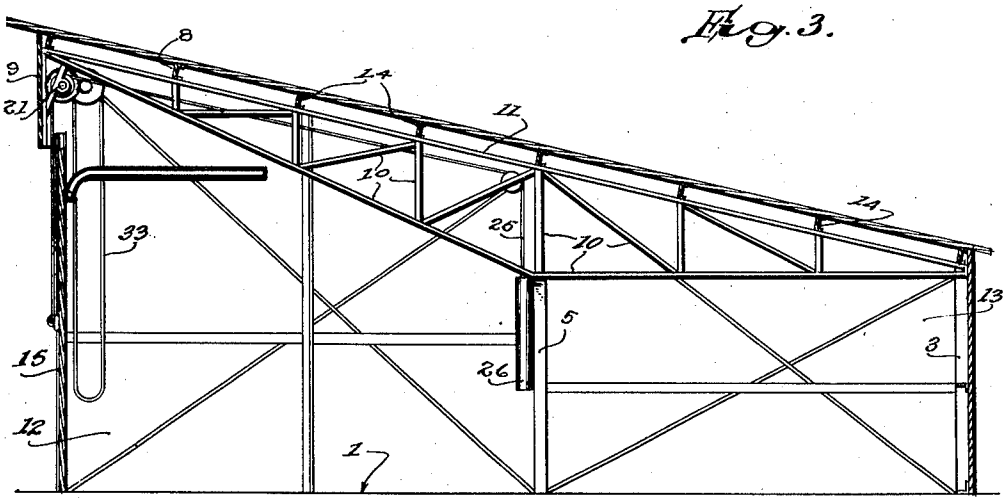
Fig. 3.



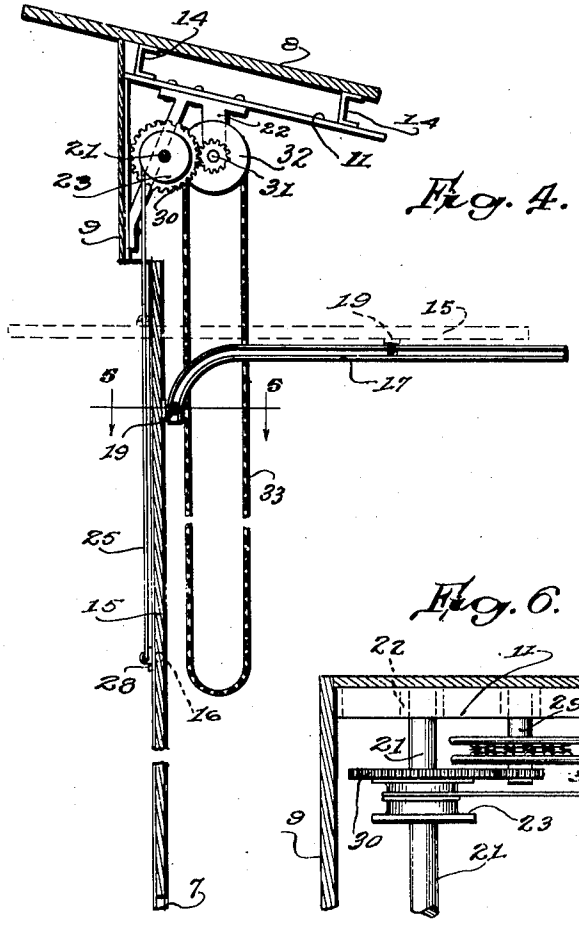


Fig. 4.

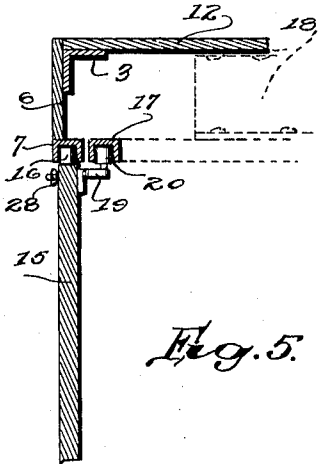


Fig. 5.

Fig. 6.

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1,970,222

DOOR

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Application February 3, 1928, Serial No. 251,614

8 Claims. (Cl. 20—19)

This invention relates to buildings having wide door openings such as airplane hangars, for example and is more particularly concerned with full width doors for such openings.

