Oct. 19, 1926.

C. H. FREESE

1,603,384

FLYING MACHINE

Filed April 7, 1925

4 Sheets-Sheet 1

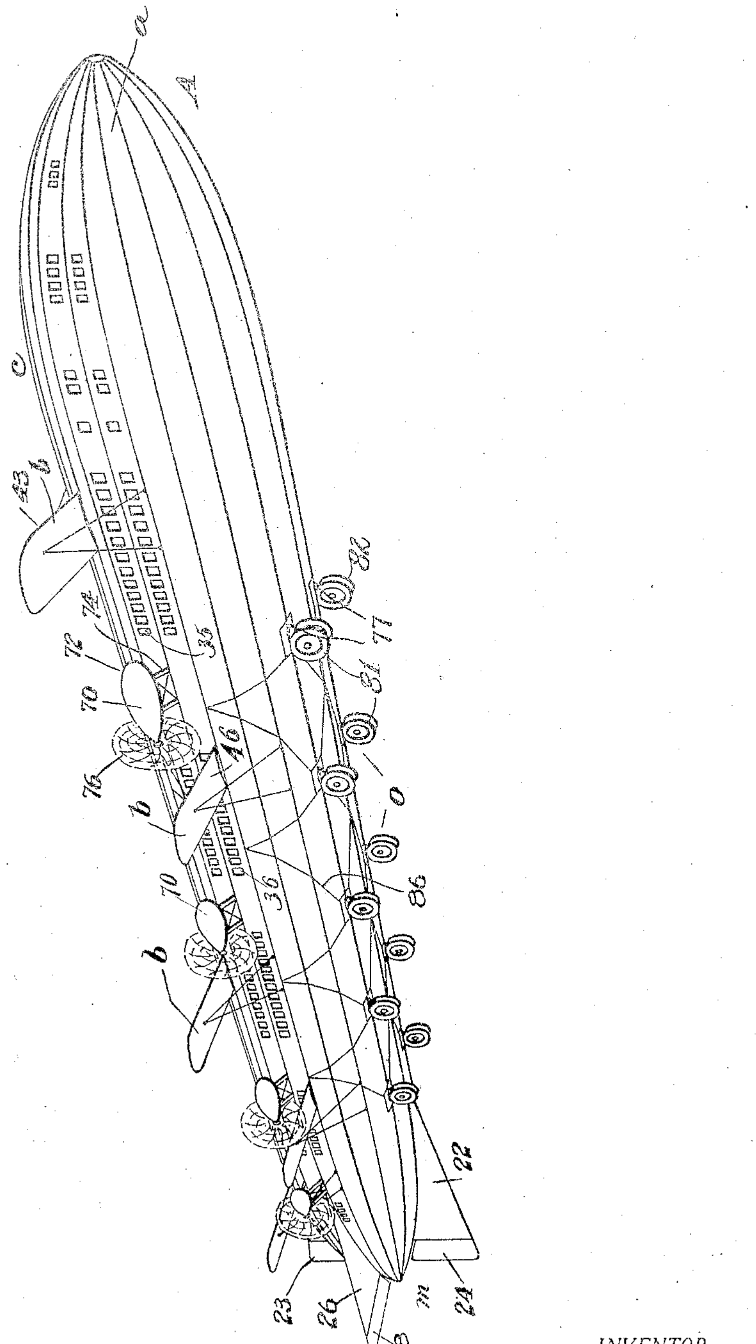

Fig. 1.

INVENTOR,
Claude H. Freese;
BY
Blakeslee & Brown
ATTORNEYS.

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4 Sheets-Sheet 2

Fig. 2.

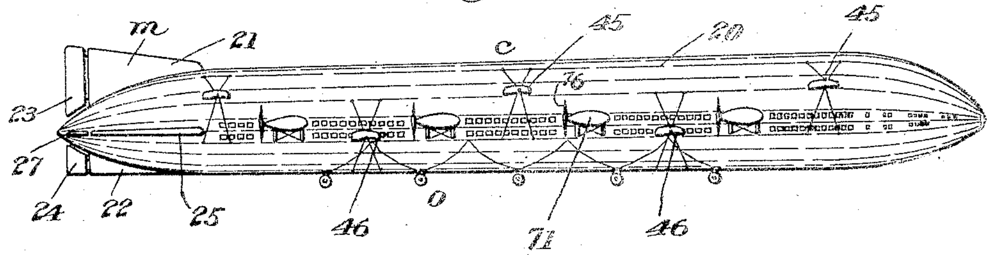


Fig. 3.

