July 21, 1959 H. J. POLLARD ET AL 2,895,635

CONTAINERS FOR ATTACHMENT TO THE EXTERIOR OF AIRCRAFT

Filed Sept. 12, 1955

2 Sheets-Sheet 1

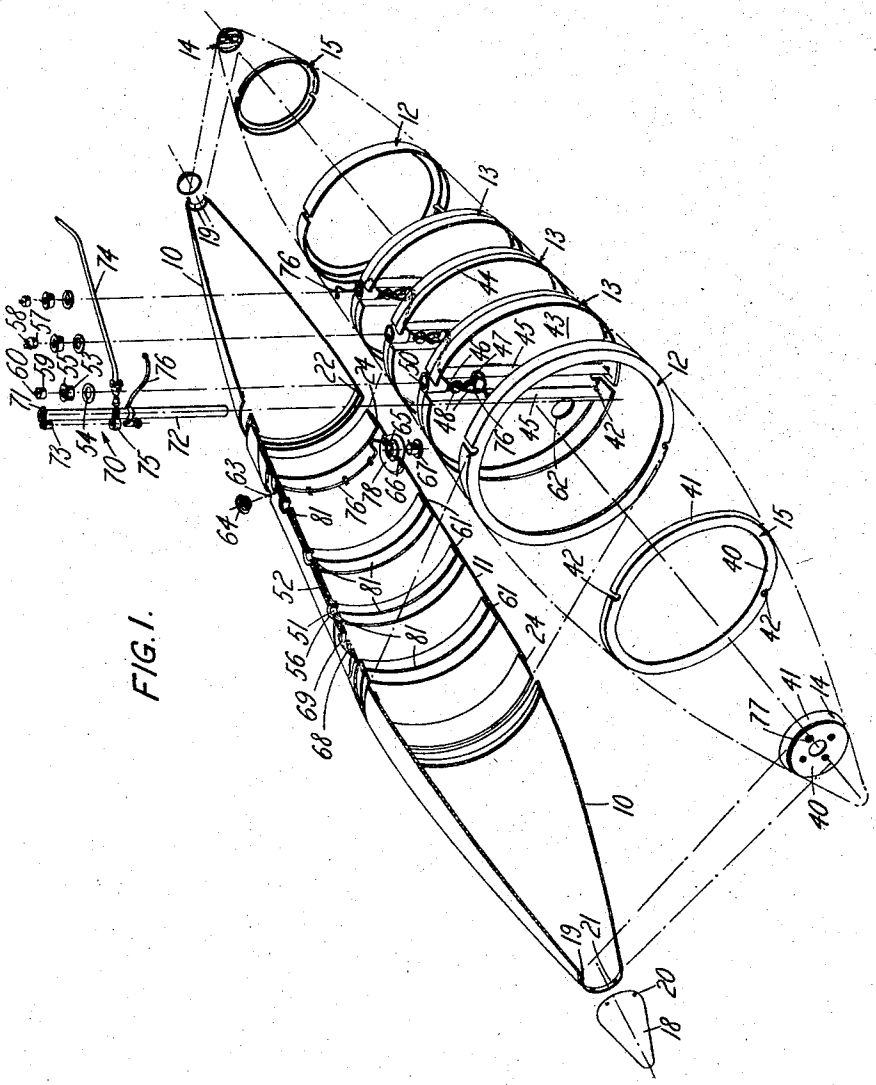


FIG. 1.

