Aug. 8, 1961 F. DICK 2,995,507

MECHANICAL SEPARATOR FOR AN ELECTROLYTIC TANK

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FIG. 2.

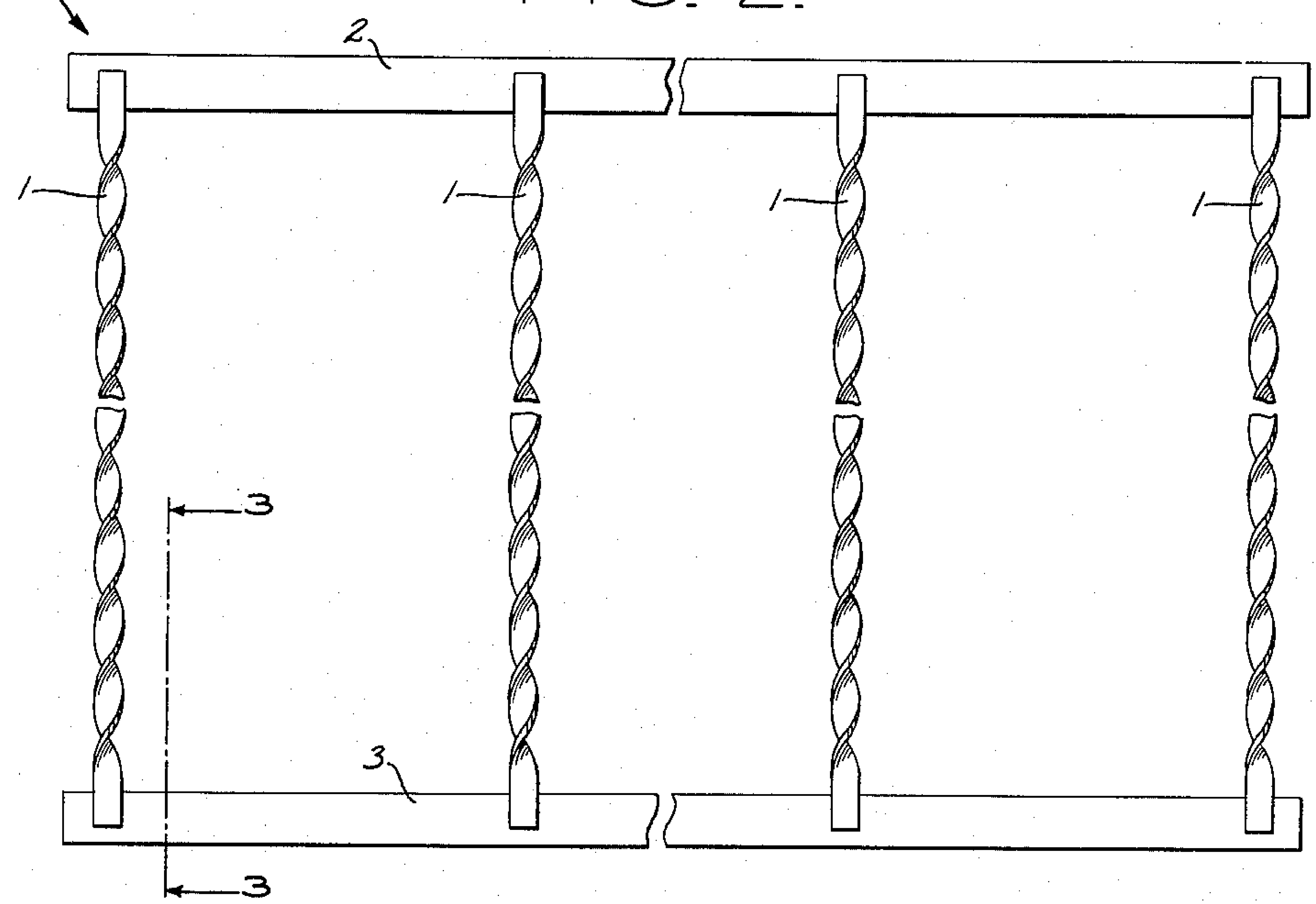


FIG. 1.