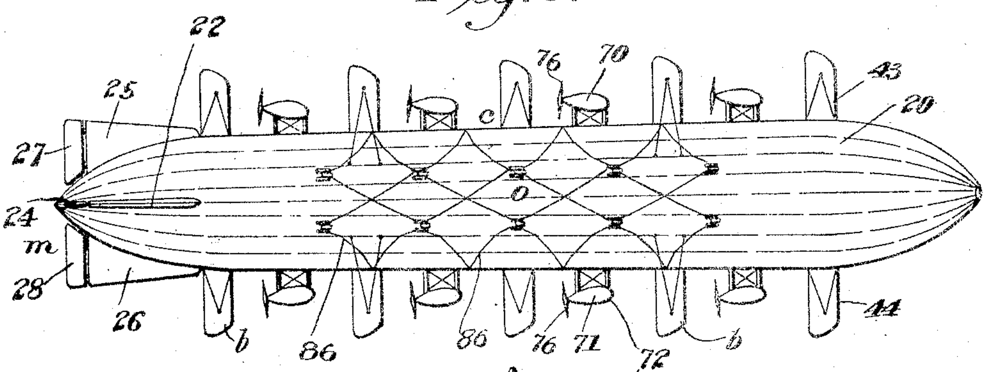
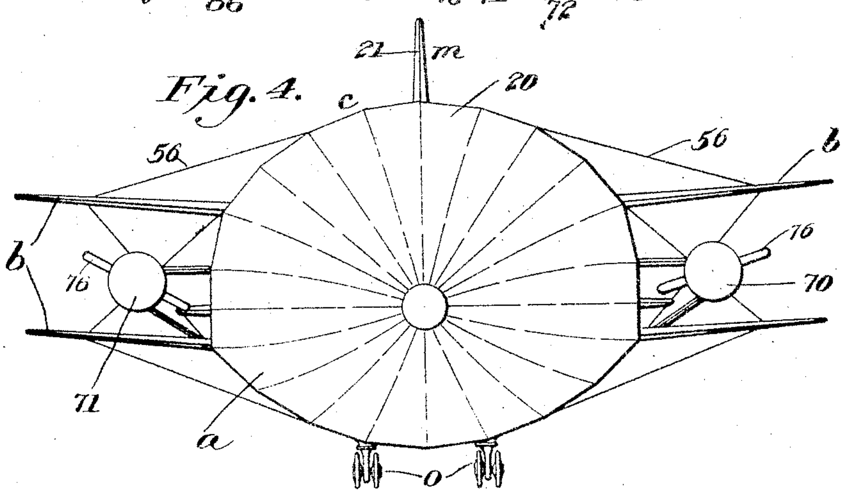


Fig. 4.



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Blakeslee & Brown
ATTORNEYS.

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Filed April 7, 1925 4 Sheets-Sheet 3

Fig. 5.

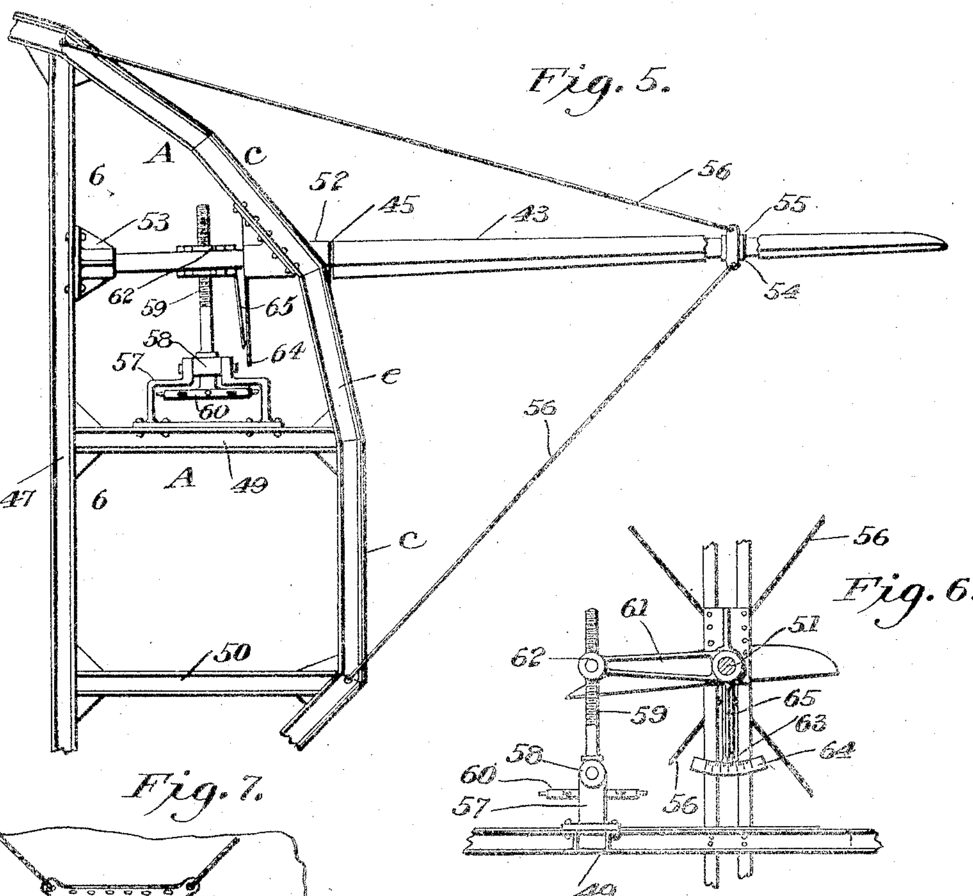


Fig. 7.

