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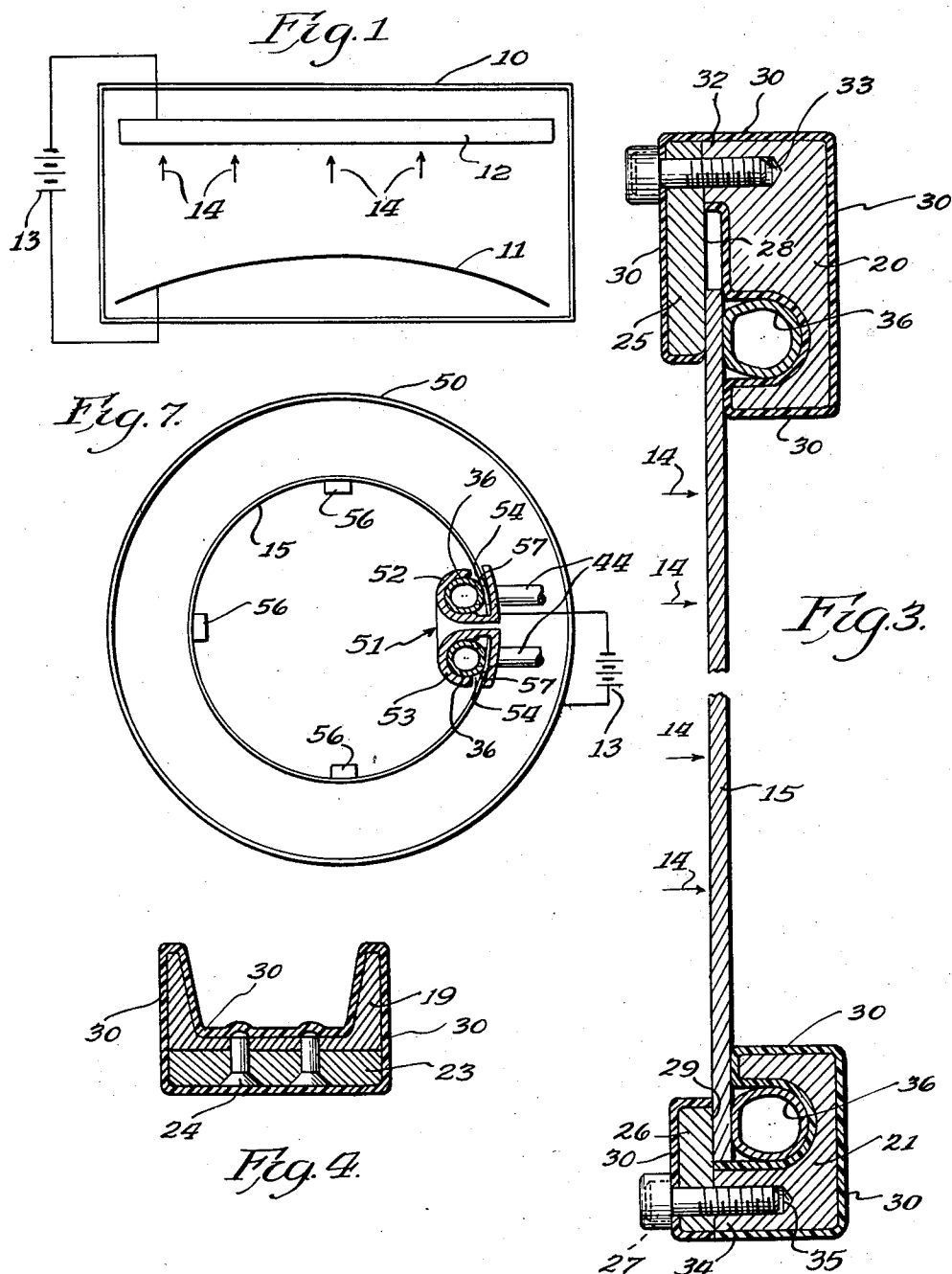
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PLATE CLAMPING MECHANISM FOR ELECTROLYTIC TREATING APPARATUS

