Oct. 28, 1941. A. EBENHACK 2,260,369

PORTABLE STRUCTURE

Filed Nov. 19, 1940 3 Sheets-Sheet 1

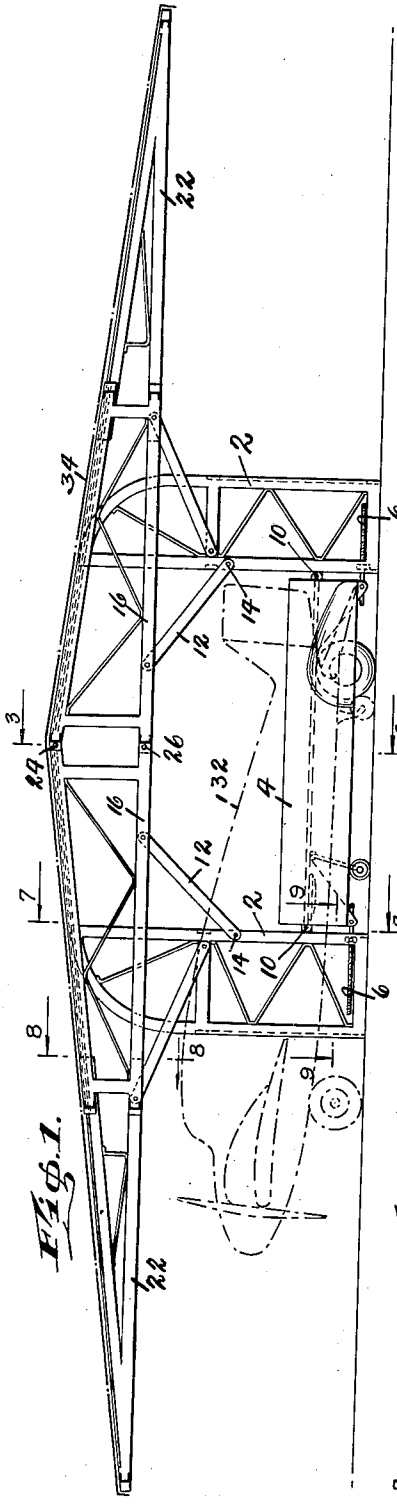


Fig. 1.

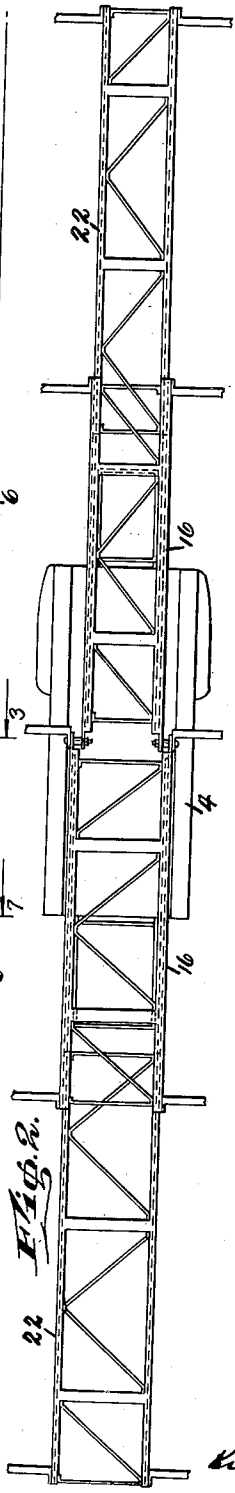


Fig. 2.

