Sept. 4, 1951 A. T. RABBITTS 2,566,676

ELECTRODEPOSITION APPARATUS

Filed Oct. 4, 1948 3 Sheets-Sheet 1

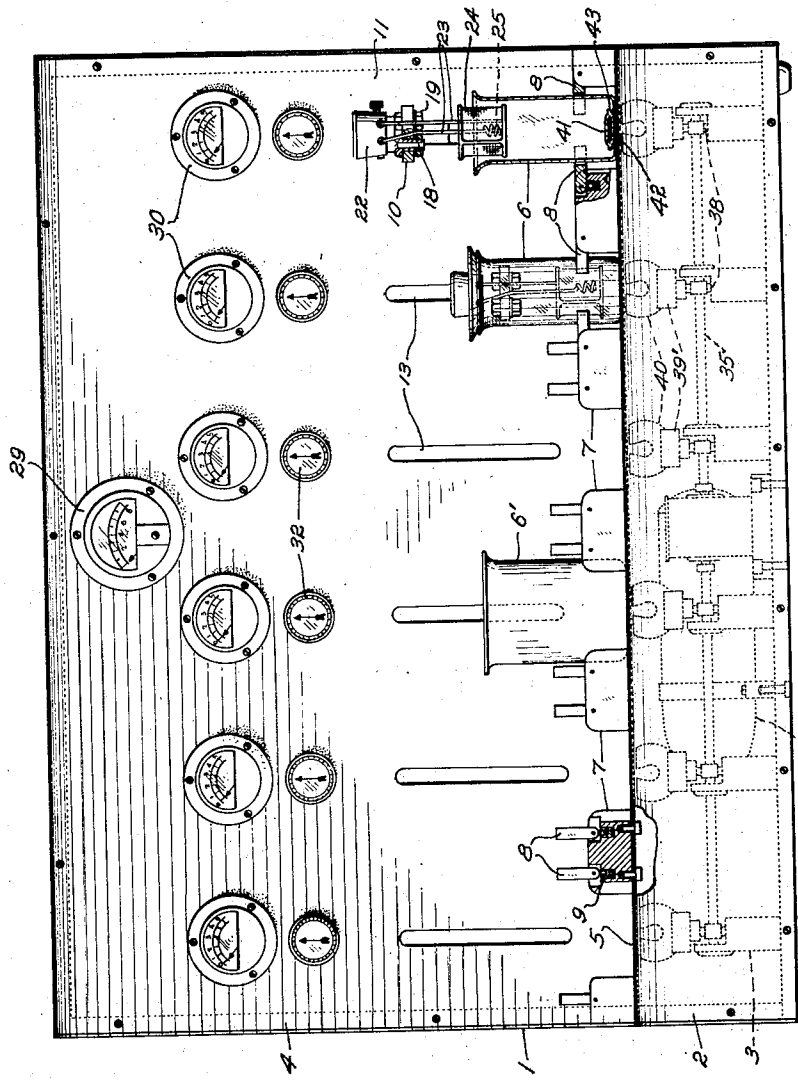


Fig. 1.

Inventor:
Alfred T. Rabbitts
By Alex. E. MacRae
Attorney.

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Filed Oct. 4, 1948 3 Sheets-Sheet 2

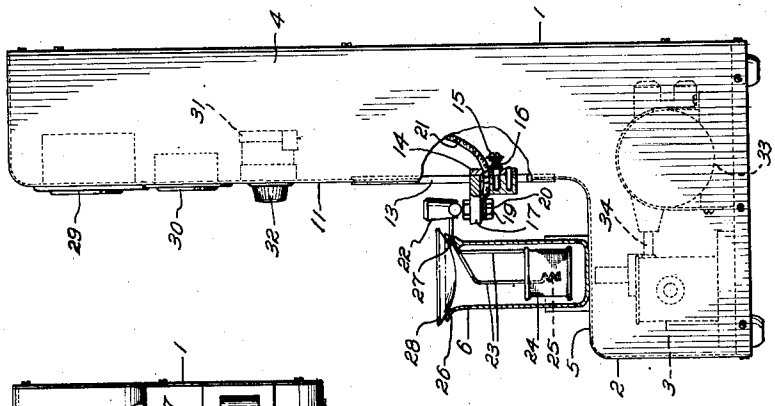


Fig. 2.

