

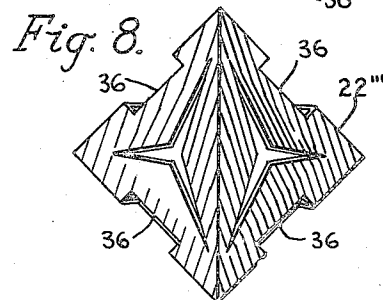
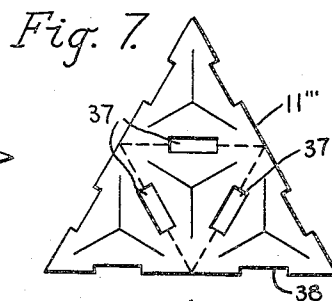
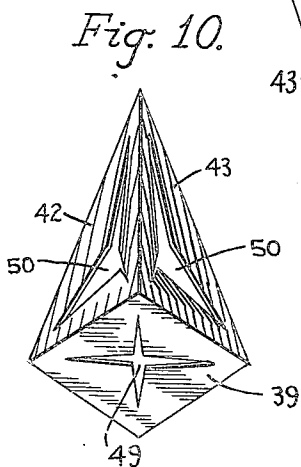
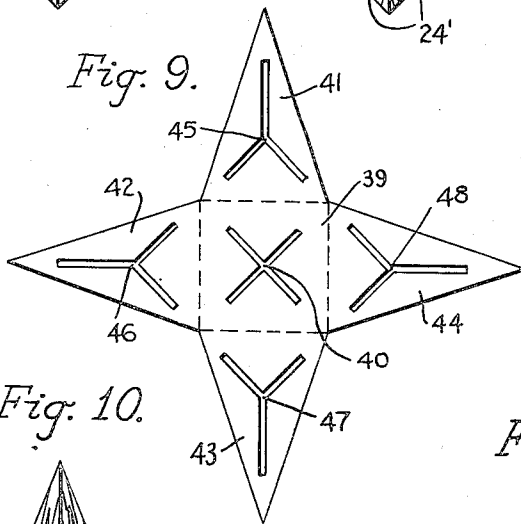
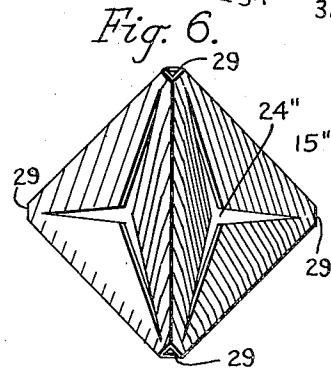
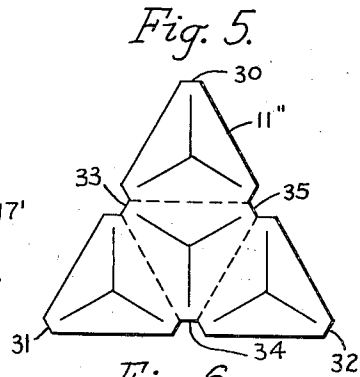
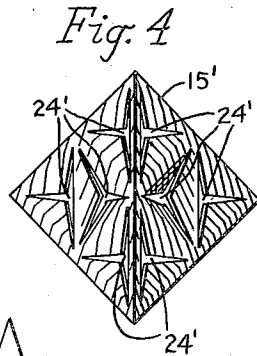
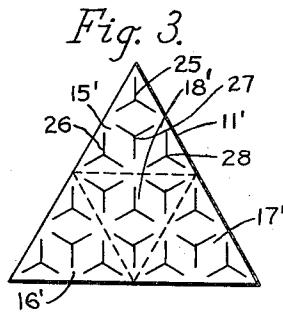
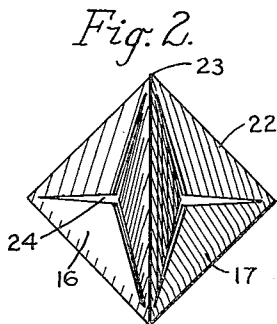
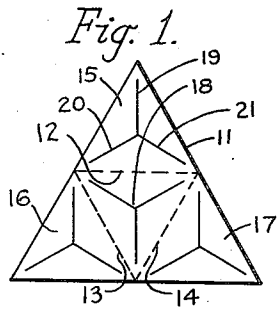
April 1, 1952