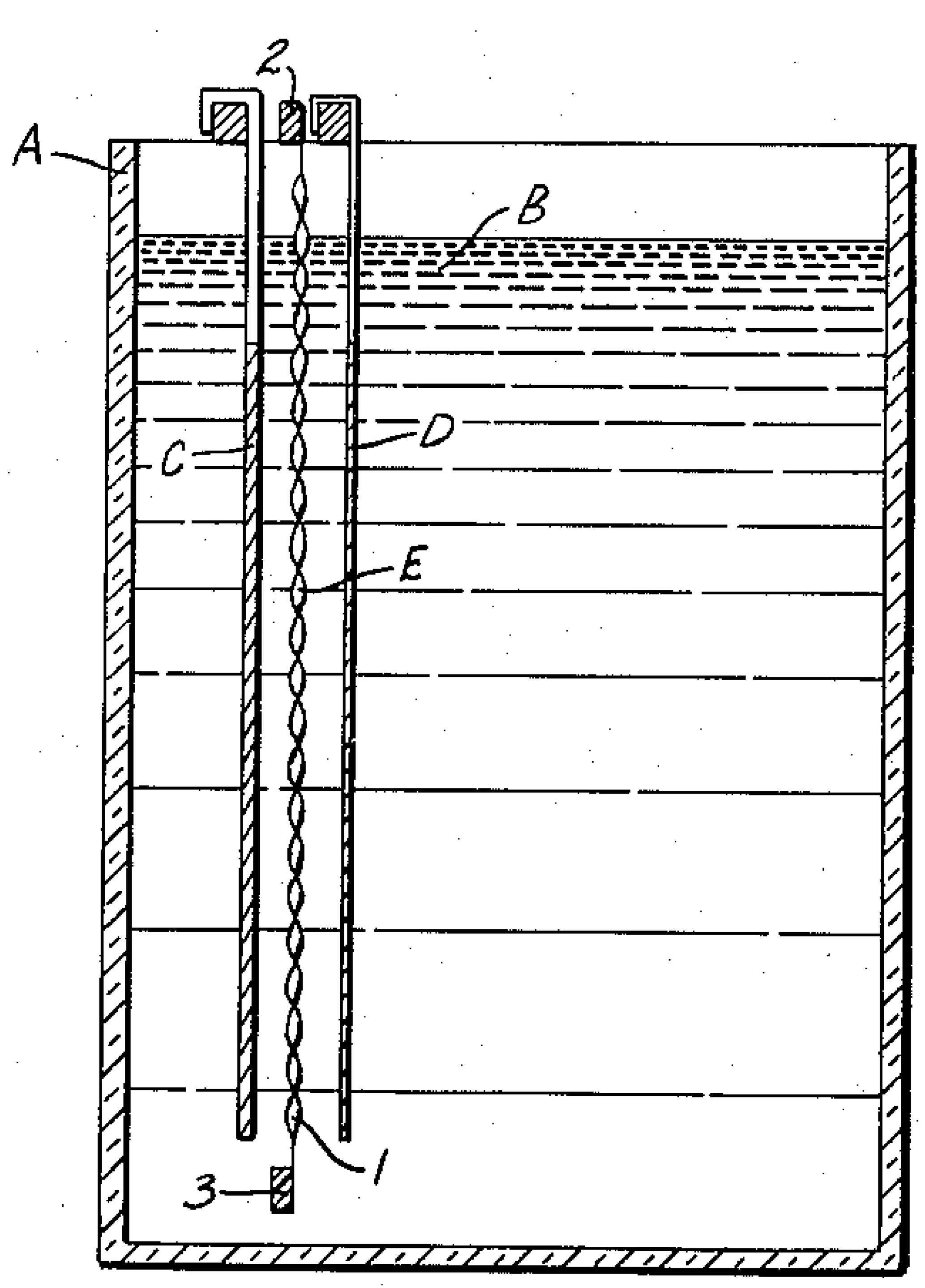
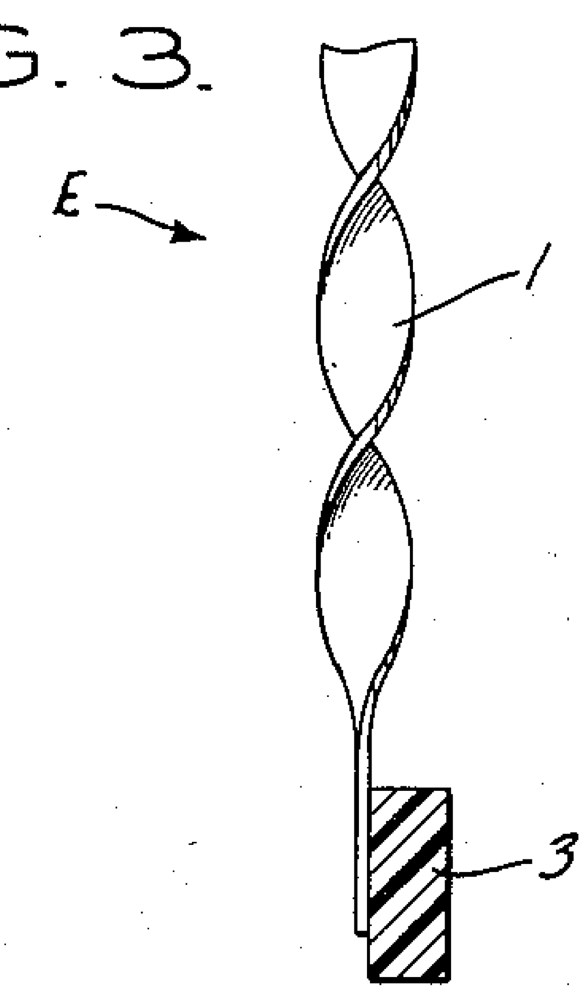


