Sept. 22, 1953 J. L. MITCHELL 2,652,906

MOBILE AIRPLANE HANGAR STRUCTURE

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FIG. 1

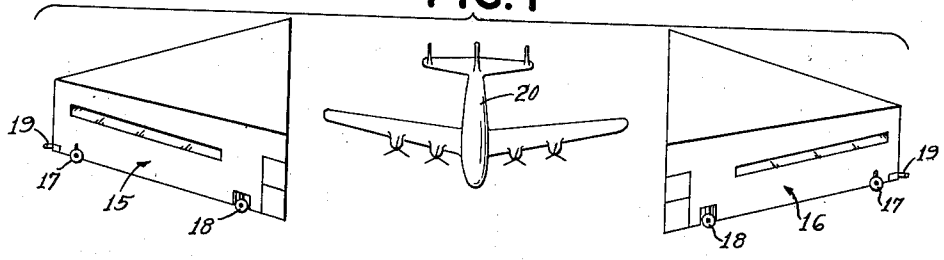


FIG. 2

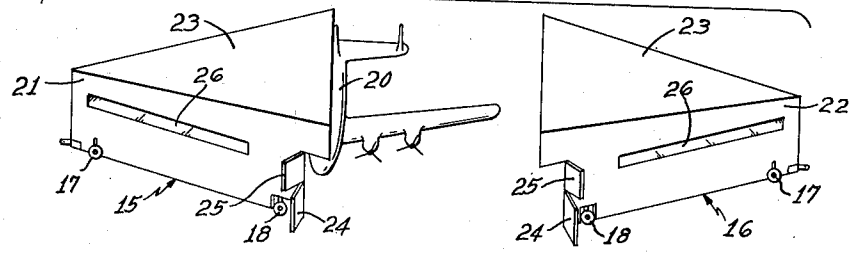


FIG. 3

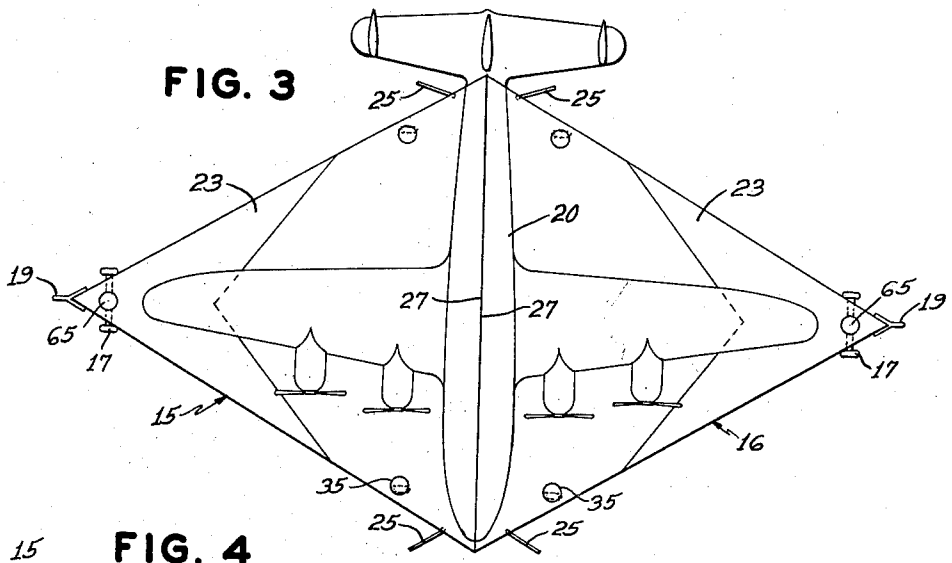
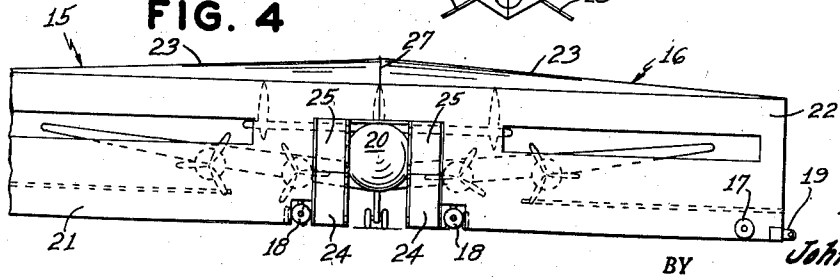


