June 8, 1943. J. R. KEYS ET AL 2,321,491

HANGAR DOOR STRUCTURE

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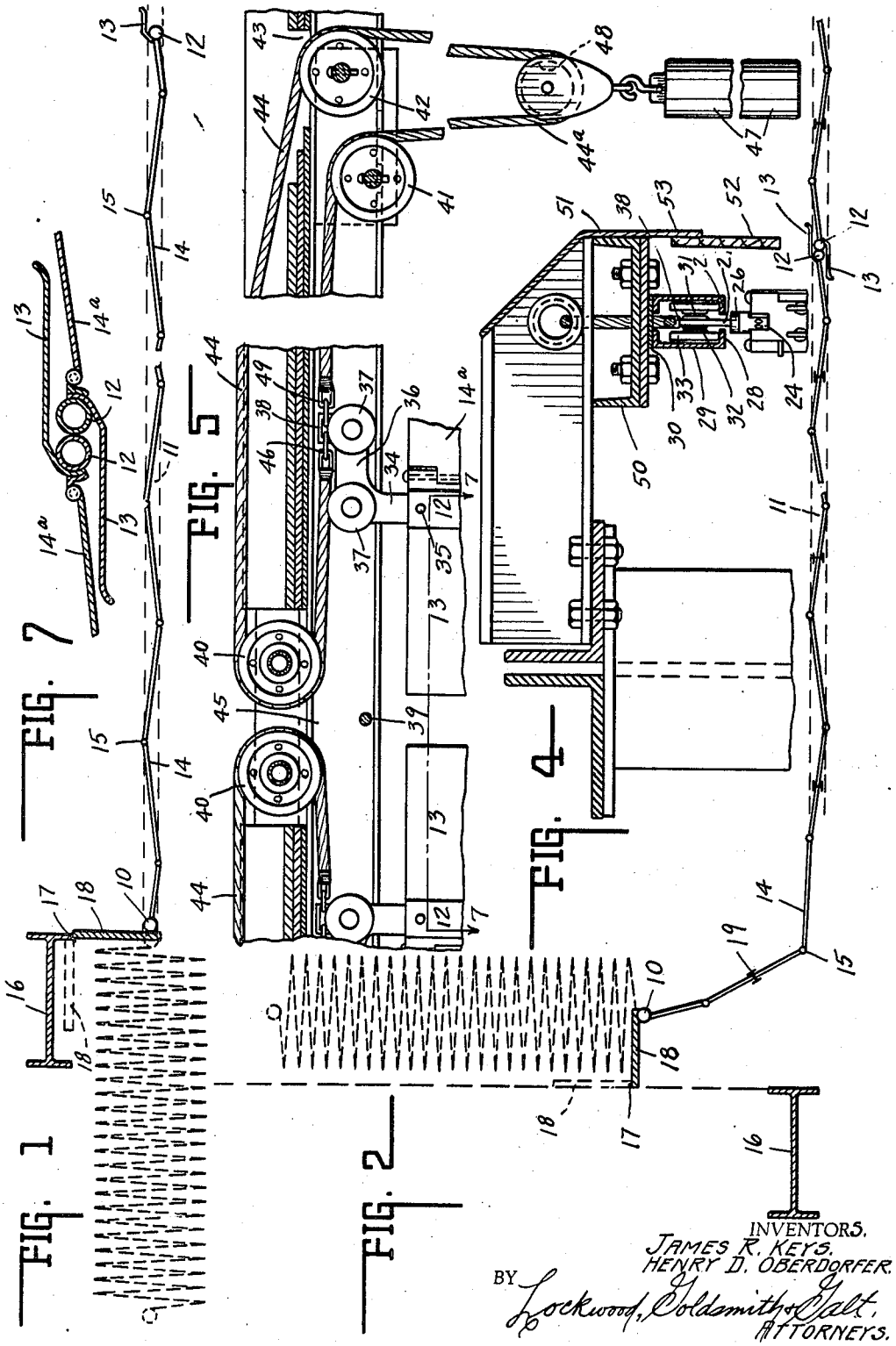