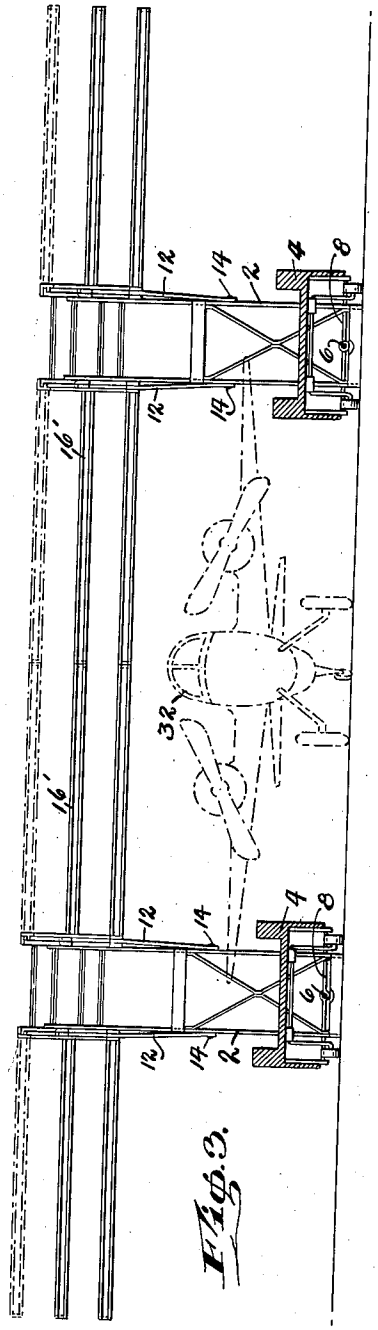


Fig. 3.

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PORTABLE STRUCTURE

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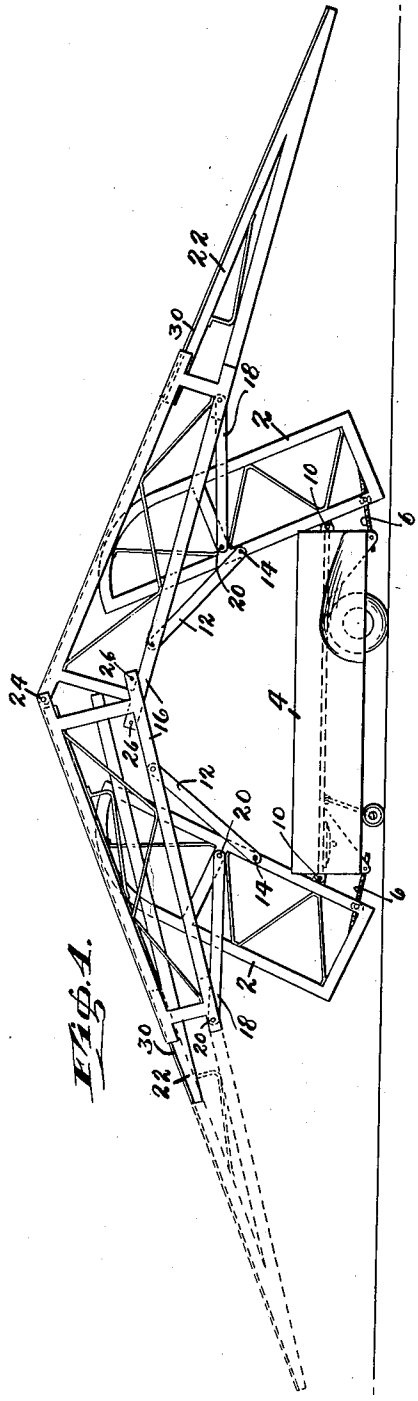


Fig. 4.

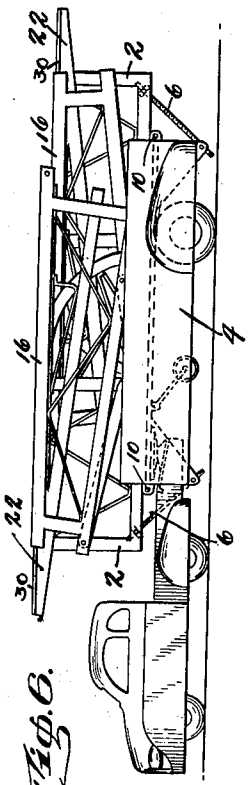


Fig. 6.

