Sept. 6, 1949. J. V. DAVIS 2,481,400

IMMERSION HAMMOCK

Filed Feb. 20, 1948 4 Sheets-Sheet 1

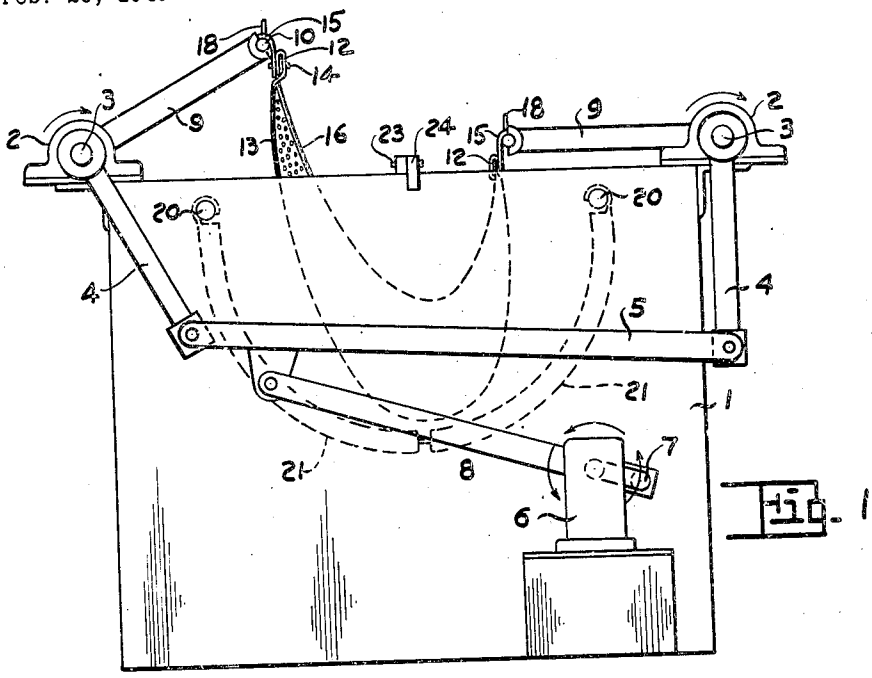


Fig. 1

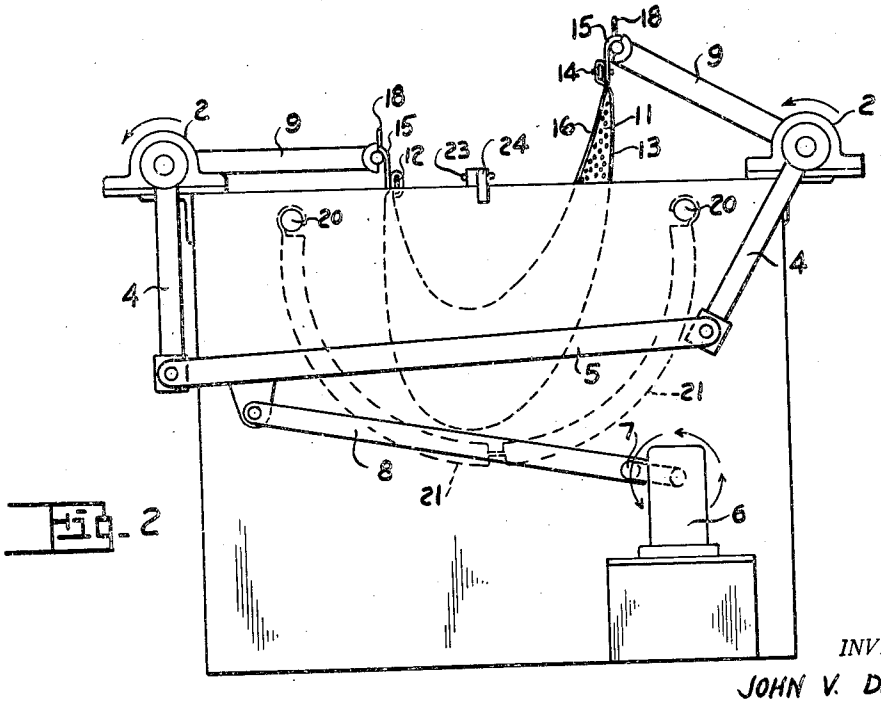


Fig. 2