Filed Nov. 14, 1956

3 Sheets-Sheet 1



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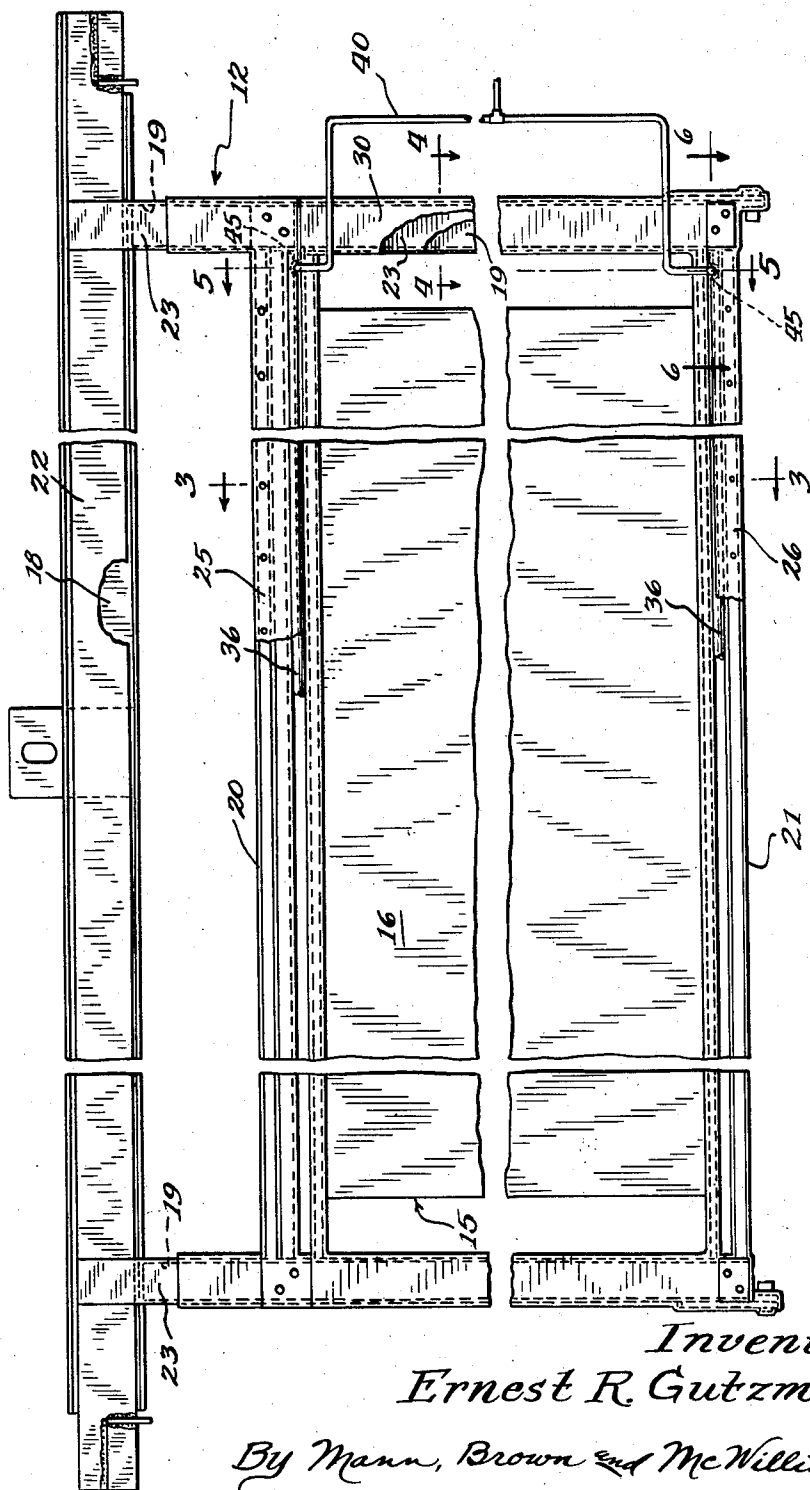
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Fig. 2.



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Fig. 5.

