Oct. 4, 1927. 1,644,285

A. B. F. SMITH

DOOR FOR AIRSHIP SHEDS, AEROPLANE HANGARS, AND THE LIKE

Filed March 6, 1924 3 Sheets-Sheet 1

Fig. 1.

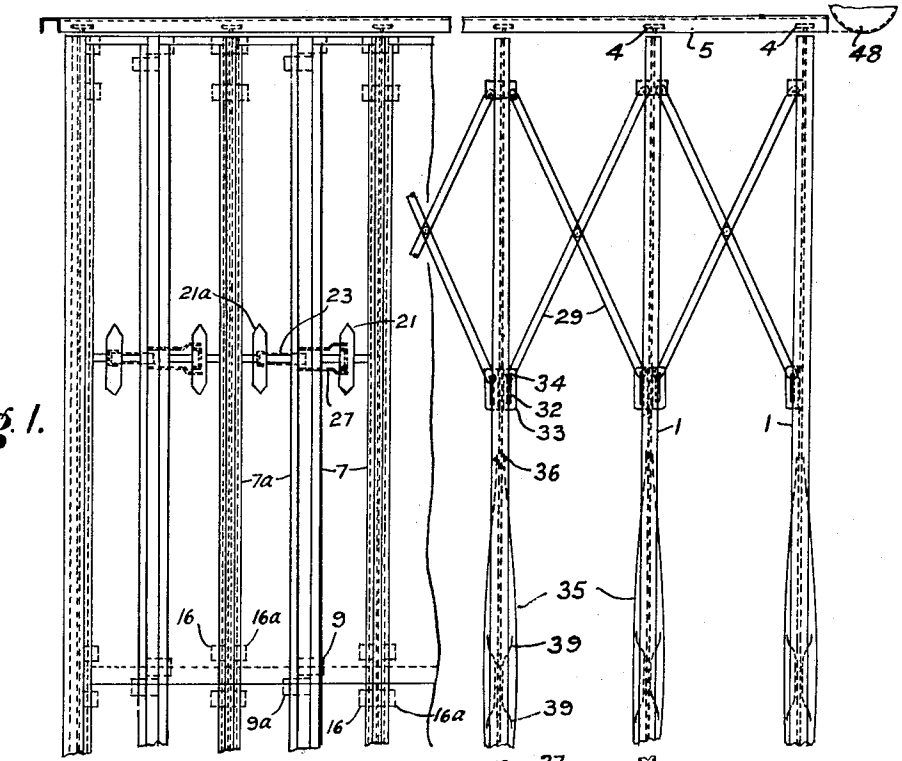
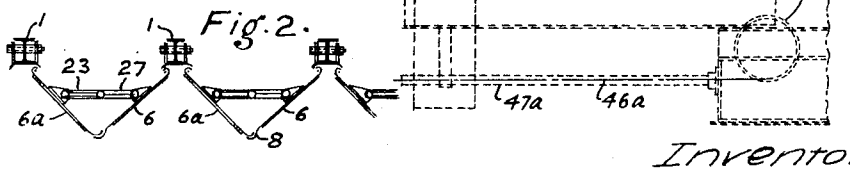


Fig. 2.



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DOOR FOR AIRSHIP SHEDS, AEROPLANE HANGARS, AND THE LIKE

Filed March 6, 1924 3 Sheets-Sheet 2

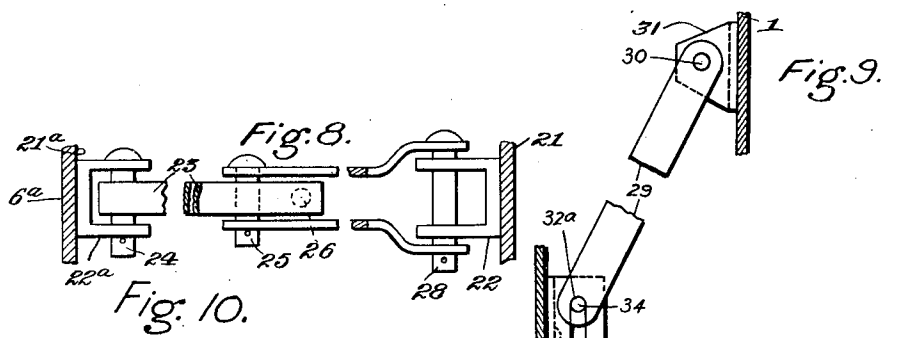


Fig. 8.

