Sept. 2, 1958 E. W. LEATHERMAN 2,850,026

AIRPLANE HANGAR

Filed July 1, 1954 3 Sheets-Sheet 1

Fig. 1

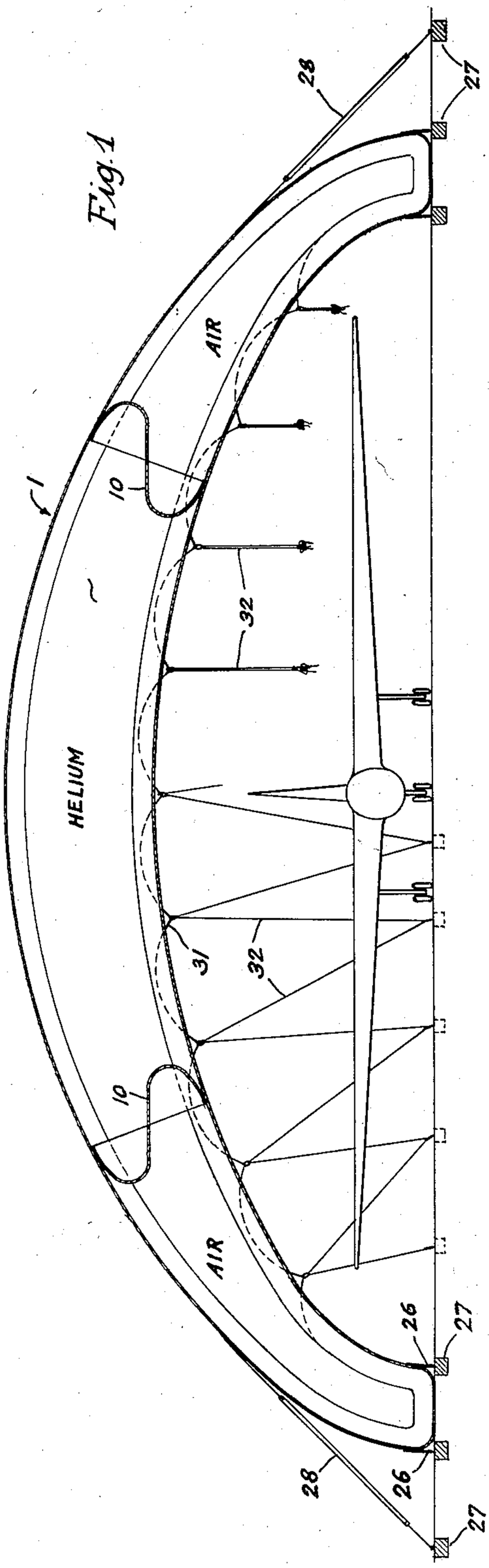
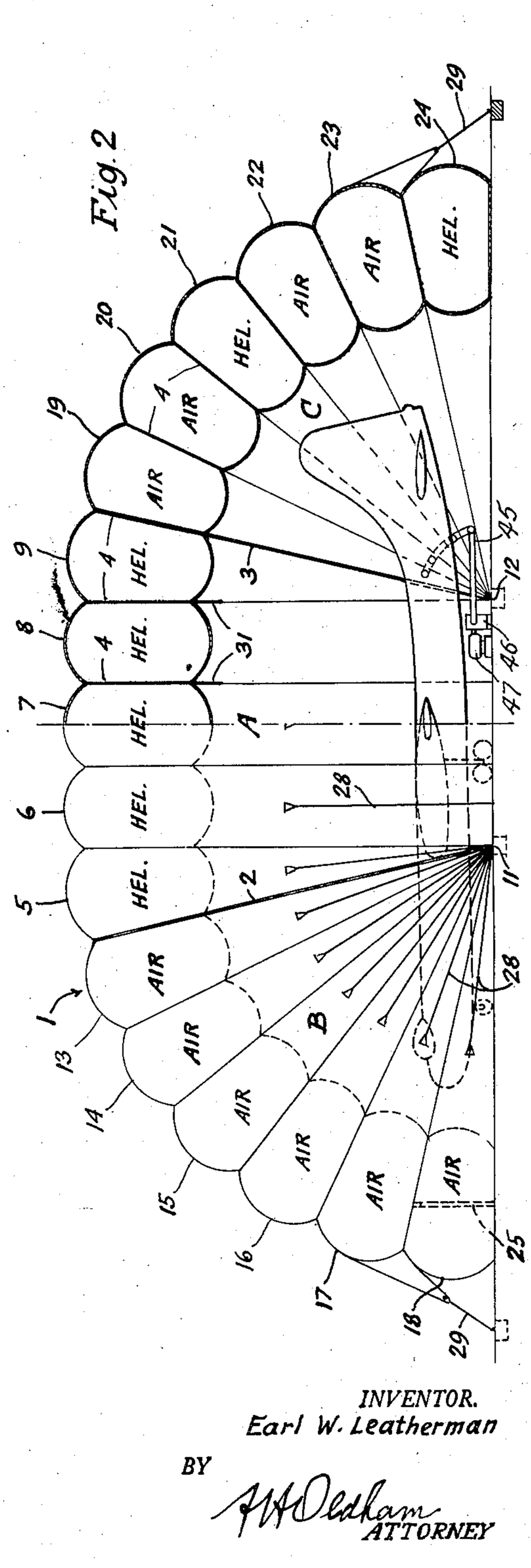


