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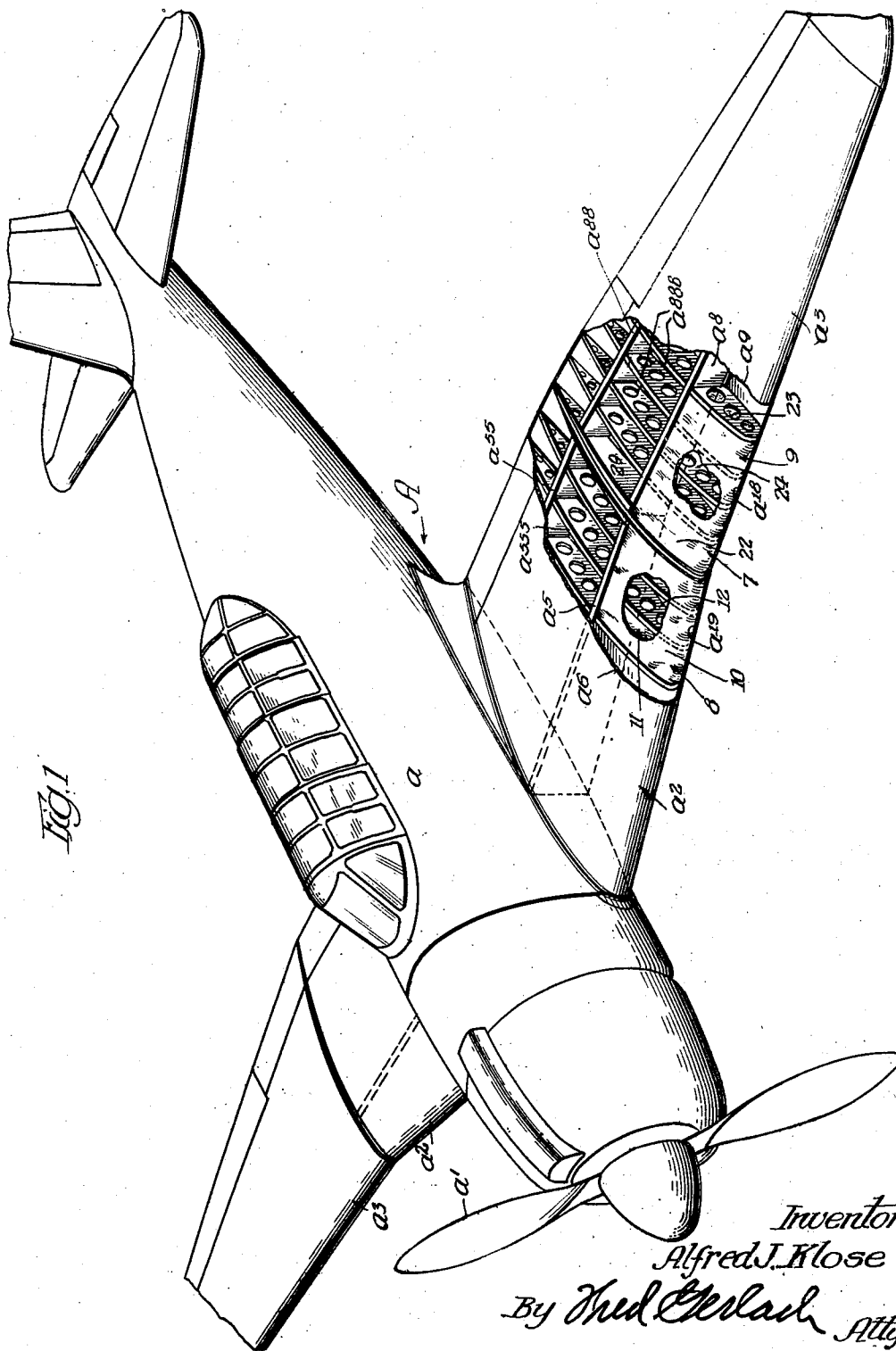
A. J. KLOSE

