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Vredevoogd

[11] **3,838,726**

[45] **Oct. 1, 1974**

[54] **OVERHEAD DOOR FOR NON-RECTANGULAR OPENINGS**

[75] Inventor: **Jon D. Vredevoogd,** Mason, Mich.

[73] Assignee: **Tension Structures Co.,** Pleasant Ridge, Mich. ; a part interest

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[52] **U.S. Cl.** ..... **160/188,** 160/201, 135/14 D

[51] **Int. Cl.** **E05f 15/00,** A45f 1/08

[58] **Field of Search** ..... 135/14 D; 160/188, 201, 160/185, 187; 49/197–200

[56] **References Cited**

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Primary Examiner—Peter M. Caun

[57] **ABSTRACT**

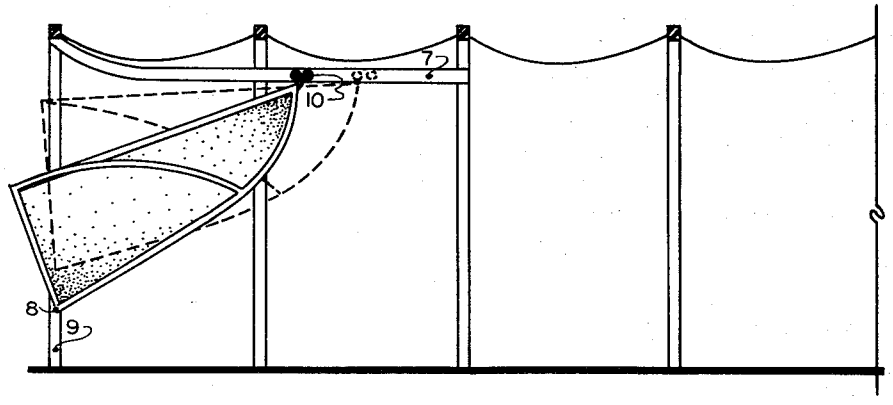
An overhead door for non-rectangular openings and a method for assembling and operating the door.

By folding the door along one or more vertical lines, the overhead door can be moved inside non-rectangular openings.

The assembly and attachment of the door consist of hinging together the sections of the door along their vertical sides. The door is attached to the structure at a minimum of three points. The outside right and left edges of the door are attached to vertical tracks located at the lower inside corners of the structural opening and the top of the door is attached to a horizontal track located at the highest point or points inside of the structure opening and extends back into the structure. The lower outside ends of the door move up their respective vertical tracks while the top attachment is moving back into the structure along its track. At the same time the door is folding along its hinged points allowing it to move into the structural opening.

The door may be powered or manual depending upon the size and need.

