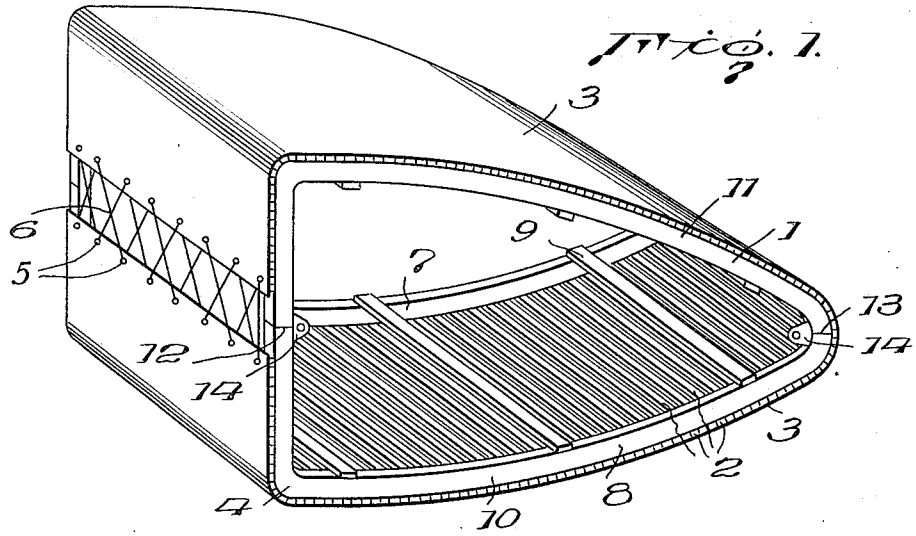
April 24, 1945. L. SHAKESBY 2,374,386

MANUFACTURE OF LIQUID CONTAINERS

Filed June 20, 1941 3 Sheets-Sheet 1

Fig. 1.



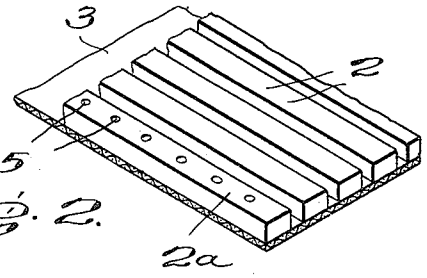


Fig. 2.

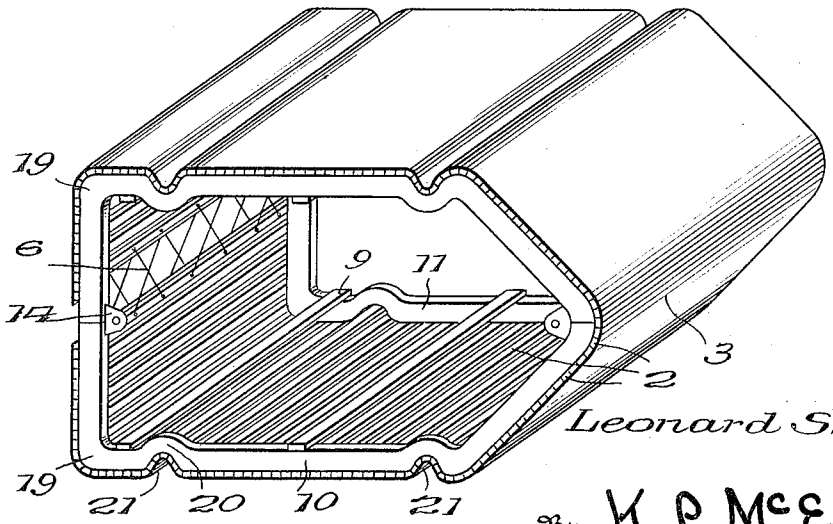


Fig. 3.