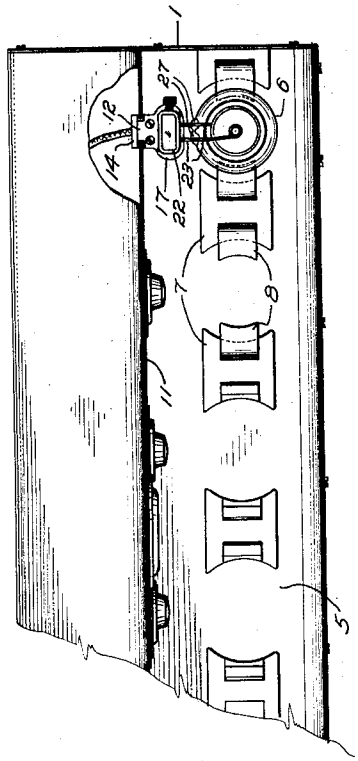


Fig. 3.

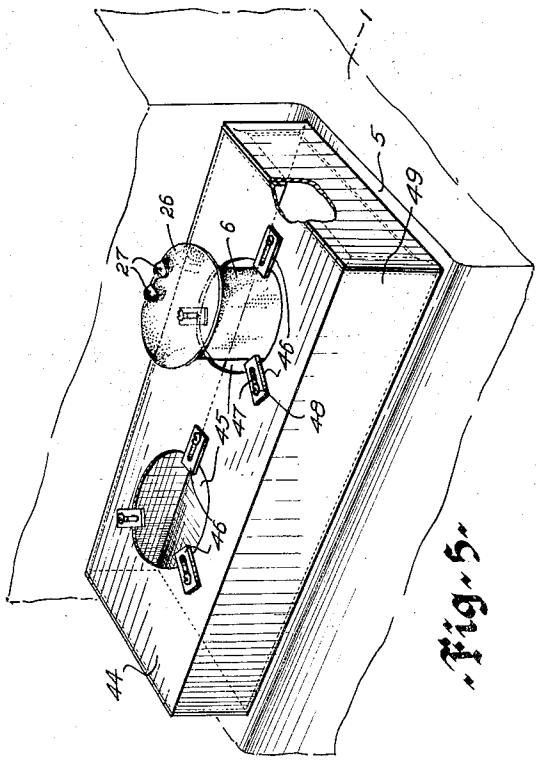


Fig. 5.

INVENTOR.
Alfred T. Rabbitts

BY Alex E. MacRae

Attorney.

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Filed Oct. 4, 1948 3 Sheets-Sheet 3

Fig. 4.

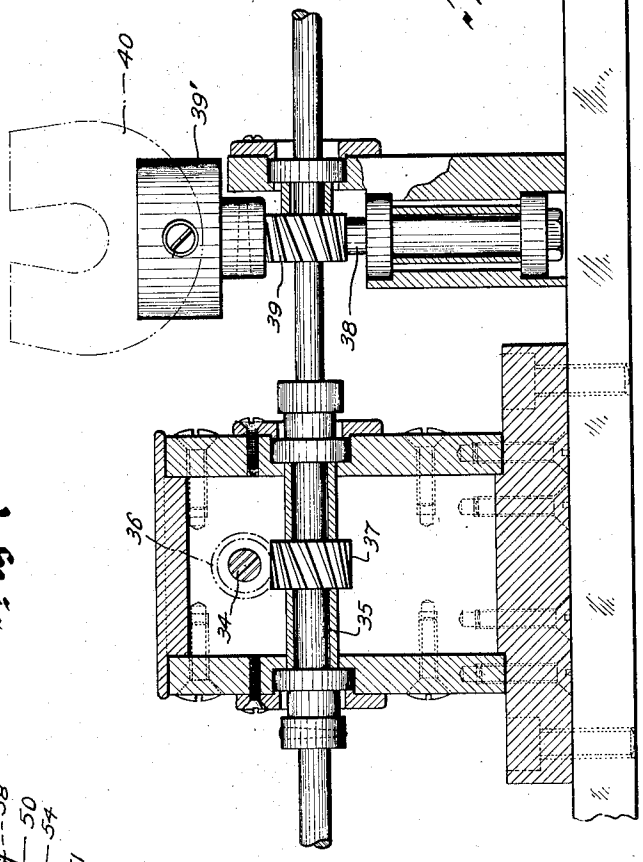


Fig. 7.