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IMMERSION HAMMOCK

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Fig. 3

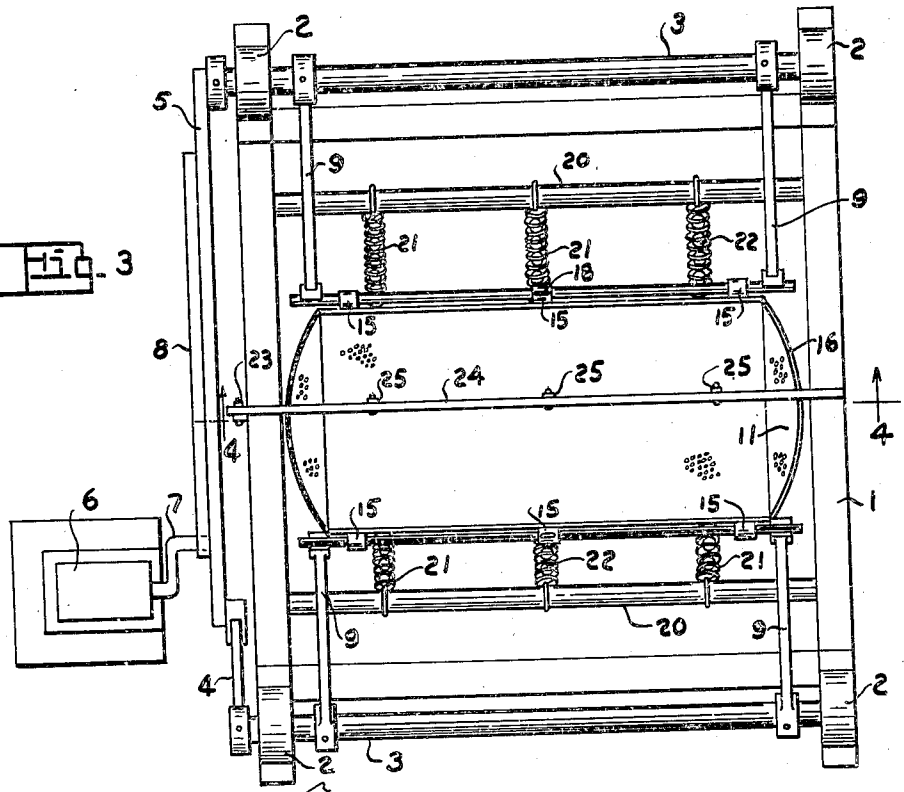
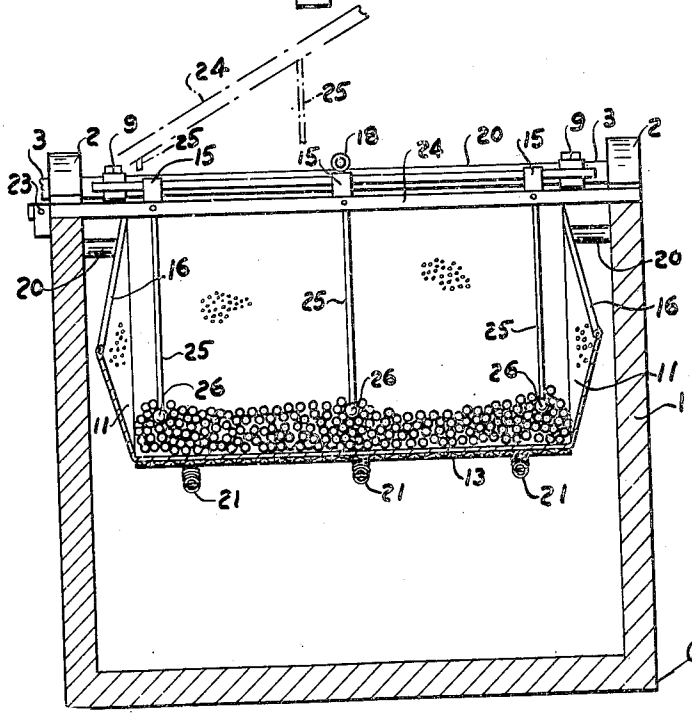