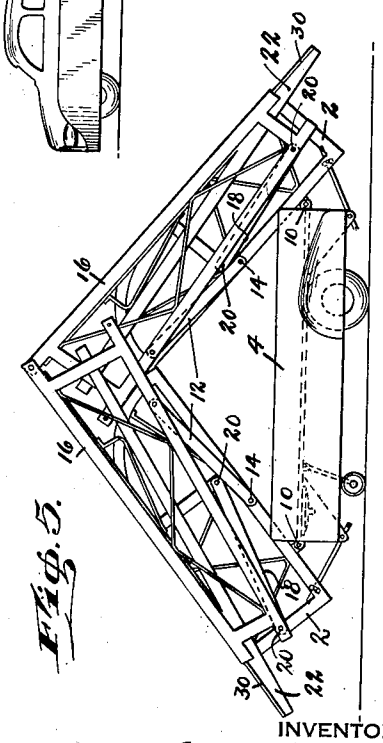


Fig. 5.

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PORTABLE STRUCTURE

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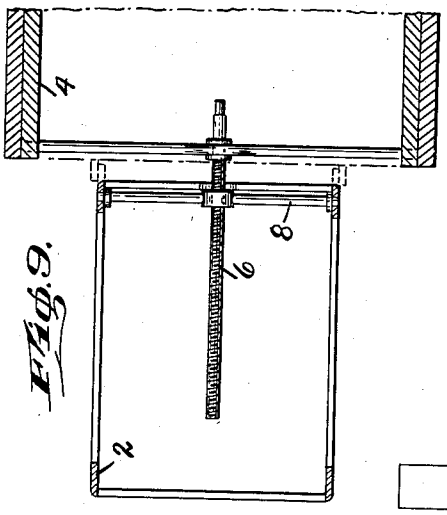


Fig. 9.

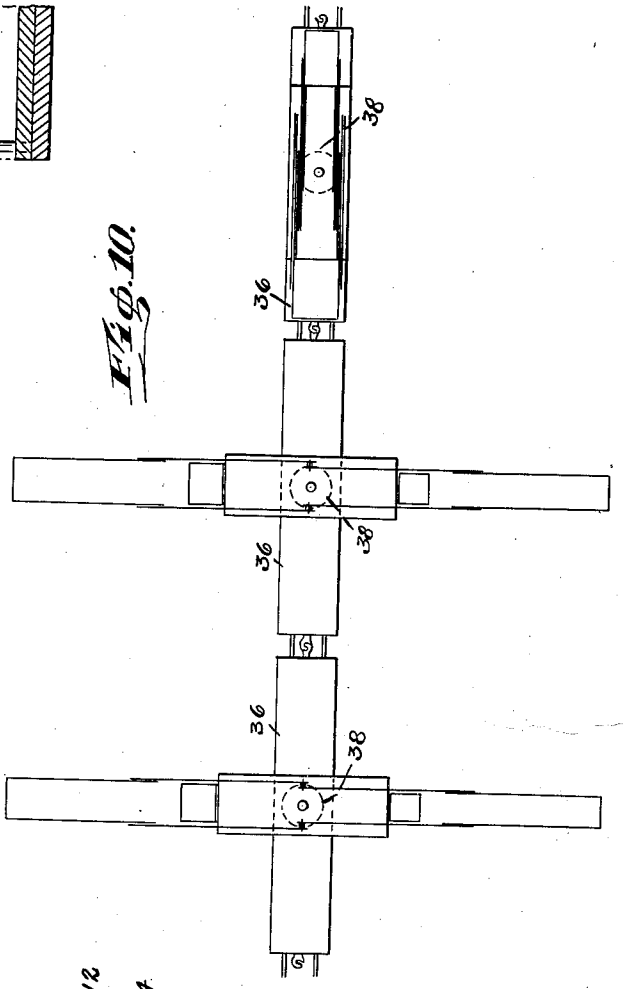


Fig. 10.

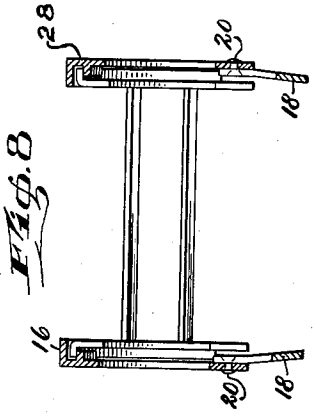


Fig. 8.