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 7

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FIG. 6

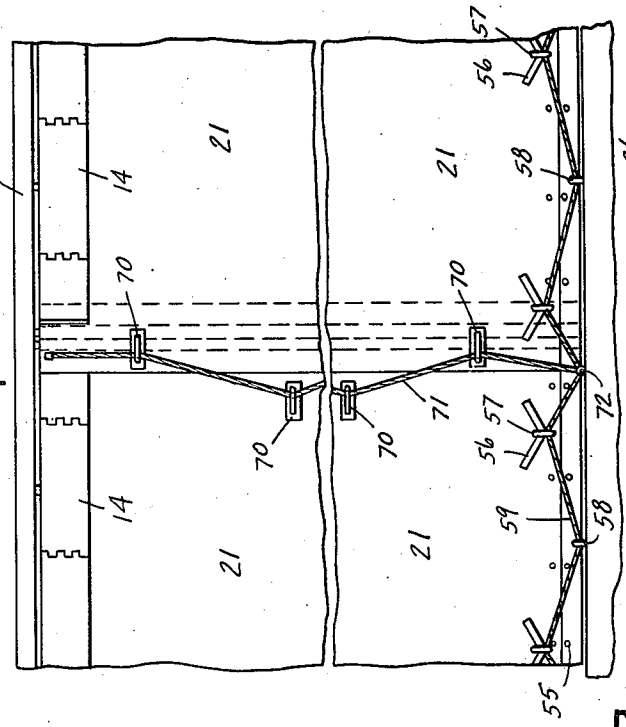


FIG. 3

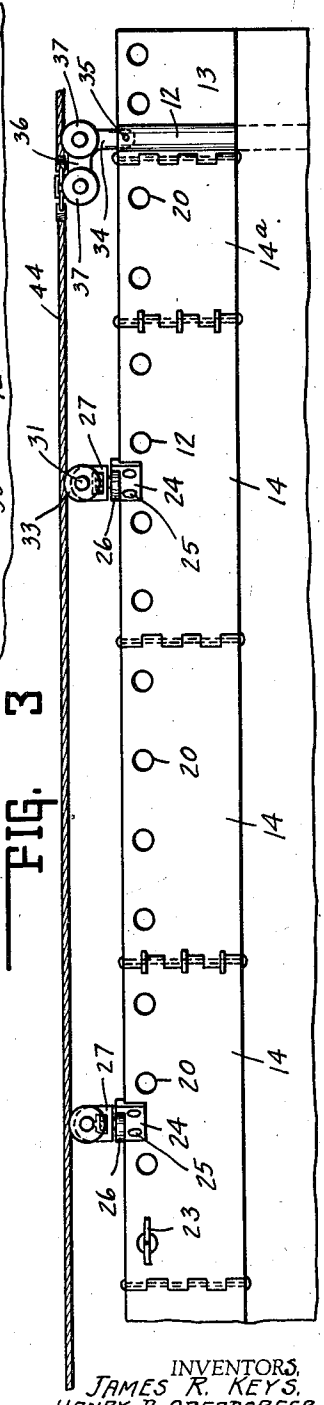


FIG. 9

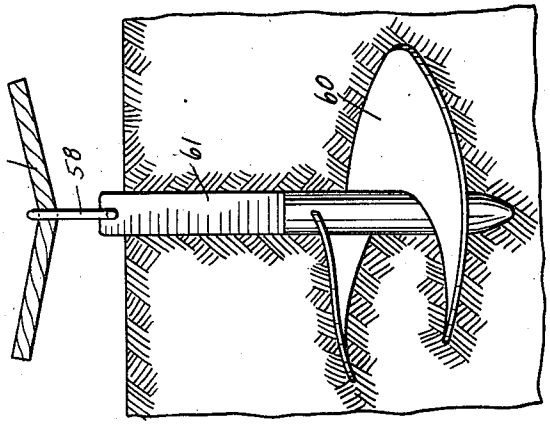
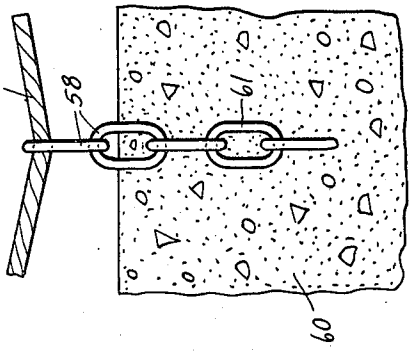


FIG. 8



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HANGAR DOOR STRUCTURE

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Application January 15, 1942, Serial No. 426,844

6 Claims. (Cl. 160—126)

This invention relates to an accordion type, extensible and collapsible, overhead supported, curved or straight structure suitable more particularly for aeroplane hangar and similar installations and uses.