Fig. 9.

Fig. 10.

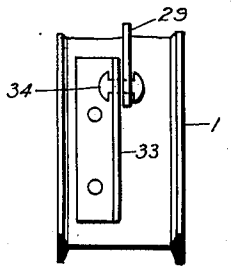


Fig. 11.

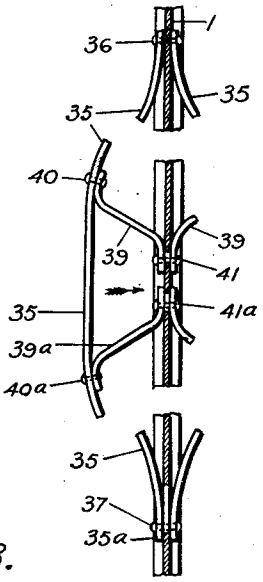


Fig. 12.

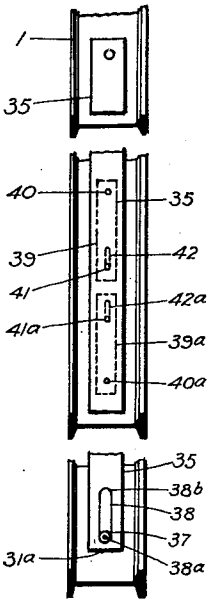
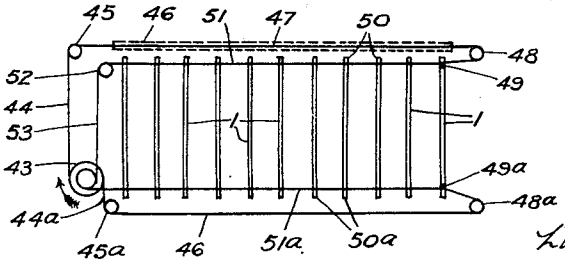


Fig. 13.



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DOOR FOR AIRSHIP SHEDS, AEROPLANE HANGARS, AND THE LIKE

Filed March 6, 1924 3 Sheets-Sheet 3

Fig. 3.

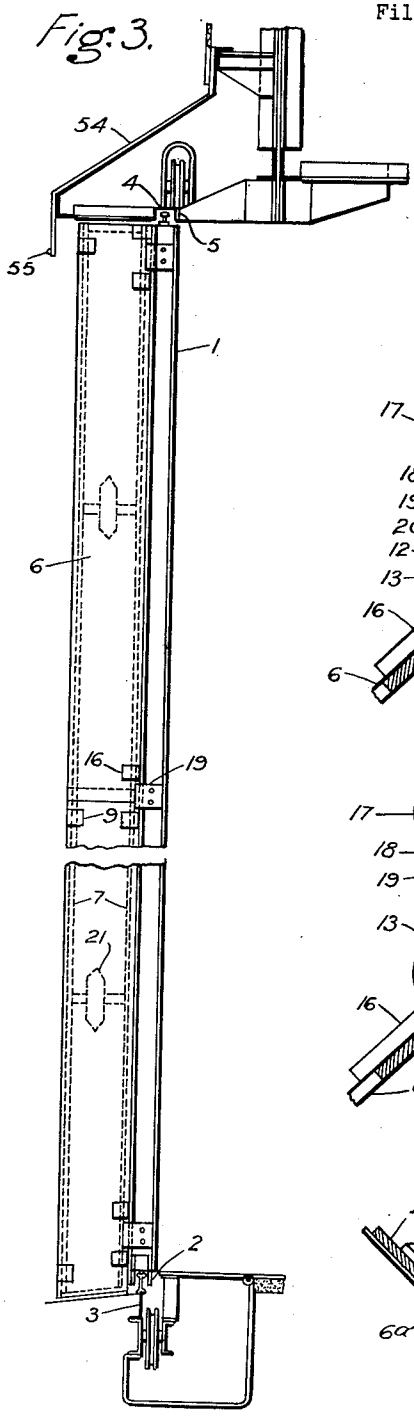


Fig. 4.