2,397,184

FUEL CONTAINER

Filed Oct. 31, 1940

2 Sheets-Sheet 1



Inventor
Alfred J. Klose
By Fred C. Elchatt Atty

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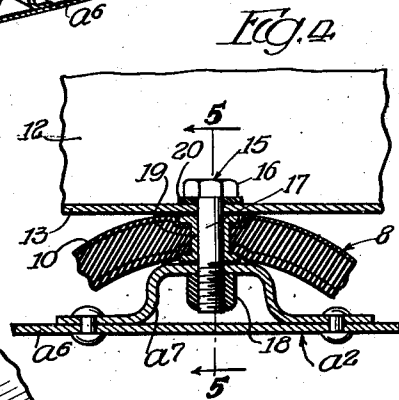
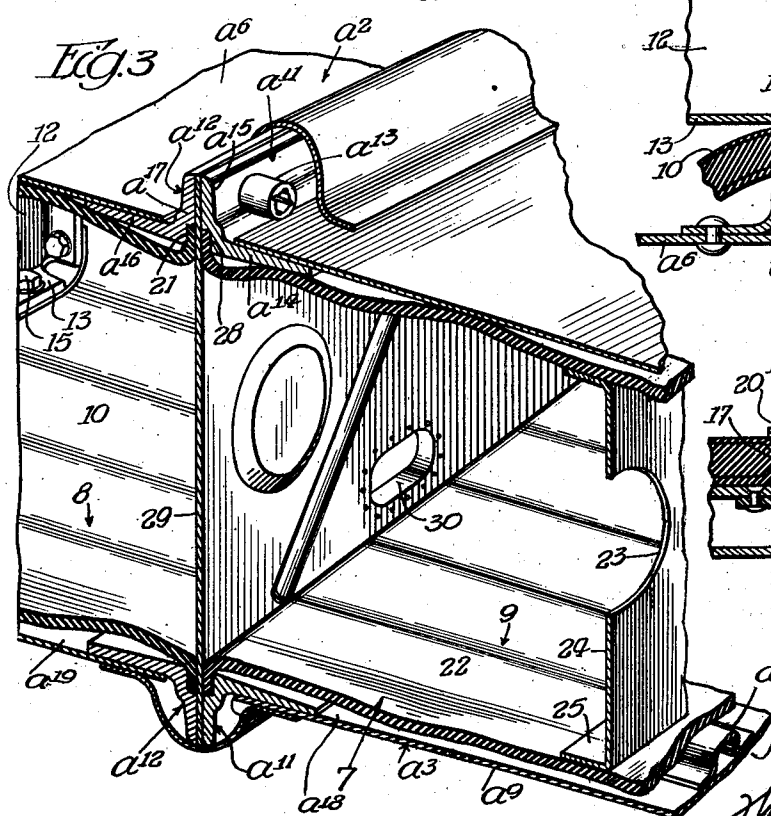
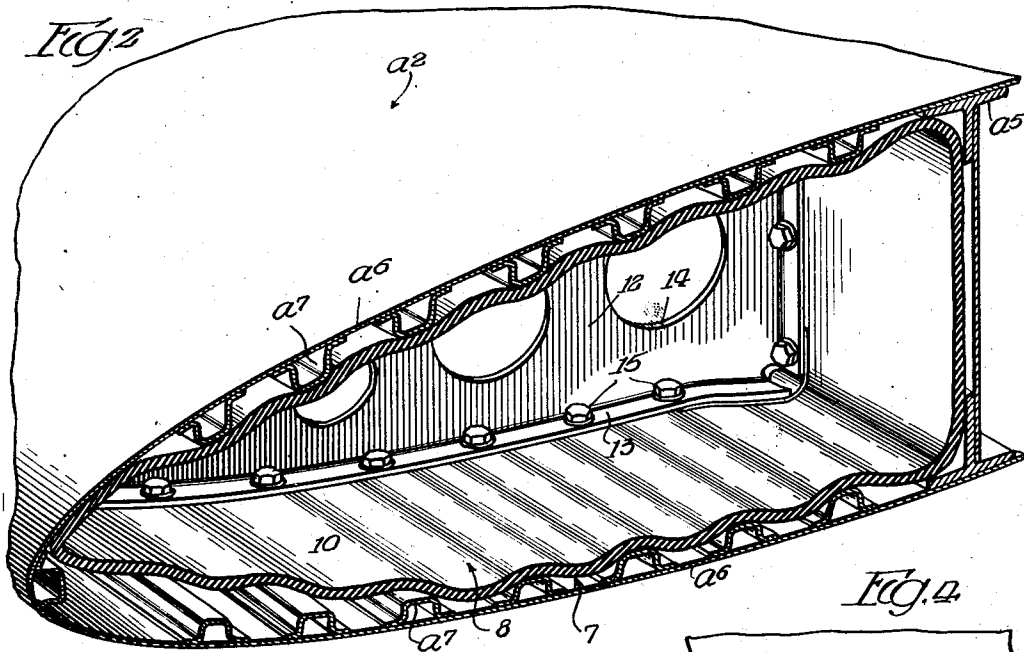
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,397,184