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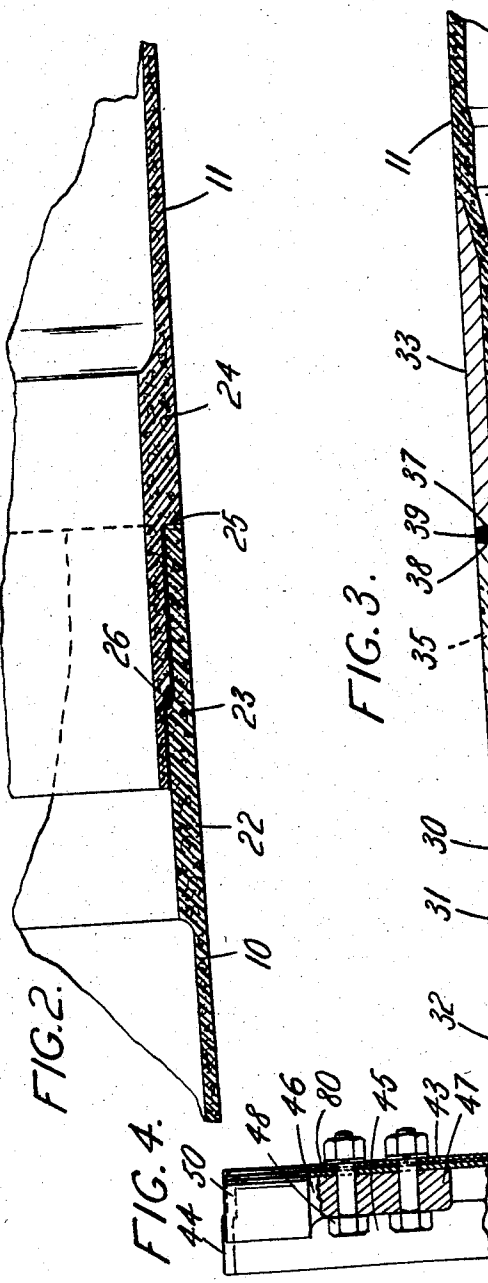


FIG. 2.

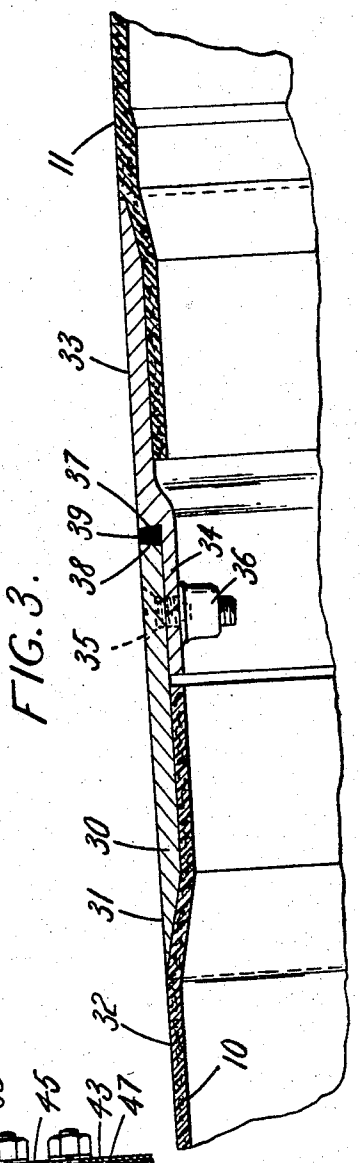


FIG. 3.

FIG. 4.

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CONTAINERS FOR ATTACHMENT TO THE EXTERIOR OF AIRCRAFT

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Claims priority, application Great Britain September 23, 1954

6 Claims. (Cl. 220—5)

This invention concerns the construction and arrangement of containers intended for attachment to the exterior of aircraft. Such containers may be used to hold liquid fuel, incendiary material or other stores and may be releasable from within the aircraft or permanently attached thereto.

According to the invention such a container comprises two ogival shell portions having their smaller diameter ends directed away from one another, at least one tubular shell portion between said ogival shell portions, and at least two diaphragms within the container, all said shell portions being one-piece mouldings composed mainly of resin-bonded fibrous material and being connected together end to end by overlapping joints, and at least two metallic mounting fittings secured each to one of said diaphragms and extending to the outside of the container.

By the expression "ogival shell portion" is meant a hollow body approximating to a surface of revolution generated by a line which is concave as seen from the axis of rotation, the body being open at one end and tapering towards the other end, which may be open or closed.