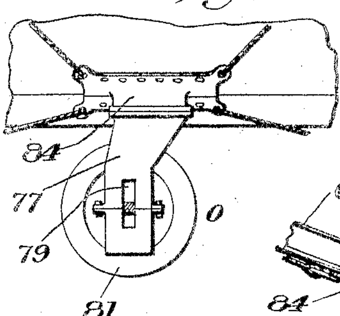
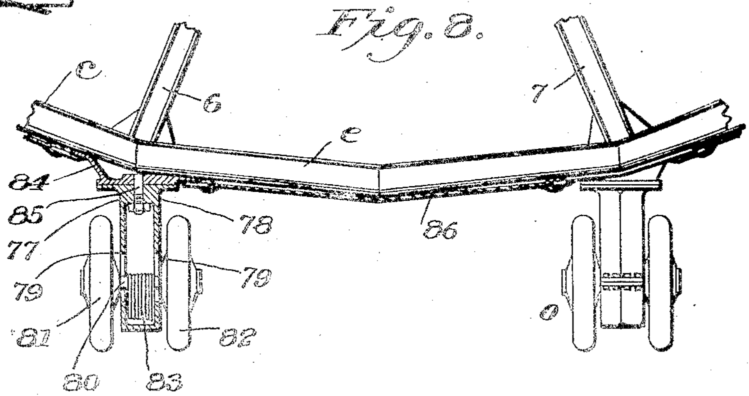


Fig. 8.



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Claude H. Freese;
BY Blakeslee & Brown,
ATTORNEYS.

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Filed April 7, 1925 4 Sheets-Sheet 4

Fig. 9.

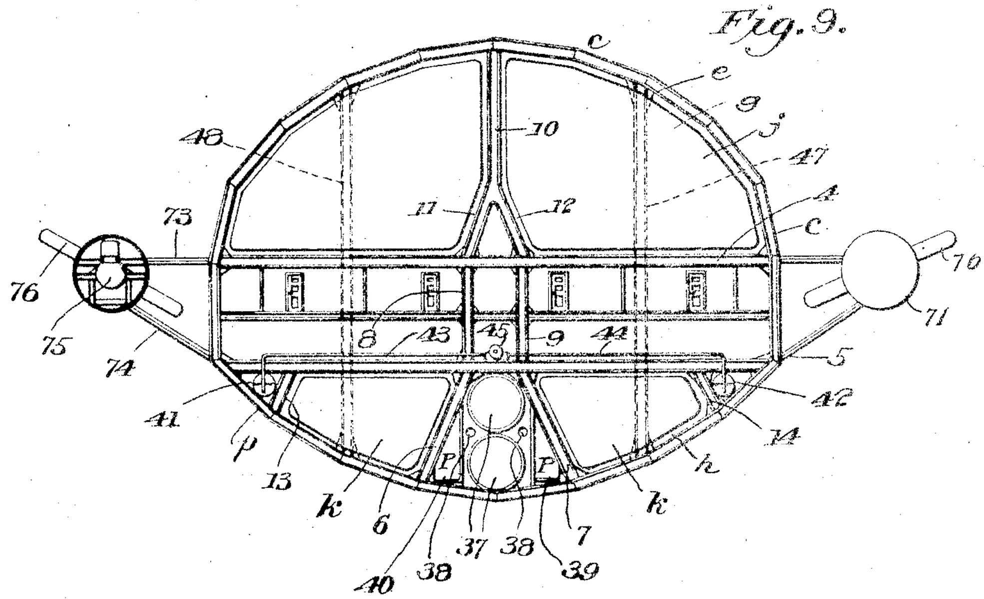
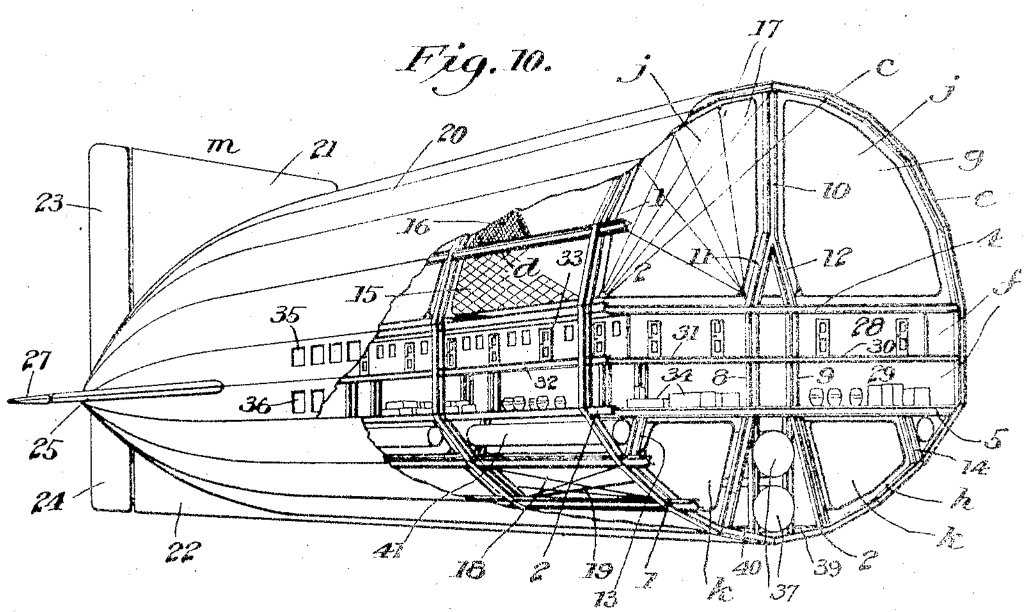