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MANUFACTURE OF LIQUID CONTAINERS

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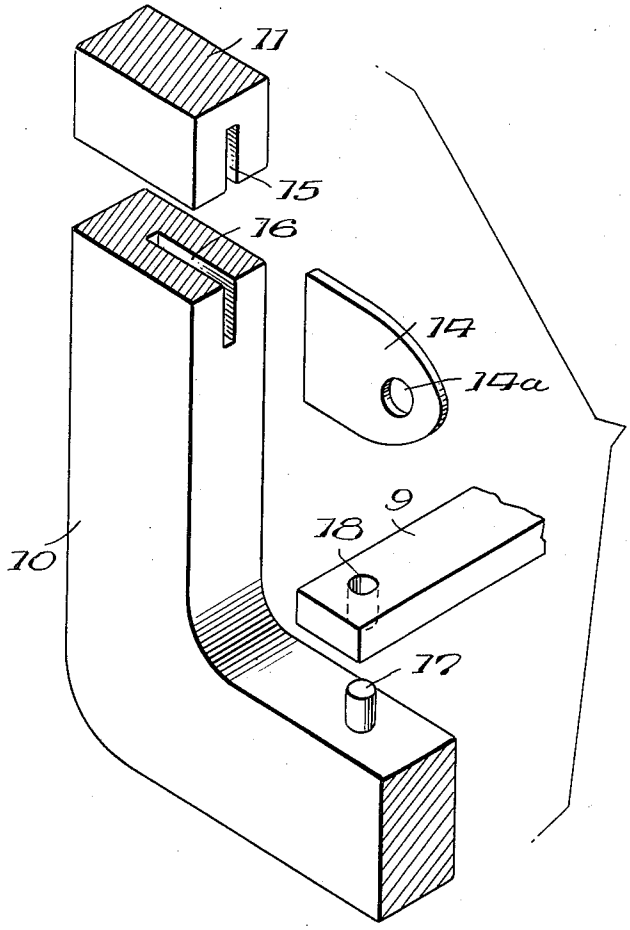


Fig. 4.

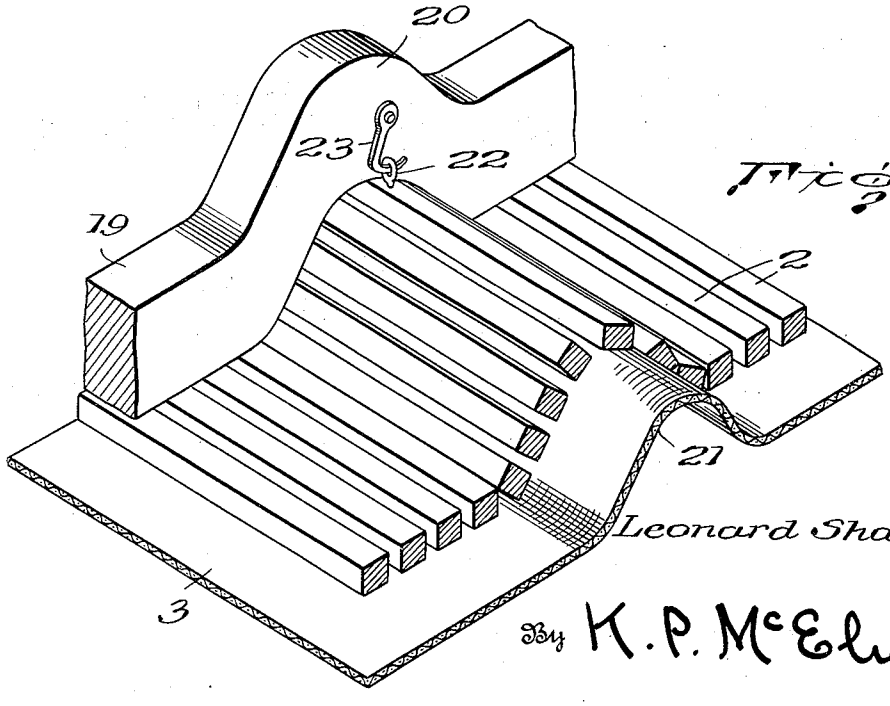


Fig. 5.