FIG. 4



INVENTOR.
John L. Mitchell
BY
Pennie, Edmonds, Morton and Barrows
ATTORNEYS

Sept. 22, 1953 J. L. MITCHELL 2,652,906

MOBILE AIRPLANE HANGAR STRUCTURE

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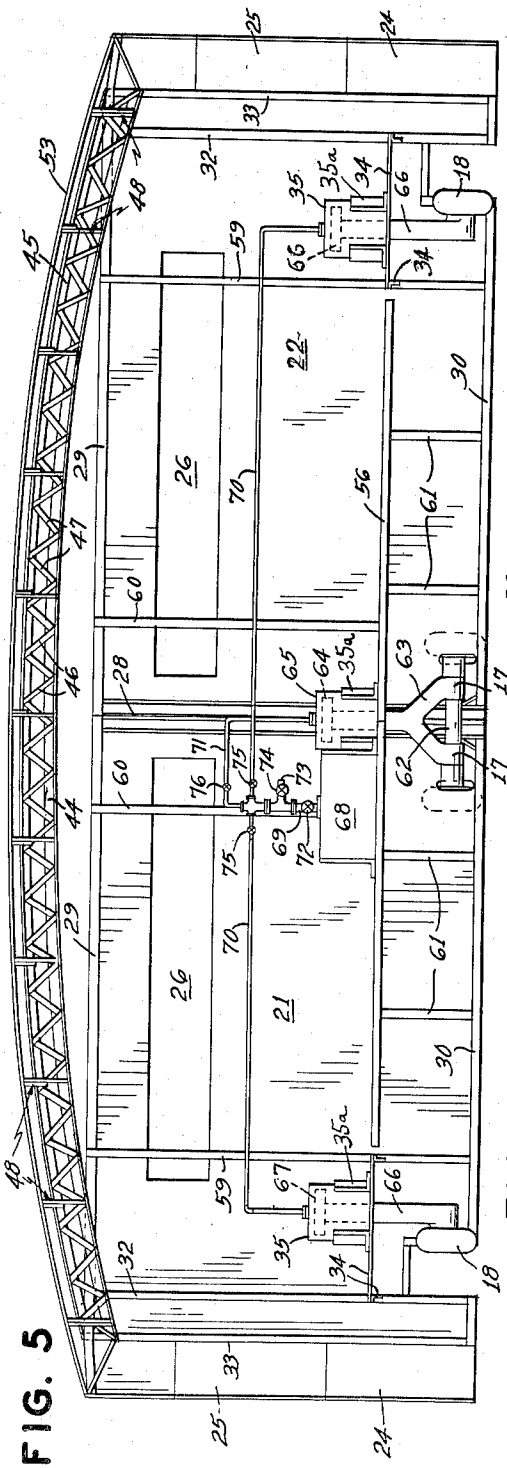