Fig. 2



INVENTOR.
Earl W. Leatherman

BY
J. A. Oldham
ATTORNEY

Sept. 2, 1958 E. W. LEATHERMAN 2,850,026

AIRPLANE HANGAR

Filed July 1, 1954 3 Sheets-Sheet 2

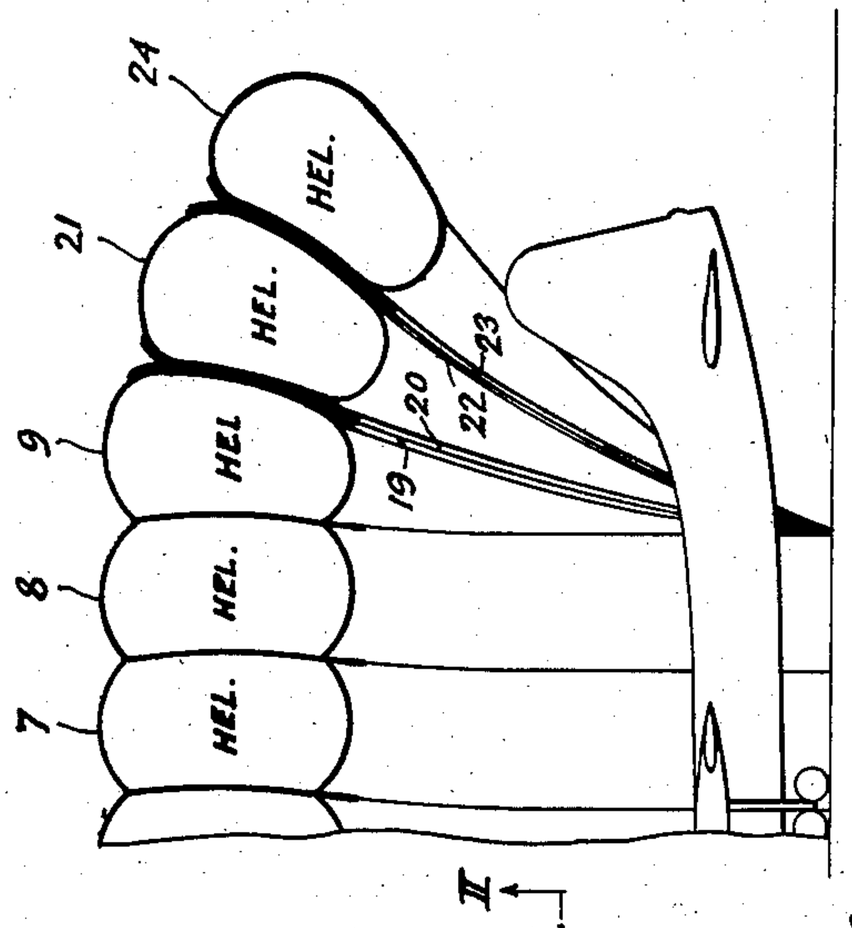


Fig. 4

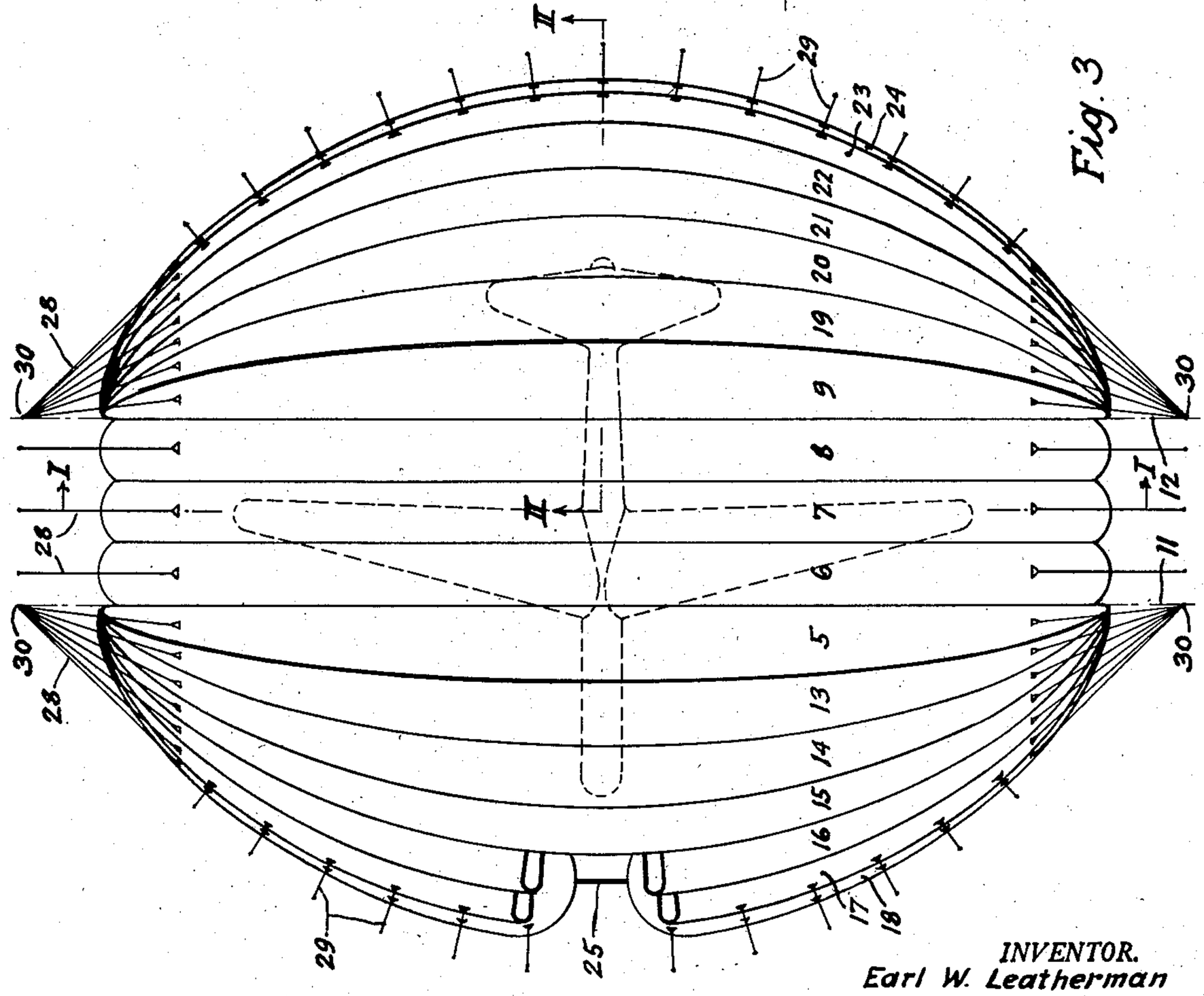


Fig. 3

INVENTOR.
Earl W. Leatherman

BY

ATTORNEY

Sept. 2, 1958 E. W. LEATHERMAN 2,850,026

AIRPLANE HANGAR

Filed July 1, 1954 3 Sheets-Sheet 3

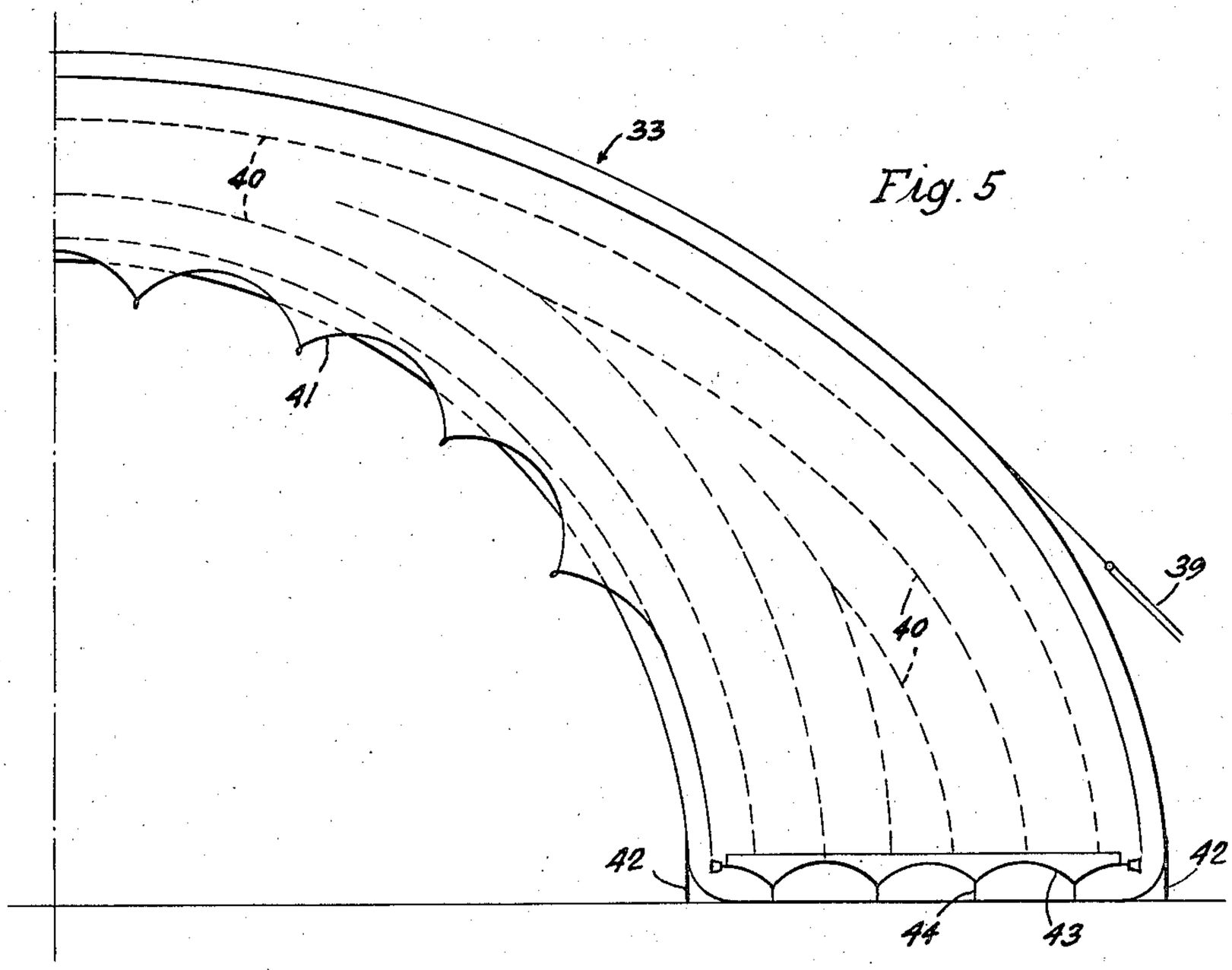


Fig. 5

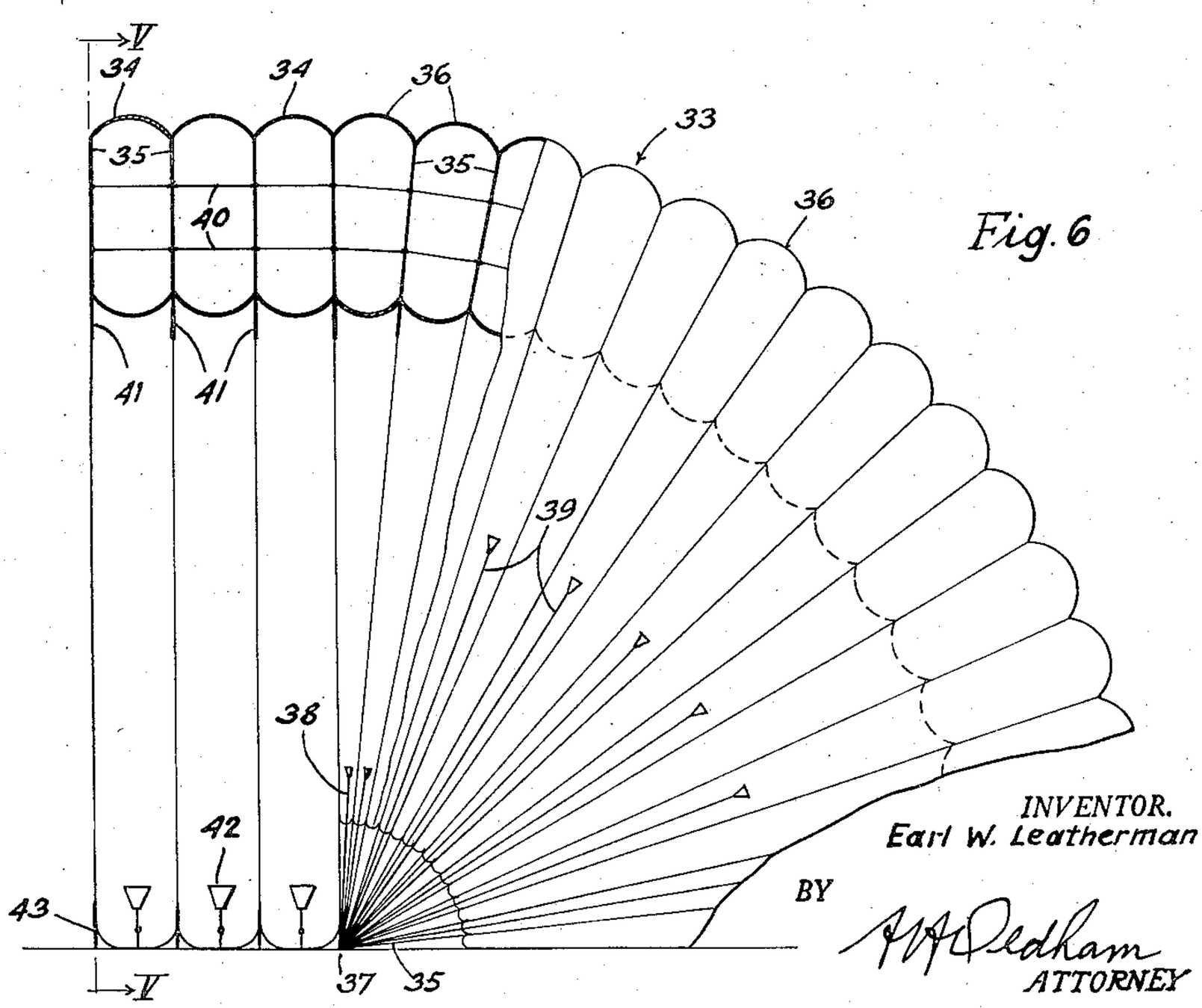


Fig. 6

INVENTOR.
Earl W. Leatherman

BY

Pedham

ATTORNEY

United States Patent Office

2,850,026
Patented Sept. 2, 1958

2,850,026

AIRPLANE HANGAR

Earl W. Leatherman, Akron, Ohio, assignor to Goodyear Aircraft Corporation, Akron, Ohio, a corporation of Delaware

Application July 1, 1954, Serial No. 440,743