One object of the invention is to provide a structure of the character set forth, which may be readily extended or collapsed and when extended may cooperate with a confronting structure of like character, oppositely movable for completely closing the hangar opening, it being understood that by reason of the relatively large or wide width of opening and the comparatively high height of opening required for aeroplane hangar purposes, some at least being approximately in the order of better than 120 ft. for the width of the opening and better than 20 ft. for the height of opening, the curtain structure and its support must of necessity for single man operation be extremely simple and of comparatively few parts.

Another object of the invention is to provide a curtain structure of the aforesaid character with an arrangement whereby the curtain at the bottom is capable of being suitably secured in place to the floor of the hangar structure when it is desired to hold the curtain in closed position against wind resistance, et cetera, it being quite apparent that in desert-like areas were it not for a curtain closure to an open hangar, the wind blown sand would normally cause considerable objection.

The chief feature of the invention consists in providing a curtain structure of the character such that the foregoing objectives are accomplished.

Other features of the invention consist in providing two oppositely movable curtain structures with confronting lapping portions so that when utilized as half curtains for a single opening, the vertical junction is of abutting and lapping character.

Another feature of the invention is the arrangement whereby the fabric near the bottom is provided with detachable anchorage arrangements such that if the curtain fabric is one that normally extends in use, the curtain may be initially arranged in fully extended relation, having reference to its vertical dimension and then as the curtain extends by reason of the fabric weight, it may be shortened by turning up a portion to the main portion; conversely if the fabric is of such character that it shortens in use, as may be the case when it becomes wet, the turned up portion may be released and lowered. In either event the length of the curtain within a range of adjustment of from 3" to 6" by way of example, may be readily effected.

Other objects and features of the invention will be set forth more fully hereinafter.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims:

In the drawings, Fig. 1 is a diagrammatic plan view of a left hand curtain structure, a portion of the hangar and the flydoor being shown in section, full lines indicating the extended position of the door and curtain, dotted lines indicating the collapsed position of the curtain and corresponding position of the door.

Fig. 2 is a view similar to Fig. 1 but of a modified form of the invention wherein the curtain is collapsed into position at right angles to the plane of the opening instead of in alignment therewith, as illustrated in Fig. 1. Fig. 2 also illustrates the junction of two cooperating curtains for a single opening.

Fig. 3 is an elevational view of the upper end of the curtain structure including more particularly the cable arrangement and the hinge plates of the curtain together with the trolleys.

Fig. 4 is a transverse sectional view taken at right angles to the longitudinal axis of the supporting track and illustrates the cable and trolley structure associated therewith.

Fig. 5 is an elevational view taken at right angles to Fig. 4 and illustrates the cable and counterbalance structure as well as the trackway.

Fig. 6 is an elevational view of two curtain portions for a single opening shown in the extended and lapped relation, and with the curtain anchored at the base, and the portions connected together.

Fig. 7 is an enlarged transverse sectional view of the confronting end portions of two cooperating curtains when in abutting relation, same being taken on line 7—7 of Fig. 5 and in the direction of the arrows, the lap extensions 13 being of metal.

Fig. 8 is a view showing one form of curtain lower end anchorage.

Fig. 9 is a similar view showing a modified form thereof.

In Fig. 1 of the drawings, 10 indicates a wall post and 12 a central post. These two posts are suspended from an overhead trackway designated by the numeral 11. The post 12 has the comparatively rigid lap seal extension formation 13. The trackway supports trolley structures which are

connected to the midportion of certain hinge plates 14 pivotally connected together as at 15. The track position is shown dotted in Fig. 1, because it is overhead. The hinge plates and posts support a suitable fabric 21 that forms the door or closure.

The side wall of the hangar includes the stationary portion 16 and hingedly mounted adjacent thereto as at 17 is a flydoor 18. As shown in Fig. 1, the door or closure when collapsed is in the dotted line position and the flydoor is in the dotted line position. In this position the door closure is open (collapsed) and access is had to the hangar. When the parts are positioned as shown by the full lines, the door is closed (extended) and access cannot be had to the hangar, through the curtain when anchored in extended position. Access is had by side doors.

Fig. 2 illustrates another form of the same invention but herein the overhead track is curved at each end and its position is indicated by numeral 11. The numeral 19 again indicates the trolley structures. It will be observed that in each of the forms of this invention the flydoor 18 closes the gap between the side wall of the hangar and the adjacent rear or wall post 10, when the curtain is extended. Suitable detachable connection may be made between the flydoor and rear post and such may be by the lacing arrangement hereinafter described for confronting curtain ends when closed. Any other connection may be utilized as found necessary or desirable.