FIG. 5

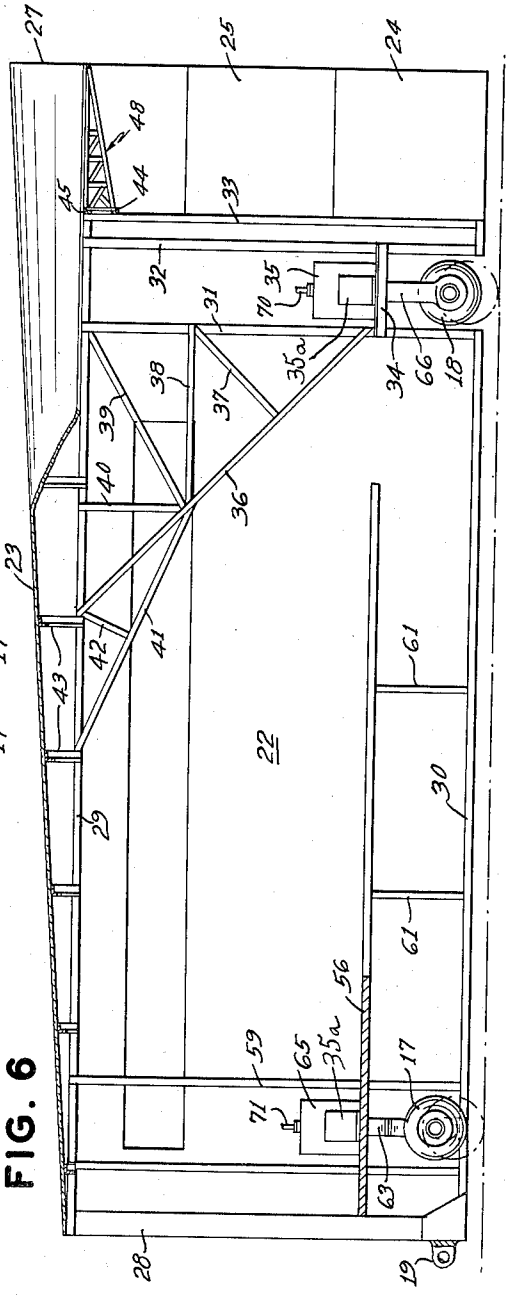


FIG. 6

INVENTOR.
John L. Mitchell
BY
Dennis, Edmonds, Morton and Parsons
ATTORNEYS

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FIG. 7

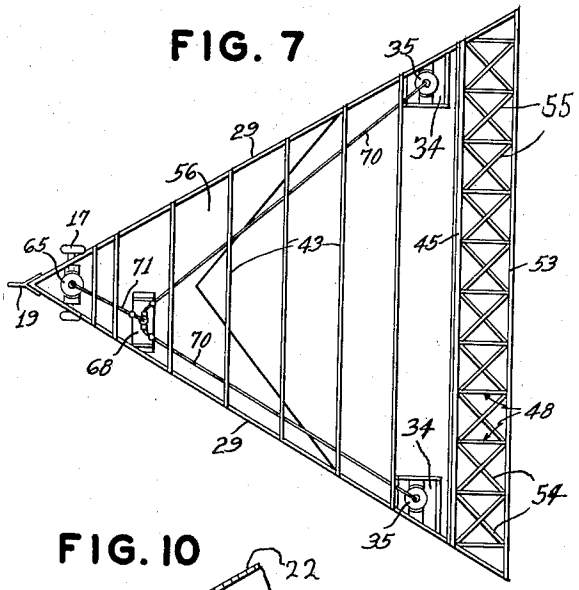


FIG. 9

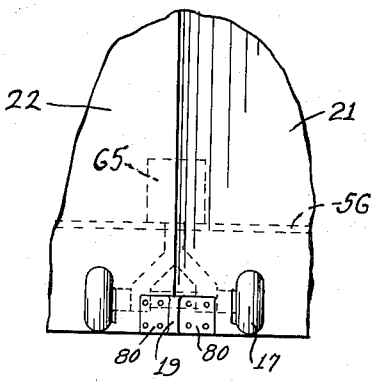


FIG. 10

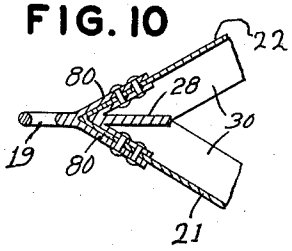


FIG. 8

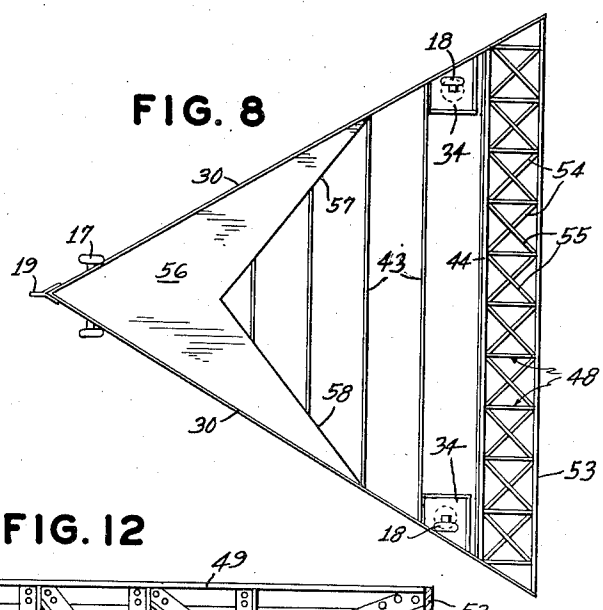


FIG. 11

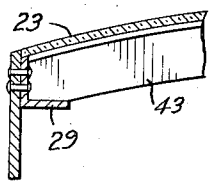
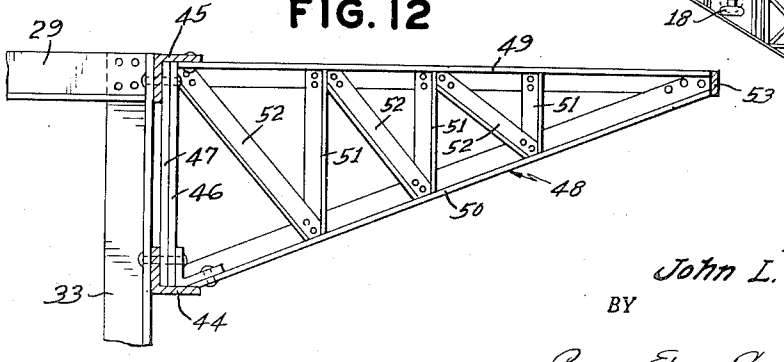


FIG. 12



INVENTOR.
John L. Mitchell
BY
Dennis, Edmonds, Morton and Parrow
ATTORNEYS

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2,652,906

UNITED STATES PATENT OFFICE

2,652,906

MOBILE AIRPLANE HANGAR STRUCTURE

John L. Mitchell, New York, N. Y., assignor to Mitchell Mobilhangar Corporation, New York, N. Y., a corporation of New York

Application April 27, 1949, Serial No. 89,977

5 Claims. (Cl. 189—1.5)

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My invention relates to improvements in portable hangars for airplanes, that is, a hangar which may be moved from one location on an air field to another without disassembly.

More particularly the invention relates to an airplane hangar having sections which may be moved relative to each other, the sections in turn being readily moved, as for example, by towing, from one part of an air field to another, and in particular relationships with respect to each other to form a complete hangar adapted to enclose or substantially enclose an airplane.

The problem of providing hangars for airplanes is a very critical problem at the present stage of aircraft development, because of the tendency to make use of larger and larger airplanes. Another problem is the extremely high cost of providing conventional type hangars for aircraft.

Air transportation companies furthermore have found it extremely difficult to operate their large airplanes at reasonable costs because of the lack of hangar space for overhauling, repairs and protection of their airplanes while at air stations or air ports.

The primary object, therefore, of the present invention is to provide a relatively inexpensive portable hangar construction which does not require heavy foundations and which may be readily moved to enclose or substantially enclose an airplane either on an air strip or on a parking location on an air field.