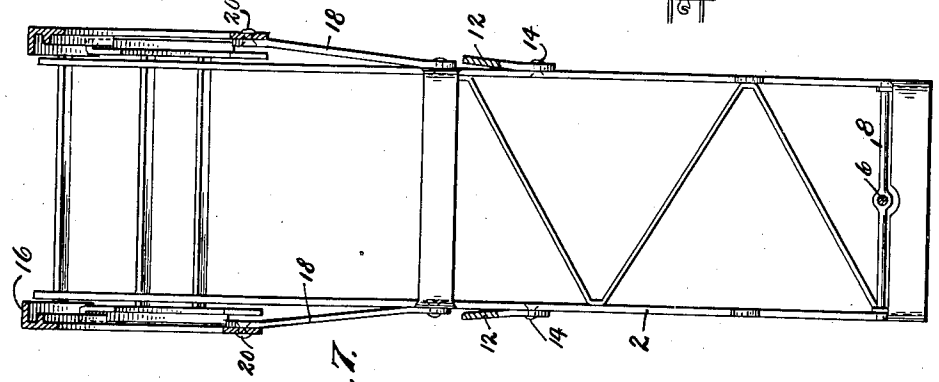


Fig. 7.

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2,260,369

PORTABLE STRUCTURE

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Application November 19, 1940, Serial No. 366,211

11 Claims. (Cl. 189—2)

This invention relates to improvements in portable structures and is particularly directed to portable roof supporting structures such, for example, as a framework for airplane hangars which under this invention are adapted to be collapsed and transported from place to place on trailers or railway flat cars and which can be erected with the minimum of time and effort.

I appreciate it has been suggested prior to my invention that portable structures be made in a knocked-down condition so that they may be readily transported, assembled at the site and erected. My construction, however, is superior to these prior structures in that the same is composed of a novel arrangement of structural sections, braces, etc. hinged together in such a manner that the structure can be collapsed in assembled form to facilitate transporting from place to place, and when the new site has been reached the equipment is simply raised or expanded into erected position in the one operation. This it will be appreciated, does away with knocking down the structure when moving from one site to another and with the necessity of reassembling when the new site has been reached.

In the accompanying drawings wherein I have illustrated an embodiment of my invention:

Fig. 1 is a side elevational view of my improved apparatus;

Fig. 2 is a plan view;

Fig. 3 is a view taken on the line 3—3 of Fig. 1;

Figs. 4, 5 and 6 are elevational views showing my equipment being lowered into completely collapsed position ready for transport;

Figs. 7, 8 and 9 are views taken on the lines 7—7, 8—8 and 9—9, respectively, of Fig. 1; and

Fig. 10 is a plan view somewhat diagrammatic showing my equipment on railway flat cars.

It is to be understood that my apparatus comprises any number of units, each being a duplicate of the other, and that each unit may be transported on its own vehicle such as a trailer, for instance, or railway flat car. On the other hand, a number of these units may be shipped or transported in the one vehicle.

I find it convenient in some instances so to arrange my apparatus that the vehicle such as a trailer by which the apparatus is transported from site to site remains in place after the units have been erected. However, this is not always necessary or desirable. When transporting my equipment on railway flat cars, for instance, after the units have been erected then the flat cars may be removed. Likewise, if more than one unit is transported in a railway car then the same can be unloaded at suitable loading platforms and erected without the railway car constituting any part of the equipment at all.

It will be seen from Fig. 1, for instance, of the drawings that each one of my units comprises a pair of steel latticework towers 2 which will stand vertically and rest upon the ground or other support when the apparatus is erected. As above noted, Fig. 1 shows one of my units in erected position and it will be seen from this figure that the base of the towers 2 rests upon the ground.

