April 25, 1933. J. SILVERMAN 1,906,114

AERIAL CRAFT CONSTRUCTION

Filed Nov. 29, 1929 2 Sheets-Sheet 1

Fig. 1.

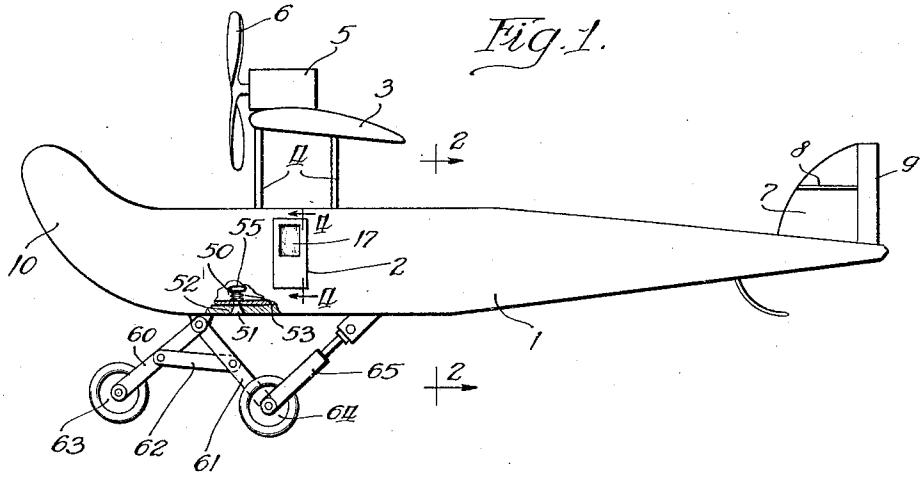


Fig. 2.

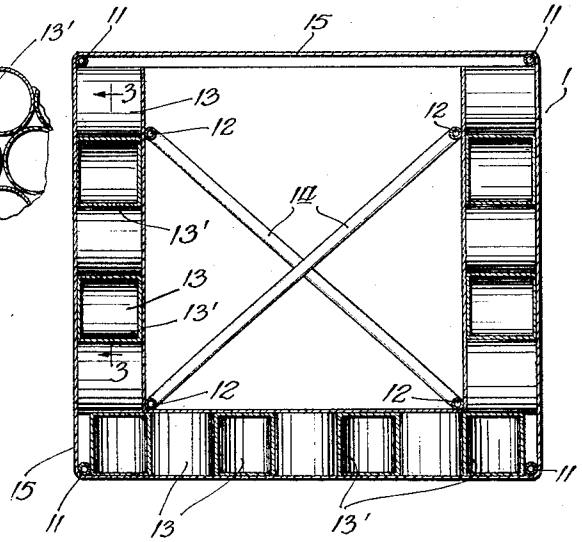


Fig. 3.

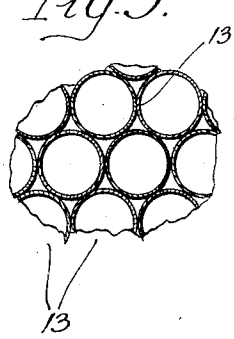


Fig. 4.

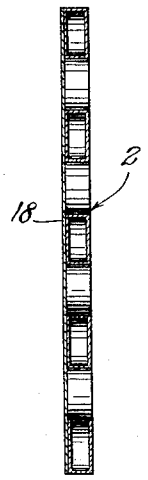
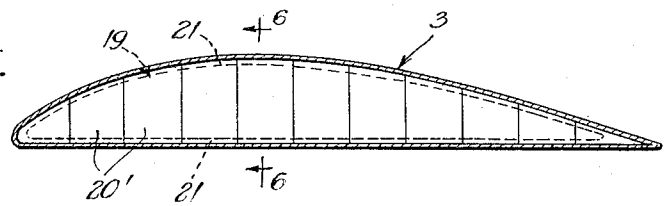


Fig. 5.