In accordance with the features of my invention, I provide a portable airplane hangar having sections, each of which are separately movable with respect to each other and which may be moved over an airplane to completely or partially enclose it so that the plane may be repaired, overhauled, or protected from atmospheric conditions.

A preferred form of my improved portable hangar comprises a pair of portable sections each being of generally triangular shape in plan, each section having two vertical side walls converging toward each other to form a corner or apex of the section, a roof portion connecting said side walls, structure forming an open side adapted to match with a similar side of another portable section, and wheels carrying each section upon which the section may be towed into any desired position.

An advantageous construction of my preferred portable hangar includes wheel units adapted to bear upon the ground and support the hangar sections a suitable height above the ground, and means for lowering the hangar sections with respect to the supporting wheel units whereby the hangar sections may be lowered down into engagement with the ground, runway or parking surface. Each portable section of the hangar advantageously includes a plurality of wheel units

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each of which is supported from a cylinder fixed to the sections, and means for supplying pressure fluid to and releasing pressure fluid from the cylinder to respectively lift the hangar section with respect to its wheel units and lower the hangar section with respect to the wheel units.

My improved portable hangar includes other features which will be described hereinafter in connection with certain illustrative embodiments of the invention as shown in the accompanying drawings forming a part of this application.

In the drawings:

Fig. 1 is an expanded perspective view of the improved hangar showing the two sections thereof separated with respect to an airplane to be covered or substantially covered by the hangar.

Fig. 2 is a view similar to that of Fig. 1 showing one of the hangar sections moved partially over the airplane.

Fig. 3 is a plan view of the hangar shown in Figs. 1 and 2 with both sections of the hangar moved in toward each other so as to enclose an airplane except for its tail section, the roof shown transparent.