In the case where an ogival shell portion is open at its small diameter end, its smaller diameter end may, according to a feature of the invention, be closed by means of a hollow tip secured thereto. Such a tip may constitute simply an erosion resisting shield for the forward end of the container or it may additionally provide a socket for the reception of a component such as a fuse, igniter or the like, in which case, the tip is preferably composed of metal.

According to a further feature of the invention all the diaphragms to which metallic mounting fittings are secured may be arranged in axially spaced relation within the same intermediate tubular shell portion. Preferably these diaphragms are secured to said intermediate shell portion with glue, the diaphragms being perforated when communication is required through them, for example, to allow fuel to pass from one compartment of the container to another.

Preferably, each of the diaphragms to which a metallic mounting fitting is secured comprises a web part, and a peripheral flange surrounding the web part, the peripheral flange being contiguous with the inner surface of part of said intermediate tubular shell portion, the thickness of said part of the shell portion being greater than the thickness of parts of the shell portion immediately adjacent the first said part of the shell portion on each side thereof.

According to a further feature of the invention, said peripheral flange may be of stepped or frusto-conical form, in which case the part of the shell portion with which the flange is contiguous is shaped to correspond therewith.

According to a further feature of the invention, the adjacent ends of adjacent shell portions may be formed each with a thickened ring portion of stepped formation, in which case, the stepped thickened ring portions

at the adjacent ends of adjacent shell portions are telescoped one within the other to form stepped overlapping joints.

According to a further feature of the invention, said thickened ring portions may be composed wholly of resin bonded fibrous material and the joint surfaces of the thickened ring portions secured together with glue.

Alternatively, however, according to a further feature of the invention, the adjacent ends of each pair of adjacent shell portions which overlap to form an overlapping joint may be provided with metallic rim members resin-bonded to the fibrous material of which the shell portions are mainly composed, in which case, said rim members are detachably connected together thereby to attach the adjacent ends of adjacent shell portions together.

In a preferred arrangement of the last-mentioned kind, one of the adjacent ends of each pair of adjacent shell portions carries a metallic rim member having its outer surface flush with the outer surface of the adjacent resin-bonded fibre part of the shell portion on which it is carried and the other adjacent end of each pair of adjacent shell portions carries a metallic rim member which fits within the first mentioned rim member, a sealing ring of resilient material being interposed in a state of compression between the free edge of the first-mentioned rim member and a shoulder on the other shell portion of the pair.

To prevent the sealing ring being squeezed out, the said free edge and/or said shoulder are preferably undercut. In practice, said shoulder may be formed by a step in the outer surface of the second mentioned rim member, the part of the second mentioned rim member on the side of the step adjacent the shell portion on which the second mentioned rim member is carried being flush with the outer surface of the adjacent resin-bonded fibre portion of that shell portion.

One embodiment of the present invention will now be described merely by way of example, with reference to the accompanying drawings whereof:

Figure 1 is an "exploded" perspective view of a container, this figure showing the shell portions sectioned along a longitudinal-vertical plane, and, alongside the shell portions the internal structural parts and the accessory fittings for the container when it is to be used as a fuel tank,

Figures 2 and 3 show alternative forms of overlapping joint between adjacent ends of the adjacent shell portions making up the container, and

Figure 4 is a partial cross-sectional view of one of the diaphragms to which a metallic mounting fitting is secured, the figure showing details of construction.

The container comprises two identical ogival shell portions **10**, open at both ends, an intermediate tubular shell portion **11**, two identical frames **12** and three identical diaphragms **13** arranged within the tubular shell portion, and two frames **14** and **15** arranged within each of the ogival shell portions. All these shell portions, frames and diaphragms are one-piece mouldings composed of asbestos fibre bonded with a thermoset phenol-formaldehyde resin. If desired, however, metal reinforcements or accessory fittings may be incorporated in the mouldings, including hollow metal tips for the ogival shell portions in substitution for the separate hollow metal tips **18** shown in Figure 1. Also, if desired, the diaphragms **13** and the frames **12** may be metal pressings instead of asbestos fibre mouldings.