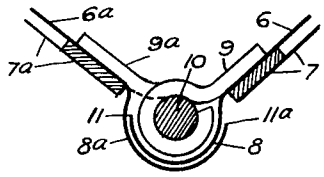


Fig. 5.

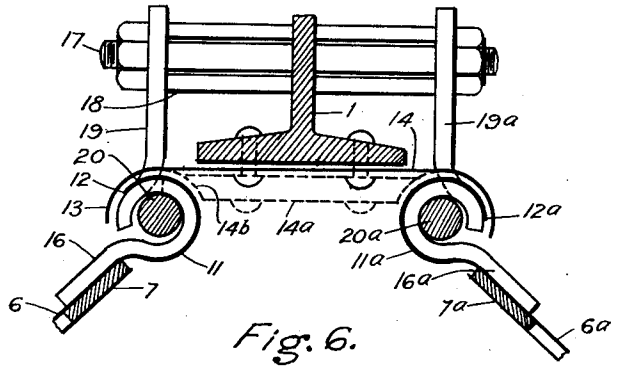


Fig. 6.

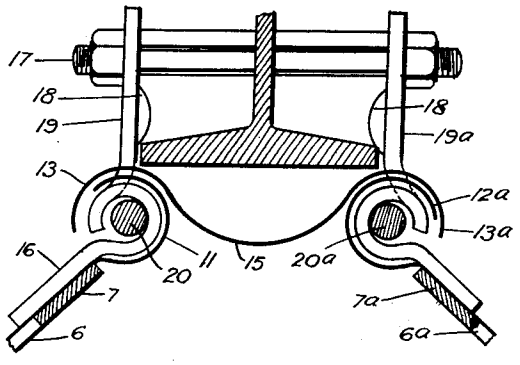
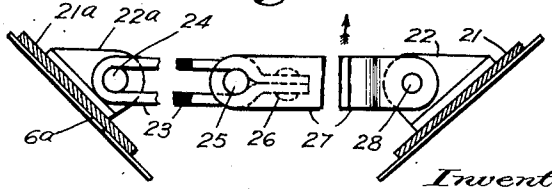


Fig. 7.



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Patented Oct. 4, 1927. 1,644,285

UNITED STATES PATENT OFFICE.

ARCHIBALD BERRIDGE FRANKLIN SMITH, OF CALCUTTA, BRITISH INDIA.

DOOR FOR AIRSHIP SHEDS, AEROPLANE HANGARS, AND THE LIKE.

Application filed March 6, 1924, Serial No. 697,372, and in British India January 11, 1924.

The invention relates to doors for airship sheds, aeroplane hangars or the like. By the expression "or the like" is meant structures like garages, cinema studios, movable partitions, core oven doors, and indeed any wide aperture which it is desired to open or close; but more particularly openings of large size exposed on one side to the weather.

For aerodromes, aeroplane hangars and the like it is necessary to have very wide and sometimes very large or lofty openings which must open to allow the airship or aeroplane to get in or out, but which it is advisable should be wind and weather-proof when closed. Heretofore it has been usual to make the doors in a series of panels or leaves each sliding in its own runway. With a wide opening in order to keep the individual leaves or panels within manageable dimensions it has been necessary to use a large number of such leaves, which has accordingly necessitated a large number of runways—and as each runway and door leaf may overall be from four to six inches wide this has necessitated a wide projecting canopy to cover all the leaves. It also needs a large staff of workmen to open or close the door quickly.

Doors have been proposed for aerodromes or the like in which a series of vertical members are adapted to slide in runways at their upper and lower ends, and a pair of solid panels are used between every two vertical members, said panels being hinged together with the outer edges of each panel of each pair hinged to the adjacent vertical members. In opening and closing these doors have a concertina action, that is to say in opening the two panels of each pair close up together and in closing the doors they may open out until the angle between the said panels is a right angle or an obtuse one. It it is in respect to doors of the kind last described that this invention relates.