5 Claims. (Cl. 135—1)

This invention relates to the construction of shelters and in particular to that of large, light-weight airplane hangars of cellular gas-inflatable structure made of fabric and which is capable to be erected by inflating it and dismounted by evacuation within a minimum of time.

Heretofore, it has been known to build Quonset-shaped shelters of relatively small spans used for various purposes out of canvas material in combination with rigid supporting arches made of light metal. Such construction, however, useful for small sized shelters, would not be applicable for shelters to house giant airplanes having wing spans of two hundred and more feet.

It is the general object of the invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by providing a shelter which is light in weight and therefore easily transportable, capable of easy erection, as well as, dismountable within shortest possible time at low cost.

Another object of the invention is to provide a novel way of operating the hangar door by deflating and inflating, respectively, the air inflated cells at the door end of the hangar structure for passage of an airplane.

The aforesaid objects of the invention and other objects which will become apparent as the description proceeds are achieved by providing a gas inflatable shelter or hangar structure of gas-impermeable fabric which is divided into a plurality of separately inflatable transverse cells some of which having parallelly spaced side walls and adjacent thereto, at both ends, cells having converging side walls radiating from a common line on the ground at each end so that longitudinally the shelter has a parallel center section with adjoining end sections contoured as quarter circles to close both ends of the shelter. Some of the cells are inflated, partly with helium, to provide the necessary lift for erecting the shelter and for supporting it, and partly with air, whereas the remaining cells are inflated only with air at proper pressure to give the shelter its shape and stiffness. By inflating some of the cells at one end of the shelter partly with helium and some only with air these cells can be operated to function as hangar door for moving an airplane in and out. This is accomplished by evacuating the air-inflated cells which then will be lifted by atmospheric pressure, as well as, by the cells containing helium. Inflating the evacuated air cells again will close the hangar.

For a better understanding of the invention reference should be had to the accompanying drawings, wherein

Fig. 1 is a cross-sectional view, taken on line I—I of Fig. 3, of one embodiment of the invention,

Fig. 2 is a longitudinal side view of Fig. 1, showing one half in cross-section taken on line II—II of Fig. 3,

Fig. 3 is a plan view, partly broken off to show the door in the bottom cell,

Fig. 4 is a fragmentary longitudinal cross-sectional view taken on line II—II showing the door air cells evacuated,

Fig. 5 is a half cross-sectional view, taken at V—V of Fig. 6, of a modification of the hangar shown in Figs. 1 to 4,

Fig. 6 is a fragmentary longitudinal side view, shown partly in section, of Fig. 5.