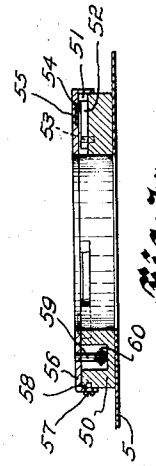
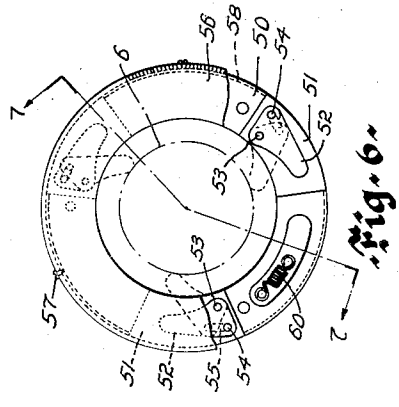


Fig. 6.



INVENTOR.
Alfred T. Rabbitts

BY Alex. E. MacRae

Attorney.

Patented Sept. 4, 1951 2,566,676

UNITED STATES PATENT OFFICE

2,566,676

ELECTRODEPOSITION APPARATUS

Alfred Thomas Rabbitts, Ottawa, Ontario, Canada, assignor to His Majesty the King in the right of Canada, as represented by the Minister of Mines and Resources

Application October 4, 1948, Serial No. 52,629

3 Claims. (Cl. 204—195)

1

This invention relates to an electrodeposition apparatus, and more particularly to an improved laboratory apparatus for the quantitative determination of materials by electrodeposition.

Devices presently available for this purpose are subject to several disadvantages. The mounting means for the electrodes and for the means for stirring the solution are not such as to make it practically possible to effectively close the container and avoid spray losses of the electrolyte. Such escaping spray results in loss of the electrolytic solution, as well as corrosion of the metal parts of the stirrer with possible contamination thereby of the solution. Moreover, if the stirrer becomes out of alignment there is danger of it damaging the electrodes.

An object of the present invention is to provide an electrodeposition apparatus of simple manufacture wherein an ordinary cylindrical container for the solution may be employed with substantially little variation in its structure, wherein substantially no spray escapes from the container during electrolysis.

The invention contemplates the provision of effective mounting means for the electrodes whereby the latter may be readily inserted and removed from the solution in the container to permit convenient handling of the container. The invention also contemplates, in association with such mounting means, the provision of suitable supporting means for the container. The invention further contemplates the provision of a special type of magnetic stirring means for the solution for convenient association with the container to permit ease of closure and handling thereof.

The invention will be described with reference to the accompanying drawings, in which,

Figure 1 is a front elevation of an apparatus in accordance with the invention,

Figure 2 is a side elevation, partly in section,

Figure 3 is a partial plan view,

Figure 4 is a detail view in section of the driving means for the stirrer,

Figure 5 is a perspective view of a modified form of container support,

Figure 6 is a plan view of a modified form of container holder, and

Figure 7 is a sectional elevation of the holder shown in Figure 6.

The apparatus comprising a supporting frame and a housing 1, having an enlarged base portion 2 containing the stirrer driving mechanism 3 and a vertically extending rearward portion 4. The top wall 5 of the forward portion of the base

2

constitutes a support for one or more glass containers or beakers 6. Preferably, the apparatus is constructed to provide means for the simultaneous electrolysis of a plurality of solutions. In the modification shown a six unit assembly of solution containers and associated mechanism is provided.

Suitable means for holding the containers 6 in fixed position on the support 5 are provided. As shown, such means may comprise a series of spaced blocks 7 fixed to support 5 and having their opposed faces oppositely curved to engage the side wall of a container such as illustrated at 6'. Holding means for a container of smaller diameter may comprise a pair of opposed arms 8 each pivoted to a block 7, such arms having curved edge portions for engagement with the container wall. Means for releasably holding the arms in upright position may comprise a spring-pressed ball 9.