Fig. 4 is a side elevational view of the hangar shown in Fig. 3 with its sections abutting each other substantially enclosing the airplane as in Fig. 3.

Fig. 5 is an inside view of one of the sections of the portable hangar looking directly toward the apex of the section.

Fig. 6 is a partial vertical sectional view of one of the hangar sections taken on a line substantially equally dividing the apex angle, with portions of the roof structure broken away.

Fig. 7 is a plan view on a smaller scale of the hangar sections shown in Figs. 5 and 6, with the roof sheeting removed.

Fig. 8 is an upside-down view of the hangar section shown in Fig. 7.

Fig. 9 is a broken fragmentary view of the apex of one of the sections of the hangar showing the wheel unit and tow-hitch.

Fig. 10 is a fragmentary horizontal sectional view through the tow-hitch at the apex, as shown in Fig. 9.

Fig. 11 is a broken sectional view showing a form of roof supporting structure.

Fig. 12 is an enlarged detailed view of one of the elements of the roof structure supporting means for the open side of each hangar section.

Referring to Figs. 1 to 4 of the drawings, the improved hangar is illustrated as comprising a pair of similar sections 15 and 16 each supported by wheel units 17 and 18 and each provided with a towing-hitch 19 at the apex.

It will be noted that each section in plan is shaped substantially like an isosceles triangle and

that each section is open along the side corresponding to the base of the triangle, that is, has no side wall along that side.

The hangar sections 15 and 16 shown in Fig. 1 are spaced apart with respect to each other, while a large airplane 20 has been moved in between the sections. Fig. 2 shows the section 15 moved into place, while Fig. 3 shows both sections 15 and 16 in matching engagement along their roof edges over the airplane 20, except for the tail portion of the plane. This may be one use for the portable hangar in taking care of relatively large airplanes for the purpose of effecting repairs or for protecting the main features of the plane from weather conditions. The two hangar sections may be used to completely enclose an airplane, or individual sections may be used to shield selected portions of the plane, such as a pair of engines, from adverse weather conditions while being repaired.

Each hangar section as shown in Figs. 1 to 4 comprises a pair of side walls 21 and 22 which converge toward each other and are joined at their meeting ends to form the apex of the hangar. Each section also includes a roof 23 attached to the top of the walls 21 and 22, lower doors 24 and upper doors 25, the outer edges of which form part of the vertical edges or ends of the walls 21 and 22 along the open side of the section.

The walls 21 and 22 are advantageously provided with windows 26 which may be of any desired construction, and the roof 23 may be sheeted with steel, aluminum or a transparent plastic such as Lucite or include transparent sections. Each hangar section 15 and 16 includes a wheel unit 18 mounted in each of the walls 21 and 22 near the doors 24.

The roof of each hangar section takes the form of a slight oval between the upper portions of the walls 21 and 22, as shown, for example, in Figs. 4 and 5 of the drawings, the roof of each section including an oval edge 27 which matches a similar edge of the other section, as shown in Figs. 3 and 4 of the drawings.

My improved hangar sections are advantageously made up of metal structural units such as duraluminum, steel or other suitable forms, and covered with suitable sheeting materials, such as steel, aluminum, Lucite, Plexiglas or other desired materials. The wall frame structures are shown more particularly in Figs. 5 and 6, the walls 21 and 22 being similar and having ends secured to a vertical apex upright or column 28. Each wall also includes a top plate 29 which may be an angle bar as shown in Fig. 11, and a bottom plate 30 which may be a similar structural member. The plates 29 and 30 are connected to the vertical column 28 at the apex and to another vertical upright or column 31 near the wheel units 18. Each wall 21 and 22 also includes a pair of vertical structural members or columns 32 and 33, the latter of which supports the doors 24 and 25. The vertical column 32 is effectively braced to the column 31 by a horizontal metal structural member or members 34 to which a cylinder 35 for the wheel unit 18 is fixed by brackets 35a.

Each of the walls 21 and 22 as shown in Fig. 6, advantageously includes a cantilever bracing structure between the plate 29 and the vertical column 31, comprising an angle brace 36 with a number of truss members 37, 38, 39, 40, 41 and 42, arranged as shown in Fig. 6. The members

36 to 42 may be metal angle irons or equivalent structural shapes.

The roof 23 includes a plurality of rafters 43 illustrated as of angle iron form. These rafters extend between the top plates 29 of the walls 21 and 22, parallel to the front edge 27.