FUEL CONTAINER

Alfred Julius Klose, Inglewood, Calif., assignor, by
mesne assignments, to Consolidated Vultee Air-
craft Corporation, a corporation of Delaware

Application October 31, 1940, Serial No. 363,590

17 Claims. (Cl. 244—135)

The present invention relates generally to fuel containers. More particularly the invention relates to that type of fuel container which is especially designed or adapted for use in connection with an airplane and comprises a bag of flexible material.

One object of the invention is to provide a fuel container of this type which is an improvement upon, and has certain inherent advantages over, previously designed fuel containers of the same general character and not only is more practical but also may be cleaned, inspected or replaced more readily.

Another object of the invention is to provide a fuel container of the type and character under consideration which is designed or constructed for disposition in the wing structure of the airplane with which it is associated, and comprises in addition to the bag a plurality of laterally spaced bolt equipped flanged webs which are disposed within the bag and have a threefold purpose in that they—(1) constitute or form part of the internal reenforcement of the wing structure; (2) serve as a medium for removably securing the bag in place, and (3) constitute means for preventing collapse of the bag when the latter is in an empty or partially filled condition.

A further object of the invention is to provide an airplane fuel container of the aforementioned type and character in which the bag of flexible material is in the form of a pair of complementary sections, the margins of which are releasably maintained in sealed or leakproof relation.

A still further object of the invention is to provide a fuel container which may be produced at a comparatively low cost and not only is extremely light as far as weight is concerned but also effectively and efficiently fulfills its intended purpose.

Other objects of the invention and the various advantages and characteristics of the present fuel container will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like letters and numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a perspective of an airplane having a fuel container embodying the invention mounted in the wing structure thereof, parts of the

wing structure and fuel container bag being broken away for purposes of illustration;

Figure 2 is a fragmentary perspective view of the center section of the wing structure of the airplane, illustrating in detail the construction and design of the webs and the manner in which they serve as part of the internal reenforcement of the wing structure and also as means for securing the bag in place and preventing collapse of the bag when the latter is in an empty or partially filled condition;

Figure 3 is a fragmentary perspective view showing the manner in which the margins of the bag sections are secured together;

Figure 4 is an enlarged section of one of the bolts for removably or releasably securing the bag in place; and

Figure 5 is a transverse section on the line 5—5 of Figure 4.

The fuel container which is shown in the drawings constitutes the preferred form or embodiment of the invention. It is illustrated in connection with, and constitutes a part of, an airplane A. The latter is of conventional or standard design and comprises a fuselage a and an engine driven propeller a^1 together with a wing structure. The latter is composite in character and consists of an inner or center section a^2 and a pair of outer wing sections a^3 and a^4 . The center section a^2 is fixedly secured to the fuselage a of the airplane A and comprises a fore spar section a^5 , an aft spar section a^{55} , a plurality of transversely extending sectional ribs a^{555} and a continuous skin a^6 of airfoil contour. The ribs, with the exception of the two nearest the outer wing section a^3 embody front sections in front of the fore spar section a^5 , intermediate sections between the fore and aft spar sections and rear sections behind the aft spar section a^{55} . The two ribs which are nearest said outer wing section a^3 are the same as the others except that they have no front sections. The skin a^6 , as shown in Figure 3, is reenforced by a plurality of laterally spaced longitudinally extending stringers a^7 of hat section type. The side flanges of these stringers are suitably secured to the inner face of the skin a^6 . The outer wing sections a^3 and a^4 are located at opposite ends of the center section a^2 and project outwardly therefrom. The section a^3 comprises a fore spar section a^8 , an aft spar section a^{88} , and a plurality of laterally spaced cross ribs a^{888} , and also comprises a continuous skin a^9 and a plurality of laterally spaced longitudinally extending stringers a^{10} . The ribs a^{888} are of sectional construction or design and all,