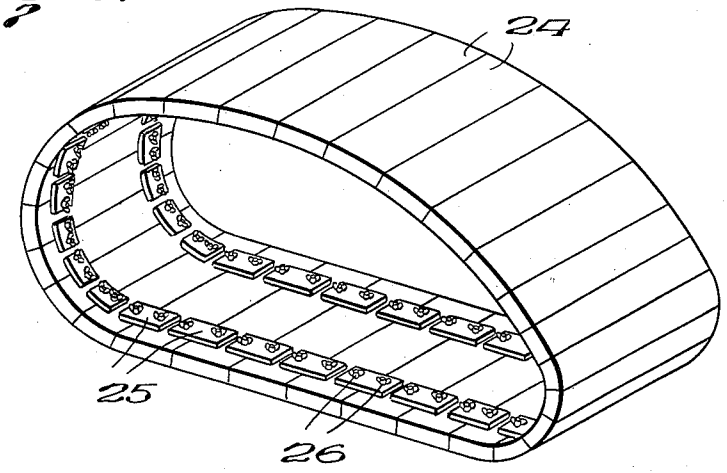
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MANUFACTURE OF LIQUID CONTAINERS

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Fig. 6.



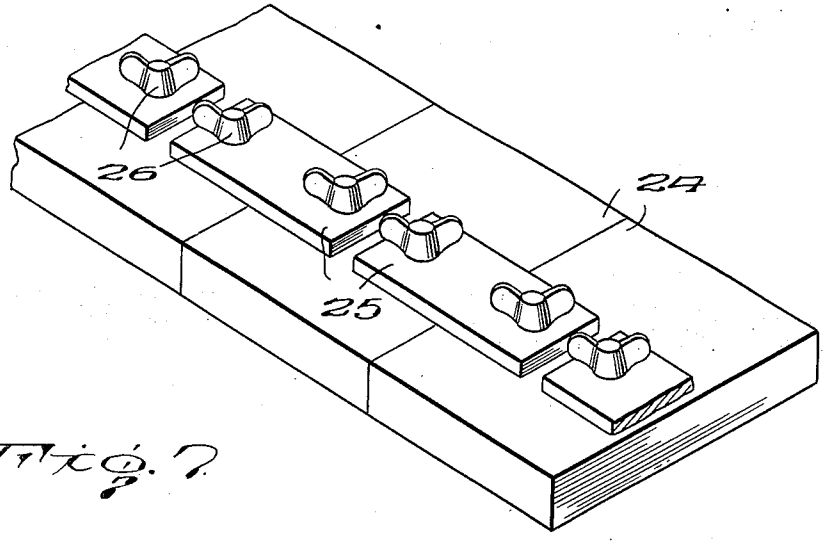


Fig. 7.

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UNITED STATES PATENT OFFICE

2,374,386

MANUFACTURE OF LIQUID CONTAINERS

Leonard Shakesby, Bradmore, Wolverhampton, England

Application June 20, 1941, Serial No. 399,033
In Great Britain April 19, 1940

11 Claims. (Cl. 18—45)

This invention relates to liquid containers and more particularly to liquid fuel or oil containers for aircraft or other vehicles, in which the container envelope comprises a flexible material treated to render it capable of retaining fuel or oil.

It has been proposed to provide liquid fuel containers of the kind described and to mount such containers within the fuselage or wing structure of the aircraft. In such proposals the flexible containers have been of substantially rectangular or other simple shape and of sufficient size to render manufacture comparatively easy. Modern requirements, however, call for fuel or oil containers to be housed in any available space in the fuselage or wing structure, irrespective of the size and shape of such space, and consequently containers of complicated and varied shape are frequently required. The manufacture of such containers presents many problems where the envelope consists of flexible material, since special formers or jigs are required to enable the various pieces which comprise the finished container to be accurately assembled and secured together. In making these containers the ends and walls are desirably made up as an integral unit, rather than being made separately, and there is the problem of taking a former out when the tank is completed.

The object of the present invention is to provide an improved method of manufacturing liquid containers of the kind referred to, in which containers of even complicated shapes can be constructed with a high degree of accuracy and in a simple and efficient manner.

