

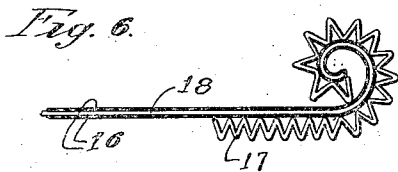
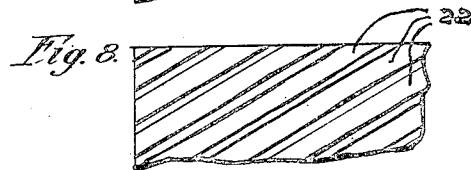
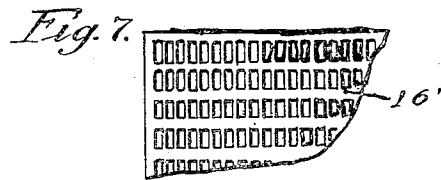
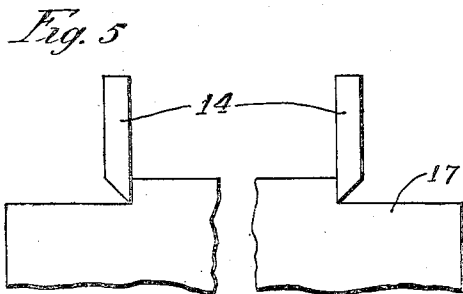
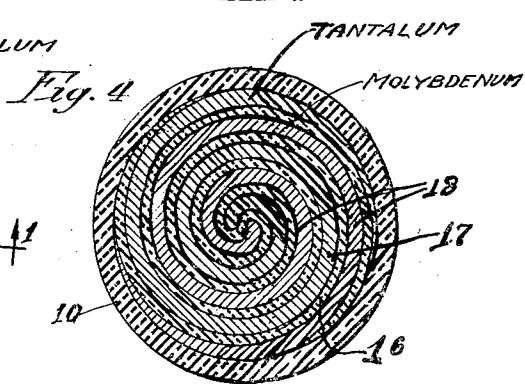
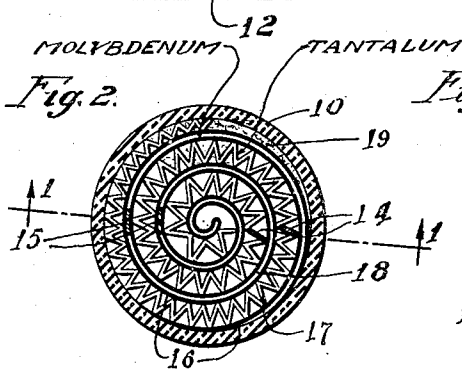
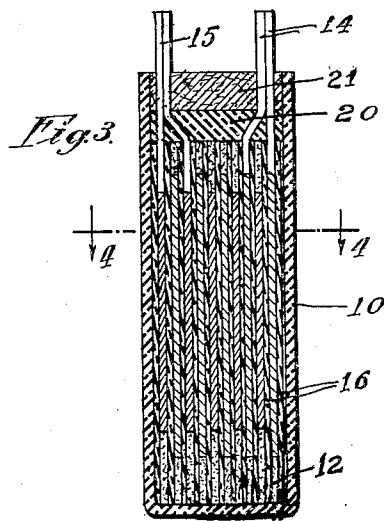
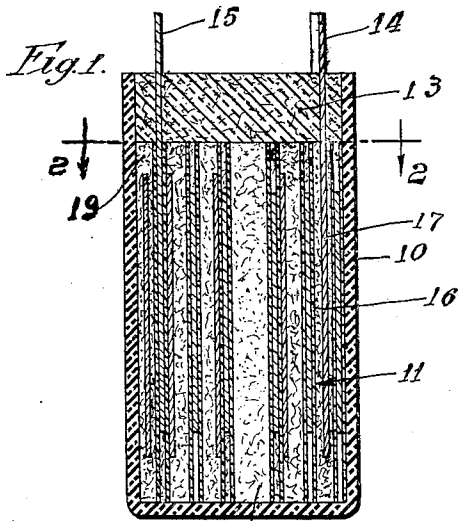
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E. W. ENGLE ET AL

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ELECTROLYTIC CONDENSER

Filed March 14, 1927



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UNITED STATES PATENT OFFICE

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ELECTROLYTIC CONDENSER

Application filed March 14, 1927. Serial No. 175,121.