with the exception of the three nearest the center wing section a^2 comprise front sections in front of the fore spar section a^8 , intermediate sections between the spar sections a^8 and a^{88} , and rear sections behind the aft spar section. The three ribs nearest the wing section a^2 are the same in design as the other ribs a^{88} , except that they include no front sections. The fore and aft spar sections a^8 and a^{88} are longitudinally aligned with the fore and aft spar sections a^5 and a^{55} , respectively. The stringers are of hat section type and serve to reinforce or strengthen the outer wing section a^3 . Such outer wing section is removably secured to the adjacent or adjoining end of the center section a^2 by way of a pair of opposed angle bars a^{11} and a^{12} and a series of bolts a^{13} . The angle bar a^{11} is associated with the outer wing section a^3 and embodies an inner leg a^{14} and an outer leg a^{15} . The inner leg fits within the inner face of the skin a^9 and is suitably secured to the outer wing section a^3 . The outer leg a^{15} of the angle bar a^{11} extends at right angles to the inner leg a^{14} and extends outwardly across the inner edge of the skin a^9 . The angle bar a^{12} is associated with the center wing section a^2 and comprises an inner leg a^{16} and an outer leg a^{17} . The inner leg fits against the inner face of that part of the margin of the skin a^9 that is adjacent the outer wing section a^3 , and is suitably secured in fixed relation with the center section a^2 . The outer leg a^{17} of the angle bar a^{12} extends outwardly from, and at right angles to, the inner leg a^{16} and is shaped conformably to the outer leg a^{15} of the angle bar a^{11} . The bolts a^{13} extend through aligned or registering holes in the outer legs a^{15} and a^{17} and serve releasably or removably to secure the outer wing section a^3 to the center section a^2 . The wing structure has a pair of opposed pockets a^{18} and a^{19} therein. These two pockets are directly opposed to one another. The pocket a^{18} is formed in the front inner corner of the outer wing section a^3 and occupies the space in front of the intermediate sections of the three innermost cross ribs a^{88} . The other pocket is formed in the adjoining front portion of the center wing section a^2 and occupies the space in front of the intermediate sections of the two ribs a^{55} that are nearest the outer wing section a^3 . When the outer wing section a^3 is removed from the center section a^2 by removal of the bolts a^{13} the two pockets a^{18} and a^{19} are exposed and access may be had to them. The outer wing section a^4 is of the same design as the outer wing section a^3 and is removably secured to the other end of the center section a^2 of the wing structure.

The improved fuel container comprises a bag 7 of flexible leakproof material. Preferably the bag is of the self-healing variety and is formed of the same material as the fuel container which is disclosed in, and forms the subject matter of, United States patent application Serial No. 348,098, filed on July 29, 1940 by Scott Rethorst, of Los Angeles, California. Such material is self-healing or self-closing when punctured by a projectile and consists of a thin inner layer of vulcanized synthetic rubber ("Neoprene" or "Thiokol"), a coextensive intermediate layer of plastic uncured rubber and a coextensive outer layer of tough vulcanized rubber. The bag is of two piece design or construction and consists of a pair of complementary sections 8 and 9.

