

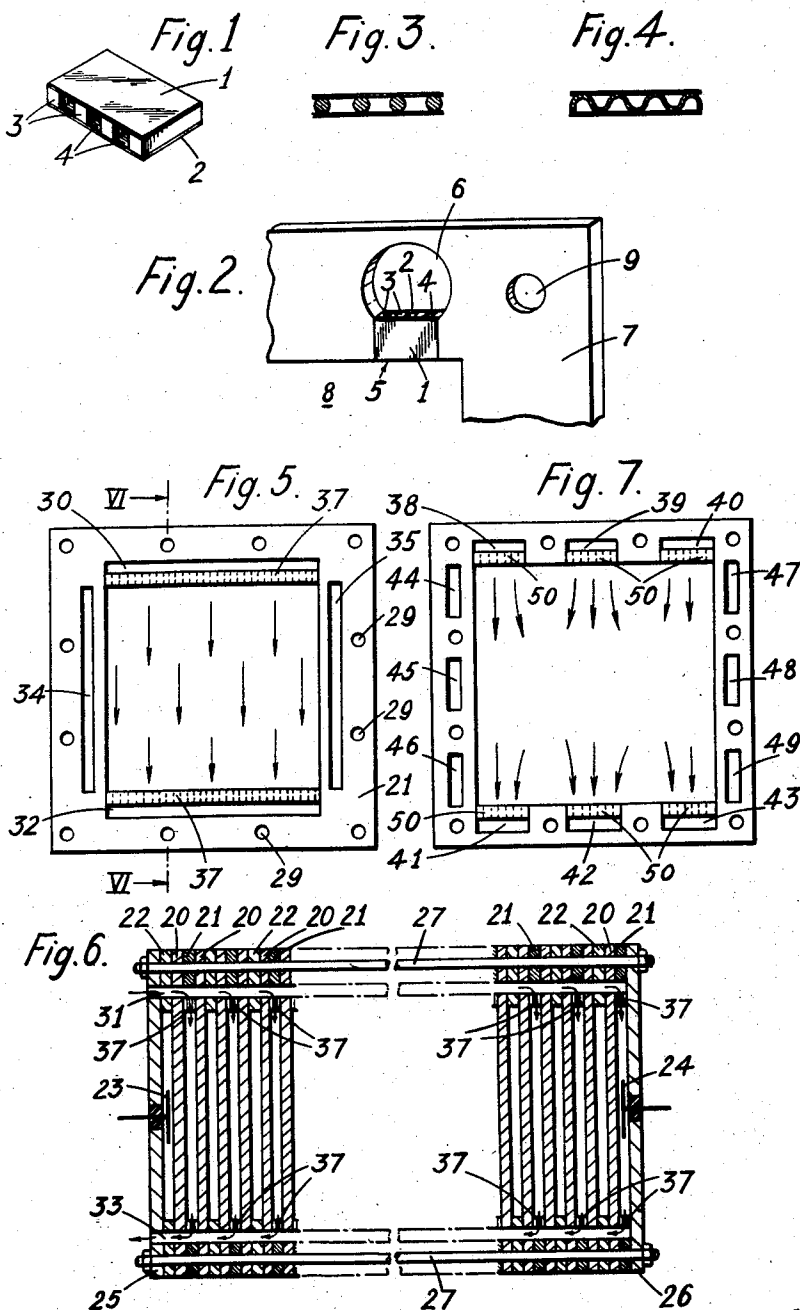
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ELECTROLYTIC CELLS

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ELECTROLYTIC CELLS

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Continuation of application Serial No. 618,618, October 26, 1956. This application March 19, 1958, Serial No. 722,513

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8 Claims. (Cl. 204—301)

This invention relates to electrolytic cells for carrying out processes of electrodialysis, the cells being made up of a series of compartments between two electrodes, the compartments being separated by ion-exchange membranes held apart round their edges by spacers in the shape of open frames. The introduction of liquid into and removal of it from each compartment is a matter of difficulty as the distance between adjacent membranes is preferably small and the spacers therefore very thin. Most conveniently conduits are formed through the cell by cooperating holes in the membranes and spacers, passages in the spacers connecting the conduits to the compartments. Now most ion-exchange membranes are flexible, being made of granules or particles of an ion-exchange resin supported in a plastic matrix and there is a tendency for these membranes to bulge and bow into a passage where they cross a passage under the pressure applied to compress the membranes and spacers and make the cell liquid-tight.