According to my invention, in the manufacture of liquid containers having flexible walls, I provide a former or jig which is capable of being collapsed and which comprises a plurality of strip, block or lath-like frame members, hingedly or detachably connected together and adapted to provide a substantially rigid and continuous supporting surface for at least part of the surface of the container envelope.

The said former is preferably adapted to be collapsed at will in such manner as to enable it to pass through a relatively small aperture in the container envelope, and is also preferably adapted to be reinserted through the aperture and to be re-erected. For this purpose, the members may be hingedly connected together by securing them in side-by side relationship on a strip or strips of flexible material in such manner as to form a band which is substantially rigid in one direction and flexible in the transverse direction, and which may be rolled up to form substantially an elongated cylinder of relatively small diameter. The terminal members and/or the flexible strip or strips adjacent the terminal members, may be provided with coupling means to enable the ends of the band to be readily joined or parted at will. The flexible endless band which is formed by thus joining the said ends may be supported on a skeleton frame designed to impart the desired contour to the flexible band, said skeleton frame also being capable of being collapsed in such manner as to enable it to pass through the said small aperture.

Instead of being hingedly connected, the frame members may be detachably connected together by interlocking portions such as tongues and grooves or pins and sockets or by coupling links on the inner surfaces of the said members. A former constructed in this manner possesses a considerable inherent rigidity, which may be increased if desired by the use of a collapsible skeleton frame.

Several embodiments of my invention are illustrated in the drawings accompanying the specification in which

Figure 1 is a general perspective view of one type of former constructed in accordance with the present invention.

Figure 2 is a perspective view of a portion of the former of Figure 1, showing the method of securing the frame members on flexible material.

Figure 3 is a general perspective view of a modified type of former.

Figure 4 is a perspective view illustrating the assembly of component parts of the skeleton frame of the former of Figures 1 and 3.

Figure 5 is a perspective view of a portion of the former illustrated in Figure 3.

Figure 6 is a general perspective view of a further modification of former constructed in accordance with the present invention.

Figure 7 is an enlarged view in perspective of a portion of the former illustrated in Figure 6.

Referring to Figures 1, 2 and 4, a former 1 comprises a plurality of lath-like frame members 2 secured to a strip of fabric material 3 by a suitable adhesive, and supported on skeleton framework 4. The terminal members 2a and the adjacent portions of the strip 3 are pierced by holes 5, to permit of joining the said terminal members by lacing 6. The said skeleton frame comprises rib-members 7, 8,

spaced apart by transverse spars 9. Each of the said rib-members is built up from two similar parts 10, 11, joined as shown at 12, 13. The method of joining the said parts comprises inserting a plate-like member 14 into longitudinal slots 15, 16, in the abutting ends of the said parts (Figure 4). The said member 14 is designed primarily to hold the said parts 10, 11, firmly in co-planar alignment, but also serves to hold them together temporarily by friction to enable the assembly of the members 2 around the skeleton frame. The transverse spars 9 are attached to the rib members by means of dowel pegs 17 secured in the said rib-members, and are provided with holes 18 therefor.

The method of assembling the former is most easily achieved by carrying out the following sequence of operations: The two corresponding lower parts 10—10 of each of the two rib-members 7, 8, are spaced apart, and the transverse spars 9 located on their respective dowels. The other two upper corresponding parts 11—11 of the rib-members are then likewise assembled. The two portions of the skeleton frame thus assembled are brought into abutting position, and the plate-like members 14 are inserted into their respective slots. The fabric material 3 carrying the members 2 is then wrapped around the assembled skeleton framework, and made taut by means of the lacing 6.