8 Claims, 11 Drawing Figures



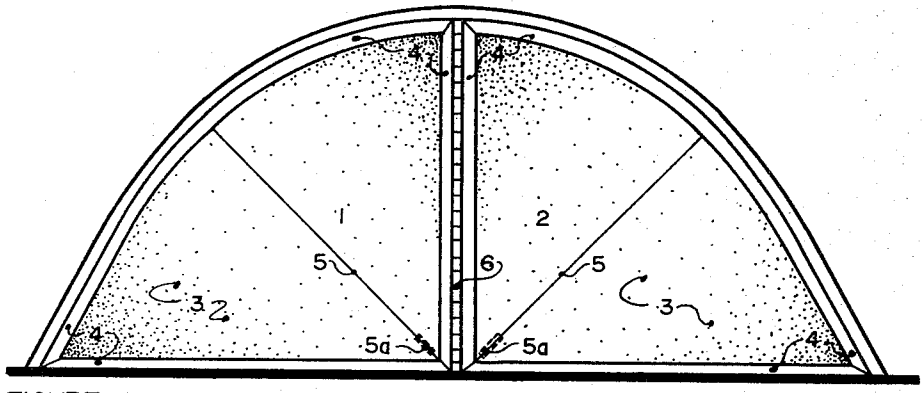


FIGURE 1

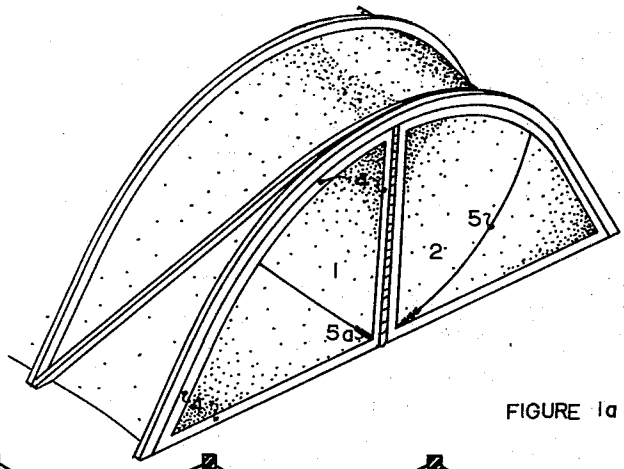


FIGURE 1a

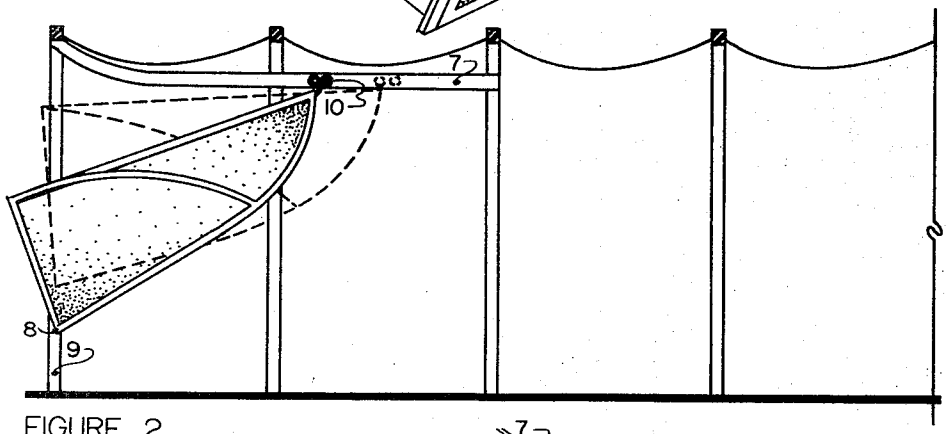


FIGURE 2

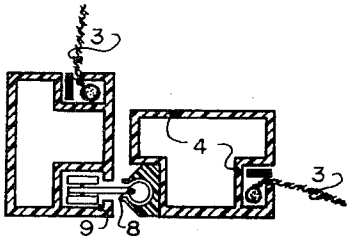


FIGURE 2b

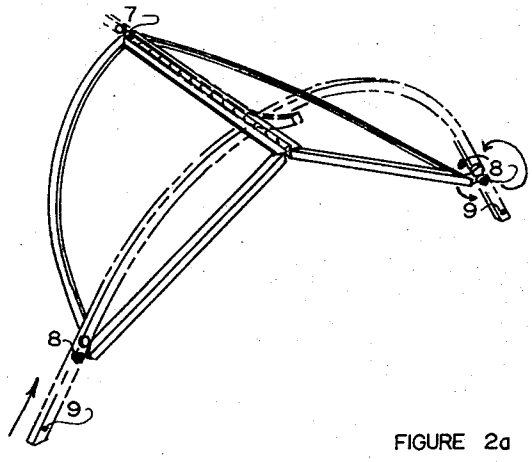


FIGURE 2a

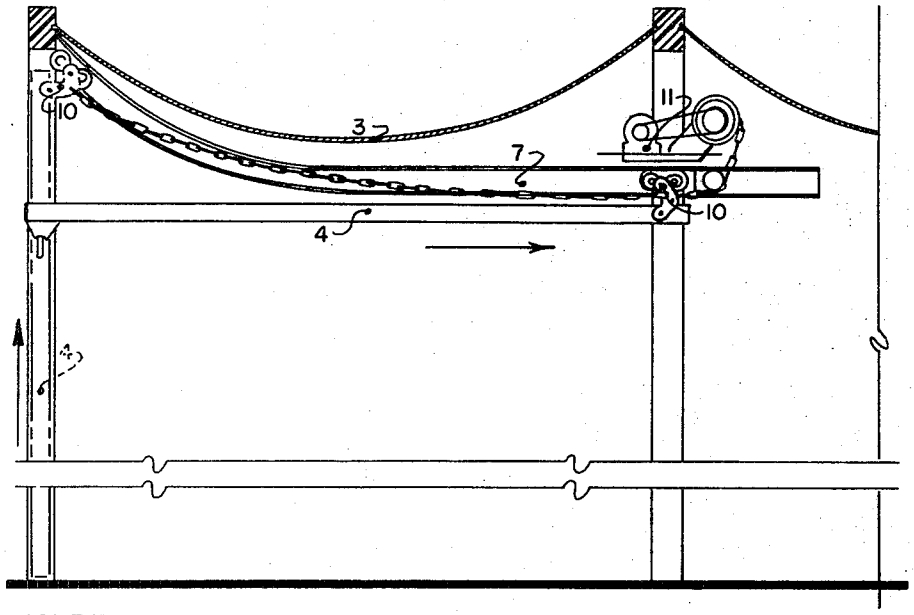


FIGURE 3

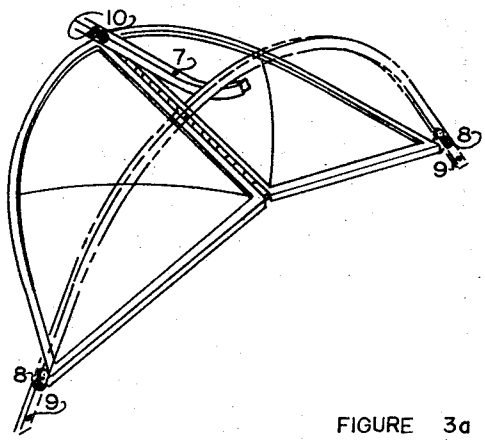


FIGURE 3a

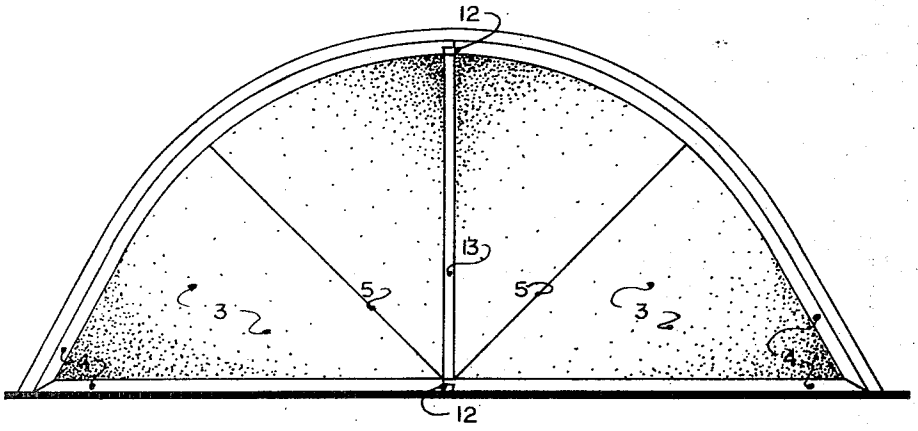


FIGURE 4

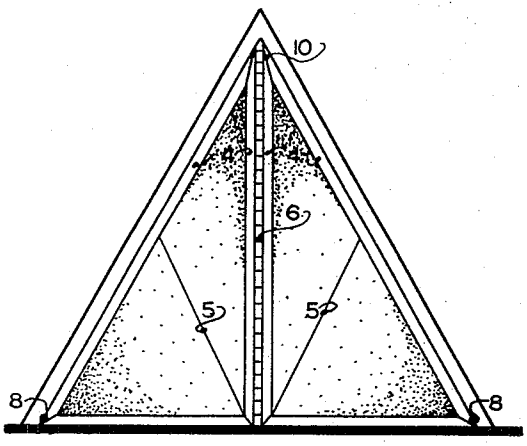


FIGURE 5

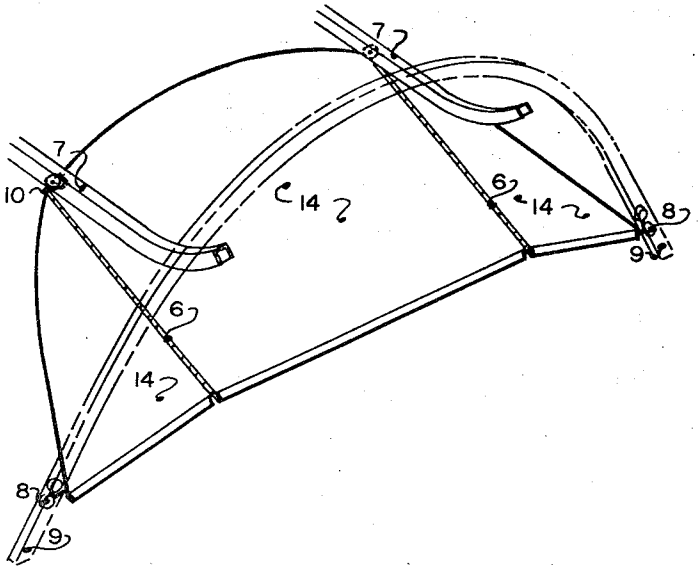


FIGURE 6

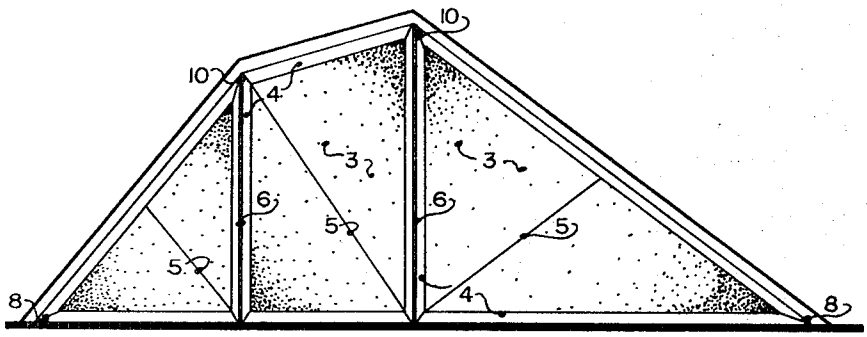


FIGURE 7

OVERHEAD DOOR FOR NON-RECTANGULAR OPENINGS

BACKGROUND OF INVENTION

This invention consists of a new door or closure for structures whose shape does not lend itself to conventional means for opening large sections of the structure as would be necessary for an air craft hangars, garages, or warehouses. This door not only provides for non-rectangular structural openings as for Arch Supported Membrane Structures, but for "A" frame structures, dome structures or any of the non-rectangular symmetric and non-symmetric structures.

SUMMARY OF INVENTION

The principal object of this invention is to provide an end closure or door for non-rectangular structural openings.

A second object of this invention is to provide an end closure or door for asymmetric or non-uniform structural openings.