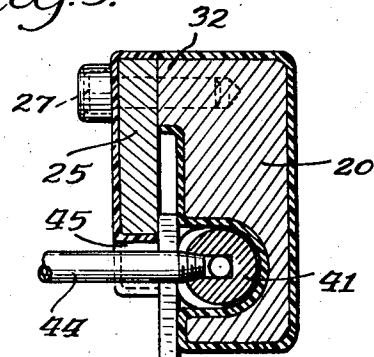
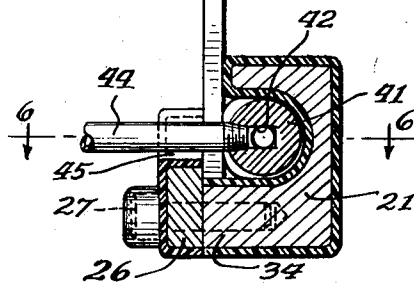
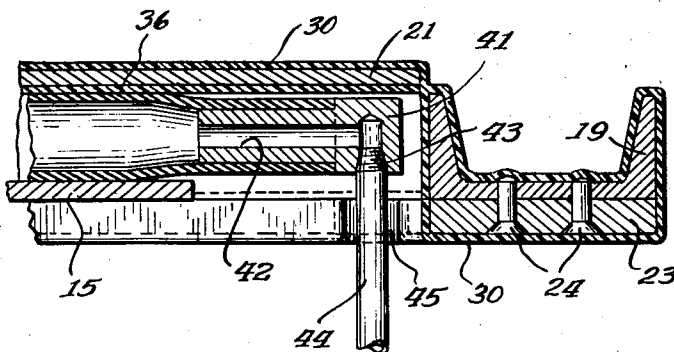


Fig. 6.



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PLATE CLAMPING MECHANISM FOR ELECTROLYTIC TREATING APPARATUS

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7 Claims. (Cl. 204—242)

This invention relates to a clamping mechanism that finds particular use in combination with a plating rack for submerging and supporting a sheet or plate within an electrolyte bath.

In the prior art, it has been customary to use racks for holding large steel sheets during an electrotreating operation and the sheets or plates have been clamped onto the racks by means of lever clamps or clamping bolts. Such arrangements require considerable time to operate and unduly increase the cost of the treating operation. In addition, they require frequent replacement since, in the case of electroplating, the surfaces of the clamps become plated while, in the case of electropolishing, the surfaces of the clamps tend to disintegrate.

It is the principal object of the present invention to provide a clamping mechanism that overcomes the above noted disadvantages of the prior art arrangements, that operates quickly and easily in applying and releasing the clamping pressures, that requires substantially no maintenance, and that necessarily keeps the contact surface clean.

Generally speaking, this is accomplished by mounting a pair of clamping mechanisms on a supporting rack to provide a pair of cooperating plate receiving notches that engage opposite edges of the plate being treated and cooperate with inflatable pneumatic tubing that is disposed in the notches for gripping the plate against a contact surface that defines one side of the notch. Preferably the tubing, the rack and the clamping mechanisms, with the exception of the contact surface, are coated with an insulating material that resists the corrosive action of the electrolyte.

Other objects and advantages of the invention will become apparent as the description proceeds.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts throughout the same;

Fig. 1 is a diagrammatic plan view of an electrotreating apparatus;

Fig. 2 is a front elevational view of a rack, according to the invention, supporting a plate that is to serve as one of the electrodes of the apparatus of Fig. 1, with parts of the rack being broken away for purposes of illustration;

Fig. 3 is a sectional view through a portion of the rack that is adapted to be submerged in the electrolyte bath, and is taken along the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view taken along the line 4—4 of Fig. 2 to illustrate the construction of one of the vertical legs of the rack;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary vertical sectional view taken along the line 6—6 of Fig. 2; and

Fig. 7 is a diagrammatic plan view of an alternative arrangement of electrotreating apparatus illustrating a

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modified rack construction that is useful with the present invention.

Referring now to the drawings and particularly to Fig. 1, a typical electrotreating arrangement is shown as comprising a tank 10 for an electrolyte bath, an anode 11, a cathode 12, and a source of D. C. current 13 connected across the electrodes 11 and 12 to send an ion current, as indicated by the arrows 14, through the electrolyte from the anode to the cathode.

For purposes of illustration it will be assumed that the arrangement of Fig. 1 is used for electroplating steel sheets in which case the anode 11 may be of lead or any other suitable material and the cathode 12, in the form of a supporting rack (Fig. 2), carries a steel sheet 15 having one of its major surfaces 16, facing the anode 11 to receive the plating current.

Preferably the rack comprises a main frame of aluminum welded construction that consists of a forwardly facing, channel-shaped, horizontal member 18, a pair of rearwardly facing, channel-shaped vertical legs 19 (see Fig. 4) carried by the member 18, and a pair of upper and lower, horizontally extending, aluminum cross bars designated 20 and 21 respectively (Fig. 3) that are connected between the legs 19; and a π shaped subframe of copper welded construction and comprising a horizontal member 22 that nests within the forwardly facing aluminum channel 18, and a pair of depending vertical legs 23 that overlie the rearwardly facing aluminum channels 19. The copper subframe is fixedly mounted on the aluminum main frame and rivets, such as shown at 24 in Fig. 4, are preferred for this purpose.