Fig. 10.



INVENTOR,
Claude H. Freese;
BY
Blakeslee & Brown
ATTORNEYS.

Patented Oct. 19, 1926. **1,603,384**

UNITED STATES PATENT OFFICE.

CLAUDE H. FREESE, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-THIRD TO H. W. ZELIFF AND ONE-THIRD TO FRANK J. SCHWEITZER, BOTH OF LOS ANGELES, CALIFORNIA.

FLYING MACHINE.

Application filed April 7, 1925. Serial No. 21,274.

This invention relates to flying machines and in particular to a combined machine utilizing lifting surfaces as well as gas for maintaining buoyancy and lift. In one form the invention embodies a rigid type of dirigible so constructed as to most efficiently carry lifting plane surfaces such as used in airplanes for the purpose of increasing the lift of such craft, and so that such craft may carry greater weights than are now possible for either an airplane or dirigible separately considered.

It is a known fact that the well-known types of dirigible balloons of the rigid type such as the Shenandoah or the Los Angeles, are capable of carrying but very little useful load. By useful load is meant a load such as passengers, baggage and the like. The gas cells of the Shenandoah have a displacement of 2,148,070 cubic feet, and this particular dirigible is filled with helium which has a lifting co-efficient of approximately 85 per cent of that of hydrogen. An authority on air ships states that hydrogen has a lift of approximately 68 pounds per cubic foot at a temperature of 60 degrees F. when the density of the air is .073 lb. per c. ft. Thus it has been found that the Shenandoah has a lift with helium of approximately 109,551 pounds, and as the dead weight of this particular air ship is approximately 82,000 pounds, it being noted that dead weight does not include passengers, water, gasoline or oil, it will be readily seen that the actual lifting efficiency of such a large air ship is very small and is only around 20,000 pounds. It therefore follows that the hope of ever designing an air ship adapted for trans-Atlantic or trans-Pacific flights for the carriage of passengers and freight, is practically impossible of accomplishment on a commercial basis, unless some new form of gas is discovered or some means is provided for increasing the buoyancy or the lifting ability of the air ship. Helium of course is used at the present time in preference to hydrogen, and certainly it must be used in a commercial air ship in preference to hydrogen because helium does not burn. However, the use of helium means a 15 per cent reduction in the lift of the ship over its lift if hydrogen is used, and a 15 per cent reduction in lift means a 40 per cent reduction in the entire load.

With my particular type of flying machine I am able to overcome in a large measure the necessity for valving the gas due to changes in buoyancy of the air ship. Valving of helium is very expensive and therefore must be avoided. It is ordinary practice at the present time to take advantage of solar heat in the early morning when a ship has been moored to a mooring mast so that the gas within the gas bags will expand to increase the buoyancy of the ship and after the buoyancy has reached a certain degree to cut loose from the mooring mast to allow the ship to rise. This must be done before the sun's rays commence to heat the surface of the ground as the expansive effect of the gas would be in a measure overcome if the ship were allowed to remain moored and the earth's surface was hot. This is well known in air ship navigation for the reason that the air-ship's buoyancy depends upon the weight of air displaced and the weight of the ship and the gas she contains, and the variation which most influences the lift of the ship is therefore that of the density of the surrounding air. After an air ship has left a mooring mast and is a considerable height above the earth's surface the motors revolving large propellers increase the ship's lift approximately ten per cent. However, after an angle of approximately 13 degrees, considering the angle of yaw, is reached, the maximum lift for the ship is obtained and the only relief to gain altitude would be to drop ballast. It appears that pressure height is usually 4,500 feet above the earth's surface when the gas bags in the airship are filled with 85 per cent of their capacity at the earth's surface, and at 4,500 feet the gas in the bags is usually expanded to full capacity. In order to maintain height, therefore, it has been customary to repeatedly discharge gas if the ship goes too high or there is danger of bursting the bags; or the automatic valves operate to discharge gas if the bags expand beyond a certain limit and when the ship loses buoyancy, ballast is discharged. Consequently in present practice it is customary to overcome deficiency of buoyancy by utilizing whatever aerodynamic lift might be obtained when the axis of the hull makes a small angle with the line of flight. When, however, the hull of an airship is acting as an aerofoil the resistance to forward motion is appreciably increased.