E. BERL

2,591,497

FILLING BODY FOR GAS-LIQUID CONTACT TOWERS

Filed Sept. 5, 1947



INVENTOR.
E. BERL, DEC'D.
BY WALTER G. BEAL,
EXECUTOR.
Jesse W. Poston
AGENT

UNITED STATES PATENT OFFICE

2,591,497

FILLING BODY FOR GAS-LIQUID
CONTACT TOWERSErnst Berl, deceased, late of Pittsburgh, Pa., by
Walter G. Berl executor, Pittsburgh, Pa.

Application September 5, 1947, Serial No. 772,364

10 Claims. (Cl. 261—95)

1

This invention relates to filling bodies, and more particularly to filling bodies to increase the internal surfaces of reaction towers, washing towers, and the like.

Filling bodies for reaction or washing towers are well known to the art. Among them are Berl saddles (U. S. Pat. No. 1,796,501, March 17, 1931; a circular blank folded in crosswise reversed manner to resemble a riding saddle), and Raschig rings (topless and bottomless hollow cylinders). Such filling bodies are dumped in bulk into the tower to increase its internal surface and to break up the descending and/or ascending fluid currents passing through the tower. Numerous materials are suitable for making such bodies: e. g. sheet metal, cast metal, ceramic materials, plastic materials, etc. Substantially the only limitation on the choice of material for a filling body are cost, resistance to deterioration by fluids to be contacted, and capacity to be shaped into the desired form. Wire mesh has also been tried as a material for filling bodies, but has not proved to be wholly acceptable in practice, as it generally lacks rigidity and fluid impermeability.

A desirable characteristic of a filling body is a favorable ratio of occupied space to fluid-contacting surface. The smaller the fraction

Occupied space
Fluid-contacting surface

is for a given filling body, the better are the performance characteristics of the filling body, inasmuch as a smaller number of favorably shaped filling bodies will suffice to provide the desired internal contact surface of the tower.

A principal object of the present invention is therefore a filling body of the character described, which occupies but little space in relation to fluid-contacting surface.

Another object of the present invention is a filling body of simple geometrical configuration, which can be easily and cheaply made from conventional structural material.

Further objects of this invention will appear more fully from the following description of several embodiments of the same, in conjunction with the appended drawings.

A filling body in accordance with the present invention is a hollow polyhedron or pyramid, of substantially fluid impermeable stock, and provided with a number of apertures to permit fluid to contact the inside as well as the outside of the body. The regular geometrical body which occupies the least space in relation to the sum of its outer and inner surfaces is a tetrahedron

2

bounded by four equilateral triangles. If the length of an edge of such a body be 1 unit of length, its outer surface is 1.7321 units of area, while it occupies only .1179 unit of volume. Consequently, the relation of the space occupied by a regular hollow apertured tetrahedron to its fluid-contacting outer and inner surfaces is

$$\frac{.1179}{2 \times 1.7321} \text{ or approximately } 1:29$$

(The obvious fact that the inner surface of a hollow body is slightly smaller than its outer surface is ignored in the above calculation, as that difference is negligible in a thin-walled body.) The corresponding ratio in a hollow apertured cube is 1:12, and of course still less favorable in a hollow apertured sphere.

An undesired reduction in fluid-contacting surface takes place when the hollow polyhedron is apertured by punching large numbers of holes therethrough. In accordance with the present invention, this disadvantage is avoided by providing the flat surfaces defining the polyhedron with a number of incisions or narrow slots converging in a common point, and distorting the incised or slotted surfaces in a direction away from or—preferably—towards the center of the body. This opens up fluid passages without decreasing the surface of the body. In a regular tetrahedron, the incisions preferably originate at the center of each surface triangle and terminate near its corners. The opening up of the fluid passages is conveniently accomplished e. g. by applying a punch to the points of convergence of the incisions. The slight geometrical irregularity caused by this distortion of the surfaces has the desirable effect of lessening the danger of "packing," i. e. the undesired accidental aggregation of filling bodies inside the tower to form an almost fluid-impenetrable block.