This invention relates to electrolytic apparatus, especially to electrolytic condensers, and the object is to provide a device of this kind which will occupy a small volume and at the same time have a large capacity.

The object of our invention is to provide an improved condenser construction.

A further object is to overcome difficulties inherent in devices using aqueous solutions by providing a means to prevent spilling of the solution.

A further object is to provide a simple method of construction.

Other objects will be apparent as the detailed description of our invention proceeds.

Preferred embodiments of our invention are illustrated in the accompanying drawings in which:

Figure 1 is a horizontal section of our improved condenser taken along the lines 1—1 of Figure 2;

Figure 2 is a cross section of the condenser shown in Figure 1 taken along the lines 2—2 of that figure;

Figure 3 is a modification in which the tantalum is not crimped before it is wound;

Figure 4 is a horizontal section of this modification taken on lines 4—4 of Figure 3;

Figure 5 is a detail of the thin metal sheets showing the method of forming the terminals;

Figure 6 is a detail showing a strip of crimped tantalum in the process of being wound on a strip of molybdenum with the thin insulating sheets between said strips; and

Figures 7 and 8 show a modified form of the insulated strip.

The preferred embodiment of our invention, as shown in Figures 1 and 2, may be described generally as an acid proof receptacle filled with a compact roll of spaced metal sheets 11 immersed in an acid electrolyte 12, the receptacle being sealed with sulphur 13 through which project the leads 14 and 15. Around the compact roll referred to is placed finely divided inert material, such as silica sand, asbestos or, diatomaceous earth, 19 for the purpose of holding the electrolyte in

suspension to prevent its spilling should the container become broken.

The preferred method of making the compact roll referred to may be illustrated by specific example. A thin sheet of tantalum metal 17 about $1\frac{1}{2}$ mils in thickness, $1\frac{5}{8}$ inches wide and $26\frac{1}{2}$ inches long is crimped in any conventional manner until the length is brought down to about 6 inches, the depth of the corrugations being about $\frac{3}{8}$ of an inch. A thin strip 14 is cut from each corner of the strip, preferably before the crimping process. This strip is bent as shown in Figure 5 to form leads for attaching the tantalum sheet to a suitable binding post. Upon this crimped sheet of tantalum is placed a thin permeable insulating sheet 16. This is preferably a thin sheet of asbestos extending over both sides of the tantalum about $\frac{1}{8}$ of an inch to prevent any short circuiting in the cell. On this insulating sheet is placed a sheet of thin molybdenum 18, about 2 mils thick, 1 inch wide and 5 inches long. The corners of the molybdenums are cut and strips are bent up to form leads 15 to a second binding post in the manner illustrated by Figure 5. The sheets of tantalum and molybdenum with the separating asbestos sheets are then wound into a tight compact roll, the sheets being so arranged that both tantalum strips 14 are at one side of the roll and both molybdenum strips 15 are at the other side of the roll. The roll is inserted in an acid proof receptacle 10, preferably of glass or hard rubber, and dilute sulphuric acid (specific gravity 1.200), to which has been added a small amount of a salt of a metal of the iron group, is slowly added. The acid is gradually absorbed by the asbestos and comes in contact with both thin sheets of metal. Should any space be left between the receptacle and the compact roll, this space should be filled with a non-corrosive, non-conducting absorbent material, such as fine silica sand or asbestos 19.

The tantalum sheet is then "formed" by subjecting it to a voltage somewhat above the voltage for which the condenser is intended to be used. For instance, if the condenser may be subjected to 8 or 10 volts, a D. C. voltage of about 12 may be imposed across the

cell. This is preferably done before the cell is sealed as the small amount of leakage current which flows during the formation process liberates a small amount of gas which might injure the seal should the cell be sealed before the plates are formed.