Reference now will be had more particularly to Figs. 3, 4, 5 and 6. As shown in these figures the numeral 14 indicates a hinge plate. 14*a* indicates a half hinge plate. 13 indicates the lap extension member while 12 indicates the intermediate post. Each of the plates 14 is provided with apertures 20 for the anchoring of the fabric, designated by the numeral 21, thereto, said fabric being anchored by clips 23 extending through the same, and through the aperture 20 in hinge plate 14. The fabric or canvas preferably will be hemmed at the top and additional reenforcement may be included in that hem or at the point where the connector is to be inserted. A conventional clawed grommet or other conventional grommet structure, may be employed so that the fabric has a reenforced portion where the member 23 anchors the same to the hinge plate 14. Various expedients may be utilized, however, and the broad invention is not concerned with this detail.

As shown clearly in the previously mentioned figures, certain of the hinge plates 14 mount a base 24 which is slotted to straddle the hinge plate and which is secured to the hinge plate as by rivets 25 and medianly thereof. The upper end of this base 24 is enlarged laterally as at 26 and pivotally supported thereon is the portion 27—see more particularly Figs. 3 and 4.

The portion 27 extends upwardly between the inwardly directed portions 28 of a U-shaped track structure, indicated generally by the numeral 29, and this may be composed of two channels directed toward each other and spaced apart and connected by base portion 30 and by which the same is suspended or the track may constitute a single U-shaped section member with ends 28.

Extending transversely through the portion 27 is an axle 31 and carried thereby at opposite ends and on roller races 32, if desired, are the wheels 33 that ride upon the inturned portions 28. It will be observed that the spaced wheels form a groove, as it were, to which reference will be had hereinafter. Each of the aforesaid structures including the pair of spaced wheels or trolley arrangement is positioned centrally with respect to the ends of the hinge plates and it has been found that a trolley arrangement on every alternate hinge plate is sufficient for support purposes. The forward or intermediate post 12 since it is associated with a half hinge is not required to be swivelably connected to the forward trolley arrangement.

Herein the numeral 34 indicates an upwardly directed portion pivoted at 35 to the post 12. The upwardly directed portion 34 is elongated as at 36. This structure is clearly shown in Fig. 5. Two pairs of trolley wheels 37 are carried by this member 34 and the trailing end of the extension 36 thereof has an upwardly extending portion 38 constituting a cable anchorage. It will be observed—see Fig. 2—that two doors may be moved into extended position toward the center of the opening of the hangar and to prevent over-travel of any one door, there is provided—see Fig. 5—the stop 39. This prevents over-travel beyond the center.

Above the track there is positioned a pulley 40—see Fig. 5. At the rear end of the track there is positioned a pulley 41 and adjacent thereto is another pulley 42. It is to be understood the rear end of the track is recessed as at 43 so that a cable 44 may pass through the aperture 43 and be associated with the pulley 42. It will also be understood that the upper portion of the track at its central portion is apertured as at 45, this again to permit the cable 44 to enter the track, and engage pulley 40 provided for return direction of the cable.

This return portion of the cable is connected at 46 to member 38. The rearward end of he cable is looped after passing over pulley 42 and pulley 41 as illustrated and this loop is designated by 44*a*. The same supports a weight 47 in turn carried by a pulley 48. The other end of the cable 44 is connected at 49 to portion 38 previously referred to. In effect, therefore, the cable 44 is of endless character to which the trolley arrangement 34—36 is secured at one point.

It will be quite apparent, therefore, that when the intermediate post 12 is moved toward the center of the track structure, as indicated by stop 39, and from the other end of the track, that this movement can be occasioned by pulling down on that section of the cable 44 between the pulley 42 and the weight 47. This will cause the trolley to move toward stop 39 and at the same time extend the door or closure. Whenever it is desired to open the door or closure, pulling down on the cable 44 in the loop portion 44*a* between the pulley 41 and the weight 47 will cause retraction of the trolley arrangement and collapse of the door structure or closure.

Of course, it is to be understood in place of the weight structure and manual power that there may be utilized a power driven drum with the cable wrapped therearound and suitably controlled and automatically controlled by travel limit switches so that the drum rotation in either direction will be limited to that necessary for complete extension of the door or complete collapse of the door and no more. Of course, manual control of the power of such a construction will permit the door to be opened and closed to any desired intermediate degree. It will be quite apparent that since in effect the structure

is of endless type, that there is always substantially the same amount of cable 44 in the loop available for manual manipulation and accordingly, in a power operable structure, the winding drum would have several turns wound around such drum, the surface of which would be spirally grooved so that these several turns could shift from one end of the drum to the other in the extension and collapse of the door closure under power operation.