It is an object of this invention to provide an improved construction of electrodialysis cell.

It is a further object of the invention to provide an insert for placing in the passages between the holes forming part of the conduits and the compartments.

Further objects will appear hereinafter.

In accordance with our invention each passage contains a separate insert which does not substantially interrupt the flow of liquid through the passage and substantially prevents deformation of the membranes into the passages.

The invention will be described in detail with reference to the accompanying drawings, which are given by way of example and not of limitation and in which:

Figure 1 is a perspective view of an insert;

Figure 2 is a perspective view of part of a spacer showing the insert of Figure 1 in position;

Figures 3 and 4 are cross-sections of two other inserts;

Figure 5 is a plan view of a spacer having inserts in position;

Figure 6 is a cross-section through a cell made up with spacers of the type shown in Figure 5, the section being taken on a plane corresponding to that shown as VI—VI in Figure 5; and

Figure 7 is a plan view of a further spacer having inserts in position.

Where it has heretofore been necessary to use small holes because of the tendency of the membranes to bow, it is now possible in accordance with this invention to use holes which are rectangular with their long sides parallel with the inside edges of the spacers. This has obvious advantages compared with small, usually circular, holes where the liquid in each compartment has to fan out from each hole on entering and to be collected again on leaving. Rectangular holes can extend right along the sides of each compartment, the liquid then flowing as a sheet, and experiencing very little drop in pressure in passing through the insert as compared with smaller

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inserts. Further the liquid path through each compartment is shorter. All these advantages combine to give a more efficient use of the membrane area, a given process therefore requiring a smaller cell or a lower power consumption.

The insert shown in Figures 1 and 2 is made up of two flat sheets 1 and 2 of identical dimensions with the plan of the passage, separated and supported the one by the other by four pieces of material 3 each of length equal to the length of the passage arranged between the sheets so as to form a number of channels 4 running parallel with one another. As shown in Figure 2 the insert is in position in a passage 5 connecting a hole 6 in a spacer 7 to a compartment 8 defined by the spacer. There is a further hole 9 for a rod for supporting the spacers and membranes which make up a cell. The insert is of the same dimensions as the passage and thus provides a continuous support for the membranes on each side of the passage.

The passages and therefore the inserts are preferably rectangular in plan, but they may be any other shape.

The pieces of material separating the sheets in the inserts may be of any convenient cross-section, for example, circular as shown in Figure 3. Alternatively, the pieces of material may be thin vertical strips. They may also be sheets with corrugated or castellated cross-section as shown in Figure 4. Whatever construction is used it must provide sufficient support for the two sheets so that these do not collapse inwards into the passage under the pressure applied when the complete cell is assembled and tightened up. The sheets and pieces separating them are preferably rigid; if they are very rigid support may be necessary only at the two ends. More than two sheets can be separated in this way, being held apart by one piece of material, as in Figure 4, or more as in Figures 1, 2 and 3.

In an alternative method of construction of inserts which is described in co-pending application Serial No. 618,617, now Patent No. 2,881,124, of Frank L. Tye, two or more sheets are fixed face to face, each sheet having holes of such size, shape and position that when fixed together each hole in one sheet overlaps at least two holes in the adjacent sheet or sheets, the overlapping holes forming a sinuous channel from one edge of the insert to the other.

The inserts should be made of material unaffected by the liquids in the compartments and should also be electrically insulating. The inserts are preferably made of rigid, that is unplasticised, polyvinyl chloride. They may also be made, for example, of polystyrene or polyethylene or of metal covered with any of these plastics.

A filter medium can be incorporated in an insert to prevent suspended matter entering the compartments or to prevent any granular ion-exchange material in the compartments from being carried out in the flowing liquid. The filter medium can be a piece of gauze mounted in the channels formed through the inserts.