In a preferred form of roof construction, as illustrated in Figs. 5 to 8, the vertical columns 33 for the walls 21 and 22, as shown in Fig. 5, support and are braced by a trussed arch structure made up of a lower beam 44, an upper rafter beam 45 spaced from the lower beam and secured thereto by a multiplicity of bracing elements 46 and 47. In making the trussed beam structure the bracing elements 46 and 47 preferably have their ends overlapped and are riveted or bolted to the beams 44 and 45, as indicated in Fig. 12.

The trussed beam comprising the arched members 44 and 45 is adapted to sustain considerable weight and is provided for the purpose of supporting a cantilever visor type of structure to form the edge 27 of the open end of each hangar section. The portion of the roof of each section, therefore, from the trussed beam to the edge 27, is supported by a plurality of basic cantilever units 48 secured in spaced relation along the beams 44 and 45 in the manner shown in detail in Fig. 12, from which it will be seen that each unit 48 includes a forwardly-projecting upper horizontal beam or bar 49 for supporting the roof sheeting and attached to the beam 45, a brace beam 50 attached to the beam 44 and to the outer end of the bar 49. The two beams 49 and 50 are made into cantilever construction by tie bars 51 and bracing bars 52. The ends of the members 48 are tied together in spaced relation by means of an end bar 53 which is at and forms the edge 27 of the hangar section.

Adjacent roof supports 48 are advantageously braced with respect to each other by means of braces 54 and 55, arranged in the manner shown in Figs. 7 and 8, at least one of the braces, as for example 54, being in the plane of the top of the beams 49 of the members 48. The braces 55 are directly under the braces 54 so that the whole structure comprising the members 48, 44, 45, 53, 54 and 55 comprise a complex cantilever construction adapted to support the roof sheeting and any reasonable snow load thereon, for the complete span between the uprights 33 of each section.

The hanger sections shown in Figs. 5 and 6, as well as those shown in Figs. 7 and 8, include a floor 56 which is preferably made up of sheet steel and supporting steel joist members connected between the sides 21 and 22 of each hangar section. As seen in Figs. 7 and 8, the floor 56 extends into the apex of the walls 21 and 22 along approximately two-thirds of each side, the floor having two converging edges 57 and 58 which meet at a point mid-way of the sides and approximately one-third of the distance from the open side of the hangar section to the apex beam 28. This floor may be at any desired level and is effective for the carrying of tools and various supplies used in the repair of airplanes. Furthermore, the particular web section of the floor 56 in the apex of the section and portions extending along the sides, as shown in Figs. 7 and 8, comprises an effective bracing means for the walls 21 and 22 of the mobile hangar sections.

The wall structures shown in Figs. 5 and 6 differ somewhat in that in Fig. 5 vertical structural members 59 are provided in place of the

members 31. The supporting members and bracing 34 for the cylinders 35 are connected between the uprights 32 and 59. Other vertical structural members 60 are also provided as well as short uprights 61 which extend to the floor 56 from the lower wall plates 30. Corner bracing may be provided between the uprights 33 and the roof beam 44.

The drawings, particularly Figs. 5 to 9, show diagrammatically, the means for attaching the wheel units to the hanger sections and the means for their operation.

The supporting wheel unit 17 adjacent the apex of each hangar section will be seen as comprising a pair of rubber-tired wheels mounted on an axle 62 carrying a forked frame 63, the upper vertical bar of which carries a piston 64 mounted in a pressure cylinder 65. The axle 62 extends through vertical slots in the walls 21 and 22.

Each of the wheel units 18 includes a single rubber-tired wheel mounted on an arm 66 having a vertical portion extending into the cylinder 35 and terminating in a piston 67. It will be understood that the cylinders 35 and 65 with their retaining brackets 35*a* are rigidly mounted with respect to the wall frame of the hangar section and that suitable bracing means are provided to insure vertical movement of the pistons and the rods or arms which connect them with the wheels. Each wheel and wheel unit may be generally of the rubber tire type used for moderately heavy airplanes. The arms 66 and pistons 69 are arranged to rotate to a limited extent in the cylinders 35 so that the wheel units 18 may turn as necessary during the maneuvering of the hangar sections.