The ogival shell portions **10** are each formed at their smaller open end with an inwardly stepped and thickened rim **19** over which the metal tip **18** fits so that the external surfaces of the shell portion and the tip are flush with one another. The tip is secured by a number of

countersunk screws (not shown) which pass through holes 20 into nut plates 21 secured to the inner surface of the shell portion, a suitable jointing compound being applied to the engaging surfaces before the tip is secured in place so as to ensure a liquid-tight joint. The tips may be identical shape, or if desired, and as shown in the drawing the forward tip may be of more rounded shape than the rear tip. One or both tips may also be provided with a socket to receive a component such as a fuse or igniter, and the rear tip may be an asbestos-fiber-resin moulding instead of metal if desired.

At their larger open end the ogival shell portions 10 are also formed with a thickened rim or ring portion 22, and as more clearly shown in Figure 2 this ring portion comprises a step 23 in its internal surface so that the part of the ring portion having an edge defining the annular end face of the shell portion 10 at the end of which the ring portion is formed is of slightly larger internal diameter than the remainder of the thickened ring portion. In a corresponding manner the open ends of the intermediate tubular shell portion 11 are formed each with a thickened rim or ring portion 24 having two steps 25 and 26 in its external surface, the first, i.e. the radially outer, step 25 corresponding to the annular end face of the ring portions 22 and the other or second step 26 corresponding to the steps 23 in the ring portions 22. The adjacent shell portions thus fit together to make a stepped overlapping joint which is flush externally. When making the joint the overlapping parts are coated with a suitable cold setting resin glue and are telescoped together, the steps 23 and 26 producing a differential piston effect which ejects glue through the jointing gap and ensures that this latter is completely filled with glue. Endwise location of the ogival portion 10 relatively to the tubular portion 11 is ensured by the step 25.

Instead of permanent glued joints between the shell portions, as just described, detachable bolted joints may be provided as shown in Figure 3, these joints permitting the shell portions to be nested one within another so as to economise in space for transport and storage and to be quickly secured together in the field with a minimum of equipment. Referring to Figure 3, each ogival shell portion 10 has a metallic rim member 30 bonded to its larger diameter end in the moulding process with the outer surface 31 of the rim member flush with the outer surface of the adjacent part 32 of the shell portion, which is formed of resin-bonded asbestos fibre as before. The tubular shell portion 11 similarly has bonded to it at each end in the moulding process a metallic rim member 33 which is stepped inwardly at 34 to slide into the rim member 30 on the adjacent shell portion 10, the step providing a shoulder 37 on the shell portion 11. The overlapping parts of the rim members are secured together by a number of countersunk screws 35 screwing into nut plates 36 secured to the inner surface of the rim members 33. A gap is left between the shoulder 37 and the free edge 38 of the rim member 30 in each overlapping joint, and a resilient sealing ring 39 is gripped between the shoulder 37 and the edge 38, the shoulder and the edge being undercut so that the ring is not squeezed out. Instead of both the shoulder and the edge being undercut, one only of these surfaces need be undercut if desired.

Referring again to Figure 1, each ogival shell portion 10 is stiffened internally by two frames 14 and 15, the smaller frame 14 being secured to the shell portion close to its smaller diameter end and the larger frame 15 being arranged approximately midway between the ends of the shell portion. Both frames comprise a web 40, which in the case of the smaller frame 14 is comparatively wide so as to constitute almost a diaphragm, and a peripheral flange 41 which is contiguous with the inner surface of the shell portion. Owing to the tapered shape of the latter the flanges 41 are of frusto conical form and this facilitates the making of a sound glued joint since the flanges can be well coated with glue some of which will be squeezed out as the frames are pushed into place. The smaller frame 14 is located in the endwise direction by contact with the thickened rim 19 round the smaller diameter end of the shell portion 10 and is provided with four small screw-threaded inserts 77 which are arranged to receive bolts securing an igniter device (not shown) in position within a socket in the tip 18 on the shell portion. Small notches 42 are provided in the frames 15 to prevent liquid being trapped by the webs 40. In the case of a container intended for use only as a fuel tank the smaller frames 14 may be omitted and the tip parts bonded to the ogival shell portions in the moulding process for the production of the ogival shell portions.