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Fig. 7.

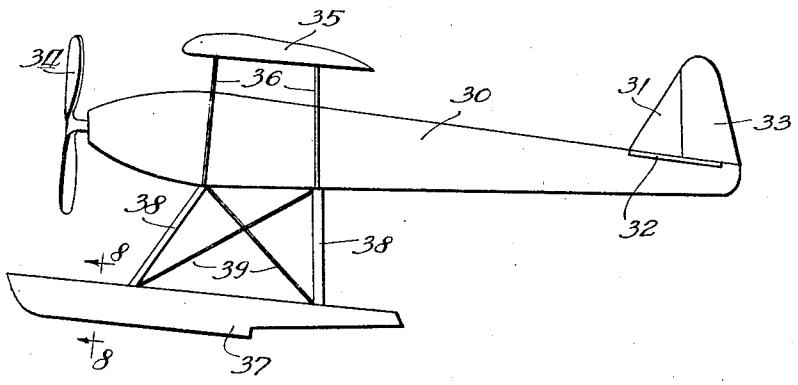


Fig. 8.

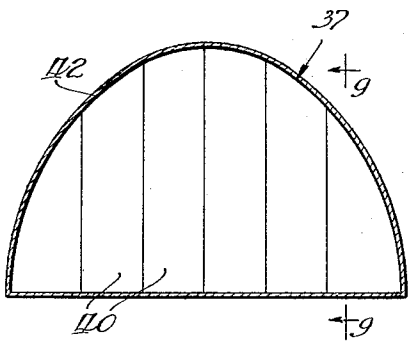


Fig. 6.

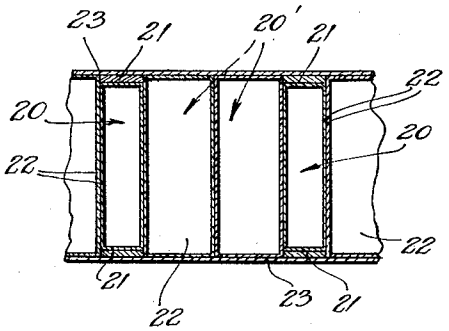
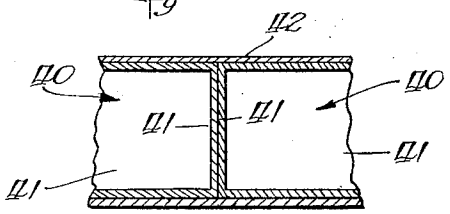


Fig. 9.



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UNITED STATES PATENT OFFICE

JOSEPH SILVERMAN, OF CHICAGO, ILLINOIS

AERIAL CRAFT CONSTRUCTION

Application filed November 29, 1929. Serial No. 410,394.

This invention relates to an improved aerial craft construction.

It is an object of my invention to provide a heavier-than-air aerial craft better adapted for and capable of sustenance on the surface of water for an indefinite period of time.

Another object is to incorporate the means for better adapting and making the craft capable of sustenance on the surface of water for an indefinite period of time in such a manner that the particular part or parts in which said means is incorporated will be strengthened and braced thereby.

Another object is to eliminate by said means at least some of the internal bracing heretofore required.

Another object is the provision of a novel fuselage construction which will positively buoy up an aerial craft on water directly and without pontoons, although it will be understood that the present invention may be employed with or without pontoons as desired.

Another object is to enable by this improved fuselage construction the provision of a land aerial craft having suitable landing gear for landing upon the ground and adapted at the same time for landing and indefinite sustenance upon water without pontoons although portions may be added as and where desired.

The foregoing objects are preferably accomplished by building up the walls of the fuselage, wing gondola or other part or parts of cellular structure. The cells forming this structure are preferably individually sealed compartments suitably secured together to form a wall structure which may be of a single thickness or of laminated construction.