The assembled former may be used for the fabrication of a flexible fuel container by methods similar to those described in my co-pending British application No. 7,113/40. After partial or complete fabrication of the fuel container, the assembled former may be collapsed very simply by withdrawing the plates 14 from their respective slots, and pushing the abutting portions of the joints out of alignment without disturbing the lacing, the component parts of the former being removed from the interior of the container through a suitable aperture provided in one of the walls of the said container. To re-assemble the former in the interior of the flexible container, the strip 3 and attached members 2 are inserted through the afore-mentioned aperture first in rolled-up form and are then unrolled within the container. The component parts of the skeleton frame are then inserted individually and erected within the unrolled but laced-up strip 3 in the order described hereinbefore. The skeleton frame is thus erected in halves and the halves combined by manipulating the appropriate ends into abutting relationship, adjusting the two portions of each rib-member into co-planar alignment and inserting the members 14 into their respective slots. To facilitate withdrawal of the said members 14 when required, each is provided with a hole 14a for the insertion of a hooked instrument or the like, not shown in the drawings.

In the manufacture of flexible containers of more complicated shape, for example containers provided with pockets or grooves for the accommodation of structural members, formers of suitable shape are required. By way of example, one such former is illustrated in Figure 3. The said former is substantially similar to that already described herein, and in fact differs only in the shape of the rib-members 19. The said rib-members incorporate concave portions 20, which portions enable the formation of grooves 21 in the surface of the former. The said grooves are effected by providing on those lath-members more centrally placed with respect to the concavities 20 an eye 22, and on the rib-members adjacent the concavities a hook 23 adapted to engage the said eye, and thus hold the lath-members substantially to the contour of the concavities in the rib-members, as shown in Figure 5.

An alternative type of former is illustrated in Figures 6 and 7 and comprises a plurality of separate members 24, wedged somewhat in the manner of barrel staves and connected together by coupling members 25, secured to adjacent stave-like members by winged screws 26. The wedge-form of the members 24 when they are all coupled together, usually provides sufficient rigidity for the purpose to be served, but additional bracing in the form of a skeleton framework (not shown) may be provided if desired. Instead of winged screws, bolts or other attaching means may be employed.

In assembling a former of the latter type in the interior of a container, the members 24 may be inserted individually through a suitable aperture in the wall of the container in numbered sequence and each succeeding member loosely attached to the preceding member. When all the members are in place, the winged screws 26 are progressively tightened until the whole assembly has been rigidly locked together.

In another type of former, not shown in the drawings, a construction somewhat similar to the form illustrated in Figures 6 and 7 may be employed, in that the individual frame-members are detachably secured together. In this case, however, no coupling links are used, but instead each member is keyed to its adjacent member by a tongue on one member engaging a corresponding groove on the other member, or by a series of dowels on one member entering a series of dowel holes on the other member.

I claim:

1. A jig for use as a temporary support in the manufacture of liquid fuel containers which when complete are substantially closed, with a restricted opening therein, the jig being adapted to be withdrawn through the restricted opening after manufacture of the container; said jig comprising a plurality of parallel container-wall-supporting strips secured to a band of flexible material, and releasable strip-holding means engaging the strips, small enough to be withdrawn through said restricted opening, for holding the strips together in rigid form of substantially smooth exterior contour conforming substantially to the desired inner contour of the container; said means being so constituted and arranged as to be manipulatable from outside, through said restricted opening, to release the strips within the container so that they can be brought closer together to each other for withdrawal through said opening.

2. A jig for use as a temporary interior support for liquid fuel containers which when complete are substantially closed, with a restricted opening therein, the jig being adapted to be inserted and withdrawn through the restricted opening; said jig comprising a plurality of parallel supporting strips secured to a band of flexible material which upon collapse is capable of being passed through said opening, and means small enough to pass through said restricted opening, for holding the strips together in rigid form of substantially smooth exterior contour conforming substantially to the inner contour of the container; said means being manipulatable from outside, through said restricted opening, to en-

gage and hold the strips, said means comprising a frame adapted to extend peripherally about the interior surface of the strips in a plane disposed transversally to the said strips, said frame being composed of a plurality of peripherally spaced rib members composed of sections which are relatively laterally displaceable for permitting collapse and removal of the sections through said restricted opening, and means releasably engageable therewith for holding adjacent extremities of said sections against lateral displacement when the sections are in operative relationship.