In doors of this kind heretofore used the panels have been relatively wide—in some cases six or eight feet—so that when the door is closed the vertical members are spaced, say, eight to twelve feet apart. This makes the construction, particularly when applied to a lofty door of an aerodrome, very heavy, and this in turn necessitates the employment of a large staff of men to open or close the door, as not only has each pair of panels to be closed up but all the series of panel pairs connected to each other at the vertical members have to be pushed along the groove. In practice this requires sufficient men to be simultaneously stationed at each pair of panels, or at each vertical member, to collapse the pair of panels and to push that part of the door along its groove.

Again, aerodromes and the like are often built in very exposed situations and the projecting panels particularly in their collapsed condition project outwards nearly the full width of one panel—and this projecting part must be covered by a canopy. A large projecting canopy increases the cost and adds to the constructional difficulties owing to the increased wind resistance offered thereby. Further, the weights of each of the pairs of panels is hung from the vertical members as cantilevers—because the outer projecting hinge between the pairs of panels is usually not supported, and this brings a considerable side strain on the vertical members. The bending moment caused thereby increases about as the square of the width of the panel, and hence wide projecting panels are at a disadvantage. In an exposed situation the wind pressure on a door may be very high and this is transferred to the vertical members.

As heretofore constructed doors of aerodromes of the kind described, as far as the applicant is aware, have had their panels hinged together or to the vertical members by hinges of ordinary types and a crack or opening has existed throughout the length of each contacting edge through which the wind and the rain may drive.

Lastly, as at present constructed the vertical members generally rely for lateral stiffness on the panels to which they are attached. A horizontal tie may have been introduced between the vertical members, but one difficulty has been to prevent these vertical members from departing from their truly vertical position owing to a twisting of the projecting panels attached thereto, which twisting may cause the vertical members to depart considerably from their vertical position and such movements make it more difficult to open and close the doors. A lofty man-handled door is at a grave disadvantage in this respect as obviously the closing forces can only be applied at about three to five feet from the ground which is not conducive to easy or regular movement of a door which may be thirty or more feet in height.

The objects of this invention are to provide improvements in or relating to doors of the kind described and a combination of said improvements which will constitute an improved door having amongst other features the following advantages:—

A considerable reduction in the cost of manufacture. This is partially effected by having the major parts of panels made of a single thickness of pressed metal sheets and the minor parts of vertical members of standard rolled or built up sections. Assistance, however, is given by keeping the width of each panel down to very conservative limits—say 2′ 6″ or 3′ 0″, whereby the side strain on the vertical members, the proportion of weight or wind pressure carried by each pair of panels and the width of projection of the canopy are all reduced.

The panels are thus rotatably mounted members having no great thickness since they are built up generally of a single thickness of metal sheeting on a light framework, the sheets being given the required amount of stiffness by having their lateral vertical edges beaded or corrugated in a manner hereinafter to be described. The vertical members on the other hand, are made of sufficient depth and width to have a relatively large amount of stiffness or rigidity.

A reduction in the cost of erection by using lighter sections and a smaller canopy.

A great reduction in the cost, labour and time required to open and close the door—and an evenness in the application of the opening and closing forces which not only will lead to less energy being required, but also influence the weight and cost of the structure by eliminating unnecessary friction, distortion and jamming of the parts and thus tend to reduce impact, strain, stress and wear of the whole.

A great increase in the speed of opening. According to this invention the opening may be effected by a few men working a winch or the like, or by a suitable motor, and the crowd of men needed for the work as ordinarily used no longer be required.

A more effective construction for distributing the wind pressure forces to the structure.

A manner of construction whereby the joints between the various panels, or panels and vertical members, are made practically wind- and weather-tight. This construction also is of great advantage in preventing the spread of fire as cracks, crevices and open interstices through which flames may pass are reduced in number or largely eliminated.