The appended drawings illustrate several embodiments of filling bodies and blanks for their manufacture in accordance with the present invention.

Fig. 1 is a plan view of a triangular incised blank for the manufacture of a filling body;

Fig. 2 is a perspective view of a regular tetrahedral filling body made from the blank shown in Fig. 1;

Fig. 3 is a plan view of a blank resembling Fig. 1, but having a greater number of converging incisions;

Fig. 4 is a perspective view of a filling body made from the blank shown in Fig. 3;

Fig. 5 is a plan view of an incised blank whose

3

surface is constituted by four truncated equilateral triangles assembled in a cluster to form a larger equilateral triangle;

Fig. 6 is a perspective view of a filling body made from the blank shown in Fig. 5;

Fig. 7 is a plan view of an incised blank whose surface is constituted by four edgewise recessed equilateral triangles assembled in a cluster to form a larger equilateral triangle;

Fig. 8 is a perspective view of a filling body made from the blank shown in Fig. 7;

Fig. 9 is a plan view of a slotted blank for the manufacture of an irregular polyhedral (pyramidal) filling body; and

Fig. 10 is a perspective view of a filling body made from the blank shown in Fig. 9.

More particularly, equilateral triangular flat blank 11 (Fig. 1) is subdivided into four equilateral triangles along scored lines 12, 13, 14, and each of the latter triangles (15, 16, 17 and 18) is incised from its center along radial lines 19, 20 and 21 to near its corners. The blank is then formed into a regular tetrahedron 22 (Fig. 2) by turning triangles 15, 16 and 17 upwardly till their corners touch at 23. The center of each of triangles 15 to 18 is pushed inwardly (e. g. by a punch) to open up the fluid passages 24 along radial incisions 19, 20, 21. The edges of tetrahedron 22 emanating from its apex 23 may be crimped or otherwise joined together.

In the embodiment shown in Figs. 3 and 4, equilateral triangular blank 11' is subdivided into triangles 15', 16', 17' and 18'. Each of the latter triangles has four Y-shaped incisions 25, 26, 27 and 28. The filling body is shaped like that of the preceding embodiment, except that there are sixteen fluid passages 24', which are made by punching each Y-shaped set of incisions inwardly at its center.

The embodiments of Figs. 5 and 6 on the one hand, and of Figs. 7 and 8 on the other hand correspond to the blank and body illustrated in Figs. 1 and 2; but additional fluid passages are provided. In the embodiment of Figs. 5 and 6, fluid passages 24'' are supplemented by truncation openings 29 of the tetrahedron which result from truncating the blank 11' at 30, 31 and 32, and making channel-shaped incisions at 33, 34 and 35.

The additional edgewise fluid passages 36 of the regular tetrahedral hollow filling body shown in Fig. 8 (22''') are provided by making corresponding rectangular incisions 37, 38 in blank 11''' (Fig. 7).

The preferred form of a filling body in accordance with the present invention is a hollow polygonal body all of whose edges are of identical length, and particularly a hollow regular tetrahedron which has an eminently favorable space-to-surface ratio. However, other polyhedral and pyramidal shapes are also within the contemplation of this invention, and possess utility as filling bodies. Thus a hollow pyramid having a square base 39 provided with narrow X-shaped slots 40, and four triangular sides 41, 42, 43, 44, with Y-shaped incisions 45, 46, 47, 48, may be used as a filling body after fluid passages 49, 50 are opened up in the same manner as in the preceding embodiments. The height of such a pyramid may be the same as, less than, or greater than the length of an edge of its base; the last-mentioned modification is illustrated in Figs. 9 and 10.

The blanks referred to in the above description may be cut from sheet metal or other suitable material. If thermo-plastic material is

4

chosen, the blank is preferably shaped into its tetrahedral or pyramidal shape while heated. Other methods of making the above-described filling body, e. g. its manufacture by injection molding, or blank-cutting with die presses, will readily occur to persons skilled in the manufacture of chemical equipment.

Changes in dimension, proportion, arrangement and/or location of incisions, etc. will be obvious to the expert, but are within the spirit and the scope of the present invention. It is intended to claim the same broadly and to limit it only by the appended claims.