FIG. 3.



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1

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MECHANICAL SEPARATOR FOR AN ELECTROLYTIC TANK

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This invention relates to mechanical separators for shielding electrodes in electrolytic tanks, particularly in electrolytic refining.

During electrolytic operations, anodes and cathodes are packed adjacent to one another in tanks for maximum electrolytic efficiency and for economical use of space.

It is important that shifting movements cause no contact between the anodes and cathodes. Contact between the electrodes causes a shorting of power and a loss of metal. The possibility of such contact frequently requires that the anodes and cathodes be spaced from each other at intervals larger than otherwise desired. These difficulties are particularly aggravated in the electrolytic refining of metals because it is customary to use flat sheets of metal as cathodes. These sheets are thin, with non-uniform thickness, and have a tendency to wrinkle and form ragged edges. During the operation, the thin sheets may flex and consequently contact the anodes. Further, the cathode substantially enlarges during the operation with consequent increase in the propensity of the electrodes to touch one another.

In an attempt to overcome such difficulties, it is an occasional practice to interpose separator elements between the electrodes in the tank to forcefully maintain the electrodes separated from one another. The elements usually have massive proportions. Such separators contact large areas of the electrodes and are sufficiently rugged to withstand the pressures of electrode movements. However, there is a decrease in the efficiency of the operation because of inherent power loss. The massive separator elements tend to interfere with the throwing action of the electric current by reducing the volume of empty space between the electrodes. The current density and consequently the plating or refining effect varies undesirably in the tank.

Less massive separator elements have been devised in an effort to decrease power losses and throwing power interference. These are less effective because they lack the rigidity and strength of the massive separators. The separation becomes non-uniform as the operation progresses and as the cathode size increases. They may bend or break under pressure, with resulting power losses and expensive replacement.