The above states some of the disadvantages now attendant in airship construction and flight.

As the cruising range of a dirigible is usually much greater than that of an airplane, I have combined the best features of air plane construction with that of the rigid type of dirigible construction, and my invention has for an object the provision of a flying machine adapted to carry greater useful load than now possible by airships or airplanes and over great distances.

Another object is the provision of a flying machine which will safely house useful load such as passengers with a maximum degree of safety and provide more freedom of movement on the flying machine than is now possible in the dirigible type of airship.

Another object is the provision of a flying machine in which the resistance to flight is appreciably overcome.

Another object is the provision of a flying machine in which great lifting ability is obtainable and in which a given altitude of flight may be maintained without the necessity of valving gas or the dropping of ballast.

Other objects include efficiency in design, economy in operation, greater net returns on capital invested where the flying machine is used for commercial purposes, and which invention is superior from the standpoint of utility, durability and efficiency and serviceability, to existing flying machines.

With the above mentioned and other objects in view, the invention consists in the novel and useful provision, formation, construction, combination, association and interrelation of parts, members and features, all as illustrated in certain of its embodiments in the accompanying drawings, described generally and more particularly pointed out in the claims.

In the drawings:

Figure 1 is a perspective view of the improved flying machine in flight;

Figure 2 is a longitudinal view of the flying machine on a reduced scale from the showing of Figure 1;

Figure 3 is a bottom plan view of the flying machine also on a reduced scale from the showing of Figure 1;

Figure 4 is a front elevation of the nose of the machine, the same being on an enlarged scale from the showing of Figures 1 to 3 inclusive;

Figure 5 is a detail of the construction of the flying machine and showing means for varying the angle of incidence of lifting plane members;

Figure 6 is a detail looking in the direction of the arrows 6—6 of Figure 5;

Figure 7 is a detail of the landing chassis;

Figure 8 is a partially sectioned view of the landing chassis, same being in front elevation;

Figure 9 is a detail of the internal construction of the flying machine, said flying machine being cut transversely; and

Figure 10 is a further fragmentary detail and perspective view of the flying machine showing its internal construction.

Corresponding parts in all the figures are designated by the same reference characters.

Referring with particularity to the drawings, the improved aircraft is designated as an entirety by A, and the same includes a combined aerostat *a* and airplane *b*, both of which types of aircraft are used in practicing one embodiment of the invention.

The aircraft of the present design does away with the necessity of providing the now familiar navigating gondolas, and rear, aft and fore power cars now almost uniformly hung below the average rigid type of aerostat. It has been found by experiment that the resistance of the cars so hung beneath an aerostat constitutes in percentages as high as 20 per cent of the total resistance of the aerostat. No cars of any form hang beneath the aerostat in the present invention so that resistance due to such cars is overcome.