The electrode holder comprises an inverted L-shaped member 10 slidingly supported on the front panel 11 of housing portion 4. Member 10 has a restricted rearward portion 12 extending into a vertical slot 13 in panel 11 and adapted to ride in such slot. A plate 14 is secured to the rear face of portion 12, with its edge portions overlapping and resiliently engaging the marginal panel edges defining the slot, by means of a bolt 15 which supports a spring 16 bearing on plate 14. The pressure exerted by the spring 16 on the plate may be adjusted by loosening or tightening the bolt, as desired, such pressure being sufficient to hold the member 10 in any position in the slot to which it may be moved, while permitting ease of manual movement of the member.

The forwardly extending arm 17 of the member 10 is provided with a pair of insulated jacks 18 and 19 each of which has a wire connection 20 through cable 21 which extends through member 10 from within the housing. The two jacks are adapted to receive a twin banana plug 22 from which are suspended, by means of wires 23 electrically connected thereto, a pair of electrodes consisting of a cylindrical wire gauze cathode 24 and an anode 25. Referring to Figure 2, it will be observed that the wires 23 extend forwardly of the plug to a position adapted to overlie the container 6, and then extend downwardly for positioning within the container. The flared lip 26 of the container is provided with a pair of small substantially V-shaped recesses 27 to receive the wires. A watch glass or other closure 28 may then be placed upon the top of the con-

tainer to substantially completely close the same. The depth of the recesses is substantially not greater than the diameter of the wires. The housing portion 4 contains the usual electrical mechanism for the apparatus. Mounted on the panel 11 is a voltmeter 29, an ammeter 30 for each unit, and a rheostat 31 having a control knob 32 for each unit. A convenient source of direct current may be provided by an 8-volt accumulator in parallel with a battery-charger type rectifier operating on 110 volts A. C. The units may be connected in parallel and means may be provided for reversing the polarity.

The stirring means is of the magnetic type and may be driven from a motor 33 having a driving shaft 34. A horizontally disposed shaft 35 is driven by shaft 34 by means of a gear 36 on the driving shaft and a spiral gear 37 on the shaft 35. The driven shaft 35 turns a plurality of vertically mounted shafts 38, one for each of the units provided, through spiral gears 39 mounted on the shaft 35 and suitable gears on each shaft 38. On top of each shaft 38 is mounted a chuck 39' in which is mounted a horseshoe magnet 40. The upper ends of the magnets lie in a horizontal plane slightly below (about 0.5 c. m.) the lower surface of the container-supporting plate 5, which is preferably formed of aluminium. The vertical axis of each magnet coincides with the vertical axis of the corresponding container 6. In the bottom of each container is placed a stirring member 41 comprising a short iron wire rod 42 of, say, 1 inch in length, sealed in a glass tube 43.

In operation, with the electrodes in raised position, as indicated at A in Figure 1, the containers 6 containing the solution to be treated are placed in position on the support. The electrodes are then lowered into the containers, as indicated at B, and the closure members 28 placed in position. The stirring mechanism is then activated to revolve the magnets and rotate the stirring members 41, which provides a positive stirring action independent of the current density in the electrolysis unit or cell. The intensity of the stirring action may be altered by employing varying sizes of gears on the driven shaft, or by using a variable speed motor.

When electrolysis is complete, the closure member is rinsed and removed and the electrode holder with the electrodes may be raised from the electrolyte with one hand while the electrodes are being washed with distilled water. When the electrodes are out of the solution, they are quickly removed by pulling the twin banana plug from the jacks and rinsed further as required. The gauze electrode is then removed, dried and weighed.

It will be observed that the design and arrangement of the electrode holders substantially eliminates spray losses and resultant corrosion, while permitting rapid removal of the electrodes from the solution when deposition is completed thus preventing redissolving of the deposit. The stirring means is simple, positive and independent of the current density used, has no parts subject to corrosion and requires no special design of container. Moreover, the apparatus may be simply and conveniently constructed.

Referring to Figure 5, a modified form of container holder is illustrated wherein a plate 44 is mounted in parallel spaced relation above plate 5. Plate 44 has openings 45 therein to receive the containers. Means for holding the containers in proper axial relation may be mounted on

the plate and comprise a plurality of arms 46 extending inwardly of the edge of the opening 45 for engagement with the container wall. The arms 46 are preferably provided with slots 47 through which the mounting screw 48 extends whereby the position of the arms may be adjusted to accommodate containers of varying diameter.