Consequently, in many electrolytic operations, separator elements are not used at all. A large amount of manual labor is required to continuously inspect and adjust the relative positions of the electrodes during the operation. Such work involves exposure to unpleasant and noxious odors, presents problems of safety, and is undesirable for a variety of additional reasons as well. Much of the work performed under such conditions is erratic and inefficient resulting in a low quality electrolytic product.

These difficulties are obviated by the present invention. Speaking generally, the invention provides a mechanical separator of moderate cost which holds the anodes and cathodes from one another with great uniformity. The separator offers strong resistance to movement of the electrodes so that the uniformity of spacing is maintained as the cathode size increases during continued operation. Substantially no labor is needed for inspection or adjustment of electrode position. Contact between the separator itself and the electrodes is sharply reduced to the point where there is substantially no power loss or interference with throwing power.

2

Briefly, this is accomplished by providing a separator for an electrolytic tank in which the separator has a top bar and a bottom bar that are connected immovably with one another in spaced relationship by a plurality of flat and stiff strips extending transversely of the bars. These strips are helically twisted throughout their length. Preferably, the strips are connected to the bars at spaced intervals for parallel disposition of the strips to one another. More preferably, the flat helical strips are of equal length to hold one bar parallel to the other bar.

Having described the invention briefly, a detailed description will now be made of the illustrative embodiment of the invention shown in the drawings. In these drawings:

FIG. 1 is a side view in vertical cross section of an electrolytic tank employing a mechanical separator in accordance with this invention for providing a uniformity of clearance between two electrodes.

FIGURE 2 is an enlarged front face view of the separator shown in FIGURE 1 but with the end portions broken away; and

FIGURE 3 is a view along the line 3—3 of FIGURE 2, showing the parts of the separator even further enlarged, and partly in section.

For clarity of illustration in the drawings, the electrolytic tank, the buss bars thereof, the anodes, the cathodes and the bath have been omitted, but it will be understood that my device is to be inserted between each anode and cathode and mounted in the tank mechanically by any of the well-known techniques familiar to persons skilled in the art.

Also, it is assumed, in the present illustration, that the tank under consideration has a rectangular cross section and that the electrodes in the tank are flat and rectangular in shape.

Referring now to FIG. 1 of the drawing, there is shown a conventional electrolytic tank A containing an electrolyte B, an anode C and a cathode D. Between the anode C and cathode D is mechanimal separator E. The separator E (FIG. 2) is made throughout of a material which is a relative non-conductor of electricity, such as Celluloid, hard rubber, polyethylene or other plastic materials, and the like.

The mechanical separator has a rigid and strong top bar **2**. It is fashioned with a length of approximately the width of the electrolytic tank with which it is to be used. A similar bottom **3** of the same length and rigid material is disposed parallel to top bar **2**. Bars **2** and **3** are immovably connected to one another by a series of flat and stiff upright strips **1**. The flat and stiff upright strips **1** are fixedly attached at their ends to the top and bottom bars **2** and **3**. Preferably, as shown, the upright strips **1** are of common length and are attached to the top bar **2** and the bottom bar **3** at equi-spaced intervals so that the strips are disposed parallel to one another with equal spacing throughout. The length of the strips **1** is fashioned to correspond approximately to the height of the electrodes in the tank with which the invention is to be used.

Each of the flat and stiff strips **1** are twisted into continuous helixes of constant pitch. Preferably, all of the flat strips have the same helical pitch.

In practice of the present invention, one of the separator elements is suspended between each anode and cathode in the tank. This positions the stiff upright strips **4** between the anode and cathode. The uniform diameter of the helical strips insures a minimum, and uniform, distance between anode and cathode.

The open space between each anode and cathode suffers only a very small reduction in volume by reason of the presence of the separator elements; the helical strips 1 occup little volume by comparison to the relatively large space created between anode and cathode by the diameter of the helix. Moreover, actual contact of the upright strips 4 to anode or cathode occurs, at most, only once for each full turn of a helix. And this touch exists only for a minute fraction of an inch. Spacing between the anode and cathode, however, is never less than the diameter of the helical strip.