In the particular arrangement shown in the drawings, the wheels of the units 17 are mounted outside the walls 21 and 22, while the wheels of units 18 are shown slightly inside the walls but the exact position of these wheels is of no particular importance except that they should be in the approximate positions shown, at the corners of the sections, to properly support and convey the hangar sections. A single wheel of the type of the wheel units 18 may replace the unit 17 if desired, but the two-wheel truck is preferred, and it may be arranged to turn with respect to the hangar section and carry the tow-hitch for pushing or pulling the hangar section.

Either pneumatic or hydraulic means may be provided for elevating the hangar sections with respect to the wheel units. As illustrated in Figs. 5, 6 and 7, this means comprises a power unit 68 for supplying pressure fluid, for example, an air compressor and air storage tank, or a pumping unit and an accumulator for hydraulic fluid. Unit 68 is connected by a main pressure-fluid supply pipe 69 and branch pipes 70 and 71, to the cylinders 35 and the cylinder 65, respectively. The pipe 69 is provided with a main control valve 72, a relief outlet 73 for the lines 70 and 71 having a control valve 74. The lines 70 have control valves 75 and the line 71 has a control valve 76.

The hangar sections shown in Figs. 5 and 6 are resting directly on the ground so that the wheels are not carrying any weight. In this position the valves 74, 75 and 76 are open, while the valve 72 is closed. If it is desired to move a hangar section, the valve 74 is closed and the valve 72 gradually opened to supply pressure fluid, such as air, to the lines 70 and 71, so that the cylinders 35 and 65 are moved up with respect to the pistons 67 and 64, thereby raising the hangar section up so that its weight is carried by wheel units 17 and 18. This position of the wheels and the ground level are shown by dot-and-dash lines in Fig. 6.

When the cylinders are completely up, all parts of the hangar section will have been raised the same amount, for example, ten inches or a foot above ground, because of the similarity of the pistons and cylinders, and then the valve 72 may be closed. When the hangar section is moved to its new position, it may be let down on the ground, if desired, by opening the valve 74 and releasing the air. The wheels may be provided with brakes for use in steering or for setting the sections when they are not let down. Where a hydraulic system is used and oil, for example, is supplied through the line 69, it will be understood, of course, that the relief line 73 will be provided with a return to the oil supply. Valves 75 and 76 may be used individually to cut off the supply of fluid to, the release of fluid from, the respective cylinders, or for controlling the relative rates of supply or release.

It will be noted that the pressure fluid supply unit 58 is carried directly upon the floor 56. This floor may also carry a portable generator, space heater and other equipment, useful in the overhauling and repairing of airplanes.

The towing hitch 19, illustrated as secured to the lower part of the apex of each hangar section, is advantageously comprised of a pair of plates 80 integral with the hitch structure and which are riveted or bolted to the main beam 28, in the manner shown in Figs. 9 and 10 of the drawings. This may be used for pulling or pushing the hangar section into place.

The vertical apex beam 28 is shown as having an arrowhead structure in section, as indicated in Fig. 10. This particular structure provides an effective truss construction for the hangar section, since the walls 21 and 22 converge toward the beam 28 and therefore provide a very stable construction. Instead of making the apex structure pointed, as shown, the apex beam 28 may have a slightly different form, as for example, a modified I-beam construction or T-construction, so that the side walls are attached to the flanges of the T which may be formed into a slightly rounded point. Where the hangar is relatively small the converging walls 21 and 22 may be secured to an end wall of from six to ten feet wide supported by a cantilever bracing frame, but then the side walls must include considerably more bracing than in the construction described above, in order to avoid twisting of the structure.

In the preferred construction, the walls 21 and 22 converge toward each other and their meeting ends are secured to the beam 28 or its equivalent. In this structure where the walls, for example, extend at an angle of 60° with respect to each other, they brace each other, prevent twisting of the structure and provide a sufficiently rigid structure to withstand the wind velocities which may be encountered.

In an illustrative example of a relatively large hangar, the side walls of each section are at an angle of 60° with respect to each other and each ninety feet long from the apex to the edge 27. The walls to the top plate are twenty-five feet high while the roof at the highest point, for example at the center of the arch shown in Fig. 5, is thirty feet. From these dimensions it will

be seen that the span between the front edges of the walls 21 and 22, that is, corresponding to the edges of the doors 24 and 25 when closed, is ninety feet. The doors 24 and 25 are about eight feet wide and the length of the structural unit 48, as shown in Figs. 6 and 12, is from eight to nine feet.