Still referring to Fig. 1 of the drawings, my units may be collapsed without the necessity of disassembling so as to be transported on vehicles 4, such as a trailer, for instance. Various devices may be employed for erecting the equipment after the same has been transported to its new site or location, and in the drawings of the present application I have shown by way of example jack screws 6 for this purpose, these jack screws passing through crosspieces 8 of the towers 2. There are two of these jack screws, one at each end of the vehicle 4. As will be pointed out shortly, operation of these jack screws will raise or lower the towers 2 to vertical or horizontal position, the roof supporting beams carried by the towers being moved accordingly at the same time. I might point out also that in erecting the towers, that is, moving the same to vertical position, the towers will be unloaded from the vehicle carrying the equipment to a position where the foot of each tower rests upon the ground.

The towers are pivoted to the vehicles 4 at 10 and it will be quite obvious from Figs. 1 and 4, for instance, of the drawings, that when the jack screws 6 are operated the towers will be raised from the horizontal position of Fig. 6, for instance, to the vertical position of Fig. 1, moving about the pivots or fulcrums 10.

Each of the towers 2 carries cantilevers 12 pivoted to the towers as at 14, the outer end of each of these levers being pivotally connected to roof supporting members or roof supporting beams 16. These beams 16 are of steel, for example, and of skeleton construction suitably braced for strength. This reduces weight but at the same time provides a sufficiently strong beam for supporting the roof. There are two of these beams to each unit, a beam being attached to each of the towers 2. Pivotally attached to the towers 2 and to the beams 16 are control levers 18. These control levers are

shown pivoted to the towers and to the beams 16 at 20.

From the description thus far given it will be seen that by proper application of power to the towers 2 and with proper connection between the towers 2 and the roof supporting beam 16 the entire equipment may be moved from the horizontal position shown in Fig. 6 to the position shown in Fig. 1. As above explained, the motive power for raising and lowering the equipment, that is, expanding and collapsing the equipment, is applied through the jack screws 6, as illustrated in the drawings, these jack screws being either manually or motor operated. It is to be distinctly understood, however, that the jack screws are shown merely by way of example and that any other suitable mechanism may be employed in their stead for this purpose. In other words, my invention comprehends the affixing of roof supporting members to the towers 2 in such a manner that the roof supporting members will rest in the same plane with the towers when the equipment is collapsed and when the towers have been raised from horizontal to vertical position the roof supporting members will be disposed in horizontal position at the top of the towers by which they are supported. I have illustrated the roof supporting members and the towers as nesting when the equipment is collapsed. It is to be understood that it is within the comprehension of my invention to have these various members lie one upon the other, if desired.

Each of the roof supporting beams or girders 16 carries one or more extensions 22. These extensions are longitudinal extensions provided for the purpose of enabling the roof supporting structure to be increased to any desired width. I have shown these members 22 as telescoped by the beams 16. This, however, is merely by way of illustration inasmuch as it is within the purview of my invention to provide several of these members for each girder 16, if so desired, and to hinge the same to each other so that they may be folded back upon the girders 16 when the equipment is collapsed. I think it plain that when the equipment is fully erected or expanded, as in Fig. 1, the provision of the extensions 22 practically, as illustrated in the drawings, doubles the length of the girders or beams 16.

During the expanding of the structure, that is to say, during the raising of the structure from horizontal position to erected or expanded position, the towers 2 are rotated about the fulcrums 10 as previously explained until the adjacent ends of the beams 16 overlap at 24 whereupon a pin is inserted through the overlapped ends of the beams at this point so that, as will be quite apparent from Fig. 4 of the drawings, further movement of the towers 2 about their respective fulcrums toward vertical position will through the cantilevers 12 and the control levers 18 effect a swing of the beams 16 downwardly and outwardly so far as their inner ends are concerned and an upward movement of the rear end of each of the roof supporting girders 16, finally to bring these girders into the position shown in Fig. 1 with the towers 2 in vertical position. It will be understood that the same effect can be produced by pinning the overlapping ends of the beams 16 together at 26 instead of at 24 as described.

It will be appreciated that in expanding my equipment the extensions 22, if they are of the sliding type, can be allowed to slide outwardly by gravity so that when the towers 2 have reached vertical position the members 22 will be fully extended. Suitable means can be provided at the inner ends of the extensions 22 to limit their outward movement.