With the above and other objects in view the invention consists of a door of the kind described for an airship shed, aeroplane hangar or the like comprising a multiplicity of relatively rigid vertical members capable of moving in upper and lower guides, runways or the like, and having and supporting two narrow panels between each pair of vertical members, characterized by their being a curved overlapping knuckle connection forming a contacting part between each pair of panels and extending substantially the full depth of the panels to form a beading or corrugation along the contacting edges of the panels adapted to strengthen the same and to provide a weatherproof overlapping joint therebetween.

This knuckle connection will be made by the sheeting or plating of the panels, or by parts fitted thereto, being curved round to engage each other, and, in all positions of opening to preferably provide a substantial width of overlap in intimate contact for the purpose of acting as a wind-, weather- or fire-proof joint efficiently and uniformly to distribute the wind pressure or other forces acting in one panel to the other panel paired thereto.

The invention may consist of a door comprising a multiplicity of relatively stiff sliding vertical members and two light panels between each pair of vertical members connected together and to the vertical members in which there is a loose fit between the panels and the hinge parts on the vertical members so that the panels float on such hinge parts and are adapted to provide substantially continuous contact between the curved edge of any panel and a contacting surface on the vertical member to which it connects. Thus the wind pressure acting on the panel surfaces causes the curved edge of each panel to take a bearing upon the contacting surface whereby the wind pressure is distributed evenly throughout the length of the panel to the vertical member instead of being concentrated at the individual hinge points. This construction also furnishes a continuous substantial windproof joint between the panels and the panel supporting vertical members.

To stiffen the panels one or more preferably horizontal tension ties may connect substantially the central points of any panel of a pair to the other panel of that pair, said ties being fully stretched when the door is closed.

To stiffen the structure one or more sets of diagonal collapsible bracings may be introduced between each pair of, or any two adjacent, vertical members, which diagonals are adapted to be stretched tight when the door is closed.

The invention may further comprise buffing arrangements attached to some, or all, of the vertical members to take the shock when opening the door. These buffing arrangements may take the form of springs arranged in the manner hereinafter described so that when the spring on one side of a vertical member receives a buffing shock the

spring on the other side will be placed under tension and stiffen or strengthen the vertical member to resist lateral deformation.

The invention may also comprise a construction or arrangement whereby a winch, windlass or other winding machinery and a wire rope or ropes or equivalent means is or are used to open the door or to close the same. The said winch or equivalent means may be worked either by hand or motive power, and have wire ropes or the like, preferably endless, so arranged that as the ropes used for opening the door wind in those used for closing the door wind out, and vice versa. The rope or ropes used for this purpose are attached to both the top and bottom of the members to be moved so that they are caused to move evenly together thus avoiding any tendency for either end to stick in its runway and thereby set up uneven and twisting strains in the structure. These ropes are usually connected to the other vertical members which, owing to the relatively great rigidity or stiffness of the same are capable of satisfactorily transmitting the stresses caused by the tension of the ropes, to the various constituent members of the door.

The wire ropes or the like for closing the door may pass through pipes, slots, or enclosed guides so as to be out of the way when the door is open.

The invention finally consists of the construction and arrangement of the parts adapted to be operated or to function substantially as herein described.

The invention will now be described with reference to the accompanying drawings in which like numbers of reference indicate like like parts and in which:—

Fig. 1 is an elevation of a portion of a door in part of which the panels are removed to show the vertical members, their diagonal bracings and the buffing arrangements more clearly;

Fig. 2 is a part plan of Fig. 1;

Fig. 3 is a side elevation;

Fig. 4 is a fragmental section showing one form the joint between a pair of panels may take;

Figs. 5 and 6 are fragmental sections showing two modifications of the joint between a panel and a vertical member;

Figs. 7 and 8 show a plan and side view of a form the tie between the two panels of a pair of panels may take;

Figs. 9 and 10 show views of details of the diagonal bracing between vertical members;

Figs. 11 and 12 show views of a form the buffing arrangements may take; and

Fig. 13 is a diagram of one arrangement of the opening and closing means.