The bag section 8 is disposed in the pocket a^{19} in the center section a^2 of the wing structure and

comprises a continuous side wall 10 and an inner end wall 11. It faces the section 9 and is arranged so that the free or outer margin of its side wall 10 fits against the inner leg a^{16} of the angle bar a^{12} . The side wall 10 of the section 8 fits loosely against the stringers a^7 and is of such size that, when the section 8 is filled with fuel the weight of the fuel is carried directly by the center wing section a^2 . When the outer wing section a^3 is removed from the center section the interior of the bag section 8 is exposed and is readily accessible for inspection or cleaning purposes. A pair of webs 12 with marginal flanges 13 serve to prevent collapse of the bag section 8 when the latter is empty or but partially filled with fuel. The webs have holes 14 for permitting the fuel in the bag section 8 to flow into different portions of the latter, and are longitudinally aligned with, and serve to complete, the two outermost cross ribs a^{55} of the center section a^2 of the wing structure, as shown in Figure 1. The end wall 11 abuts against the front section of the third rib a^{55} from the wing section a^3 and hence is supported against collapse. The bag section 8 and the webs 12 are removably secured in place by means of bolts 15, comprising heads 16 and screw threaded shanks 17. The heads 16 of the bolts are adjacent the inner face of the flanges 13 and are accessible from the interior of the bag section 8. The shanks 17 of the bolts extend through aligned holes in the flanges 13, the side wall 10 and certain of the stringers a^7 , as shown in Figure 5, and are releasably anchored in place by way of nuts 18 which are riveted or otherwise fixedly secured to the interiors of the stringers a^7 . Grommets 19 extend through and are anchored within the holes in said wall 10 of the bag section 8. These grommets fit snugly around the central portions of the shanks 17 of the bolts 15 and so grip the shanks of the bolts when the bolts are fully tightened that no leakage of fuel occurs from the bag section 8 around the bolt shanks 17. The nuts 18 are of the elastic stop variety and assist the grommets 19 in preventing leakage of fuel from the bag section 8. Washers 20 fit around the inner ends of the shanks 17 and are interposed between the heads 16 of the bolts and the adjacent portions of the flanges 13 of the webs 12. When it is desired to remove the bag section 8 from the pocket a^{19} in the center section a^2 of the wing structure it is only necessary to remove the bolts 15. As soon as these bolts are released the bag section 8 together with the webs 12 may be removed bodily through the outer end of the pocket a^{19} . The outer margin of the side wall 10 of the bag section 8 is bent outwards, as shown in Figure 4, and is cemented or otherwise fixedly secured within a groove 21 in the corner portion of the angle bar a^{12} .

The bag section 9 is disposed in the pocket a^{18} in the front inner corner of the outer wing section a^3 and is the same as the bag section 8, except that it is in a reversed position. It comprises a continuous side wall 22 and an outer end wall 23 and is held against collapse by three apertured or hole equipped webs 24. The side wall 22 of the bag section 9 fits against the hat section type stringers a^{10} and is of such size that when the section 9 is filled with fuel the weight of the fuel is carried by the outer wing section a^3 . The webs 24 are disposed in laterally spaced relation in the bag section 9 and are longitudinally aligned with and serve to complete the three innermost cross ribs a^{88} of the outer wing section a^3 . They constitute part of the internal

reinforcement of the wing structure and embody continuous marginal flanges 25. The latter extend at right angles to the webs and fit against the inner face of the side wall 22 of the bag section 9. Bolts (not shown) extend through aligned or registering holes in the flanges 25, the side wall 22 and certain of the stringers a^{10} and serve removably to secure the webs 24 and the bag section 9 in place. The last mentioned bolts correspond to, and are arranged in the same manner as, the bolts 16. The shanks of the bolts for the bag section 9 extend through and fit snugly within metallic grommets (not shown) in the holes in the side wall 22 of the bag section 9 and have screw threaded outer extremities which fit within elastic stop type nuts (also not shown) on the interiors of the hole equipped stringers a^{10} . Said nuts are riveted or otherwise fixedly secured to the stringers. When the outer wing section a^3 of the wing structure is disconnected from the center section a^2 the interior of the bag section 9 is exposed and access to it may be readily had. Should it be desired to remove the bag section 9 it is only necessary to withdraw or remove the bolts 26. As soon as the bolts are removed from their operative or connected position with respect to their nuts the bag section 9 is free and may be readily removed by pulling it through the open inner end of the pocket a^{18} in the outer wing section a^3 . The inner or free margin of the bag section 9 is folded or bent outwards, as shown in Figure 4. It fits within a groove 28 in the corner of the angle bar a^{11} and is secured in place by rubber cement or other suitable adhesive.