3. A jig for use as a temporary support in the manufacture of liquid fuel containers, comprising a plurality of parallel container-wall-supporting strips secured to a strip of flexible material so as to form a band which is rigid in the direction of the length of the strips and flexible in the direction at right angles thereto, detachable coupl ng means for the ends of the band, and a collapsible frame engaging and holding the strips together in rigid form of substantially smooth exterior contour conforming substantially to the desired inner contour of the container; said frame being collapsible from outside so as to release the band of strips so that it can be rolled to smaller dimensions for removal.

4. A jig for use as a temporary support in the manufacture of liquid fuel containers which, when complete, are substantially closed, with a restricted opening therein, the jig being adapted to be withdrawn through the restricted opening after manufacture of the container; said jig comprising a length of flexible sheet material, a plurality of elongated relatively rigid parallel supporting strips disposed longitudinally of the sheet and extending laterally in spaced relationship, said strips being secured to the length of sheet material thereby to form a band which is relatively rigid in a lateral direction but is capable of being rolled longitudinally to form a relatively small bundle, releasable coupling means for coupling the longitudinal extremities of the band, and means for supporting the band in rigid form of substantially smooth exterior contour conforming substantially to the desired inner contour of the container when the extremities of the band are coupled, said last-named means comprising a frame adapted to extend peripherally about the inner surface of the strip and comprising a plurality of separable, peripherally disposed sections releasably interengageable but laterally separable through said restricted opening for removal in sections to release the band so that it may be rolled to small dimensions for withdrawal through said opening.

5. A jig for use as a temporary support in the manufacture of liquid fuel containers which, when complete, are substantially closed, with a restricted opening therein, the jig being adapted to be withdrawn through the restricted opening after manufacture of the container; said jig comprising a length of flexible sheet material, a plurality of elongated relatively rigid parallel supporting strips secured to the sheet longitudinally thereof and extending laterally in spaced relationship to form a band which is relatively rigid in a lateral direction but is capable of being rolled longitudinally to form a relatively small bundle, detachable coupling means for coupling the longitudinal extremities of the band, and means for supporting the band in rigid form of substantially smooth exterior contour conforming substantially to the desired inner contour of the container when the extremities of the band are coupled, said last-named means comprising a peripherally extending frame interiorly of the band, said frame being disposed in a plane extending transversely of the strips, and comprising a plurality of peripherally spaced sections releasably interengageable but separable through said restricted opening for removal in sections to release the band so that it may be rolled to small dimensions for withdrawal through said opening.

6. A jig as defined in claim 5, wherein said band supporting means comprises a plurality of frames as defined, which frames are held in spaced relation by transverse spars.

7. A jig as defined in claim 5, wherein said band supporting means comprises a plurality of frames as defined, which frames are held in spaced relation by transverse spars, and means for interengaging the frames and spars comprising pin and aperture means associated therewith and disposed on inwardly extending axes whereby the spars are separable from the frames by manipulation in a direction inwardly of the frames.

8. A jig as defined in claim 5 wherein the said coupling means comprises perforations in the elongated strips disposed at the extremities of the sheet and adapted to permit connection of said extremities by lacing.

9. A jig as defined in claim 5 wherein said frame member is provided with an inwardly extending recess on its outer periphery and wherein said frame member and band are provided with internal coupling means for releasably holding adjacent portions of the band within said recess.

10. A jig for use as a temporary support in the manufacture of liquid fuel containers comprising a band having means for coupling its longitudinal extremities, means for holding the coupled band in substantially rigid form of substantially smooth exterior contour conforming to the inner contour of the container, said last-named means comprising at least one frame adapted to extend continuously about the interior periphery of the band in supporting relationship, said frame comprising a plurality of peripherally disposed sections having their extremities in abutting relationship and collapsible when said sections are shifted in relative lateral directions and means insertable and releasable from adjacent sections for holding said extremities against lateral displacement.

11. A jig as defined in claim 10 wherein said means for holding the sections against lateral displacement comprises recesses extending centrally within adjacent extremities of said sections and a member insertable in said recesses when the extremities are in operative position.

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