In these figures the door comprises a multiplicity of vertical members 1, 1 mounted at their lower ends on rollers 2, 2 on runways or guides 3, and having suitable rollers or the like 4, 4 at their upper ends running in a channel or guide 5 which may conveniently be attached to the bottom boom of the girder spanning the opening or to the horizontal wind girder to distribute the wind loads, if such is used or to both. Panels in pairs 6 and 6^a are fitted between the vertical members. These panels may be made of sheet metal or other suitable material fixed to metal frame members 7, 7^a. The outer vertical edge 8 of the panel 6 is bent round into the segment of a circle, forming a strengthening corrugation or beading, and the edge 8^a of panel 6^a formed to fit the same curve so that the over-lapping edges 11, 11^a will form a sort of continuous knuckle joint preferably extending the full depth of the joint. The overlap 11, 11^a will be such that even when the panels are collapsed in order to open the door to its fullest limit there will still be a reasonable width of overlap.

To hold the parts together hinges or palms (flattened and widened connecting extensions or rods) with hooks thereon 9, 9^a may be fixed to, or form part of, the frames 7, 7^a, or of the panels 6, 6^a, which hooks hold the panels together by means of pins 10.

It will be seen that the overlap 11, 11^a makes a substantially wind and weather-proof joint, which will also help to prevent the spread of fire. Also the continuous contact between 8^a and 8 helps to distribute the force exerted by the wind most effectively over the length of the panel 6 and therethrough to the vertical post.

In Figs. 5 and 6 a constructional feature is shown wherein the edges 11, 11^a of the panels are curved round at 12, 12^a and make a sort of knuckle joint with the ends 13, 13^a of the member 14 which is riveted or otherwise secured to the vertical members.

If preferred the member 14 may be replaced by one curved as shown at 15 whereby a closer connection between the ends 12, 12^a and this member 15 may be made. Palm or hinge parts 16, 16^a may be fitted to the frame 7 or 7^a which may co-operate with hinge parts 19, 19^a fixed say by bolt 17 to the vertical member 1. Suitable distance pieces 18 may be introduced if desired. The pins 20, 20^a hold the parts together.

If desired the pins 20, 20^a may have a loose fit in the parts 16, 19 or 16^a, 19^a, so that the panels have a floating connection with the vertical members and any wind pressure transmitted by the panel in question 6 or 6^a may be distributed evenly throughout the length of the vertical member instead of being concentrated at the individual hinge points. This occurs due to the floating fit causing the curved ends 11, 12 or 11^a, 12^a to move under the wind pressure so that they take a continuous bearing

on a suitable contact surface on the vertical member or on the curve of the part 15 as the case may be. The clearance between the panel fittings and the pins 20, 20ª allow for the bearing to be taken as explained above.

A sufficient overlap of the parts 12, 13 or 12ª, 13ª will be given to make the joint weather, wind and flame proof.

As a modification a plate or packing 14ª (as shown dotted in Fig. 5) may be riveted to, or otherwise fixed to, the part 14 and the vertical member and have bevelled edges 14ᵇ. This bevelled surface acts to guide the curved end portion 12 or 12ª of the panel sheet when forced home by wind pressure. The plate 14ª might indeed be used for reinforcing the vertical member and thus serve two purposes.

Figs. 7 and 8 illustrate a form the tie between two panels of a pair may take. Spreader plates 21, 21ª may be fitted to the panels 6, 6ª substantially about the centre of the panels and cleats 22, 22ª or equivalent devices fixed thereto. A tie 23 is fixed to the pin 24 passing through cleat 22ª. The other end of this tie 23 engages the pin 25. The tie 23 as shown is riveted on pins 24, 25, by rivets 26 connecting its ends, but may take any suitable form. A second pair of tie plates 27 connect the pins 25 and 28 together. The tie may be given a "set" so that upon the door starting to be opened the tie will give inwards in the direction shown by the arrow on Fig. 7. By a slight movement of the pin 25 in the slot formed by the two parts of 23 and a movement about the pins 24 and 28 the tie buckles up out of the way when the panels 6 and 6ª are collapsed.