Finally the rack includes upper and lower aluminum contact bars (Fig. 3), designated 25 and 26 respectively, that are attached to the upper and lower cross bars 20 and 21, by suitable screws 27, to cooperate therewith in providing a pair of clamping mechanisms for gripping opposite edges of the sheet 15. The upper contact bar is provided with a contact surface 28 and the lower contact bar is provided with a contact surface 29 for establishing the necessary electrical contact with the sheet 15. With the exception of the contact surfaces 28 and 29, all of the exposed portions of the rack that are intended for submergence in the electrolyte are provided with a coating 30 of insulating material that is capable of resisting the corrosive action of the electrolyte. For this purpose a vinyl plastic is preferred, though any other suitable material may also be employed.

One of the principal advantages of the invention resides in the fact that there are no exposed surfaces which will become plated by the electrolyte and hence the rack is not subject to becoming coated with the plating material. To accomplish this goal a system of inflatable pneumatic tubing of a material that is substantially unaffected by the electrolyte, is mounted on the rack in association with the contact surfaces 28 and 29 to grip the sheet against these surfaces. The tubing is preferably made of a gum rubber or other suitable inflatable material that is capable of returning to its original size and shape after being subjected to internal pressure. The gum rubber is resistant to the action of most plating solutions but even when it is adversely affected it will stand up for a number of weeks. Of course, any material that better achieves the general purpose outlined above would be preferred.

As is best seen in Fig. 3, in the preferred arrangement of the clamping mechanisms, the upper aluminum cross bar 20 includes a laterally or rearwardly offset recess at its lower end and a forwardly projecting ledge 32 at its upper end, with the ledge having a series of tapped bores 33 cooperating with the screws 27 to secure the upper contact bar 25 in spaced relation to the remainder

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of cross bar 20 to define therewith a horizontally elongated, downwardly facing plate receiving notch that extends substantially the entire length of the cross bar and that includes a generally semi-circular pocket which confines a length of pressurized pneumatic tubing 36. In a similar manner, the lower aluminum cross member 21 is formed near its upper end with a laterally offset recess and at its lower end with a forwardly projecting ledge 34, with the ledge having a series of tapped bores 35 cooperating with the screws 27 to secure the lower contact bar 25 in spaced relation to the remainder of cross bar 21 to define, therewith, a horizontally elongated upwardly facing plate receiving notch that extends substantially the entire length of cross bar 21 and includes a generally semi-circular pocket in which is confined another length of pressurized tubing 36.

Preferably the upper cross member 20 and the upper contact bar 25 are somewhat wider than the lower cross member 21 and the lower contact bar 26 and the arrangement is such that the upper notch is considerably deeper than the lower notch. The depth of the notches is correlated so that in locating the sheet 15 it is first inserted into the upper notch a sufficient distance to permit the bottom end of the sheet to clear the lower contact bar 25. The sheet is then swung inwardly and lowered into the bottom notch until it assumes the position shown in Fig. 3. During the insertion or removal of the sheet 15 the pneumatic tubing 36 is in its deflated condition to provide the necessary clearance.

Referring again to Fig. 3, it will be seen that the upper portion of contact surface 28 is exposed to the electrolyte but due to the arrangement of the clamping mechanisms, substantially no plating will be deposited on this exposed surface. It will be seen that as viewed in Fig. 3 the ion path 14 approaches from the left and would have to follow a tortuous path in order to actually contact surface 28 and in practice this simply does not occur. This fact would also indicate that the clamping tubing's location is effectively shielded from the plating deposits and hence, even if there were exposed surfaces in this location, there is little likelihood that they would become coated.

Obviously the mounting of the sheet 15 may be handled in other ways. For example, the sheets are usually sufficiently thin that they may be bowed to foreshorten them sufficiently to permit their direct insertion into the notches. Alternatively, the notches may be opened at their ends to permit the sheets to be moved into place from the side.