In buildings of this general type employing full or substantially full width door openings, the front wall and roof construction must be afforded adequate support and be properly braced, and if the full width of the door opening is to be utilized and maximum use made of the internal area of the building, doors of the vertical lift type must be employed.

An object of the present invention is the provision of a full or substantially full width or single unit door of the vertical lift type with means for applying uniformly distributed lifting pull permitting vertical lift of a full width door as a unit.

As a further object and feature of the invention, provision is made of means for guiding and supporting the lifted door to present in its opened position a portion projecting horizontally outward at the top of the door opening providing, in effect, a pent house affording shelter for the door opening.

These and other objects and features of the invention will be more clearly apparent from the following detailed specification when read in conjunction with the accompanying drawings forming part thereof and in which:

Figure 1 is a perspective view of a one plane hangar unit mounting a door constructed in accordance with the present invention, the door being shown as lifted to fully open position.

Figure 2 is a plan view of the hangar, the roof being removed to show the interior arrangement of the door operating mechanism.

Figure 3 is a transverse vertical section through the door and hangar shown in Figure 1.

Figure 4 is a fragmentary vertical section on an enlarged scale through the front end of the hangar with the door lowered, the section being taken on line 4—4 of Figure 2.

Figure 5 is a fragmentary horizontal section taken on line 5—5 of Figure 4.

Figure 6 is a fragmentary horizontal section taken near the roof line at a front corner of the building showing a portion of the door hoisting mechanism.

The building selected to illustrate the application of the present invention is of the one plane hangar type, the sides inclining upwardly toward the front to permit the use of roof trusses and provide ample clearance for the door closure when lifted and for the tail wing of the plane. In form, the building comprises a main rectangular front section 1 to house the plane wings and front fuselage and a central rearward section 2 to house the rear fuselage and tail. The sides of the main section 1 are outlined and braced by suitable columns which may be in the form of angle irons 3, the external covering being of any suitable material bolted or otherwise secured to the angle iron columns. The rear and front corners of the rearward extension 2 are similarly braced and outlined by columns such as the angle irons 4 at the rear and 5 at the front. These columns being utilized as presently appears as anchorage and fulcrum supports for roof trusses extending for the full depth of the building. The front of the building at its edges is provided with narrow vertical strips 6 of suitable building material, the inner edges of which are provided with channel guides 7 (Figure 5). The roof 8, which may be of any suitable building material, projects forwardly beyond the vertical line of the door guides 7 and is provided with a depending brow panel 9 edging the top of the door opening, the sides of which are outlined by the guide panels 7.

In hangar or similar storage buildings, it is necessary, owing to the large size required of the building and its cost, to economize in space and size of buildings as much as possible. It is, therefore, essential that the door opening of such a building extend for substantially the full width of the building. This requires that the roof be adequately supported intermediate of the sides of the building, since with an extremely wide door opening such as is found in hangars, the center of the spanning roof structure would tend to sag.

To this end, the front columns 5 at the front ends or corners of the rear extension 2 of the building are utilized as fulcrum supports and the rear columns 4 as anchorage supports for cantilever roof trusses 10 extending for the full depth of the building from the rear end of the extension 2 to the front end of the roof 8. The upper chord members 11 are joined to the side walls 12 of the main section 1, and the side walls 13 of the rear section 2 by means of superposed channel bars 14 (Figures 1 and 3) resting in the notched upper edges of the sides and supporting the roof 8. The upper flanges of these bars may offer means by which the roof may be conveniently fastened thereto. The cantilever trusses 10 which as stated are anchored at their rear ends to rear support columns 4 of the rear extension 2 of the building, and at points intermediate their ends substantially midway of the full depth of the building have fulcrum supports upon the upper ends of the front columns 5, extend forwardly of the building and

support the roof 8 at points intermediate its ends and equally spaced therefrom to uniformly distribute the supporting load. While dual trusses are shown and are preferable in a building of the type disclosed, it may be feasible under different conditions to reduce or may be necessary to increase the number of roof trusses, the principle of construction remaining the same in all cases.

The side covering of the building and the column may be suitably cross braced as indicated, the details of the building construction not entering into the present invention.