Figs. 9 and 10 show a form the diagonal ties or bracings between the vertical members may take. In these figures the tie 29 is pivoted to pin 30 in cleat 31 fixed to the web of the vertical member 1. At the further end the tie engages the pin 34 moving in the slot 32 in the cleat 33 riveted to the web of the next vertical. When the door is open the pin 34 moves to the end 32ᵇ of the slot, but when the door is closed the pin is hard up against the end 32ª of the slot and holds the verticals to proper spaced position.

In Figs. 11 and 12 the buffing arrangements are shown. In the modification illustrated the spring 35 is held by the bolt, pin or rivet 36 and its further end is adapted to slide on the rivet or the like 37, a slot 38 being formed in the spring for that purpose. Subsidiary springs 39, 39ª are riveted to the main spring 35 at 40 and 40ª and adapted to slide on the rivets or the like 41, 41ª—the ends of these springs 39, 39ª having slotted holes 42, 42ª for the purpose. These buffing arrangements are preferably fixed to the centre of the length of the verticals. Upon a shock being received in the direction of the arrow shown in Fig. 11 the spring on the side receiving the shock is compressed and the end 35ª slides downwards until the pin, bolt or rivet 37 engages the end 38ᵇ of the slot 38. The ends of the springs 39 and 39ª simultaneously slide on their pins 41, 41ª until they engage the ends of their slots 42, 42ª. The arrangement then acts as a spring buffer to transmit the shock to the vertical member with a certain cushioning effect. To assist the vertical member to resist this shock the spring on the further side of the vertical member comes into tension. The pin 37 is at the end 38ª of its slot and cannot move further. The whole of the spring 35 on the further side of the vertical member therefore comes into greater or less tension and helps to truss the vertical member and prevent it deflecting unduly under the shock.

An arrangement for opening and closing the door is illustrated diagrammatically in Fig. 13. In this a winch or equivalent means 43 is shown which may be worked by hand or by power. The wire rope or equivalent 44 passes around pulley 45 and along the top of the door as shown at 46. This part of the rope is preferably encased in a pipe 47, or otherwise protected. The rope then passes around pulley 48 and the end is fastened at 49 to the outermost vertical member 1. A return rope 51 passes through apertures or slots 50, 50 (shown in Fig. 13) in the tops of the vertical members 1, 1, then around pulley 52 and back as shown at 53 to the winch or the like 43.

Similar arrangements are made with regard to the ropes connected to the lower ends of the door, corresponding reference numerals with the designation "a" referring to like parts. The rope 46ª, however, may lie in a pipe or in a slot. As arranged upon turning the drum of the winch in one direction the door is opened and on turning it in the other direction the door closes. It will thus be seen that the rope or ropes are attached to both the top and the bottom of the other vertical members and both ends of these members must therefore, operate together in opening and closing the door. The said vertical members being relatively stiff and the opening and closing force being applied close to both ends, the stresses produced in operating the door are reduced to a minimum and a much lighter construction can be used than is possible when the rope acts only on one side of the door, as on either the top or the bottom.

It will of course be understood that I do not confine myself to the exact construction shown as it will be obvious that the details may be varied considerably without departing from the scope of the invention.

Panels having curved flanged edges forming continuous knuckle-like joints provide a very effective means for transmitting wind

pressure, because the curved formation strengthens and stiffen the edges and renders them capable of acting as the booms of a girder. The framing 7, 7ª riveted to the edges of the panels also enormously stiffens and strengthens the panels. The knuckle-like joints may be made capable of transmitting any reasonable wind load coming onto a panel direct to the vertical members and distributing the load substantially uniformly throughout the length of the vertical member.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A door for aeroplane hangars and the like comprising, an upper and a lower runway, a plurality of rigid vertical members arranged to resist substantially the whole of the lateral forces applied to the door and slidably mounted for movement in the runways, a pair of light relatively narrow panels of rigid, non-inflammable material connected between each adjacent pair of vertical members, each pair of panels being interconnected by an overlapping knuckle extending along the entire contacting edges of the panel to form a beading along the contacting edges so as to strengthen the panels and to provide a water proof overlapping joint between the panels, the connections between the panel and its vertical member being a loose folding horizontal connection extending continuously throughout the entire height of the panel, such connection including contacting curved edge portions on the vertical member and its panel whereby wind pressure on the panel surface forces the curved edge of the panel to bear throughout its entire length against the curved surface on the vertical member whereby to evenly transmit the load from the panel to the vertical member.