The cell is now sealed with molten sulphur 13. Another modification is illustrated in Figures 3 and 4. Here a sheet of tantalum 28 inches by $3\frac{1}{2}$ inches by 1 mil is tightly rolled with a molybdenum sheet 28 inches by $1\frac{1}{4}$ inches by 1 mil with thin sheets of filter paper or asbestos separating the tantalum and molybdenum sheets. The latter are made by cutting the corners of the sheets and bending up strips as described above and illustrated in Figure 5. This roll occupies a still smaller space than the roll of crimping tantalum. The compact roll formed is inserted in a glass tube 5 inches long and 1 inch in diameter. The filter paper or asbestos is saturated with dilute sulphuric acid electrolyte and the plates are formed as in the above example. This tube may be closed by a rubber stopper 20 sealed in a tube with suitable wax or sealing compound 21. This condenser thus has a capacity of about 1200 microfarads at 6 volts while an ordinary paper condenser of the same size only has the capacity of 1 or 2 microfarads.

While the operation of this improved condenser is obvious, it may be pointed out that the tantalum sheet serves as the positive plate, the film formed on the tantalum sheet serves as a dielectric and the electrolyte serves as the negative plate of the condenser. The molybdenum sheet merely serves as the lead to conduct the charge to the various parts of the electrolyte. If the condenser is to be used in an alternating current circuit, both metal strips should be of tantalum, the construction being otherwise essentially the same.

A feature of our invention is the fact that a large surface area of tantalum is obtained in a relatively small volume, while current is conducted to every part of the electrolyte by means of the spaced molybdenum sheet.

It is understood, of course, that we are not limited to the specific examples given. The insulating strip may be a thin sheet of hard rubber, such as a battery separator 16' shown in Figure 7. Also the molybdenum sheet may be coated with an insulating porous film of any material which is not affected by the acid and which will allow the acid to come in contact with the metal. The molybdenum sheet may be printed with rubber as shown in Figure 8, where the thin metal sheet is passed through suitable rollers and rubber strips 22 are diagonally printed on the sheet so that when it is rolled with the tantalum the rubber will keep the plates in spaced relation and at the same time contact may be had by the electrolyte with portions of the metal between the rubber strips. Should this expedi-

ent be used the rubber strips should be diagonally printed so that no air bubbles will be entrapped when electrolyte is added to the cell.

While we have described the use of molybdenum as a conductor, it will be apparent that any conductor may be used for this purpose which is not affected by the electrolyte, i. e., is not decomposed or filmed. We have found that another metal of the chromium group, tungsten, is peculiarly adapted for this purpose and carbon or other electrodes have also given satisfactory results. The use of molybdenum is probably most noteworthy as its behavior in a rectifier would not lead one to expect its peculiar merit as a condenser electrode.

The metals of the tungsten-molybdenum group have been found to be particularly suitable for use as condenser electrodes of this type.

Although tantalum is preferred as a film forming electrode, it is understood that aluminum or other valve metals fall within the scope of our invention.

Any suitable electrolyte may be used instead of the sulphuric acid described, and it is understood that we are not to be limited to the precise details shown and described except as defined by the following claims.

We claim:

1. An electrolytic condenser comprising an acid proof container, a compact roll of tantalum and molybdenum sheets, a thin sheet of asbestos between said tantalum and molybdenum sheets and a sulphuric acid electrolyte absorbed in said asbestos.

2. A condenser comprising a tantalum electrode and a molybdenum electrode in a sulphuric acid electrolyte.

3. In an electrolytic condenser a filmed electrode, and an electrode comprising a metal of the tungsten-molybdenum group.

4. An electrolytic condenser comprising a compact roll of tantalum, and a metal of the tungsten-molybdenum group, a thin permeable insulating spacing means, and an electrolyte incorporated in said spacing means.

5. An electrolytic condenser comprising a compact roll of tantalum and a metal of the tungsten-molybdenum group, a thin absorbent insulating spacing means, and a sulphuric acid electrolyte held by said absorbent means.

6. An electrolytic condenser comprising thin layers of tantalum, thin layers of a metal of the tungsten-molybdenum group, thin layers of a permeable insulating material between these layers, and an electrolyte held by said insulating material whereby a large surface area may be contained in a relatively small unit.

In witness whereof, we hereunto subscribe our names this 5th day of March, 1927.

EDGAR W. ENGLE.

HAROLD L. OLESEN.