The aerostat of the present invention takes the form of an air ship of the rigid type, and the airplane utilizes the hull of the air ship as its fuselage and the lifting planes are distributed along the hull in staggered relation in order to do away with interference between the planes from bow to stern. The motive elements are also distributed in spaced relation outward from the hull and from aft to stern of the hull. The air ship hull is designated generally by *c*, and the same includes frame-work such as longitudinal girders *d* and transverse frame-work commonly called polygonal frame-work *e*. The number of longitudinal girders will of course depend upon the size of the polygonal frames *e*, and a sufficient number of such longitudinal girders are provided to suitably brace the hull. The girders *d* at the zones 1 would be known as the intermediate longitudinal girders, while girders at 2 would be known as the main longitudinal girders. The hull is internally subdivided to provide a central transversely extending and longitudinally extending compartment member *f*, and spaced transverse girders 4 and 5, of which there may be a great number extending the entire length of the hull, act to divide the space between the top and bottom of the air ship hull to form a top compartment portion *g* and a lower compartment portion *h*. These transverse girders 4 and 5 are secured to the main longitudinal girders 2, and this method of trussing forms a very rigid structure for the air ship hull, so far as transverse stresses are concerned. Throughout the length of the hull framework and included in the bottom portion *h* of the hull are struts 6 and 7 extending between the girders 5 and certain of the main longitudinal girders 2. It is to be understood that there would be a plurality of such struts 6 and 7 for each complete polygonal frame member *e*. These struts 6 and 7 incline at an angle as shown in Figs. 9 and 10, and immediately above the same and secured to the transverse members 5 are struts 8 and 9 which extend between the members 4 and 5 for bracing the same. An apex strut having a central member 10 and two angularly related legs 11 and 12 extends between the top center line girder and the member 4 with the legs directly over the struts 8 and 9. In one sense it might be said that the hull is provided with upper and lower keel members; that is to say, the plurality of struts 6 and 7 with the longitudinal girders with which they are joined and which extend from bow to stern, as well as the transverse frame-work, constitute the lower keel, while the apex strut members which extend from bow to stern and are associated with the transverse girders 4 as well as the longitudinal girders at these panel points, constitute a top keel. It is thus evident that the air ship is quite rigidly braced both above and below the compartment *f*. As a result longitudinal buckling of the air ship is practically impossible. The frame-work of the hull is so fabricated as to give a maximum degree of rigidity and strength without using a great number of frame-work members, and which fabrication is comparatively light. The various frame-work members might be formed of I-beam duralumin. Bracing members are provided wherever necessary, such as shown for the lower division of the hull at 13 and 14. Upper gas cells *j* are carried in the top compartment portion *g*, and lower gas cells *k* are within the lower compartment portion *h*. As is customary in air ship practice a plurality of such gas cells both *j* and *k* are provided from aft to stern of the air ship hull. It is to be particularly noted that the top compartment portion *g* of the hull is much greater in size than the lower portion *h*, and that the cubic contents of the gas cells *j* is therefore much greater than the cubic contents for the gas cells *k*. Furthermore, the air ship hull is not cylindrical in transverse section, but the maximum horizontal transverse dimension is considerably greater than its maximum vertical transverse dimension. The maximum transverse horizontal dimension would be at the central compartment portion *f*, and the maximum vertical transverse dimension would be directly central of the ship's hull. This form of construction has been adopted for the reason that it gives more space in the upper compartment *g* for the gas cells and likewise adds to the all round stability and efficiency of the ship. It has been found by experiment that with the exception of a few isolated cases, the introduction of cylindrical body construction causes an increase in resistance co-efficient at higher speeds. In this connection the forward curved portion of the air ship body, namely, that portion of the hull which curves inwardly to form the forward curved portion or bow, is also elliptical in form, as shown in Figure 4, and is preferably made at least two diameters in length as it has been found that this will give a low resistance co-efficient and likewise the tail portion has a gradual curve the same as the bow portion and is some two and five-tenths diameters in length so as to give a low resistance co-efficient. The gas cell bags are of any preferred material such as gold beater's skinned fabric and are surrounded by cord netting next to such bags, as indicated fragmentarily in Fig. 10 at 15, with wire netting 16 next to the cord netting. Likewise in between the adjacent ends of the gas bags and associated with the polygonal frame members and the longitudinal and transverse girders, are the various chord wires 17 for internally bracing the hull frame-work. This is standard practice, and likewise it is standard practice to provide main diagonal wires 18 between the intermediate transverse frame-work and the intermediate longitudinal frame-work, as well as secondary diagonal wires 19 between such members. An outer cover 20 encloses the hull from aft to stern. The stern portion has what is known as a tail group designated generally by *m* and the same includes fins 21 and 22, rudders 23 and 24 in alignment with the fins, and stabilizers 25 and 26 as well as elevators 27 and 28 in alignment with such stabilizers.

The central compartment *f* is divided into upper and lower compartment portions 28 and 29 with a flooring 30 between such compartments, and this flooring is suitably braced by transverse girders as well as longitudinal girders, as indicated at 31 and 32, it being noted that the girders 32 would form a part of the main longitudinal girders. The compartment space 28 might be divided into rooms having entrance doors such as indicated at 33, and be very much like the average ocean liner in appearance. There might be a dance hall, sleeping compartments and dining room, toilets and the like all included upon this floor, while the compartment space 29 could be used for the storage of various commodities such as indicated at 34. The outside covering 20 of the air ship is provided with a plurality of windows 35 and 36 for the compartment portions 28 and 29 and whereby passengers might survey surrounding scenery, during flight of the machine. The general appearance of the flying machine would be like that shown in Fig. 1, and the window portions would be substantially flush with the outer covering so as to reduce skin friction as much as possible. As was stated formerly, the percentage of resistance of the cars which hang below an air ship is as high as 20 per cent of the total resistance, and therefore the doing away with hanging cars and enclosing the passenger compartments, as well as the useful load portions and the operating portions of the air ship is of great importance. The pilot's house would be in the forward portion of the ship and the pilot would have a clear outlook through certain of the windows. The space between the struts 6 and 7 in the lower compartment portion *h* of the ship is adapted to carry fuel tanks 37 and suitable pipes 38 communicate with the fuel tanks for conducting fuel therefrom to propulsive elements to be described. Portions as 39 and 40 between the fuel tanks and the struts 6 and 7 as well as the gas cells furnish space whereby operators of the ship may have a keel run-way for examining the gas bags and for straightening the same out as the gas within the bags expands. On each side of the hull, and in the lower compartment portion *h*, and included as between the struts 13 and 14, and running longitudinally of the hull, are water ballast tanks 41 and 42, there being pipe connections 43 and 44 associated with the tanks 41 and 42 respectively and with pump means 45, whereby the water level within the tanks on either side of the hull may be controlled at will. It is of course understood that there is a plurality of such tanks 41 and 42 and that separate pipe connections with separate pumps for the respective tanks would be provided, such separate water tanks being shown in part in Fig. 10. The upper keel portion and particularly the space between the legs 11 and 12 of the apex struts, would act as a keel run-way whereby operators might examine the gas cells in the upper compartment *g* and straighten the cell bags as the gas within such cell bags expanded.