By referring to Figs. 4 and 5, it will be observed that the cable in its lower run, as it were, is positioned between the spaced wheels of each trolley arrangement, and accordingly, is guided thereby. It will also be noted from these figures that the upper run of the cable is above the track structure and above the support for the track structure, this support being indicated by the numeral 50.

For complete "black-out" purposes, there may be secured to this support structure 50 a depending flap, the same constituting an extension of the flashing 51 and consisting of a strip of canvas 52 suitably secured as at 53 to the flashing 51 in much the same manner that the canvas body portion 21 is secured to the hinge plates, as previously described.

It is to be understood that the hinge plates can be collapsed about 173° to 175° and that is sufficient for all practical purposes. It is also to be understood that openings of this general character are in many cases more than 20 ft. in height and more than 120 ft. wide. Two doors or curtains structures, therefore, to take care of this opening must be so arranged as to offer minimum resistance to opening and closing movements. Whenever the doors are closed—that is, extended—it frequently is desirable to secure the doors at the bottom so that they are held in place and not be subject to wind movement and unauthorized access. Whenever it is desired, intermediate pipes at altenate hinges may be mounted, in that case, by fastening a slit or notched pipe to the hinge plate at the bottom thereof. In this connection, it should be secured to the middle of the hinge plate because the middle of the hinge plate has only movement substantially in accordance with the track direction, whereas, each of the hinge pins at the end of a full hinge not only has a general movement corresponding to track direction but also has a movement lateral thereto with respect to that general direction as the structure is collapsed or extended.

In order to secure complete "black-out" and in view of the large areas involved in door closures of this type, minor expansion and contraction so accumulates particularly in view of the depending support character imposed on the fabric, that preferably the bottom of this fabric as shown in Fig. 6, is provided with glove or grommet snap fastener constructions indicated by the numeral 55 and if desired, successive parallel series may be provided much in the manner in which reef ties are provided on sails.

Whenever the bottom of the door is to be free of the ground or floor of the hangar to reduce resistance or drag the lower end may be turned upwardly and quickly snapped into doubled relation. Whenever the fabric elongates so that it would drag on the ground or floor, the similar shortening in height may be effected. Whenever shrinkage occurs, as may happen following a rain storm if canvas is the curtain material, the previously shortened curtain may be let out, all without cutting of the curtain or closure.

Above this extensible arrangement, there is provided V-shaped, fabric, anchoring members 56, which support loops 57. There is also provided in the ground or floor beneath the overhead trackway loops or links 58. These loops or links are alternated with the rings 57 and a rope 59, which alternately passes from one ring to the other through the ground loop or link, will, as shown in Fig. 6, anchor the lower end of the curtain or door to the ground or floor.

In Fig. 8, the numeral 60 indicates a concrete formation of the floor and in which is imbedded a part of a chain 61, the upper link being designated by the numeral 58. In Fig. 9 the upper link 58 or ring is carried by a polygon shaft 61 having the spiral screw portion 60 by which the structure is screwed or spiralled into the ground to serve as an anchorage.

Reference now will be had to the right hand portion of Fig. 2, and Figs. 6 and 7. It will be noted in the first two mentioned figures, that 14a designates the half hinge and that 12 designates the confronting intermediate posts of the two door curtains while 13 indicates the forwardly extending lap sealing extension portions which when the two door closures are extended may abut as shown in Fig. 7 and seal the opening.

The adjacent ends of the door and more particularly the fabric portions thereof, are provided with rope anchoring portions 70 as illustrated, and it is to be understood the cable 71 may be anchored as at 72 to one of the ground yokes immediately adjacent the midportion of the hangar opening and then alternately laced across the lapping doors as shown in Fig. 6.

Preferably, of course, this rope 71 would be secured at its upper end to one of the closures and then the cable would be passed from right to left by the operator therebeneath and secured in the hook-like arrangements 70 until finally the lowermost hook-like arrangement shown in Fig. 6 would be engaged and then the rope would be pulled taut and following that it would be passed through the ground anchor loop 72 and securely tied. This is the preferred form of construction and operation since it is quite apparent that manipulation of this tie some eighteen or twenty feet above the ground is otherwise impossible without ladders, inasmuch as the curtains must move in such a manner that movement is only horizontal.