As the operation proceeds, the cathodes increase in size, and they may shift in position or they may flex, to press against the separator elements. However, the helical upright strips 1 offer the same type of resistance to pressure from flat surfaces as do solid tubes or rods. The helical upright strips act as roller bearings. They distribute and equalize the compression forces throughout the separator.

As another and more specific example of use of the invention, description will be made in an instance where mechanical separators of the invention are installed in tanks used for the electrolytic refining of copper. In this process, a smelted slab of copper is the anode and a thin sheet of electrolytically refined copper is the cathode. The bath has the usual acid solution. The cathode has a thickness of about $\frac{1}{32}$ of an inch and the desired clearance between the anode and cathode faces is 1 and $\frac{1}{8}$ inches at the start of the operation. The anode and cathode are both about 1 yard square. The operation is carried on in electrolytic tanks of slightly greater width.

For use in this installation, the mechanical separator of the instant invention was prepared from polyethylene selected with a specific gravity slightly greater than 1.26, the specific gravity of the electrolyte solution. The heavy top bar 2 and the bottom bar 3 were made about 27 inches in length and were connected by flat upright strips 1 of 1 and $\frac{1}{16}$ inches thickness. Six strips were provided, each separated from the other by five inches. Each of the upright strips 1 was twisted into a helix made up of six full turns per foot. The width of the flat strips was such that they had a diameter of $\frac{3}{8}$ of an inch after the helical twisting.

With this application of the instant invention, the separator elements were inserted in the tank between anode and cathode. As the operation proceeded, the anode and cathode were prevented from approaching each other any closer than $\frac{3}{8}$ of an inch. The number of contacts between the helical upright strips 1 to an anode or cathode was six places per foot. Each touch comprised a small fractional area of an inch of about $\frac{1}{16}$ of an inch in width and about the same in length or approximately $\frac{1}{64}$ square inches in area. Nevertheless, the uniform spacing of the small contacts provided a uniformity of clearance between anode and cathode and also provided large rugged resistance to compression by the anode and cathode as the cathode bult up to $\frac{3}{4}$ of an inch. Thereupon, the

electrodes were removed and replaced and the operation was repeated.

It will be understood that electrolytic tanks and electrodes are modified on occasion to shapes other than rectangular. Similar modifications should be made in the disposition of the top and bottom bars 2 and 3, the length of the upright strips 1 and their disposition, as well, to conform to use with tanks and electrodes of differing shapes and sizes. In each instance, however, the results of the invention can be achieved without departing from the principles of the invention.

Since variations and departures may be made from the illustrative embodiment of the invention described above and shown in the drawings, it should be understood that the invention is not limited to the details thereof, except as expressly appears in the following claims.

I claim:

1. An electrolytic tank comprising a tank containing an electrolyte, electrodes and a mechanical separator between said electrodes for providing a uniformity of clearance between said electrodes, said mechanical separator comprising a top bar and a bottom bar connected immovably to one another in spaced relationship by a plurality of flat and stiff strips extending transversely of the bars, each strip being helically twisted throughout its length.

2. An electrolytic tank according to claim 1, wherein the strips of the mechanical separator all have a common helical pitch throughout their length.

3. An electrolytic tank according to claim 2, wherein the flat transverse strips are connected to said bars at spaced intervals for parallel disposition of the strips to one another.

4. An electrolytic tank according to claim 3, wherein the flat strips are of equal length to hold one bar parallel to the other bar.

5. An electrolytic tank for the electrolytic refining of copper comprising a tank containing an electrolyte, a copper sheet anode and a thinner copper sheet cathode, a mechanical separator between said anode and said cathode, said mechanical separator being of polyethylene and comprised of two bars immovably held spaced parallel from one another by at least three flat and stiff strips extending transversely to said bars, said strips being fixedly attached at their ends to said bars at equi-spaced intervals and being twisted throughout their length with a common helical pitch.

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