March 30, 1948. T. W. CAIRNS 2,438,536

BUBBLE CAP STRUCTURE

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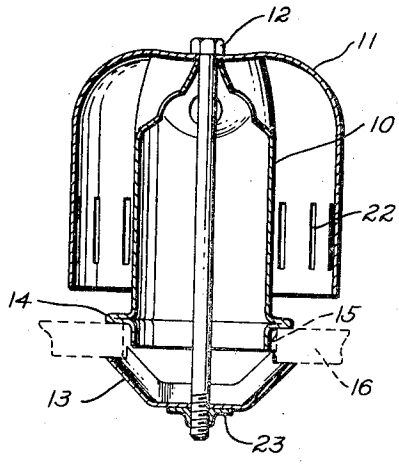


Fig. 1

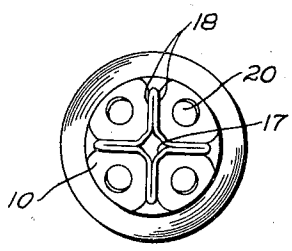


Fig. 2

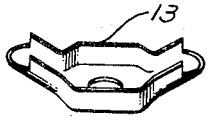


Fig. 4

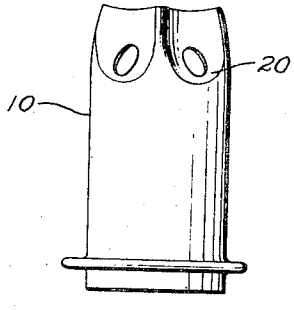


Fig. 3

INVENTOR.
THOMAS W. CAIRNS
BY Ellwoodbury
ATTORNEY

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BUBBLE CAP STRUCTURE

Thomas W. Cairns, National City, Calif., assignor to Solar Aircraft Company, San Diego, Calif., a corporation of California

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4 Claims. (Cl. 261—114)

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This invention relates to bubble cap assemblies for use in bubble trays of fractionating towers and the like.

An object of the invention is to provide a bubble cap assembly that is relatively inexpensive and has a long life.

Another object is to provide a design that facilitates the fabrication of bubble cap assemblies from thin sheet metal.

A more specific object is to provide a design of riser for a bubble cap assembly which can be formed from sheet metal and which constitutes an effective support for the bubble cap.

In the refining of oil and similar industries it is common practice to produce fractional distillation of a gas by moving the gas upwardly through a fractionating tower while simultaneously moving the condensate downwardly and producing intimate contact between the gas and the condensate. It is common practice to produce the desired intimate contact between the gas and the liquid by repeatedly bubbling the gas through the liquid during its travel upwardly through the tower. To facilitate this bubbling, a large number of bubble trays are provided at different levels in the tower. Each bubble tray consists of a shallow reservoir having a bottom wall containing apertures through which the gas flows upwardly and the liquid flows downwardly. The liquid is maintained at a predetermined depth in each bubble tray and the gas is caused to bubble through the liquid in the tray by employing a plurality of bubble cap assemblies in each tray. Each bubble cap assembly consists of a riser, a bubble cap and means for securing them together and to the bubble tray. The riser is a tubular member which is connected at its lower end to an opening in the bubble tray and has openings spaced from its lower end through which liquid from the bubble tray can flow when it exceeds a predetermined level. The bubble cap is essentially an inverted cup of larger diameter than the riser and secured to the top of the riser with its skirt extending below the level of the liquid in the bubble tray so that gas flowing upwardly through the riser must then flow down through the cap and bubble through the liquid in the tray.

The liquids and gases present in a fractionating tower are often of a relatively corrosive nature and it is therefore desirable to make the bubble cap assemblies of corrosion-resistant materials. On the other hand, suitable corrosion-resistant materials are relatively expensive and it has heretofore been found difficult to form thin sheets of

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suitable alloys into the requisite forms to make satisfactory risers and bubble caps. Hence the industry has, to a large extent, employed materials that are not resistant to corrosion but are relatively inexpensive and can be cast into suitable shape.

Briefly, the present invention resides in a bubble cap assembly in which both the riser and the bubble cap, and also other minor elements of the assembly, can be economically formed from sheet alloy having corrosion-resistant characteristics, such as stainless steel or Monel metal.

A full understanding of the invention may be had from the following description when read in connection with the attached drawing, in which:

Fig. 1 is a vertical section through a bubble cap assembly in accordance with the invention;

Fig. 2 is a plan view of the riser shown in Fig. 3;

Fig. 3 is an elevation view of the riser employed in the assembly of Fig. 1; and

Fig. 4 is a perspective view of a hold-down spider employed in the assembly.

Referring first to Fig. 1, the bubble cap assembly therein disclosed includes as its essential elements a riser 10, a bubble cap 11, a hold-down bolt 12 and a hold-down spider 13.