It will be appreciated that many different types of connections may be provided between the extensions 22 and the beams 16 to permit a sliding movement of one with respect to the other, if this is the arrangement to be employed. I have simply illustrated a channel for the side members 28 of the beams or girders 16 and the webs 30 of the extensions 22 slide in these channels. Transverse girders 16' may be provided between and beyond the towers as shown in Fig. 3. These girders may be in the form of channels and secured to the towers in any suitable manner.

It will be seen from the drawings that all of my equipment is in skeleton form for reducing the weight of the equipment but properly braced for strength.

In the use of my equipment it will be understood that the unit of Fig. 1 is used in pairs as illustrated in Fig. 3, for instance, which is a view taken at right angles to Fig. 1. Here I have shown a pair of the units of Fig. 1 disposed side by side so as to provide a space between the towers 2 of one unit and the towers 2 of an adjoining unit, which space is usable, for example, as a storage space for an airplane which has been indicated in dot and dash line at 32. It is to be understood that any suitable type of roof may be supported by my roof supporting structure when the same has been erected. This may be merely a tarpaulin, for instance, and for this reason I have merely indicated a roof diagrammatically in Fig. 1 where it has been designated 34. I should like to point out, however, that it is practicable to apply the roof to the structure as the structure is being erected. For example, as illustrated in Fig. 4 it is feasible to roll the roof up the inclined surface of the roof supporting members 16 and 22 before these members have reached their final position so that when the towers 2 have reached their vertical position not only will the roof supporting members or girders be in roof supporting position but the roof will be in place also.

It is thought that further explanation of the operation of my equipment is unnecessary as the same has been very fully illustrated in the drawings, particularly Figs. 4, 5 and 6.

In Fig. 6 of the drawings the equipment is completely collapsed ready for transport on a vehicle such as a trailer 4. When the vehicle has been transported to the site at which the equipment is to be erected, it is merely necessary to operate the jack screws 6.

In Fig. 5 I have shown the equipment being raised. In this figure it has been raised sufficiently so that the pins 24 may be placed in position and further operation of the jack screws 6 will raise the towers 2 to a more nearly vertical position carrying with it the roof supporting members.

In Fig. 4 it will be seen that the parts are almost in completely raised position. As the towers 2 move from a horizontal or collapsed position toward the vertical, the roof supporting girders carried thereby will be raised higher and higher until they have assumed the position shown in Fig. 1. As above mentioned, with the parts in this position the base of each tower rests upon the ground so that the whole structure has

a steady footing and is not merely supported by the vehicle 4.

If desired the equipment may be transported on railway flat cars such as illustrated in Fig. 10 wherein 36 designates the flat cars. In the car at the right of this series of three the equipment is shown in collapsed position and extending lengthwise of the cars.

In this connection it is desirable to equip each of the flat cars with a turntable 38 and when the cars have been brought to the desired site then these turntables are operated to turn each unit through an angle of 90° so that the units then lie crosswise of the cars. They may then be erected as described in connection with Figs. 1 to 6, for instance, disconnected from the turntables 38 and the cars moved away. As many units, of course, under these conditions can be erected as there are cars 36.

I have described my equipment in connection with the erection of hangars for airplanes, for instance. This is for the purpose of illustration and clarity of description, it being obvious that my construction may be employed for supporting the roof of any building which is to be temporary and which is to be transported from site to site. Of course there is nothing to prevent the structures being left in position permanently but I believe my invention finds its greatest field of use in connection with the erection of temporary structures such, for instance, as airplane hangars and the like.

While the question of dimensions does not enter into this invention particularly, I might mention that in practice my equipment can be transported on trailers 30 feet long and expanded when erected to a width of approximately 120 feet. This would provide adequate size in multiple units to create the framework of an airplane hangar for most planes. Of course, if the equipment is to be transported on railway cars then the possibilities so far as width of expansion are concerned are much greater.