2. A door for aeroplane hangars comprising, spaced runways, a plurality of rigid slidable vertical members arranged to resist substantially the whole of the lateral forces applied to the door and slidably received in the runways, a pair of panels connected together along one edge and connected between each pair of adjacent vertical members at their other edges, the connections between the panels and between the vertical members and the panels being curved, overlapping knuckle joints running continuously throughout the height of the panel, and hinges loosely interconnecting the panels and loosely interconnecting the panels and vertical members to form folding joints, curved knuckle connections forming a continuous contact between each panel and its corresponding vertical member.

3. A door for aeroplane hangars comprising, spaced runways, a plurality of rigid slidable vertical members arranged to resist substantially the whole of the lateral forces applied to the door and slidably received in the runways, a pair of panels connected together along one edge and connected between each pair of adjacent vertical members at their other edges, the connections between the panels and between the vertical members and the panels being curved, overlapping knuckle joints running continuously throughout the height of the panel, and hinges loosely interconnecting the panels and loosely interconnecting the panels and vertical members to form folding joints, curved knuckle connections forming a continuous contact between each panel and its corresponding vertical member, at least one substantially horizontal articulated tie member connecting the central points of each pair of panels, the tie members being arranged to be fully stretched when the door is closed.

4. A door for aeroplane hangars comprising, spaced runways, a plurality of rigid slidable vertical members arranged to resist substantially the whole of the lateral forces applied to the door and slidably received in the runways, a pair of panels connected together along one edge and connected between each pair of adjacent vertical members at their other edges, the connections between the panels and between the vertical members and the panels being curved, overlapping knuckle joints running continuously throughout the height of the panel, and hinges loosely interconnecting the panels and loosely interconnecting the panels and vertical members to form folding joints, curved knuckle connections forming a continuous contact between each panel and its corresponding vertical member, a diagonal collapsible bracing interconnecting the adjacent vertical members, the bracings being positioned to be stretched tight when the door is closed.

5. A door for aeroplane hangars comprising, spaced runways, a plurality of rigid slidable vertical members arranged to resist substantially the whole of the lateral forces applied to the door and slidably received in the runways, a pair of panels connected together along one edge and connected between each pair of adjacent vertical members at their other edges, the connections between the panels and between the vertical members and the panels being curved, overlapping knuckle joints running continuously throughout the height of the panel, and hinges loosely interconnecting the panels and loosely interconnecting the panels and vertical members to form folding joints, curved knuckle connections forming a continuous contact between each panel and its corresponding vertical member, buffing members connected to the vertical members to ab-

sorb shock when opening the door, the buffing members comprising springs so arranged at either side of a vertical member that a shock absorber places the spring on one side of the tension and the spring on the other side under compression.

6. A door for aeroplane hangars comprising, spaced runways, a plurality of rigid slidable vertical members arranged to resist substantially the whole of the lateral forces applied to the door and slidably received in the runways, a pair of panels connected together along one edge and connected between each pair of adjacent vertical members at their other edges, the connections between the panels and between the vertical members and the panels being curved, overlapping knuckle joints running continuously throughout the height of the panel, and hinges loosely interconnecting the panels and loosely interconnecting the panels and vertical members to form folding joints, curved knuckle connections forming a continuous contact between each panel and its corresponding vertical member, and cable means for operating the door to opening and closing positions.

7. A door for aeroplane hangars, comprising, a door, cables attached to the door for opening and closing the same, the cables being attached to both top and bottom portions of the door, and a single operating means to simultaneously operate the cables, whereby uneven movement and sticking is prevented.

In testimony whereof I hereto affix my signature, this 7th day of February, 1924.

ARCHIBALD BERRIDGE FRANKLIN SMITH.