In Fig. 2 the lengths of pneumatic tubing 36 are shown connected to a system of tubing 40 which in turn is connected to a source of air pressure (not shown) for inflating the pneumatic tubing. The connection between the copper tubing and the pneumatic tubing is accomplished by providing a stepped plug 41 which may also be of gum rubber which is inserted through the open end of the pneumatic tubing and which includes a pair of intersecting axial and transverse bores, designated 42 and 43 respectively. The axial bore 42 opens into the pneumatic tubing 36 and the transverse bore 43 receives a nipple 44 adapted for connection to the copper tubing 40. The nipples pass through appropriate access notches 45 provided in the contact bars.

It is a matter of choice whether the copper tubing is permanently connected to the pneumatic tubing, in which case the copper tubing constantly is submerged in the electrolyte and hence must be coated with vinyl plastic. Alternatively the copper tubing can be temporarily connected to the nipples 44 for inflating the pneumatic tubing. In this latter instance, the nipples would include an air valve of the type commonly used in automobile tires and the nipple and valve would be suitably masked to prevent exposure to the electrolyte.

The assembly and operation of the device is exceedingly simple. Prior to the mounting of the contact bars the lengths of pneumatic tubing are inserted in the pockets

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formed in the aluminum cross bars. Finally the contact bars are screwed in place and the screws 27 are masked off. The sheet 15 to be plated is then inserted and the pneumatic tubing is inflated to grip the sheet against the contact surfaces 28 and 29. After the plating operation is completed the tubing is deflated to permit the removal of the sheet. It will be apparent that a single simplified control can be employed for applying and releasing the clamping pressures and furthermore the parts of the rack and clamping mechanism are entirely free from the action of the electrolyte and are not subject to becoming plated.

The use of inflatable tubing for applying the clamping pressures has the additional advantage that sheets or other articles of irregular contour can readily be gripped by the tubing. In such instances the tubing merely distorts to assume the contour of the surface against which it is engaged and this insures a more uniform gripping action irrespective of the surface contour of the article being held.

The concepts of the invention find application in a variety of supporting arrangements, one such additional arrangement being shown in Fig. 7. In this instance the tank for the electrolyte bath, as shown at 50, is of circular configuration and may itself be provided with a lead coating in order that it will serve as the anode. The rack is designated generally at 51 and it includes a pair of complementary clamping mechanisms 52 and 53, each of which is formed with elongated open faced notches 54 for gripping the opposite ends of a steel sheet 15 which again serves as the cathode. The exterior D. C. source is again shown at 13.

The arrangement of Fig. 7 is frequently useful for the plating of relatively thin sheets and the sheet is shown bent around a number of support posts 56 with one of its major surfaces facing the circular anode 50. Each of the clamping mechanisms again includes a length of inflatable tubing 36 carried in a laterally offset pocket and gripping the edges of the sheet against contact surfaces 57. Finally the nipples 44 are shown for connection to a source of air pressure. In this instance also, the supporting rack 51, with the exception of the contact surfaces 57, is coated with a vinyl plastic to protect it from the electrolyte and to prevent coating of the rack. This arrangement offers the same advantages as does the clamping arrangement shown in Figs. 1 to 6.

It should be understood that the description of the preferred form of the invention is for the purpose of complying with section 112, Title 35 of the United States Code, and that the appended claims should be construed as broadly as the prior art will permit.

I claim:

1. In apparatus for the electrolytic treating of a plate, said apparatus including a reservoir for an electrolyte bath; an electrode submerged in said bath; a rack for supporting said plate in said bath with a major surface of said plate facing said electrode, said rack including a pair of cooperating clamping mechanisms gripping opposite edges of the plate, and intermediate structure connected between said clamping mechanisms and holding them in predetermined spaced relationship; and a current source connected to said electrode and to said clamping mechanisms: the improvement wherein each of said clamping mechanisms has an elongated open-faced plate receiving notch defined in part by laterally spaced elongated interior wall surfaces with one of said surfaces being formed of current conducting material and establishing electrical contact between the major surface of said plate and said clamping mechanism, hollow pressurized members of inflatable material disposed in said notches in facing relation to said surfaces of current-conducting material to grip said plate against said last-mentioned surfaces, and means for varying the pressure in said hollow members.