In some instances, it may be desirable to maintain the solutions in the various containers at a uniform predetermined temperature. This may readily be effected by enclosing the space between the plates 5 and 44 as by the walls 49, and providing a fluid bath therein into which the containers extend. Any suitable means of heating or cooling the bath to a desired temperature may be provided.

Referring to Figures 6 and 7, the modified form of container holder illustrated is particularly effective. The holder comprises an annular frame 50 mounted in fixed relation on the wall 5. The upper surface of the frame 50 is provided with three recesses 51, in each of which is mounted an arm 52 adapted to swing about a pivot 53. An upwardly extending pin 54 carried by the arm slides in a complementary groove 55 formed in an annular member 56 which is rotatably mounted on frame 50 by means of pins 57 which extend into an annular groove 58 on the side of frame 50. A pin 59 on member 56 is connected to a spring 60 carried by frame 50. It will be observed that the spring 60 normally positions the member 56 with respect to the frame 50 so that the arms 52 extend into the space within the frame, and on rotation of the member 56, the arms 52 may be swung outwardly and wholly within the frame, the member 56 is permitted to rotate under the action of the spring 60, which action swings the arms inwardly into engagement with the walls of the container. Thus, the holder is automatically adjustable for holding containers of varying diameter and, moreover, acts to center the container accurately with respect to the frame and to the associated stirring and electrode holding mechanisms.

What I claim is:

1. An electrodeposition apparatus comprising a frame having a horizontally disposed upper wall, a cylindrical vessel closed at the bottom and open at the top supported on said wall, means mounted on the wall for holding the vessel in fixed position, a stirring member in the vessel, means below the wall and remote from the stirring member for magnetically rotating the latter, a vertically disposed frame member rearwardly of the wall and in fixed relation thereto, an electrode holder slidably mounted on said frame member in rearwardly opposite relation to the vessel, said holder being slidable in a vertical direction, resilient means releasably holding the electrode holder in selected fixed position on the frame member to permit vertical adjustment thereof, an arm carried by the holder, a pair of insulated jacks mounted on the arm, means electrically connecting the jacks to a source of electric current, a twin electric plug seated in said jacks, a pair of substantially rigid wires electrically connected to said plug and carried thereby, each said wire having a portion extending forwardly from said plug over the mouth of the vessel and a portion extending downwardly into the vessel, an electrode carried on the downwardly extending portion of each wire and located in the vessel, and an imperforate closure plate freely seated on the mouth of the vessel over said wires, said holder

on removal of said closure plate being vertically slidable to withdraw the electrodes from the vessel, and said plug with said wires and electrodes being unitarily removable from said jacks and holder.

2. An electrodeposition apparatus as defined in claim 1, the lip of said vessel having a pair of adjacent recesses therein, the forwardly extending portions of the wires extending through said recesses and being located substantially below the lip of the vessel, the depth of the recesses being not substantially greater than the diameter of said wires, said closure plate overlying the recesses to substantially completely enclose the vessel.

3. An electrodeposition apparatus comprising a frame having a horizontally disposed upper wall, a plurality of cylindrical vessels closed at the bottom and open at the top supported on said wall, means mounted on the wall for holding the vessels in fixed position, a stirring member in each vessel, means below the wall and remote from the stirring members for magnetically rotating the latter, a vertically disposed frame member rearwardly of the wall and in fixed relation thereto, a plurality of electrode holders slidably mounted on said frame member, each said holder being independently slidable on said frame member in a vertical direction and being located rearwardly opposite one of said vessels, spring means releasably holding each holder in selected fixed position on the frame member to permit vertical adjustment thereof, an arm carried by each holder, a pair of insulated jacks mounted on each arm, means electrically connecting each pair of jacks to a source of electric current, a twin electric plug seated in each pair of jacks, a pair of substantially rigid wires electrically connected to each plug and carried thereby, each said wire having a portion extending forwardly from said plug over the mouth of the adjacent vessel and a portion extending downwardly into the vessel, an electrode carried on the downwardly extending portion of each wire and located in the respective vessel, and an imperforate closure plate freely seated on the mouth of each vessel over the respective pair of said wires, each said holder on removal of a respective closure plate being vertically slidable to withdraw the electrodes carried thereby from the respective vessel, and each said plug with the wires and electrodes carried thereby being unitarily removable from the respective jacks and holder.

ALFRED THOMAS RABBITTS.

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