The inserts may be built up by gluing or welding together the component parts, or by any suitable technique used in shaping plastics, for example, by extrusion.

The inserts may either be laid into the passages or joined to the membrane or the spacer, for example, by gluing or welding.

Referring now to Figures 5 and 6 the cell is made up of a series of plane ion-exchange membranes 20 separated alternately by the spacers 21 shown in Figure 5 and by spacers 22 of identical shape which have been turned through 90°, and has an anode 23 and a cathode 24 between end-plates 25 and 26. The cell is held together by rods 27 passing through holes 29 in the membranes, spacers and end plates. The spacers 21

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and 22 and also the membranes 20 have four rectangular holes round their edges, these holes when the spacers and membranes are assembled forming four conduits through the cell. In the spacer 21 which defines one set of the alternate compartments in the cell, the hole numbered 30 forms part of the conduit 31 leading a liquid to these compartments. The hole numbered 32 forms part of the conduit 33 removing the liquid from the compartments, the flow of liquid through the compartments being indicated by arrows. The holes numbered 34 and 35 form parts of the other two conduits which lead the liquid to and remove it from the other set of alternate compartments.

The holes 30 and 32 have passages connecting them to the compartments defined by the spacers. Each passage has in it an insert 37, which can take the shape of any of those described above.

In Figure 7 there are twelve holes around the edge of the spacer. The conduits of which the holes 38 to 40 form part lead the liquid to and the conduits of which the holes 41 to 43 form part remove it from one set of the alternate compartments and the conduits of which the holes 44 to 49 form part lead the liquid to and remove it from the other set of the alternate compartments. The passages connecting the holes 38 to 43 to the compartments defined by the spacers have inserts 50. These spacers are assembled with membranes to form a cell in a similar manner to that shown in Figure 6.

It will be apparent that other constructions of inserts and cells can be used within the scope of the present invention.

This application is a continuation of our co-pending application Serial No. 618,618, now abandoned.

We claim:

1. An electrodialysis cell comprising two electrodes, a series of ion-exchange membranes between two electrodes dividing the space therebetween into compartments, spacers around the edges of the membranes in the shapes of open frames separating the membranes, said membranes and spacers each having successively communicating holes through them cooperating to form conduits through the cell at right angles to the membranes, some of said holes extending to the inside edges of said spacers to form passage means through them substantially rectangular in plan connecting said conduits to said compartments, said passage means extending across a substantial part of the length of the edges to which they extend, and rectangular insert means filling each passage means, each said insert means being

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substantially equal in thickness to the spacer and having parallel side walls of a length equal to the width of such passage means and means extending between the side walls holding them in spaced relation, said last means defining a plurality of openings spaced longitudinally of the side walls to permit the flow of liquid therethrough and supporting the adjacent membranes across the width of the passage means.

2. In a cell as claimed in claim 1, each said insert means comprising at least two sheets of identical dimension with the plan of said passages forming said side walls, and said means holding the walls in spaced relation comprising at least one piece of material of a length equal to the length of said passages arranged between the said sheets and only partially filling the space therebetween.

3. In a cell as claimed in claim 1, said insert being formed of rigid polyvinyl chloride.

4. In a cell as claimed in claim 1, said insert including a filtering medium.

5. In an electrodialysis cell as claimed in claim 1, one of the holes extending to the inside edges of the spacers in each compartment forming a liquid inlet extending along a substantial part of the length of one edge of the compartment and another of the holes extending to the inside edges of the spacers in the same compartment forming a liquid outlet extending along a substantial part of the opposite edge, the inlets and outlets in adjacent compartments being so arranged that the directions of liquid flow in adjacent compartments are at right-angles to one another.

6. An electrodialysis cell according to claim 5 in which the liquid inlet and outlet extend along the whole length of the respective edges of each compartment.

7. An electrodialysis cell according to claim 5 in which the compartments defined by the spacers are square, the inlet edges in adjacent compartments being at right angles to one another.

8. An electrodialysis cell according to claim 7 in which the spacers in adjacent cells are identical but are rotated through 90° relative to one another in the plane of the membranes.

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