A further object is the provision of a fuselage, wing, gondola or other structure comprising a cellular or sectionalized construction in which the cell construction will perform the dual function of constituting both a buoying means and at the same time serving as a reinforcing or strengthening means for the part. The cells are assembled side by side preferably with the side walls of adjacent cells secured together, providing a multiplicity of transverse walls or partitions between the cells which will aid in taking up the strains and stresses imposed upon the craft.

The invention may be embodied in a wing structure by omitting some or all of the reinforcing struts and substituting a cellular structure forming a multiplicity of bracing walls and a multiplicity of individually sealed compartments between the upper and lower members of the ribs.

Additional cells may be provided between the cells positioned in the ribs and secured thereto so that the entire wing comprises a cellular structure. It will be evident that in the case of the ribs, the vertical walls of adjacent cells will constitute reinforcing members for the ribs thereby replacing the usual struts. Thus, here again, the cells provided in the wing structure will serve not only as buoying means but likewise will have the additional function of serving as reinforcing means for the wing structure against strains and stresses usually imparted thereto as the craft is projected through the air.

It will be further evident, that by combining the provision of a cellular structure in the wings, with a cellular construction in the fuselage and in the gondola if there is a gondola, that if the plane upon alighting in rough water is immersed below the surface of the water due to squalls and waves, the craft will be materially aided in remaining afloat by the combined buoyancy of the various parts. It will be further evident that should the craft nose over or be turned over by the force of the waves, the buoyancy of the wings will materially aid in maintaining the fuselage or gondola above the surface of the water.

A further object is the provision of a cellular aerial craft construction of such a nature that the desired buoyancy will not be lost by one or even a number of punctures.

If the outer walls are punctured at any one or even at a number of points, the buoyant effect of the remaining cells will remain intact and the buoyancy of the entire craft will not be materially impaired.

Another object is the provision of a novel pontoon or water gliding and alighting structure of sectionalized or cellular structure. As is often the case in the alighting of

planes upon harbor waters, the pontoons frequently come into contact with derelict floating matter and a puncture resulting in the covering immediately results in a filling of the pontoon with water, thereby endangering the craft by drawing the craft down into the water. It will be evident that with my improved sectionalized or cellular construction, a puncture in one or even in a few of the cells will have no material detrimental effect upon the pontoon in general so that in spite of the filling up of one or a few of the cells with water, the pontoon will still be effective to maintain the craft afloat.

A further object is the provision of a novel fuselage providing glider means forwardly of the fuselage of a craft which may alight in water directly on the fuselage so as to prevent the craft from nosing over should it strike the water at an abnormal angle particularly in a rough or choppy condition of the alighting surface.

Other and further objects will appear from the following detailed description of a preferred embodiment of my invention illustrated in the accompanying drawings in which:

Figure 1 is a side elevation of an aerial craft of the monoplane type embodying the present invention;

Figure 2 is a cross-section of the gondola or fuselage of the craft illustrated in Figure 1 taken along the line 2—2 of Figure 1;

Figure 3 is a cross-section of a wall of the gondola or fuselage taken along the line 3—3 of Figure 2;

Figure 4 is a section of a door to the inner compartment of the gondola taken along the line 4—4 of Figure 1 and showing the cellular construction thereof;

Figure 5 is a section of the wing of the craft illustrated in Figure 1, the section being taken through the wing between adjacent ribs thereof along a line parallel to the longitudinal axis of the craft;

Figure 6 is a fragmentary section of the wing of the craft illustrated in Figure 1 taken along the line 6—6 of Figure 5;

Figure 7 is a side elevation of an aerial craft of the sea-plane type illustrating a form of craft adapted to take off and alight in water and being equipped with pontoons for that purpose;

Figure 8 is a section through one of the pontoons of the craft illustrated in Figure 7 taken along the line 8—8 of Figure 7; and

Figure 9 is a fragmentary section of the pontoon taken longitudinally thereof as viewed along the line 9—9 of Figure 8.