2. In apparatus for the electrolytic treating of a plate, said apparatus including a reservoir for an electrolyte

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bath; an electrode submerged in said bath; a rack for supporting said plate in said bath with a major surface of said plate facing said electrode, said rack including a pair of cooperating clamping mechanisms gripping opposite edges of the plate, and intermediate structure connected between said clamping mechanisms and holding them in predetermined spaced relationship; and a current source connected to said electrode and to said clamping mechanisms: the improvement wherein each of said clamping mechanisms has an elongated open-faced plate receiving notch defined in part by laterally spaced elongated interior wall surfaces with one of said surfaces being formed of current conducting material and establishing electrical contact between the major surface of said plate and said clamping mechanism, elongated pressurized pneumatic tubing confined in each notch to hold said plate against said one surface, and means for varying the pressure in said tubing.

3. In apparatus for the electrolytic treating of a plate, said apparatus including a reservoir for an electrolyte bath; an electrode submerged in said bath; a rack for supporting said plate in said bath with a major surface of said plate facing said electrode, said rack including a pair of cooperating clamping mechanisms gripping opposite edges of the plate, and intermediate structure connected between said clamping mechanisms and holding them in predetermined spaced relationship; and a current source connected to said electrode and to said clamping mechanisms: the improvement wherein each of said clamping mechanisms has an elongated open-faced plate receiving notch defined in part by laterally spaced elongated interior wall surfaces, pressurized pneumatic tubing disposed in each of said notches laterally of the open faces therein to react against one of said surfaces and grip said plate against the other of said surfaces and establish electrical contact between said plate and said clamping mechanisms, and means for varying the pressure in said tubing.

4. In apparatus for the electrolytic treating of a plate; said apparatus including a reservoir for an electrolyte bath; an electrode submerged in said bath; a rack for supporting said plate in said bath with a major surface of said plate facing said electrode, said rack including a pair of cooperating clamping mechanisms gripping opposite edges of the plate and intermediate structure connected between said clamping mechanisms and holding them in predetermined spaced relationship, and a current source connected to said electrode and to said clamping mechanisms: the improvement wherein each of said clamping mechanisms has an elongated open-faced plate receiving notch defined, in part, by laterally spaced elongated interior wall surfaces, one of said notches being deeper than the other to facilitate the mounting of a plate therein, pressurized pneumatic tubing disposed in each of said notches laterally of the open faces therein to react against one of said surfaces and grip said plate against the other of said surfaces and establish electrical contact between said plate and said clamping mechanisms, and means for varying the pressure in said tubing.

5. A plate supporting rack for use in the electrolytic

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treating of a plate and comprising a pair of cooperating clamping mechanisms for gripping opposite edges of the plate, and intermediate structure connected between said clamping mechanisms and holding them in predetermined spaced relationship, each of said clamping mechanisms including an elongated open-faced notch defined in part by laterally spaced elongated interior wall surfaces, elongated pressurized pneumatic tubing disposed in each of said notches laterally of the open faces therein to control said plate and react against one of said surfaces and grip said plate against the other of said surfaces to establish an electrical connection between said plate and said clamping mechanism, and means for varying the pressure in said tubing, said rack, with the exception of said other surfaces, being coated with an acid resisting, insulating material.

6. In apparatus for the electrolytic treating of an article; said apparatus including a reservoir for an electrolyte bath; an electrode submerged in said bath; a rack for supporting said article in said bath in operative relationship to said electrode, and a current source connected to said rack and said electrode: the improvement wherein said rack includes means providing an elongated open-faced article receiving notch defined in part by laterally spaced elongated interior wall surfaces, pressurized pneumatic tubing disposed in said notch laterally of the open face thereof to react against one of said surfaces and grip said article against the other of said surfaces to establish electrical contact between said article and said rack, and means for varying the pressure in said tubing.

7. In apparatus for the electrolytic treating of a plate, said apparatus including a reservoir for an electrolyte bath; an electrode submerged in said bath; a rack for supporting said plate in said bath with a major surface of said plate facing said electrode, said rack including a pair of cooperating clamping mechanisms gripping opposite edges of the plate, and intermediate structure connected between said clamping mechanisms and holding them in predetermined spaced relationship; and a current source connected to said electrode and to said clamping mechanisms: the improvement wherein said clamping mechanisms have exposed surfaces of current-conducting material disposed along opposite edges of one of the major surfaces of said plate for current-conducting contact therewith and said clamping mechanisms include hollow pressurized members of inflatable material disposed along and in facing relation with said exposed surfaces to engage the other major surface of said plate and grip said plate against said exposed surfaces, and means for varying the pressure in said hollow members.

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