The tubular shell portion 11 is stiffened at its ends by the frames 12 which are of similar construction to the frame 15 and are glued in place within the thickened ring portions 24.

Between its ends the tubular shell portion 11 is further stiffened by the three diaphragms 13. Each diaphragm comprises a web 43, a peripheral flange 44 and two transverse stiffeners 45. The two stiffeners extend parallel to one another across the web on opposite sides of a diameter, and towards the periphery of the part of the web enclosed between them is arranged a metallic attachment means 46 for a metallic mounting fitting, the attachment means 46 comprising a screw-threaded socket 50 and a palm 47 secured to the web by bolts 48 (see also Figure 4). In the region of the palm the web 43 is reinforced by a steel plate 80 moulded into the web in sandwich fashion. When the diaphragm is in position in the tubular shell portion 11 the socket 50 registers with a hole 51 in a thickened saddle portion 52 of the shell and an internally and externally screw-threaded ferrule 53 is screwed into the socket from outside the shell, a washer 54, of resilient material being interposed between a flange 55 on the ferrule and seating 56 on the shell to ensure a liquid-tight joint. The ferrule 53 is internally screw-threaded to receive any desired mounting fitting. In the example shown in Figure 1 the ferrule associated with the middle diaphragm is provided with a suspension lug 57 having a cross pin 58 adapted to be engaged by a releasable jaw device carried by the aircraft to which the container is to be attached, while the ferrules associated with the other two diaphragms are provided with plugs 59 having a projecting spigot 60 adapted to engage a corresponding recess in a part fixed to the aircraft. The suspension lug and spigot fittings may be reversed in the ferrules to provide a flush external surface during transport and thus avoid the danger of accidental damage. For some purposes, as for example, containers which are not required to be released from the aircraft while in flight, two mounting fittings might well be sufficient in which case one of the diaphragms 13 might also be omitted.

The flange 44 of each diaphragm is contiguous with the inner surface of parts 81 of the tubular shell portion 11, the thickness of the parts 81 of the shell portion 11 being greater than the thickness of the parts of the shell portion 11 immediately adjacent the parts 81 on each side thereof, as shown at 61.

It will be seen also that the flanges 44 and the thickened parts 81 are of stepped formation similar to the formation of the overlapping joint between adjacent ends of adjacent shell portions as already described in connection with Figure 2. In this way, the "differential piston" effect is again obtained when gluing each of the diaphragms 13 in place, thus facilitating the work and ensuring a strong joint. The diaphragms 13 are a comparatively free fit within the shell portion 11 and a glue is used having good gap-filling qualities. A satisfactory mixture for this purpose has been found to be an epoxy resin glue of the kind known by the trade name "Araldite D" mixed with 60% by weight of mica or kaolin powder

ground to pass through a 200 mesh per inch sieve. Instead of being stepped the flanges could be made slightly frusto-conical in shape to facilitate gluing, but the stepped arrangement is preferred since it allows more tolerance for endwise adjustment of the diaphragms into their correct positions.

The diaphragms **13** are provided with notches **42** and holes **62** to allow sufficiently free passage of liquid carried in the container while acting as anti-surge baffles.