Referring particularly to Figures 1 to 6, inclusive, of the drawings, I have illustrated an aerial craft of the land type. The craft comprises generally the fuselage 1 provided with a door 2 for gaining access to the interior of the fuselage, a wing 3 supported in spaced relation to and above the fuselage by struts 4 and adapted to carry a motor 5 furnishing motive power to the craft by the usual propeller 6, and equipped with a landing gear of the character disclosed in my copending application Serial No. 339,775, filed February 14, 1929, for landing gear for aeroplanes. This landing gear comprises pivotally connected supports mounted under and one at each side of the fuselage, the supports comprising two downwardly diverging arms 60 and 61, secured against relative movement by a cross-strut 62. Arms 60 and 61 carry wheels 63 and 64, respectively, the former being supported forwardly and above the latter, and the arm 61 is connected to the fuselage by a shock absorbing brace 65, for purposes of preventing nosing over of the craft when landing on rough and uneven ground. It will be understood of course that while I have illustrated the above type of landing gear, any other suitable type of landing gear may be employed.

At the forward end, the fuselage 1 is constructed with its forward portion 10 curved upwardly so as to prevent the nosing over of the craft due to alighting of the craft in rough or choppy waters. It will be understood, of course, that while I have disclosed the fuselage as being modified for this purpose, one or more runners of the same general shape may be provided on present craft not so provided.

Referring now to the fuselage construction, it comprises the usual outer longitudinal frame members 11 and inner spaced longitudinal frame members 12. The usual outer covering indicated at 15 may be of metal, fabric or other material usually employed.

Whereas in the usual construction, the inner and outer frame members are usually connected together by struts, in my novel construction, I have provided a series of juxtaposed individual cells 13 positioned between the frame member and the outer wall or frame members 11. These cells are each individually sealed and are preferably made of relatively light sheet material such for example as aluminum or aluminum alloy of magnesium or may be made of relatively thin sheets of metal known commercially as "duralumin", or, if desired, of fabric suitably treated to maintain the desired seal. The cells may be suitably secured together by welding or soldering or in any other suitable or preferred manner preferably so as to form an integral cellular structure. This structure may be in the nature of a multiplicity of individually sealed cans secured together. It will be evident that where the adjacent walls 13′ of the cells are secured together, substantial reinforcing portions result. These reinforcing portions will perform the function of struts and it will be readily ap-

parent that with a structure such as is shown in Figure 2, the frame members 11 and 12 will be substantially braced and at the same time some or all of the usual struts may be omitted. A series of internal diagonal reinforcing struts 14 may be provided if desired. I have shown the cells 13 as formed preferably of substantially round or circular cross-section in the nature of tin cans but they may be of any other form or shape, such for example as of square, trapezoidal or other polygonally shaped section.

The relative strength of tin cans or cells of five inch diameter, I have found to be approximately 500 pounds for a can weighing but seven ounces. An aluminum alloy can or cell weighing but two to two and a half ounces will permit of stresses and strains to a relatively proportionate degree. It will be evident, therefore, that the combined resultant strength of cells suitably secured together will be such as to give the craft substantial rigidity. It is to be further noted that round or cylindrical cans or cells are cheap and the preferable employment of this type of cell provides a very cheap way of constructing the craft at the same time providing a structure of great strength.

Cells 13 which are individually hermetically sealed may contain air or may be filled with a gas lighter than air for purposes of increasing the buoyancy in the air as well as on the water. The fuselage may be provided with an inner covering 16 of sheet duralumin or other material.

The door 2 which may have the usual transparent plane 17 provided therein, is also constructed of cellular, sectionalized structure as clearly indicated in Figure 4. It will be readily seen that with this sectionalized or cellular structure, the door is quite substantially reinforced against excessive strain imparted thereto and will at the same time supply its share of buoyancy to the craft. The door is likewise provided with the usual covering 18.