A hangar may be constructed without the visor roof portion supported by the units 48, so that the open face of the hangar would be at the position of the uprights 33. Where the hangar sections are first constructed and used in this way they may be thereafter enlarged by adding the structural units 48 and extending the roof eight or ten feet as the case may be, the doors and other elements of course being added.

What I claim as new is:

1. A generally diamond-shaped mobile aircraft hangar construction, consisting of a pair of similar separately movable sections each of generally triangular-shape in plan and having a closed end and an open end, each section comprising a pair of upright side walls converging toward each other to form the closed end of the section, the ends of the side walls at the closed end of each hangar section being rigidly joined together to form a rigidly braced structure, a roof for each hangar section supported by the side walls thereof and extending from the closed end of the section to the opposite ends of the side walls thereof, the roof and side walls of each hangar section forming a structure having an open end opposite its closed end, the edges of the side walls and roof of one hangar section at its open end matching and engaging the edges of the facing side walls and roof, respectively, of the open end of the other hangar section when the pair of hangar sections are brought together to form an enclosed hangar structure with said hangar sections opening directly into each other, and means for supporting the roof at the open end of each hangar section including a vertical column inwardly of such end at each side thereof, a braced roof-supporting structure extending across the open end portion of the hangar section inwardly of the edge of the roof with its respective ends attached to and carried by the upper portions of the vertical columns of said section, and a plurality of braced roof-supporting members distributed along said braced roof-supporting structure in spaced relation to each other and extending laterally therefrom toward the open end of the hangar section and supporting the portion of the roof extending beyond said roof-supporting structure, said pair of hangar sections being movable apart relative to each other to permit the entrance of an aircraft to a position to be enclosed when the pair of hangar sections are thereafter brought together with their edges at their open ends in engagement with each other.

2. A generally diamond-shaped mobile aircraft hangar construction as defined in claim 1 in which the braced roof-supporting structure extending across the open end of each hanger section is of cantilever construction and each side wall of each hanger section includes a doorway and a door at its edge at the open end of the hangar section, whereby the adjacent doorways of the two hangar sections provide an enlarged doorway on opposite sides of the hangar when the sections are together.

3. A generally diamond-shaped mobile aircraft hangar construction as defined in claim 1 having a wheel unit at each of the three corners of each section for supporting the section above the ground, and power means for the wheel units for lowering and raising the wheel units relative to the hangar sections, whereby the lower edges of the hangar sections may be set on the surface of the ground.

4. A generally diamond-shaped mobile aircraft hangar construction as defined in claim 1 including a floor in each hangar section extending from its closed end a substantial distance but a portion only of the distance therefrom to the open end of the hangar section, said floor extending across the hangar section and being secured to said side walls and thereby bracing the lower portion of the side walls with respect to each other.

5. A generally diamond-shaped mobile aircraft hangar construction, consisting of a pair of similar separately movable sections each of generally triangular-shape in plan and having a closed end and an open end, each section comprising a pair of upright side walls converging toward each other to form the closed end of the section, the ends of the side walls at the closed end of each hangar section being rigidly joined together to form a rigidly braced structure, a roof for each hangar section supported by the side walls thereof and extending from the closed end of the section to the opposite ends of the side walls thereof, the roof and side walls of each hangar section forming a structure having an open end opposite its closed end, the edges of the side walls and roof of one hangar section at its open end matching and engaging the edges of the facing side walls and roof, respectively, of the open end of the other hangar section when the pair of hangar sections are brought together to form an enclosed hangar structure with said hangar sections opening directly into each other, and means for supporting the roof adjacent the open end of each hangar section including a vertical column adjacent the edge of each side wall at the open end of each section, a braced roof-supporting structure extending across the open end portion of each hangar section and under the roof with the respective ends thereof attached to and carried by the upper portions of the vertical columns of the respective sections, and a braced roof-supporting structure extending inwardly and upwardly from the vertical columns at the opposite sides of each hangar section to the upper edges of the adjacent side walls of the respective sections, said pair of hangar sections being movable apart relative to each other to permit the entrance of an aircraft to a position to be enclosed when the pair of hangar sections are thereafter brought together with their edges at the open ends in engagement with each other.

JOHN L. MITCHELL.

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