With specific reference to the form of the invention illustrated in the drawings, Figs. 1 to 4, the numeral **1** indicates generally the air and gas inflated hangar structure which for reasons of easier handling in transportation and erecting is composed of several sections, for instance, a middle section A joined together at **2** with section B and at **3** with section C. Section A is divided by walls **4** into arch-shaped cells **5**, **6**, **7**, **8** and **9**, each of which being provided with a pair of floating diaphragms **10** dividing each cell into a middle compartment inflated with helium and into two side compartments inflated with air. The walls **4** of the cells **6**, **7** and **8** are parallel, whereas those of the cells **5** and **9** converge at the transverse hangar floor lines **11** and **12**, respectively. Section B consists of six cells, **13** to **18**, all inflated entirely with air and with the planes of their side walls converging at the floor line **11**, whereas section C, also consisting of 6 cells, **19** to **24**, with the planes of their side walls converging at the floor line **12**. The cells **19**, **20** and **22**, **23** are inflated entirely with air, whereas, cells **21** and **24** provided with diaphragms **10** contain helium and air. All cells and compartment are provided with separate inflation sleeves. The inflation pressure applied to all cells is kept above that of the atmosphere to give the structure the necessary rigidity. In order to open the hangar for moving an airplane in or out, the air in the cells **19**, **20** and **22**, **23** is evacuated therefrom so that the lifting gas contained in the cells **21** and **24** will cause to lift these cells together with the evacuated air cells to a height permitting the passage of an airplane. More specifically, a hose manifold **45** connected to a pump **46** driven by a reversible motor **47** may be used to inflate or deflate cells **19**, **20**, **22** and **23** to close or open the hangar, as will be understood. Opposite thereof is provided a door **25** built into the bottom air cell **18** made in two parts for the passage of trucks. Attachments **26** at the bottom of the cells are anchored in suitable foundations **27** and outside guy lines **28** and **29** tangentially attached to the fabric structure hold the same in secure position on the ground. Each of the four groups of guy lines **28**, extending from the cells having converging side walls, is fastened to a single anchorage **30**. This arrangement makes it possible to operate the pneumatic door without removing the guy lines **28** from the movable cells being held thereby in proper position. The guy lines **29** on this side of the hangar are provided with quick-release devices to open and close the pneumatically operated door at a minimum of time. Between some of the cells are provided catenaries **31** from which are suspended emergency guy lines **32**, which ordinarily are not in use but will be secured to the ground in case of high winds to give the hangar additional safety.

For smaller size shelters or hangars a modification of the invention is illustrated in Figs. 5 and 6. In this case the hangar structure, designated in general by the numeral **33**, is inflated entirely by air and composed of arch-shaped, transverse, cells **34** having a wide supporting base and parallel sidewalls **35**, as well as, of cells **36** having converging sidewalls **35**. The cells **36** extend in both directions from the cells **34** to form hangar ends of, longitudinally, quarter circular contour, one end of which is to be operated as a door by evacuating the air from as many cells **36** as is necessary to provide an opening sufficiently large to move an airplane in and out of the hangar. By evacuating these cells, starting at the bottom, they will move upwards and swing by atmospheric pressure about a common axis **37** along which the cells **36** are anchored by cables **38** on the inside and by cables **39** on the outside of the hangar. All cells are

provided on the inside with a plurality of transverse fabric connections 40 between adjacent side walls 35. These fabric connections, however, may take the shape of catenaries laced together. For practical reasons, the radial cells 36 end short from the axis 37, but are anchored with their side walls, provided with catenaries, along the axis 37. Some of the side walls or diaphragms 35 forming the cells may extend inwardly as catenaries 41 to which emergency guy lines can be attached for additional anchorage in case of adverse wind conditions. The catenaries 41 may also be used for supporting lights or for other purposes. Anchor means 42 are provided at the bottom inside and outside of, and catenaries 43 between the cells 34 to hold the fabric structure firmly on the ground by ties 44.

From the aforesaid it will be recognized that the erection of shelters according to the invention is very simple. First, with the necessary ground anchors in place and the guy lines and other attachment means on the fabric structure secured to the ground anchors while the fabric structure is spaced out on the ground, and blower and suction equipment has been set up, inflation with gas and air, respectively, by blowers will automatically raise the fabric structure and give it shape, strength and rigidity at required pressure. The operation of the hangar doors is equally simple since it is accomplished either by evacuation or by inflation of some of the cells for opening and closing the door, respectively.