The riser 10 consists of a tubular element opened at its lower end and having a portion of its side wall pressed outwardly to define a flat flange 14 adapted to rest on the edge of an aperture 15 in a bubble tray 16. The tubular portion of the riser is extended a short distance below the flange 14 into the aperture 15 to center the riser with respect to the aperture. In Fig. 1 the flange 14 is shown resting directly upon the bubble tray 16 but it is to be understood that a gasket may be employed under the flange, if desired, to reduce leakage at this point.

The upper end of the riser 10 is deformed to provide a suitable seating surface for supporting the bubble cap 11. Thus referring to Figs. 2 and 3, it will be observed that the upper edge of the tubular member constituting the riser has been deformed from its normal circular shape into a shape that may be described as cruciform. The upper edge consists of four short arcuate sections 17 which define an aperture of suitable size to receive the hold-down bolt 12. The ends of each arcuate section 17 merge into a pair of straight radially extending sections 18. The two radially extending sections 18 associated with successive arcuate sections 17 lies close along-

side each other and are continuous with each other at their outer ends.

The body of the riser 10 is merged gradually from a true cylindrical shape into the edges 17 and 18, as shown in Figs. 2 and 3. The exact shape of the transition portions of the riser between the cylindrical portion and the edges 17 and 18 is not important from a functional standpoint but is so chosen as to facilitate the shaping of the riser from a piece of stock that is originally cylindrical in shape.

Apertures 20 are provided in the wall of the riser 10 to permit passage of gas and liquid. The height of these apertures 20 determines the level of the liquid in the tray. Hence the apertures can be located at any desired height, depending upon the depth of the liquid that it is desired to maintain in the tray.

The edges 17 and 18 of the riser lie in a surface that is slightly dished, and the center portion of the cap 11 is correspondingly shaped when it is drawn into contact with the riser by tightening the hold-down bolt 12. Originally the upper end wall of the cap 11 may be flat so that it is distorted by tightening of the bolt 12, thereby producing intimate contact between the upper end of the bubble cap and the surfaces 17 and 18 of the riser.

The bubble cap 11 may be provided with thin vertical slits 22 in its skirt portion, through which the gas is discharged, instead of forcing the gas to escape past the lower edge of the skirt of the cap.

The hold-down spider 13 is preferably stamped from a thin piece of sheet alloy and may be of channel section and arched longitudinally to increase its strength. The hold-down member preferably has a nut plate 23 welded thereto, into which the hold-down bolt 12 is screwed. This eliminates the necessity of employing a separate nut which constitutes another part liable to be lost and which makes the assembly of the unit more difficult.

By enabling the construction of bubble caps from sheet metal, the invention effects a substantial reduction in weight, with resultant economies. Thus some fractionating towers contain over 5,000 bubble caps, and a reduction in the weight of each cap not only effects a substantial direct saving in weight but also makes possible a reduction in the weight of the trays, towers and supporting structures that may aggregate several tons.

Although for the purpose of explaining the invention, a particular form thereof has been described in detail, various departures from the exact structure shown may be made without departing from the invention which is to be limited only to the extent set forth in the appended claims.

I claim:

1. A bubble cap assembly adapted to cover an opening in a bubble tray and including a riser adapted to seat on said tray opening, a cap adapted to rest on and be supported by said riser, a hold-down spider adapted to engage the under side of said tray, and a hold-down bolt interconnecting said cap and spider, in which said riser comprises: a tubular member open at the lower end and having a seat for engaging the tray opening, said member having a gas discharge aperture therein and having upper edge portions folded back upon themselves and extending radially to constitute a seat for supporting said cap in fixed position relative to said riser.

2. A bubble cap assembly adapted to cover an opening in a bubble tray and including a riser adapted to seat on said tray opening, a cap adapted to rest on and be supported by said riser, a hold-down spider adapted to engage the under side of said tray, and a hold-down bolt interconnecting said cap and spider, in which said riser comprises: a tubular member open at the lower end and having a seat for engaging the tray opening, said member having a gas discharge aperture therein and having an upper edge comprising arcuate portions defining a central hole for the passage of said bolt and other portions extending approximately radially from said arcuate portions and constituting a seat for supporting said cap.

3. A riser for a bubble cap assembly adapted to seat on a bubble cap tray opening and support a bubble cap, said riser comprising a tubular member open at the lower end and having a seat for engaging the tray opening, said member having a gas discharge aperture therein and having upper edge portions folded back upon themselves and extending radially to constitute a seat for supporting said cap in fixed position relative to said riser.

4. A riser for a bubble cap assembly adapted to seat on a bubble cap tray opening and support a bubble cap, said riser comprising a tubular member open at the lower end and having a seat for engaging the tray opening, said member having a gas discharge aperture therein and having an upper edge comprising arcuate portions defining a central hole for the passage of said bolt and other portions extending approximately radially from said arcuate portions and constituting a seat for supporting said cap.

THOMAS W. CAIRNS.

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