The wing structure 3 comprises the usual ribs 19. Instead of providing the usual struts for these ribs, I have provided a series of cells 20 which are disposed between the upper and lower portions 21 forming the ribs, or between the upper and lower walls of the wing, the cells being suitably secured together as by soldering or welding or the like to form an integral structure with said ribs.

Referring particularly to Figure 6, between adjacent ribs the wing is provided with additional series of cells 20′ which are suitably secured to each other and to the cells 20. Here again, it will be apparent that adjacent walls 22 of the cells 20 and 20′ will form substantial reinforcing members for both the ribs 19 and the entire wing structure.

As in the case of the fuselage, the wing is also provided with the usual covering 23 of duralumin or, if preferable, the covering may be of fabric or any other suitable material. Referring to Figure 5, while I have shown the entire wing as built up of cellular structure, it will be evident that a line of intermediate cells may be omitted to provide a space for the passage of the usual control wires for the usual ailerons. Cells 20 and 21′ may contain air or may be filled with a lighter-than-air gas. It will be evident that in place of using rectangular cells, any other types of polygonally shaped or cylindrical cells of the character employed in the fuselage may be employed instead.

By the construction above described, it will be evident that I have provided an aerial craft structure of substantial durability, providing a substantial amount of buoyance, with the cellular structure performing a dual function of constituting reinforcing means as well as buoying means.

In Figures 7, 8 and 9, I have illustrated another form of aerial craft having a fuselage 30 with the tail portion thereof comprising the usual fin 31, elevators 32 and rudder 33. The motive power is provided to the craft by the usual combustion engine housed at the forward end of the fuselage (not shown) through a propeller 34 operatively associated therewith. This craft is of the monoplane type having a single wing of considerable span suitably secured to the fuselage 30 by means of usual struts 36.

For purposes of alighting and taking off in water, the craft is provided with pontoons 37 (only one of which is shown) suitably supported from the fuselage by means of struts 38 and reinforced by guy wires or cables 39.

As is frequently the case in the taking off and alighting of aerial crafts of this type, the pontoons may be damaged by floating wreckage or other derelict matter which they may come in contact with upon the surface of the water. The pontoons are generally constructed of a single shell structure reinforced by angularly disposed struts so that in the event a single puncture results from a collision with floating objects, the chamber formed by the shell immediately becomes flooded and the pontoon sinks thereby dangerously tilting the craft and, as is frequently the case, overturning it in the water. To alleviate such a condition I have provided a novel pontoon structure composed of the usual shell 42 and have replaced the usual strut structure by a sectionalized or cellular construction. Referring particularly to Figures 8 and 9, the cells 40 are constructed in the form of rectangular oblongs with the upper sides thereof conforming generally to the shape of the upper portion of the shell. The cells 40 are suitably secured together

along the side walls 41 thereof as by welding or soldering and are constructed of very light sheet material of the same character as employed in the fuselage and wing structure hereinbefore described.

These cells likewise are filled with air or may be filled with a lighter than air gas to supply better buoyancy to the pontoons. As will be observed in Figure 9, the adjacent secured walls 41 provide a substantial reinforcing means for the pontoon structure and quite readily replace the usual struts employed. Here again the cells may be of any other polygonal design or may be cylindrical, as desired. It will be apparent that should a pontoon of my improved construction strike a floating object and be punctured at any one point, only one or a comparatively small number of cells will be effected by such a puncture thereby not materially impairing the buoyant effect of the remainder of the cells forming the pontoon structure. While I have shown the pontoon as constructed of cells extending entirely vertically through the pontoon, it will be evident that a series of juxtaposed cells might be employed instead.

As in the case of the construction illustrated in Figures 1 to 6, inclusive, the fuselage 30 and wing 35 may be likewise constructed of cellular structure so that should the pontoons be entirely broken away from the fuselage by sliding with a floating object of relatively large proportions, the craft will still be supported on the surface of the water by the buoyant effect of the cellular structure of the fuselage and wing.