Again reverting to the uses to which my equipment may be put, it is to be understood that the same is suitable as a framework for barracks, mess rooms, staff headquarters, portable bridges and the like in addition to its use as a structure for supporting the roof of airplane hangars.

It is to be understood that changes may be made in the details of construction and arrangement of parts without departing from the spirit and scope of my invention.

What I claim is:

1. A portable structure comprising a pair of towers and a pair of roof supporting girders pivotally attached thereto by a cantilever and a control lever, whereby as the towers are swung about a fulcrum intermediate their ends from a horizontal to a vertical position the roof supporting girders will be elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position.

2. A portable structure comprising a pair of towers, a pair of roof supporting girders pivotally attached to the towers, and means for actuating each of the towers about a fulcrum intermediate the ends of each tower from a horizontal to a vertical position the roof supporting girders being elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position.

3. A portable structure comprising a pair of towers fulcrumed intermediate their ends and so disposed that when in horizontal position they will overlap each other, a roof supporting girder pivotally attached to each of said towers by a cantilever and a control lever, whereby as said towers are swung about their respective pivots from a horizontal to a vertical position the roof supporting girders will be elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position.

4. A portable structure comprising a pair of towers fulcrumed intermediate their ends and adapted to be swung from vertical position to horizontal overlapping position, a roof supporting girder pivotally attached to each tower by a cantilever and a control lever, said girders with the towers collapsed lying in overlapped relation, whereby as said towers are swung about their respective fulcrums to carry them into vertical position in spaced relation to each other, the said girders will be elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position.

5. A portable structure comprising a pair of towers fulcrumed intermediate their ends, roof supporting girders pivotally connected thereto and to each other, one for each tower, means for pivoting the towers about their respective fulcrums, the connections between the towers and girders being such that when the towers are pivoted about their fulcrums to horizontal position the girders will be lowered into an intermediate position, where, upon removing the pivotal connection between them, continued movement of the towers to a horizontal position will move the girders to a horizontal position.

6. A portable structure comprising a pair of towers fulcrumed intermediate their ends, roof supporting girders pivotally connected to each other, one for each tower, a control lever and a cantilever through which the girders are attached to the towers, the connections between the towers and girders being such that when the towers are pivoted about their fulcrums to horizontal position the girders will be lowered into an intermediate position, where, upon removing the pivotal connection between them, continued movement of the towers to a horizontal position will move the girders to a horizontal position.

7. A portable structure comprising a pair of towers fulcrumed intermediate their ends to a carrier, roof supporting girders pivotally attached to the towers, and actuating means for pivoting the towers about their fulcrums from a horizontal to a vertical position, to unload the towers from the carrier, the roof supporting girders being elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position.

8. A portable structure comprising a pair of towers fulcrumed intermediate their ends, roof supporting girders pivotally attached thereto, a

vehicle carrying the structure, and actuating means carried by the vehicle for pivoting the towers about their fulcrums from horizontal to vertical position with the foot of each tower resting upon the ground, the girders being elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position to a horizontal position end to end at the top of the towers.

9. A portable structure comprising a pair of lattice towers fulcrumed intermediate their ends, roof supporting girders connected thereto by a control lever and a cantilever, means for pivoting said towers about their fulcrums from horizontal to vertical position, said girders being of channel section and so dimensioned that when the towers are horizontally disposed the girders will telescope each other as well as the towers.

10. A portable structure comprising a pair of towers fulcrumed intermediate their ends, roof supporting girders pivotally connected to the towers, extensions for said girders, and means for pivoting said towers about their respective fulcrums to raise the same from horizontal to vertical position thereby to carry the girders therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position.

11. A portable structure comprising a pair of lattice towers fulcrumed intermediate their ends, lattice roof supporting girders connected to the towers by a control lever and a cantilever, means for pivoting said towers about their fulcrums to raise the same from horizontal to vertical position, the girders being elevated therewith to an intermediate position, where, upon a pivotal connection being made between adjacent ends of the girders, continued movement of the towers to a vertical position will move the girders to final elevated position and extensions for said girders slidable endwise thereof, said extensions being telescoped by the girders when the towers are pivoted to horizontal position.

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