In connection with buildings having full width or substantially full width door openings of the type and character described, I have provided, in accordance with the present invention, novel and advantageous means of mounting and raising and lowering full width doors without interference with planes or other material stored within the building and with the door in open position and extending substantially horizontally and partially projecting beyond the front line of the building to form, in effect, a pent house protecting or sheltering the door opening.

The door 15 extends for the full width of the door opening and vertically from just below the brow panel 9 approximately to the ground line, is provided at its opposite end edges with guide rollers 16 (Figures 4–5) swiveled on roller studs carried by the edges of the door, these studs being positioned substantially midway between the upper and lower edges of the door and, as shown, below the middle line of the door at a point near the point of attachment of the hoisting cables which will be later referred to. Adjacent to the edges of the door (in its lowered or closed position) upwardly and rearwardly directed channel guides 17 are supported from the inner faces of the opposite sides 12 of the front section of the hangar or other building as by means of the channel plates 18 indicated in dotted lines in Figure 5. Brackets 19 attached to the inner face of the door at its opposite edges and adjacent to its upper edge as shown in Figure 4 carry studs mounting guide rollers 20 engaging in the guide channels 17.

Above and spanning the door opening and extending horizontally and positioned above the upper edge of the door 15 in its lowered position, is a hoisting shaft 21 which as shown in Figure 6 is journaled at its ends in suitable bearings 22 attached to the sides 12 in alinement with the shaft. Mounted on and rotating with the shaft are end cable drums 23 positioned in alinement substantially with the opposite sides edges of the door 15 and intermediate cable drums 24 which as shown, are substantially alined with the rear extension 2 of the building and are spaced approximately equi-distant from the ends to equally distribute the load. Advantageously the hoist shaft is afforded additional supports intermediate its ends through bearings engaging the shaft at opposite sides of each of the intermediate cable drums 24 as shown in Figure 2. The rear ends of the hoisting cables 25 (Figures 2 and 3) carry counter-weights 26 which as shown are suspended at the corners of the building out of the way, the cables extending upwardly from the weights over sheaves or pulleys 27 positioned adjacent to the roof line and thence forwardly over the drums 23 and 24 and downwardly over the outer face of the door 15 and through eyes in brackets 28 fastened to the front face of the door and positioned preferably below the middle line of the door, and in line with rollers 16 as previously stated. The position of the guide rollers 16 vertically of the door determines the extent to which the edge of the door will project forwardly beyond the building line and shelter the door opening as will be seen later. Preferably, as shown in Figure 3, these cables are attached at or near the vertical center of the door between its top and bottom edges to make the lifting force constant and to permit the use of a uniform counter weight.

The hoist or drum shaft 21 as previously stated is positioned substantially vertically above the upper edge of the door so that the cables 25 in the lowered portion of the door will extend vertically downward and form a line substantially tangential to the peripheries of the cable drums. At one side 12 of the building, a counter-shaft 29 is mounted adjacent to the end of the hoist shaft 21 with its outer end substantially in line with a large gear 30 fixed on the hoist shaft 21 and meshing with a small gear 31 keyed or otherwise fixed to the counter-shaft 29. The latter adjacent to its gear 31 is, as shown in Figure 6, provided with means for effecting door raising and lowering rotation of the hoist shaft 21 in the form of a chain sprocket wheel 32 looped by a depending hand hoist chain 33.

By pulling downwardly on one side of the hoist chain 33, the hoist shaft 21 is rotated in a direction to pull upwardly upon the door attached ends of the cables 25, the counter-weights 26 lowering and facilitating this operation. As the door is thus lifted upwardly by pull applied, as shown, at four distributed points through the four lines of cable 25, its upper end carrying the guide rollers 20 will tilt inwardly or rearwardly by reason of the curvature of the guide channel bars 17 at the opposite sides of the door opening and as the upward movement continues, the door will swing upwardly and rearwardly in an arc, until the door is positioned to extend substantially horizontally and the cable attached brackets 28 reach a point slightly below the lower edge of the brow panel 9 edging the door opening. In this position, further upward movement of the outer end of the door beyond the horizontal is unnecessary for full door opening and any appreciable movement beyond this point, is prevented by the counter-weights and would be opposed by the edge of the brow panel 9 of the door casing. Reverse movement of the hoist chain 33 will obviously have the opposite effect and permit the door which is supported in raised position by the counter-weights to drop down to closed position through a reverse swinging path. The edges of the door are maintained in their proper relation to the door casing in the channel guides 7 and 17 and the intermediate portion of the door is given adequate support against sagging through the intermediate cables 25 and their counter-weights. Such an operating construction therefore enables an extremely wide door to be lifted as a unitary structure to permit the full width of the door opening to be utilized. It is particularly advantageous in connection with hangar structures and forms a structure which is particularly and most advantageously combined in a hangar building of the "hat-box" type formed by a main front section 1 and a rearward extension 2 shaped to house the broad outline of an airplane. Obviously, the number of points at which vertical lifting force is applied to the door may be varied and where the width of the door opening is extreme, upward lifting pull may be