The shell portion **11** is also provided in the thickened saddle part **52** with a hole **63** into which is glued a screw-threaded ferrule (not shown) to receive a filler cap **64**. A similar ferrule **65** is glued into a hole provided in the bottom of the shell to receive a drain plug **67**. The ferrules are provided with a flange **66** which abuts and is glued to the inner surface of the shell, and a strengthening boss **78** is then built up over the flange **66** from glass fibre cloth impregnated with a cold setting resin glue. Two further holes **68** and **69** are provided in the thickened saddle part **52** which register with the upper end of a combined fuel pipe and air vent fitting **70** including a fuel pipe **72** extending down to near the bottom of the container. The fitting **70** comprises a plate **71** which is secured to the upper-end of the fuel pipe **72** and seats in a recess provided on the outside of the shell around the holes **68** and **69**. A short internally threaded air-vent sleeve **73** is secured to the plate **71** and extends through the hole **68** into the container where a pipe **74** leading to a point near the filler hole **63** is secured to it by a banjo-type union **75**. The upper end of the fuel pipe is also internally threaded to receive an external connection as may be required. The plate **71** is glued to the bottom of the recess around the holes **68** and **69** and the recess is then filled up flush with the external surface of the shell with a mixture of resin and a filler. The fitting **70** and all other metal parts are earthed by electrical connections, some of which are shown at **76** in Figure 1.

To ensure liquid tightness of the container the inner surfaces of the shell portions are coated with a drying or setting liquid sealing composition which is sufficiently immune to attack by the liquid concerned.

Although the container particularly described and illustrated comprises only one intermediate tubular shell portion **11**, it will be clear that more than one such portion may be included if desired without altering the general character of the container. Furthermore, one or more of the shell portions may be provided with fins, which may either be moulded separately and attached to the shell portion or may be moulded integrally with the latter.

We claim:

1. A container section comprising a shell composed mainly of resin bonded fibrous material, and a diaphragm secured in said shell section by an adhesive, said diaphragm including a web part and a peripheral flange having an outer stepped surface and the shell section being thickened and stepped on the inside around the flange the contiguous surfaces of the shell and the flange being of corresponding shape.

2. A container section as claimed in claim 1, wherein said diaphragm carries a metallic mounting fitting, the diaphragm comprising two transverse stiffeners which extend parallel to one another across the web part of the diaphragm on opposite sides of a diameter, and a metal attachment means for the metallic mounting fitting carried by the web part between said stiffeners.

3. A container section as claimed in claim 2, wherein said diaphragm is a one piece moulding composed of fibrous material bonded with thermoset resin, and said metal attachment means is bolted to the web part of the diaphragm between said stiffeners, the web part having a moulded-in metal reinforcement in the region of said attachment means.

4. A container section as claimed in claim 2, wherein said metallic attachment means comprises an internally screw threaded socket which aligns with a hole in the part of said shell which is contiguous with the diaphragm flange, and said metallic mounting fitting is supported from said socket, said fitting extending through said hole to the outside of the container section.

5. A container section as claimed in claim 4, wherein a screw threaded ferrule lies in said hole and is engaged in said socket, said ferrule making a fluid tight joint with the outer surface of said shell, and said fitting is received in said ferrule.

6. A container section as claimed in claim 4, wherein said hole is formed in a thickened saddle portion of said shell.

References Cited in the file of this patent

UNITED STATES PATENTS

1,303,027	Carr	May 6, 1919
1,432,583	Williams	Oct. 17, 1922
2,164,660	Miller	July 4, 1939
2,269,617	Borstel	Jan. 13, 1942
2,285,220	Morrell	June 2, 1942
2,365,080	Humphreys	Dec. 12, 1944
2,415,260	Richards	Feb. 4, 1947
2,541,371	Kops	Feb. 13, 1951
2,545,481	Maier	Mar. 20, 1951
2,653,541	Kanode et al.	Sept. 29, 1953
2,678,750	King	May 18, 1954
2,727,286	Moore	Dec. 20, 1955
2,770,386	Mitchell	Nov. 13, 1956
2,793,779	Woods	May 28, 1957

FOREIGN PATENTS

1,052,703	France	Sept. 23, 1953