Fig. 4



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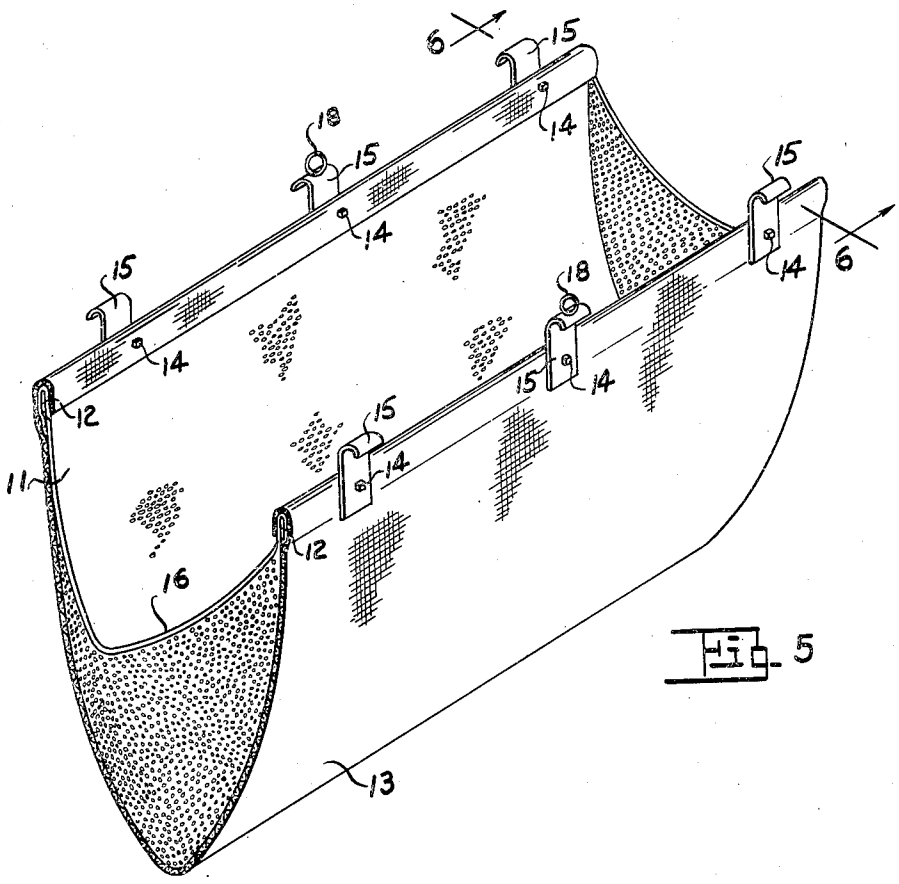