In addition to the bag 7 and the webs 12 and 24 the container comprises a bulkhead 29. This bulkhead has the marginal portion thereof clamped between the outer legs of the angle bars a^{11} and a^{12} . The grooves in which the adjacent margins of the bag sections side walls fit are shallower than such margins with the result that when the outer wing section a^3 is bolted to the center section a^2 there is no leakage between the bag sections 8 and 9 and the bulkhead and the margins of the bag sections side wall are in sealed or fluid-tight relation. Holes 30 are formed in the bulkhead to permit the fuel to circulate between the interiors of the sections 8 and 9 of the bag 7. The bulkhead 29 coacts with the webs 12 and 24 to prevent surging of the fuel.

The container is provided with suitable means (not shown) for filling it and has any suitable means (also not shown) for connecting the bottom thereof to the fuel supply means for the propeller driving engine of the airplane.

The herein described fuel container is characterized by the fact that it effectively and efficiently fulfills its intended purpose and may be produced at a comparatively low cost due to its simplicity of its design and construction. It may be quickly and readily replaced when punctured or damaged and is in condition for immediate inspection upon disconnection or removal of the outer wing section a^3 from the center section a^2 of the wing structure. The container is further characterized by the fact that the sections 8 and 9 of the bag are releasable from the wing sections with which they are associated by way of bolts which are releasable from the interiors of the bag sections. By having the bag 7 of the fuel container of sectional or composite design it is not necessary in the event of bag damage or injury to replace the entire bag. Because of the fact that the con-

tainer includes the webs 12 and 24 which not only prevent collapse of the bag 7 but also constitute part of the internal reinforcement of the wing structure, it is not necessary in connection with use of the container to change the normal arrangement and design of the cross ribs, spars and stringers.

Whereas the container has been described as being for fuel and as primarily useable in connection with an airplane it is to be understood that it may be used as a holder or retainer for lubricating oil or other liquids and in connection with vehicles other than airplanes. It is also to be understood that the invention is not to be restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In combination with a support, a container for fuel or other fluid comprising a flexible bag carried by the support and formed of complementary sections, and a rigid web type element for preventing complete collapse of the bag when empty, extending across the bag interior and serving to divide the latter into adjoining chambers.

2. In combination with a support, a container for fuel or other fluid, comprising an elongated flexible bag carried by support, formed of a pair of oppositely positioned cup shaped complementary sections and having releasable means for maintaining the free marginal portions of the sections in sealed relation, and a rigid web type element for preventing collapse of the bag during use thereof, extending across the bag interior, spaced from the ends of the bag so as to divide said bag interior into chambers, and accessible for removal purposes upon release of said means and separation of the sections.

3. In combination with a support, a container for fuel or other fluid, comprising an elongated flexible bag of self-healing material, carried by the support and formed of a pair of complementary oppositely positioned sections each consisting of a continuous side wall and an outer end wall, releasable means for securing the inner or free marginal portions of said side walls together and in sealed relation, and rigid laterally spaced cross webs for preventing collapse of the bag during use thereof, extending transversely across the interior of the bag, spaced from the end walls of the bag so as to divide said bag interior into chambers, having holes therein whereby the fuel may flow back and forth between the chambers, and adapted upon release of the means and separation of the sections to be removed from said sections.

4. In combination with a support, a container for fuel or other liquid, comprising a flexible bag carried by the support and formed of separable complementary sections, and leakproof means for removably securing the bag to the support, including elements extending through the sections and releasable from the interiors of said sections when the latter are in separated relation.

5. In combination with a support, a container for fuel or other fluid comprising a flexible bag carried by the support and formed of separable complementary sections, and leakproof means for removably securing the bag to the support embodying bolts extending through the sections and support and arranged so that they are removable

from the interiors of the sections when the latter are in separated relation.