In the event that the inner compartment of the body or fuselage 1 of the craft of the type illustrated in Figure 1 should, for some reason or other in taking off or when retrieved from water after having fallen, permit the entry of water so that the compartment becomes partly flooded, I have provided a valve 50 in the bottom thereof. This valve comprises a frusto-conical or otherwise suitably shaped valve head 51 normally held on its seat 52 by means of a spring 53 positioned about the stem thereof between a plunger head 54 and the bottom of the fuselage. After the craft has taken off, the plunger may be depressed, unseating the valve head, thus permitting the accumulated water within the compartment to freely drop out.

In the event the craft constructed in accordance with my invention is employed as a war craft, and may consequently be subjected to rifle or machine gun fire of small caliber, it will be evident that puncturing of one or several of the cells of the structure will not impair buoyancy or rigidity of the craft to any dangerous degree, as the remaining cells will still be capable of providing sufficient buoyancy while the rigidity of the structure will be unimpaired due to the bracing effect of all the cans or cells on each other.

While I have disclosed several preferred embodiments of my invention as applied to heavier-than-air craft, it is to be understood that the term "aerial craft" as employed in the claims is not to be limited thereto as the invention may be embodied in the gondola structure of both rigid and non-rigid lighter-than-air craft, and in the cylinders, envelopes or hulls of rigid lighter-than-air craft.

While I have disclosed several preferred embodiments of my invention, I do not wish to be limited thereto.

As will be understood by those skilled in the art, certain changes may be made therein without departing from the essence of the invention or the spirit and scope of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. A pontoon comprising an outer shell, and an inner hermetically sealed rigid cellular structure comprising a plurality of individual hermetically sealed cells secured together to form an integral structure, the cells being of circular section and arranged with the axes of the cells disposed generally normal to said outer shell.

2. In an aerial craft, a structural body part having inner and outer coverings and comprising a plurality of cells inherently rigid and offering material resistance to deformation by external pressure when relieved of internal pressure, said cells being arranged with the endwise dimension of the cells disposed transversely of said body part and with the opposite ends of the cells contacting the inner and outer coverings, said cells being rigidly secured together and providing a unitary reinforcing structure.

3. In an aerial craft, a structural body part having inner and outer coverings and comprising a plurality of cells inherently rigid and offering material resistance to deformation by external pressure when relieved of internal pressure, said cells being arranged with the endwise dimensions of the cells disposed transversely of said body part and with the opposite ends of the cells contacting the inner and outer coverings, said cells being rigidly secured together in contacting relation and forming an inherently rigid unitary reinforcing structure.

4. In an aerial craft, a structural part having inner and outer coverings and comprising a plurality of inherently rigid non-communicating cells offering material resistance to deformation by external pressure when relieved of internal pressure, said cells being disposed in contacting relation and being arranged with the endwise dimensions of the cells disposed transversely of said body part and with the opposite ends of the cells contacting the inner and outer coverings, said

cells being rigidly secured together for forming an inherently rigid unitary reenforcing structure.

5. In an aerial craft, a structural part comprising a plurality of individual hermetically sealed cells of circular section and inherently rigid and offering material resistance to deformation by external pressure when relieved of internal pressure, said cells being disposed in contacting relation and being rigidly secured together for providing a unitary reenforcing structure, said cells being arranged with the axes of the cells disposed transversely of the structural part.

6. In an aerial craft, a structural part comprising a plurality of inherently rigid hermetically sealed non-communicating cells offering material resistance to deformation by external pressure when relieved of internal pressure, said cells being disposed in contacting relation and being rigidly secured together to provide a unitary reenforcing structure, said cells being arranged with the axes of the cells disposed transversely of the structural part.

In witness whereof, I hereunto subscribe my name this 22 day of Nov., 1929.

JOSEPH SILVERMAN.