What is claimed is:

1. A filling body for reaction and washing towers and the like, formed from a substantially fluid impermeable sheet-like blank and folded to form a hollow polyhedron, the boundary surfaces of said polyhedron including a plurality of triangles, the surface of each triangle being substantially linearly incised with the blank area bordering each incision being distorted from the plane of the triangle providing a fluid passage through said hollow polyhedron without substantially decreasing the surface area.

2. A filling body for reaction and washing towers and the like, formed from an equilateral substantially fluid impermeable sheet-like blank and folded to form a hollow polyhedron, the boundary surfaces of said polyhedron including four equilateral triangles of equal area, the surface of each triangle being substantially linearly incised with the blank area bordering each incision being distorted from the plane of the triangle providing a fluid passage through said hollow polyhedron without substantially decreasing the surface area.

3. A filling body for reaction and washing towers and the like, formed from an equilateral substantially fluid impermeable sheet-like blank and folded to form a hollow tetrahedron whose boundary surfaces include four equilateral triangles of equal area, the surface of said triangles being provided with a plurality of substantially linear incisions and being distorted by folding along lines joining the terminating points of said incisions to permit the passage of a fluid through said hollow tetrahedron without substantially decreasing the surface area.

4. A filling body for reaction and washing towers and the like, formed from an equilateral triangular substantially fluid impermeable sheet-like blank and folded to form a hollow tetrahedron defined by four equilateral triangles of equal area, the surface of said triangles having three substantially linear incisions from the triangle center towards the corners and terminating short of said corners, and said surface being distorted by folding along lines joining the terminating points of said incisions to permit the passage of a fluid through said hollow tetrahedron without substantially decreasing the surface area.

5. A filling body for reaction and washing towers and the like, comprising a sheet-like hollow tetrahedron defined by four triangles, the surface of each triangle having radial incisions with the blank area bordering each incision being distorted from the plane of the triangle providing a fluid passage through said hollow tetrahedron without materially decreasing the surface area of the tetrahedron.

6. A filling body for reaction and washing towers and the like, comprising a sheet-like hollow tetrahedron defined by four triangles, each

5

triangle having radial incisions with the blank area bordering each incision being distorted from the plane of the triangle and each triangle being truncated providing a fluid passage through the hollow tetrahedron without substantially decreasing the surface area of the tetrahedron.

7. A filling body for reaction and washing towers and the like, comprising a sheet-like hollow tetrahedron defined by four equilateral triangles, each of said triangles being substantially linearly incised with the blank area bordering each incision being distorted from the plane of the triangle and each triangle being truncated at its corners, thereby providing a fluid passage through the hollow tetrahedron without substantially decreasing the surface area of the tetrahedron.

8. A filling body for reaction and washing towers and the like, comprising a sheet-like hollow tetrahedron defined by four radially incised triangles with the blank area bordering each incision being distorted from the plane of each triangle and each of said triangles being edgewise slotted, thereby providing a fluid passage through the hollow tetrahedron.

9. A filling body for reaction and washing towers and the like, comprising a sheet-like hollow tetrahedron defined by four equilateral edgewise abutting triangles, each of said triangles being provided with radial incisions with the blank area bordering each incision being distorted from the plane of the triangle and said

6

triangles being recessed at their edges to provide slots for the passage of a fluid through said body.

10. A filling body for reaction and washing towers and the like, comprising a regular hollow tetrahedron made of substantially fluid impermeable sheet stock, said hollow tetrahedron having a plurality of substantially linear apertures with the blank area bordering each aperture being distorted from the plane of the tetrahedron to provide a passage for a fluid without substantially decreasing the surface area of said tetrahedron, whereby the inside as well as the outside of said body may be contacted by said fluid.

WALTER G. BERL,

Executor of the Last Will and Testament of Ernst Berl, Deceased.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,206,440	Walker	July 2, 1940

FOREIGN PATENTS

Number	Country	Date
180,734	Great Britain	May 23, 1922
236,880	Germany	July 14, 1911
263,200	Germany	Aug. 4, 1913
377,408	Germany	June 18, 1923