The airplane portion *b* in the present instance includes airplane main supporting surfaces or lifting wings spacedly distributed along opposite sides of the hull as illustrated in Fig. 3 at 43 and 44, which wings are alternately staggered as indicated at 45 and 46, 45 indicating the upper wing portions and 46 the lower wing portions. The wing structure is further illustrated in Figs. 5 and 6 and as each wing structure is identical only one of such wings will be described.

Referring to Fig. 9 it will be seen that there are vertically extending struts 47 and 48 between certain of the longitudinal girders and the polygonal frame-work, and that one of such vertical struts 47 is shown in Fig. 5 and that horizontal brace members are included as between such strut 47 and the polygonal frame-work as indicated at 49 and 50. Figure 5 illustrates one of the wing members 43 and this wing member is likewise one of the upper wing members which would be situated as shown at 45. The wing 43 is conventional in form having a curved top surface and comparatively flat bottom surface, the general cross section of the wing not being important, as the curvature of such wing will largely depend upon the size of the ship, and such wing has interposed as between the top and bottom surfaces thereof, a shaft member 51. This shaft member is preferably located centrally of the center of gravity of the wing and likewise at the most forward travel of the center of pressure of the wing. The shaft extends through a suitable bearing member 52 carried by the hull frame-work to where it terminates in a bearing member 53 associated with the strut 47. The wing framework as well as the covering of such wing is cut away at a portion thereof, as indicated at 54, and a bearing collar 55 surrounds the shaft 51 and bracing rods or wires 56, of which there may be a plurality, are directly connected to this collar and with the hull frame-work. As stated, this bearing collar is located near the extremity of the wing. A standard 57 is carried by the brace member 49. A bearing member 58 is pivotally carried by such standard 57, and such bearing likewise carries a screw-threaded shaft 59. The bearing allows a rocking or oscillation of the shaft. Received within the standard is a wheel 60 associated with the shaft 59. An arm member 61 is fixedly carried on the shaft 51 and said arm member is furcated and between the furcations is pivoted a nut 62 with which the shaft 59 is in engagement. A turning of the wheel 60 will rotate the shaft 59 and thereby cause movement in one direction or the other of the arm 61. The change in radius of the arm 61 during movement thereof will be compensated by the fact that the shaft is allowed to oscillate in the bearing 58 and likewise allowed limited oscillatory movement in the nut 62. It is obvious that a turning of the wheel will rotate the shaft 51 carrying the wing 43 and that the angle of incidence of the wing will therefore be changed. Within the frame-work of the hull and carried by the member 52 and depending from such member is an indicator 63 which is graduated as shown at 64 and attached to the arm 61 and centrally of the shaft 51 is a pointer 65 adapted to play over such graduations 64 whereby the angle of incidence of the wing may be directly read. As every other wing is constructed in a similar manner and as its angle of incidence is regulated in a similar manner, it is evident that instructions from the officers of the flying machine to the men to set the wings at certain angle of incidence could be readily complied with, certain wings could be set at certain positive angles and other wings set at negative angles, or various wing setting combinations could be had. The pitch of the threads of the screw 59 is under four degrees, so that when the wheel 60 stops rotating no amount of pressure on the wing surface will change the angle of incidence of the wing, as the shaft could not be rotated by attempted movement of the nut 62. The wings would act to carry a large percentage of the useful load of the machine and I do not desire to restrict my invention to any specific number of wings, as the number used will depend upon the size and load to be carried by the machine. The wings on opposite sides of the hull are given a positive dihedral for purposes of stability, and it will be seen that whereas cars are usually hung beneath an air ship in order to overcome a transverse rolling effect, the use of wing surfaces will overcome in a large measure any tendency for the machine to roll transversely or to pitch longitudinally and that the machine in actual use would be comparatively safe and that the provision of a central compartment *f* would have little if any effect upon the lateral stability of the machine. The lift due to unequal loading of the machine could be compensated by changing the angle of incidence of certain of the wings. Maneuverability of the machine is very easy as the tail group is of a size sufficient to properly stabilize and direct movement of the ship. Located intermediate the planes 43 and 44 on both sides of the hull are the propulsive means or elements 70 and 71. The propulsive elements in each instance may include small stream-lined cars or housings 72 suitably carried by means of girders 73 and 74 attached to the frame-work of the hull and within such housings are engines 75 with propellers 76 connected to the crank shafts of the engines. The number of these propulsive elements will depend upon the size of the machine. In the showing of Figure 3 the axis of rotation of the propellers is at an angle to the sides of the hull so that the general tendency will be to drive the ship in a straight line. Furthermore, this arrangement in a measure does away with interference as between the propulsive elements and prevents following propellers of other propulsive elements from having to work in a disturbed air stream. It is intended that the propulsive elements should be situated a sufficient distance apart to avoid air wash between the propellers and likewise so that the lifting surfaces might work at their highest efficiency without the air about the same being unduly disturbed by the air wash of the propellers.