Another object of this invention is to provide a door which can be stored within the structure and requires very little additional projected area, to the building covered area, for its operation.

A further object of this invention is to provide a door which can be used with membrane, tension inflatable or rigid structures.

Another object of this invention is to provide a door which will resist hing winds while closed and during its travel to its open position.

Still another object of this invention is to provide a more simplified mechanism for opening and closing large non-rectangular doors.

A still further object of this invention is to provide a light weight, economical door for large structures.

Another object of this invention is to provide a door which will open the entire end of a structure.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a front view of an arched structural opening with a door in its closed position.

FIG. **1**a is an isometric view of an arched structural opening with a door (FIG. **1**) in its closed position.

FIG. **2** is a section view of an arched structural opening with a door (FIG. **1**) in its partly opened position.

FIG. **2**a is an isometric view of an arched structural opening with a door (FIG. **1**) in its partly opened position.

FIG. **2***b* is a cross-sectional view showing the relationship between arch **9** and door frame **4.**

FIG. **3** is a section view of an arched structural opening with a door (FIG. **1**) in its open position.

FIG. **3**a is an isometric view of an arched structural opening with a door (FIG. **1**) in its open position.

FIG. **4** is a front view of a membrane and frame door illustrating the use of pivot hinges and membrane as the folding mechanism.

FIG. **5** is an isometric view of a triangular structural opening with a door in its partly opened position.

FIG. **6** is an isometric view of an arched structural opening with a double hinged door in its partly opened position.

FIG. **7** is a front view or an asymmetric structural opening with a door in its closed position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. **1** this overhead door is illustrated in a circular arch opening. The door has two sections, **1** and **2,** comprised of a membrane **3,** attached to frames **4** and tensioned by a bowed (outward) resilient tensioning member **5.** An adjustable means **5***a* is used to increase or decrease the length of the bowed member **5,** which in turn, increases or decreases the tension in the membrane **3.** The sections **1** and **2** are joined by a hinge **6** to permit partial folding of the door as it is opened.

FIG. **1***a* is a view of the above door at the end of a curved arch structure illustrating that it can be used as a full opening door for such structures.