Fig. 5

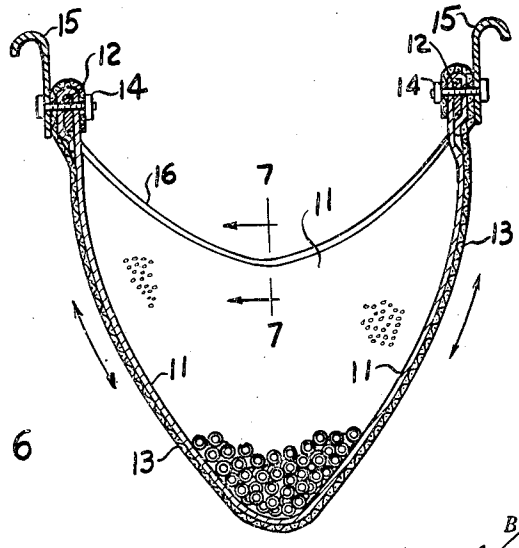


Fig. 6

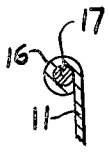


Fig. 7

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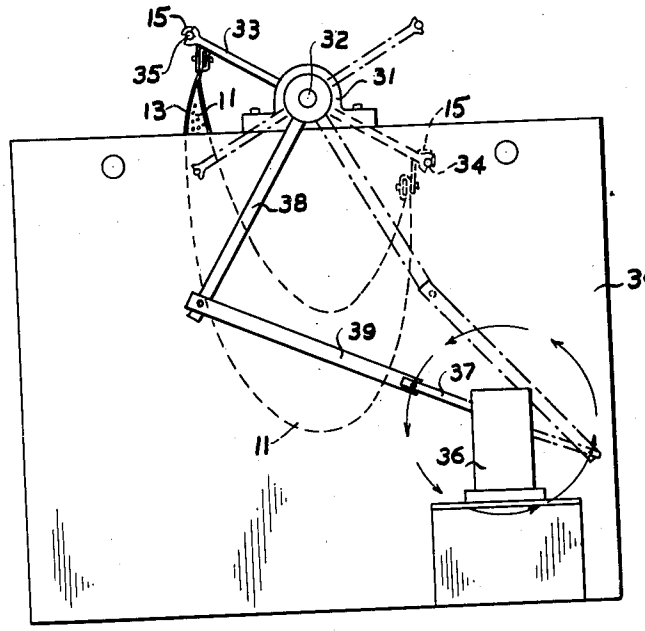


Fig. 8

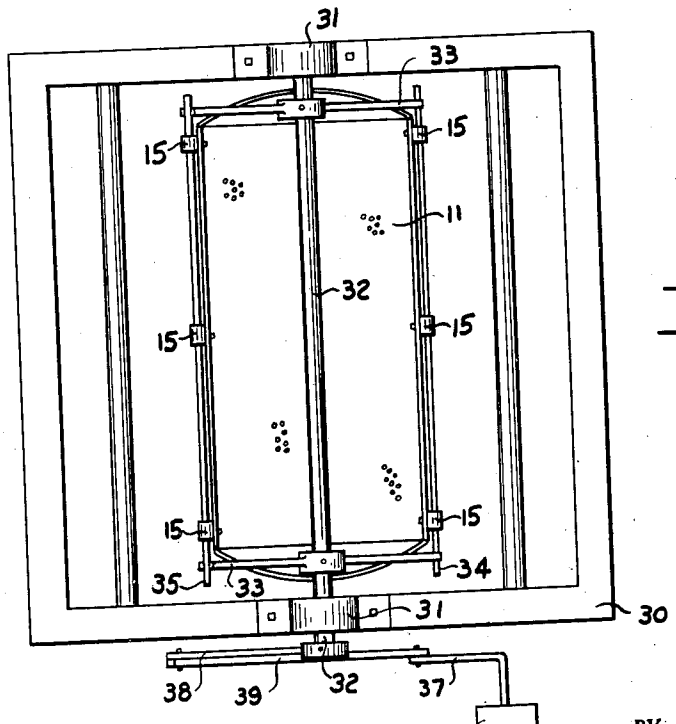


Fig. 9

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UNITED STATES PATENT OFFICE

2,481,400

IMMERSION HAMMOCK

John V. Davis, Detroit, Mich., assignor to The Udylite Corporation, Detroit, Mich., a corporation of Delaware

Application February 20, 1948, Serial No. 9,821

10 Claims. (Cl. 51—163)

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The present invention pertains to a novel hammock for articles undergoing liquid or vapor treatment, and also to an apparatus embodying the hammock. Examples of such treatments are cleaning, dipping, rinsing, electro-plating, and degreasing.

One of the objects of the invention is to provide a non-metallic receptacle for work in a plating or other solution or gas and one that is devoid of the usual objectionable features of conventional plating drums and cradles. Such drums and cradles, being mechanically rotated or oscillated, require shafts and bearings that are immersed in the solution or at least exposed to it. Consequently the metal parts as well as the receptacle itself are subject to corrosion and to deposition of metal thereon or dissolution, according to the electrolytic potential of the metal.

The objections are overcome in the present invention by the use of a hammock as the plating receptacle. The hammock is merely an apertured sheet of pliant and chemically resistant material folded into upright U-form, with the ends of the U-member preferably closed by pieces of similar material. The hammock is suspended from horizontal supports, and the latter are oscillated substantially vertically and oppositely to each other. Thus, the sides of the hammock move vertically relatively to each other while the bottom remains at a substantially constant level.