In the present embodiment I have provided a landing chassis *o* for the machine. This landing chassis is detailed in Figs. 7 and 8 and the same includes a plurality of independent carriage members 77 which are spaced apart along the bottom of the hull frame-work. One of such carriage members 77 will be described.

Referring to Figs. 7 and 8 the carriage includes a bracket member 78 which is cut away as shown at 79 and extending through such cut-away portions is an axle 80, there being a pair of wheels 81 and 82 carried on such axle and on opposite sides of the bracket 78. Shock absorber cord 83 is wound about the axle and about a member within the bracket. When the wheels strike the ground the shock is taken up by the shock absorber cord and the axle is permitted to move within the slot 79 of the bracket. A bearing plate 84 is carried by the hull frame-work, and the bracket 78 is swivelly connected by means 85 to such bearing plate. The underside of the hull in addition to the usual fabric covering 20 is likewise provided with a metal sheathing *p* extending as far up as the intermediate compartment portion *f*. This metal sheathing may be of duralumin or other metal. The purpose of this sheathing is to permit the machine to land on the water safely in case of an enforced landing of the machine and where the machine is flying over a body of water. The wheels of the carriage are of large diameter so that the machine would stand considerable height above the ground when the same is resting upon the ground. If desired, the nose of the machine might be provided with a bow cap having a mooring cone outrigger so that the entire machine might be moored to the mooring mast if desired.

In the showing I have provided a series of bracing bands 86 for securely lacing and bracing the bottom portion of the covering of the machine and for distributing stress to the frame-work in a measureable degree when the machine is about to land on the landing chassis *o*.

A statement of the operation is perhaps unnecessary. However, it will be seen that the various wings may be adjusted to obtain maximum lift and that after the gas in the gas cells has become sufficiently buoyant to allow the machine to drift away from the mooring mast if it has been moored to a mast, or to allow the machine to run along the ground with the wings set to obtain a maximum lift so that the same may rise from the ground directly, that it will be unnecessary to attempt during the flight of the ship, to constantly tip its nose upwardly to increase the lift, as is now customary, as the wings will lift a large percentage of the weight. Thus the necessity of throwing over ballast or valving the gas is practically done away with under ordinary flight conditions. The pressure height can be maintained most of the time without loss of gas, and lateral balance of the machine is maintained both by the water ballast system that has been described, as well as the lifting wing surfaces themselves.

All the refinements of detail that enter into modern airship construction have not been described, but the essential features of my invention have been described.

The enclosing of the load space is of supreme importance. It is felt that it is unnecessary to go into the general aerodynamic theory of lifting wing surfaces, as well as the aerodynamic theory or aeronautic theory of buoyancy with relation to air ships. It is, however, evident that the lifting efficiency of a wing surface depends upon the velocity of the ship as well as the area of the wings. I would therefore so proportion my wings that the same would have a high lift efficiency and also so that the wings would not be overly loaded.

There may be a common tube running the length of the airship hull in the upper chamber which has branches connecting with the gas cells whereby the pressure between the gas cells may be equalized. A similar arrangement would be provided for the gas cells in the lower chamber.

There is apparently no reason why aircraft constructed in accordance with my invention should not be able to follow a mean flight path as the lifting wings could be so adjusted that a large percentage of the load could be carried by the same. This being the case the aircraft could follow a horizontal flight path, and to again repeat, without the necessity of constantly tipping the nose of the craft upwardly to take advantage of whatever small lift might occur by pressure against the hull. In other words, a zero incidence might be maintained for the hull which would be of great advantage so far as resistance and speed are concerned.

It is obvious that various changes and modifications may be made in practicing the invention, in departure from the particular showing of the drawing, without departing from the true spirit of the invention.

Having thus disclosed my invention, I claim and desire to secure by Letters Patent:

1. In improvements in aircraft, comprising an airship hull, said hull being interiorly subdivided to provide upper, intermediate, and lower chambers which extend transversely and longitudinally of the hull; the sides of the hull being provided with window spaces communicating with the intermediate chamber.

2. In improvements in aircraft, comprising an airship hull, said hull being interiorly subdivided to provide upper, intermediate, and lower chambers which extend transversely and longitudinally of the hull; the maximum transverse dimension of the hull being greater than the maximum vertical dimension thereof.

3. In improvements in aircraft, comprising an airship hull, said hull being interiorly subdivided to provide upper, intermediate and lower chambers which extend transversely and longitudinally of the hull; the maximum transverse dimension of the hull being greater than the maximum vertical dimension thereof, and said maximum transverse dimension of the hull being at the intermediate chamber portion.

4. In improvements in aircraft, comprising an airship hull, said hull being interiorly subdivided to provide upper, intermediate and lower chambers which extend transversely and longitudinally of the hull; there being balancing control means in the lower compartment.

5. In improvements in aircraft, the combination: an airship of the rigid type, and a plurality of lifting wings projecting from both sides of the airship; said wings being spaced apart from bow to stern of the airship, and in alternately staggered relation; said wings being given a positive dihedral.

In testimony whereof, I have signed my name to this specification.

CLAUDE H. FREESE.