6. In combination with a support, a container for fuel or other fluid, comprising a flexible bag carried by the support formed of complemental sections and having releasable means for maintaining the sections in sealed relation, a cross web within one of the sections for preventing collapse of the bag, and leakproof means for removably securing the bag to the support including bolts extending through the web, bag and support.

7. In combination with a support, a container for fuel or other fluid comprising a support carried flexible bag formed of complemental sections and having releasable means for maintaining the sections in sealed relation, a flange equipped web disposed in one of the sections and serving to prevent collapse of the bag during use thereof, and leakproof means for removably securing the bag to the support, including bolts extending through the flange of the web, the bag and the support.

8. A container for fuel or other fluid, comprising a flexible bag formed of a pair of opposed oppositely positioned sections each comprising a continuous side wall and an outer end wall, a bulkhead between the inner ends of the two sections, means for releasably clamping the inner or free marginal portions of the side walls against, and in sealed relation with, the bulkhead, and rigid cross webs for preventing collapse of the bag during use thereof, disposed in the bag sections and accessible upon release of the means.

9. In combination with a vehicle having a pair of removably connected parts with opposed pockets therein, a container for fuel or other fluid comprising a pair of complemental hollow sections disposed in the pockets respectively, secured removably to said parts, and having registering open inner ends removably connected together in leakproof relation at the juncture of the pocket equipped parts.

10. In combination with a vehicle having a pair of pocket equipped parts together with means for removably securing the parts together, a container for fuel or other fluid comprising a pair of complemental hollow sections disposed in the pockets respectively secured removably to said parts and having registering open inner ends removably secured together at the juncture of the pocket equipped parts by said means.

11. In combination with a vehicle having a pair of pocket equipped parts removably secured together, and a container for fuel or other fluid, comprising a collapsible bag in the form of a pair of opposed oppositely positioned complemental sections disposed and removably secured within the pockets respectively having registering open inner ends releasably maintained in sealed relation at the juncture of the pocket equipped parts.

12. In combination with a supporting structure in the form of a pair of pocket equipped sections together with means for releasably securing the sections together, a container comprising a flexible bag in the form of a pair of opposed oppositely positioned sections disposed in the pockets respectively and removably secured together at the juncture of the pocket equipped sections by said means, and cross webs disposed in the bag sections and accessible for removal purposes upon removal of one of the pocket equipped sections and its bag section from the other pocket equipped section.

13. The combination of a pair of adjoining supporting parts with opposed pockets therein, a bulkhead fitting between the two parts, means for releasably securing the supporting parts to the bulkhead, and a fuel container comprising a pair of complemental oppositely positioned hollow sections disposed and removably secured within the pockets respectively and having certain margins clamped by the pocket equipped parts against the margin of the bulkhead.

14. In combination with an airplane having a wing structure in the form of a center section with a pocket therein and an outer wing section removably secured to the center section and provided with a pocket adjoining the pocket of the center section, a fuel container comprising a pair of complemental hollow sections disposed and removably secured within the pockets respectively and removably secured together at the juncture of the two wing sections.

15. In combination with an airplane having a wing structure including an incomplete rib and an external skin, and provided with a pocket therein adjacent the rib, a fuel container comprising a bag in the pocket and a web-like element disposed wholly within and extending across the interior of the bag and aligned with, and serving to complete, said incomplete rib.

16. In combination with an airplane having a wing structure formed of an external skin and an internal reinforcement including a plurality of adjacent incomplete ribs, and provided with a pocket therein adjacent said ribs, a fuel container comprising a flexible bag in the pocket and a plurality of webs disposed in the bag and aligned with and serving to complete said ribs.

17. In combination with an airplane having a wing structure formed of an external skin and an internal reinforcement including a plurality of adjacent incomplete ribs, and provided with a pocket therein adjacent said ribs, a fuel container in the pocket having a plurality of hole equipped cross webs disposed therein and aligned with and serving to complete the ribs.

ALFRED JULIUS KLOSE.