This motion causes the sides of the hammock to rub against the work pieces, maintaining good contact among the pieces and between the pieces and the inserted cathode contacts. Because of this action, the sheet should also have good resistance to abrasion against the work. The materials having the desired properties are described below.

Inasmuch as the materials now available have some elasticity, the sheet is backed on the outside by a screen or apertured member which is inelastic and resistant to the plating solutions. Materials for this purpose are also described in more detail below.

The mechanism for actuating the hammock at its upper edges is relatively simple. Moreover, it is positioned at the top and exteriorly of the plating tank where it is out of contact with the solution. In other words there are no metal parts below the solution level except the cathode contacts.

The hammock is merely suspended from its oscillating supports and can therefore be easily moved from one tank to another by means of a traveling hoist. Removal for repair and storage

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is performed in like manner. Another desirable property of the described hammock is its light weight in relation to its capacity. For example, such a hammock weighing 50 pounds has the capacity of a 300 pound barrel.

The invention is fully disclosed by way of example in the following description and in the accompanying drawings in which:

Figure 1 is an end view of an apparatus embodying the invention;

Figure 2 is a similar view of the apparatus in a different position;

Figure 3 is a plan view;

Figure 4 is a section on the line 4—4 of Figure 3;

Figure 5 is a perspective view of the plating hammock;

Figure 6 is a cross section thereof on the line 6—6 of Figure 5;

Figure 7 is a detail section on the line 7—7 of Figure 6;

Figure 8 is an end view of a modified form of apparatus, and

Figure 9 is a plan view of the modification.

Reference to these views will now be made by use of like characters which are employed to designate corresponding parts throughout.

In Figures 1, 2, 3 and 4 is shown a plating tank 1 of suitable construction and lined, if desired, for protection against attack by the plating solution. Along two parallel edges of the tank, at the top, are mounted sets of alined bearings 2 for supporting a pair of parallel shafts 3. A pair of arms 4 are secured to and suspended from corresponding ends of the shafts, and the free ends of the arms are joined by a link 5 which is preferably of less length than the distance between the shafts 3.

A motor or other driver 6 is mounted adjacent to the link 5 and drives a crank 7. The latter is joined by a link 8 to the link 5, and the ends of both links are articulated to the respectively attached parts. As the crank 7 is rotated, it is apparent that the shafts 3 are oscillated.

Another set of arms 9 is attached to each shaft 3 and extends generally inward or over the tank 1. The arms 9 on a given shaft are parallel to each other but not necessarily to the arms 9 on the other shaft. The free ends of each set of arms 9 support a non-conducting bar 10 which preferably lies parallel to the shafts 3 for supporting the plating hammock which will now be described.

The hammock includes first a perforated sheet of material 11 which is pliant under its own

weight and resistant to plating solutions as well as to other solutions used in operations auxiliary to the plating process, such as cleaning and rinsing, for example. Such materials are somewhat similar to rubber in their pliability and chemical resistance and are available on the market as synthetic products. One such product is known in the United States and elsewhere as "Koroseal" and is a plasticised vinyl chloride polymer or a rubber-like resin in sheet form. Two parallel edges of the sheet, preferably the longer edges, are wrapped around a pair of parallel rigid strips **12** and secured thereto in a manner that will presently be described.

The sheet **11** possesses excellent resistance to abrasion and ordinarily does not stretch materially at temperatures below 150° F. However, the commercial material selected may have some elasticity below 150° F., or the temperature of the plating solution may rise above 150° F. and thereby introduce more elasticity. In order to avoid stretching of the sheet **11** under such conditions, it is provided with an outer backing **13** of a screen or woven material which is substantially inelastic and resistant to the plating solutions. A synthetic material having these properties is available but is too abrasive for direct contact with the work. Thus, the combination of the two materials in the manner described provides a hammock having all the necessary properties for the desired purpose. A suitable material for the outer screen is sold in the United States and elsewhere under the name "Saran" which is a vinylidene chloride or polyvinylidene chloride manufactured by the Dow Chemical Company of Midland, Michigan, U. S. A.