applied at more than the four distributed points herein shown and described.

While in the foregoing, I have disclosed and described specific structural embodiments of the invention, these are intended as illustrative rather than restrictive thereof and it is contemplated that various structural modifications and adaptations may be made in consonance with the spirit of the invention and the scope of the appended claims.

What I claim therefore and desire to secure by Letters Patent is:

1. In combination with a wide unitary door structure mounted for bodily vertical movement and for tilting movement about a horizontal axis, means for applying upward lifting pull thereto at a series of transversely spaced points between its opposite side edges, and means effecting tilting movement of said door structure about its horizontal axis coincidently with upward lifting movement of the door structure.

2. In combination with a wide unitary door structure mounted for bodily vertical movement and for tilting movement about a horizontal axis between its upper and lower edges, means for applying upward lifting pull thereto between its upper and lower edges at a series of transversely spaced points between its opposite side edges, and means for guiding said door structure when upwardly lifted, to so effect tilting movement thereof about its said horizontal axis coincidently with bodily vertical movement thereof that the lower end of the door moves outwardly from the building.

3. In combination with a wide unitary door structure mounted for bodily vertical movement and for tilting movement about a horizontal axis, a rotatable hoisting shaft supported above the top of the door, a series of hoisting cables carried thereby in longitudinally spaced relation extending downwardly to and connected to said door at a series of transversely spaced points at and between its opposite side edges, means for rotating said shaft to apply upward lifting pull to said door structure through said cables, and means for guiding the upper end of said door structure when upwardly lifted to effect tilting movement thereof about its horizontal axis.

4. In a building having a relatively wide door opening, a unitary door for closing the opening, said door being mounted for bodily upward and rearward tilting movement to open position, door counterweighting means, flexible linear members connected to said door and counterweighting means and transmitting substantially the full force exerted by said counterweighting means to said door, said linear members comprising end and intermediate linear members extending substantially vertically in front of the rear face of said door when closed and connected to said door when closed at substantially aligned points located substantial distances from its upper and lower edges.

5. In combination with a relatively wide door member mounted to move vertically and tilt about a horizontal axis with its upper edge movable rearwardly, substantially axially aligned pivots spaced a substantial distance from its upper edge, means for opening said door member comprising end and intermediate flexible linear members spaced from and connected to said door at substantially aligned points between its side edges and in front of its rear face and a substantial distance above its lower edge, and counterweighting means for said door member connected to said linear members.

6. In combination with a door member adapted to move bodily upwardly and tilt about a horizontal axis with its upper edge movable rearwardly, substantially axially aligned pivots spaced a substantial distance from its upper edge, end and intermediate flexible linear members connected to said door member at substantially aligned spaced points between its side edges and a substantial distance above its lower edge, and counterweighting means opposed directly to the weight of said door member through said linear members.

7. In combination with a relatively wide door member mounted for substantially vertical and tilting bodily movement, means at the side edges of said door member for guiding said door member upwardly during its opening, means connected to the upper portion of said door member for guiding said door member rearwardly during its movement, and means for opening said door member comprising end and intermediate flexible linear members connected to said door member at substantially aligned points spaced transversely thereof at a substantial distance above the lower edge thereof and near the line connecting said first mentioned guiding means.

8. The combination of a relatively wide door member movable bodily upwardly and rearwardly to open position, members upon said door member at its side edges and approximately midway between its upper and lower edges for guiding said door member upwardly to open position, end and intermediate flexible linear members spaced transversely of and connected to said door member between its upper and lower edges near the line of said guiding members, and counterweighting means for said door member connected to said linear members.

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