FIG. **2,** is a cross-sectioned side view of a curved arch structure as shown partially in FIG. **1***a* to illustrate an overhead track **7** that is attached to the structural arches **9** and supports the sectional door shown in FIG. **1***a*, as the upper part of the door moves inward under the apex, or crown of the structure, as the door is opened. The door lower side edges are structurally attached to the arch **9** by a pivoting guide device **8** that permits the lower edges of the door to rise along the lower legs of the arched opening as the crown of the door moves inward supported by the track **7** through the roller attaching device **10.**

In FIG. **2***a*, the relation of the door frame sections **1** and **2** hinged together and partially folded in its full open position is illustrated to show that the lower side edges of the door move upward along the arch **9,** while being secured to the arch **9** by the structural guide **8.**

FIG. **2***b* is a cross-section through the arch **9** which serves as the opening frame and the door frame **4** which are attached to each other structurally to secure the lower part of the door to the building structure as it is opened or closed. In this illustration, the membrane-arch structure has the building membrane **3***a* attached to the building arch **9** and the door membrane **3** attached to the door frame **4.** The pivoting-roller attachment between the door frame **4** and the opening frame **9** is shown in cross-section as **8.** This attachment to the lower part of the door permits three movements at this junction: (1) up and down, (2) pivot front to back, and (3) pivot right to left. This is accomplished by use of a ball joint attached to a slide or roller guide. It is also possible to use an independent support instead of the column **9** to secure the roller-pivot device **8** to the base instead of attaching it to the frame of the opening.

In FIG. **3** a power drive **11** is illustrated to open and close the door. This cross-section indicates the position of the trolley-carrier **10** at the top of the curved track **7** when the door is closed, and near the opposite end of the curved track **7,** when the door is in the full open position. The frame member **4** indicates the position of the door frame member that is hinged to the adjacent door frame member in the center of the door, in this case.

FIG. **3***a* illustrates the relation of the frame of the door to the frame of the opening when the door is partially opened.

In FIG. **4** the same door as shown in FIG. **1** is illustrated without a continuous hinge. Individual hinges **12** are installed at the top and bottom of member **13** which has the membranes **3** attached to it in a manner that permits the membrane to pivot around the fastener

without effecting a change in membrane tension. This provides a weatherproof fabric or membrane hinge between pivot hinges **12.**

In FIG. **5** a triangular door opening is shown with a triangular two sectional door. The sections are hinged together **6** and the door is opened and closed as described above.

In FIG. **6** a three sectional door is illustrated with hinges **6** attaching the adjacent panels **14** together. In this case two tracks **7** are used and are attached **10** to the upper portion of the door near the upper ends of the hinge points. The tracks **7** support the door as it moves inward and outward on the roller attachment **10** to the door. The door panles can be rigid. Multiple hinges **6** of two or more allows flexibility in shaping the door opening.

FIG. **7** illustrates that this invention can be used for odd shaped openings such as the asymmetric opening shown here. Multiple hinges **6** and door panels of different configurations consisting of tensioned membrane panels **3** in frames **4** as shown here or solid panels of wood, glass or other materials could also be used instead of the membrane **3,** without the member **5.**

I claim:

1. An overhead door in an opening of a structure comprised of a plurality of vertical panels hinged together between their adjacent vertical edges and operatively attached to at least one overhead door track and at least two door lower guides; said overhead track being attached to and supported by said structure and said door lower guides being structured fixed in relation to said door opening; means to operatively attach said vertical panels to said overhead track and means to attach the lower portion of said door panels to at least two structural guides located near said door lower side edges; the arrangement being that as the door opens said vertical panels partially fold as the top of said door moves inwardly while supported by said overhead track and the bottom of said door moves upwardly while being secured by said door guides until the center portion of said door reaches a substantially horizontal position at the maximum opening.

2. Same as claim **1,** except that said overhead door includes a vertical panel that is shaped concavely outward.

3. Same as claim **2,** except the multiplicity of said vertical panels form a curved arc between outer edges of said door.

4. Same as claim **1,** except that the vertical panels comprise frames and contoured tensioned membranes having outward curvature to resist wind forces.

5. Same as claim **4,** except said membranes form a tensioned surface with a double curvature.

6. Same as claim **1,** except that said door opening is an arch with a formed bight section.

7. Same as claim **1,** except that said door opening is triangular in shape.

8. Same as claim **1,** except that included in a powered means for opening and closing the door.

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