Two parallel edges of the screen **13** are folded over the edges of the sheet **11** and the strips **12**, and the two materials and the enclosed strip are fastened together by bolts **14** passed therethrough. The bolts also secure a number of hooks **15** to the strips **12**, and the hammock is suspended from the bars or rods **1** by means of these hooks. End walls for the hammock may be provided by means of suitably shaped pieces **16** suitably fastened to the remaining edges of the sheet **11** and consisting of the same material as the sheet. The pieces **16** need not be faced with the screen material **13** since they are not subjected directly to the weight of the work in the hammock.

The mechanism for oscillating the shafts **3** is such that one of the bars **10** is being raised while the other is being lowered, with substantially simultaneous reversals of direction. The result is that one of the sides of the hammock is being raised while the other is being lowered. The width of the hammock remains substantially constant, and its bottom maintains a substantially constant level. The flexing that occurs in the upper edge of each piece **16** is resisted by a cord or wire **17** on which each such edge is rolled, as shown in Figure 7. The cord may consist of stainless steel or of the same material as the screen **13**. The central hook **15** on each side carries a ring **18** permitting the hammock to be raised by a hoist and transferred from one tank to another for the auxiliary operations as well as from the loading station to the first tank and from the last tank to the unloading station.

A pair of conducting bars **20** are mounted horizontally in the tank **1** at opposite sides of the hammock and parallel to the shafts **3**. Coils **21** are suspended between the bars **20** and are slung beneath the hammock and into the plating solution. The coils are of a material resistant to the plating solution and contain balls **22** of an anode material as already known in the art.

To one of the upper edges of the tank **1** is pivotally attached, at **23**, one end of an arm **24**, the other end resting on the opposite edge of the tank in such a manner that the arm **24** lies parallel to the rods **10** and substantially centrally between them. Insulated cathode conductors **25** are suspended from the arm **24** into the hammock, as shown in Figure 4, and carry cathode contacts **26** adapted to engage and deliver current to the work pieces. The cathode current is connected to the arm **24**, and the anode current to the bars **20**, by any suitable means known in the art. As an alternative to the arm **24** and the cathode contacts suspended from it, the cathode current could be brought to the arms **9** and the cathode contacts suspended from the rods **10** which in this case would be conductive. When the hammock is to be transferred in the manner described, the arm **24** is raised on its pivot **23** to a position that does not obstruct removal of the hammock.

Because of the pliability of the hammock in the described substantially vertical motion of its sides, the bottom of the hammock takes a form that forces the work pieces into a compact mass transversely of the hammock. Consequently the work pieces are always in relatively good electrical contact with each other and with the cathode contacts **26**. The flow of current through the work is enhanced, with a corresponding improvement in the plating action. The linear motion of the sides of the hammock also tumbles the work pieces and thus exposes them uniformly to the current and the solution, whereby each piece becomes uniformly plated over its entire area. The tumbling action is more vigorous than in the barrel or rigid cradle of like capacity, and for this reason the material selected for the sheet **11** is one that is resistant to abrasion as well as pliant and resistant to the plating solutions, as already indicated.

No metal parts, except the work and the cathodes, are immersed in the plating solution. Consequently there is no dissolution or plating on the permanent mechanism, and considerably less repair of the apparatus is therefore required. A barrel or cradle, even if made of wood, is reinforced with metal and the metal coated with a chemically resistant material. This material eventually cracks, and exposes the metal parts to deposition or dissolution. This cannot occur with the hammock herein described. Another characteristic of the hammock is its relative lightness for a given capacity. A hammock weighing 50 pounds has the capacity of a conventional barrel or cradle weighing about 300 pounds.

In the modification shown in Figures 8 and 9, the tank **30** has a pair of alined bearings **31** at approximately the center of opposite edges. The bearings support a shaft **32** which in turn carries a pair of cross arms **33** from which the plating hammock is suspended. Thus, if the shaft **32** is oscillated, it will move the hammock in substantially the manner described in connection with Figures 1 to 7. Rods **34** are secured across the corresponding ends of the arms **33**, and the hammock **35** is suspended from the rods by means of hooks in the manner already described.