While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What I claim:

1. A closed airplane shelter, or the like, made of gas-impermeable fabric and having an arch-like cross-section with both ends of the shelter forming in side view substantially a quarter circle, said shelter being composed of a caternary-contoured outer wall, a catenary-contoured inner wall spaced from the outer wall and united therewith at the shelter base, transverse partitions between opposite wall catenaries dividing the space between said walls into cells each extending the full width of the shelter, gas in the cells at a pressure above that of the atmosphere, at least certain of the cells at one end of the shelter being deflatable, and means for evacuating the deflatable cells to be lifted by atmospheric pressure so as to provide a doorway in the shelter.

2. A closed airplane shelter, or the like, made of gas-impermeable fabric and having an arch-like cross-section with both ends of the shelter forming in side view substantially a quarter circle, said shelter being composed of a catenary-contoured outer wall, a catenary-contoured inner wall spaced from the outer wall and united therewith at the shelter base, transverse partitions between opposite wall catenaries dividing the space between said walls into cells each extending the full width of the shelter, pairs of spaced transverse diaphragms in certain ones of said cells dividing them into a center compartment and side compartments, said center compartment being inflated with helium and said side compartments with air, pairs of deflatable, fully air-inflated cells at one end of the shelter being located between adjacent, partly helium-inflated cells, and means for evacuating the deflatable cells to be lifted by the helium and in addition by atmospheric pressure so as to provide a doorway in the shelter.

3. An airplane hangar comprising an inflatable gas-impermeable self-supporting fabric structure including spaced outer and inner wall portions, and partitions connecting said wall portions to form a plurality of transverse cells each extending the full width of the hangar, the cells included in the hangar middle portions being formed by vertical partitions and the cells positioned at the ends of the hangar being formed by partitions positioned in planes converging at common transverse axes on the hangar floor, said end cells having quarter circular contour in longitudinal section.

4. An airplane hangar comprising an inflatable gas-impermeable self-supporting fabric structure including spaced outer and inner wall portions, partitions connecting said wall portions to form a plurality of transverse cells each extending the full width of the hangar, the cells included in the hangar middle portion being formed by vertical partitions and the cells positioned at the ends of the hangar being formed by partitions positioned in planes converging at common transverse axes on the hangar floor, said end cells having quarter circular contour in longitudinal section, and a pair of spaced diaphragms within a group of adjacent cells in the hangar middle portion and also in at least two non-adjacent cells on one of the hangar end portions with one of them being a bottom cell, said diaphragms dividing said cells into a center compartment inflated with helium and end compartments inflated with air, whereas, all other cells are inflated with air only, the helium furnishing additional support to the structure and also acting as a lifting force for one end of the hangar to be operated as a door swingable about one of said transverse axes when the air cells between the cells carrying helium are evacuated and which door is closed by again inflating the air cells.

5. A closed airplane shelter, or the like, made of gas-impermeable fabric and having an arch-like cross-section with both ends of the shelter forming in side view substantially a quarter circle, said shelter being composed of a catenary-contoured outer wall, a catenary-contoured inner wall spaced from the outer wall and united therewith at the shelter base, transverse partitions between opposite wall catenaries dividing the space between said walls into cells each extending the full width of the shelter, gas in the cells at a pressure above that of the atmosphere, at least certain cells at one end of the shelter being inflated with a gas lighter than air, and means for deflating at least certain other of the cells at said end of the shelter to allow the cells inflated with gas lighter than air to lift and provide a doorway in the shelter.

References Cited in the file of this patent

UNITED STATES PATENTS

511,472	Sumovski	Dec. 26, 1893
2,411,316	Capita	Nov. 19, 1946
2,636,457	Finlay et al.	Apr. 28, 1953
2,698,020	Phane	Dec. 28, 1954

FOREIGN PATENTS

132,134	Great Britain	Sept. 11, 1919
512,001	Belgium	June 30, 1952

OTHER REFERENCES

Scientific American Magazine (front cover and page 483), published November 15, 1919.