It is also contemplated that these hooks 70 permit rope 71 to slide therethrough when the lower end is untied, and either or both doors are opened. In this connection these hooks may include in the root thereof an assisting pulley wheel to reduce friction and binding.

It will also be apparent that when either type of floor anchorage is utilized, as shown in Figs. 8 or 9, that the portion 58 of either can be collapsed and lie parallel to the ground, as it were, and offer but little obstruction. It will, of course, be understood that an operator may start at one end of the closed door structure and alternately pass the rope 59 through a ground anchor 58 and then a closure ring 57, and so on, to the opposite end of the other door, whereupon it can be tied and then the first and loose end anchored or if the latter has been first tied, then the surplus may be pulled through all the rings or anchors and the last end tied to the last anchor on the floor near the side wall.

In any event in order to open the curtain or

door closure, one end only need be untied and then the opposite end pulled until all the intermediate anchors are freed of the cable or rope **59**. In like manner, the cable **71** will be untied from anchor **72** and then the rope will be swung to the left and right in a direction opposite to that previously employed, until the cable is free. Thereupon there is nothing holding either one of the closures against collapse movement. Then pulling down on the loop portion **44***a* of the cable **44** and on that portion which is closest to the intermediate post **34**, will cause the door closure to collapse into the dotted position shown in Fig. 1 or Fig. 2, depending upon the type of hangar structure that is being utilized.

Of course, the central portion of cable **59** could be anchored or tied down so that when the outer ends were untied, opening of the doors would automatically pass the cable through the links or loops **57** and **58**.

Preferably the intermediate trolley hangars are made slightly wider, at the widest part, than the diameter of the trolley wheels to prevent said trolley wheels touching in folded position, thus preventing interference between trolley wheels and insuring ease of operation at all times.

While the invention has been illustrated and described in great detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character.

The several modifications described herein as well as others which will readily suggest themselves to persons skilled in this art, all are considered to be within the broad scope of the invention, reference being had to the appended claims.

The invention claimed is:

1. In a hangar structure having an opening, an accordion type collapsible and extensible curtain therefor, track means for curtain guidance, said curtain being collapsible adjacent a side wall of the opening, and a flydoor movable when the curtain is extended to bridge the space between the side wall and curtain end.

2. In combination, a curtain extensible along a track, spaced loop means in spaced relatively fixed relation to the track, spaced relatively fixed loop means carried by the curtain, and a tie rope alternately receivable by respective loop means for anchoring the loop means carried by the curtain.

3. In combination, a pair of extensible curtains movable along a track, spaced relatively fixed loop means in spaced relation to the track, other spaced loop means carried by each curtain, tie rope means alternately receivable by the fixed loop means and the curtain loop means for anchoring the loop means carried by the curtains, rope engaging means carried by the adjacent ends of the curtains, and other tie rope means cooperable with said engaging means for securing the curtains together when extended.

4. A suspensible, extensible accordion type curtain including in combination an overhead track, trolleys rollable thereon, an articulated sequentially arranged, hingedly connected series of plates, a curtain secured at its upper end to said plates for suspension support and movement by the latter, a certain portion of each plate only having a travel direction, in collapse and extension movements, corresponding to the track direction, the trolleys being connected to the plates in registration with said certain portions, and means rigid with the certain portion of one of the plates and depending therefrom for curtain guidance and like purposes.

5. A suspensible extensible accordion type curtain including in combination an overhead track, trolleys rollable thereon, an articulated, sequentially arranged hingedly connected series of plates, a curtain secured at its upper end to said plates for suspension support and movement by the latter, a certain portion of each plate only having a travel direction, in collapse and extension movements, corresponding to the track direction, the trolleys being connected to the plates in registration with said certain portions, and at least one series of detachable connectors substantially parallel to the curtain bottom and adjacent thereto for holding up the curtain bottom to eliminate drag thereof, and permitting curtain enlargement upon vertical shrinkage and curtain shortening upon vertical stretching.

6. A suspensible, extensible accordion type curtain including in combination an overhead track, trolleys rollable therein, a pair of articulated, sequentially arranged hingedly connected series of plates, certain of the trolleys being connected to the midportions of certain plates, half hinge plates at the adjacent ends of the two series, a trolley connected to each half plate at the outer end thereof, a depending member rigid with said half plate and aligned with the last mentioned trolley, a curtain for each series and secured at its upper end to the plates thereof for suspension support and movement thereby, and a lap member rigid with each depending member and projecting laterally therefrom and secured to the curtain, said lap members lapping the adjacent series half plate when the depending members are positioned immediately adjacent each other.

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