The actuating mechanism for the shaft **32** includes a motor **36** or other driver adapted to re-

volve an arm **37** about one of its ends. Another arm **38** is fixed to the shaft **32**, and the free ends of the arms **37**, **38** are joined by a link **39** articulated thereto. It is evident from the two positions shown in Figure 8 that the revolving of the arm **37** oscillates the shaft **32** and imparts the desired motion to the hammock **35**.

The "Koroseal" or like material constituting the body of the hammock lends itself well to reinforcement wherever desired and also to patching in places where it becomes worn or torn. This is a property of the plasticised vinyl chloride polymers and rubber-like resins. The backing may consist of a material other than that mentioned. The essential properties are inelasticity and resistance to the plating solutions. For example, a Monel metal screen or other metal screen having the stated properties may be employed.

The body of the hammock may be a woven as well as a perforated material. Likewise the backing may be perforated if desired. The word "sieve-like" in the claims is intended to include either form. "Chemically resistant" signifies resistance to the solution or gas to which the work is subjected.

Although specific embodiments of the invention have been illustrated and described, it will be understood that various alterations in the details of construction may be made without departing from the scope of the invention as indicated by the appended claims.

What I claim is:

1. An immersion apparatus comprising a pair of spaced horizontal supports, means for imparting relative and substantially vertical reversing movement to said supports, and a sieve-like sheet suspended in U-form by opposite edges from the respective supports, end pieces bridging each of the remaining edges of said sheet, said sheet consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work.

2. An immersion apparatus comprising a pair of spaced horizontal supports, means for imparting relative and substantially vertical reversing movement to said supports, and a sieve-like sheet suspended in U-form by opposite edges from the respective supports, end pieces bridging each of the remaining edges of said sheet, said sheet consisting of a plasticised vinyl chloride polymer.

3. An immersion apparatus comprising a pair of spaced horizontal supports, means for imparting relative and substantially vertical reversing movement to said supports, and a sieve-like sheet suspended in U-form by opposite edges from the respective supports, end pieces bridging each of the remaining edges of said sheet, said sheet consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work, and a pliant sieve-like backing on the outer surface of said sheet, said backing being substantially inelastic and chemically resistant to industrial chemicals.

4. An immersion apparatus comprising a pair of spaced horizontal supports, means for imparting relative and substantially vertical reversing movement to said supports, and a sieve-like sheet suspended in U-form by opposite edges from the respective supports, end pieces bridging each of the remaining edges of said sheet, said sheet and end pieces consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work.

5. An immersion apparatus comprising a pair of spaced horizontal supports, means for imparting relative and substantially vertical reversing movement to said supports, and a sieve-like sheet suspended in U-form by opposite edges from the respective supports, end pieces bridging each of the remaining edges of said sheet, said sheet and end pieces consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work, and a pliant perforate backing on the outer surface of said sheet, said backing being substantially inelastic and chemically resistant to plating solutions.

6. An immersion apparatus comprising a tank, a pair of horizontal supports mounted on said tank above the normal level of liquid therein, means external of the liquid-filled portion of the tank for imparting relative and substantially vertical reversing motion to said supports, and a sieve-like hammock suspended by opposite edges from the respective supports, said hammock consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work.

7. An immersion hammock comprising a sieve-like sheet bent into upright U-form, end pieces bridging the bent edges of said sheet, means on the upper edges of the sheet for suspending the sheet, said sheet and end pieces consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work.

8. An immersion hammock comprising a sieve-like sheet bent into upright U-form, end pieces bridging the bent edges of said sheet, means on the upper edges of the sheet for suspending the sheet, said sheet and end pieces consisting of a plasticised vinyl chloride polymer.

9. An immersion hammock comprising a sieve-like sheet bent into upright U-form, end pieces bridging the bent edges of said sheet, means on the upper edges of the sheet for suspending the sheet, said sheet and end pieces consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work, and a pliant sieve-like backing on the outer surface of said sheet, said backing being substantially inelastic and chemically resistant to industrial chemicals.

10. An immersion hammock comprising a sheet bent into upright U-form, end pieces bridging the bent edges of said sheet, means on the upper edges of the sheet for suspending the sheet, said sheet and end pieces consisting of a material that is pliant, chemically resistant to industrial chemicals and resistant to abrasion against the work.

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