

[54] **ETCHANT RINSE APPARATUS**
 [75] Inventors: **Daniel L. Goffredo**, Riverton, N.J.;
John Alfred Dunkelberger, Jr.,
 Centre Hall, Pa.

[73] Assignee: **Chemcut Corporation**, State
 College, Pa.

[22] Filed: **Oct. 18, 1971**

[21] Appl. No.: **190,136**

[52] **U.S. Cl.**..... **134/109, 134/151, 134/199,**
156/345, 210/287

[51] **Int. Cl.**..... **B08b 3/02, B08b 3/10**

[58] **Field of Search** **134/109, 111, 131, 151,**
134/199, 83, 10; 156/345; 210/287, 433

[56] **References Cited**

UNITED STATES PATENTS

2,440,134	4/1948	Zademach et al.	134/111 X
3,082,774	3/1963	Benton et al.	134/151 X
3,255,106	6/1966	Reid et al.	134/10 X

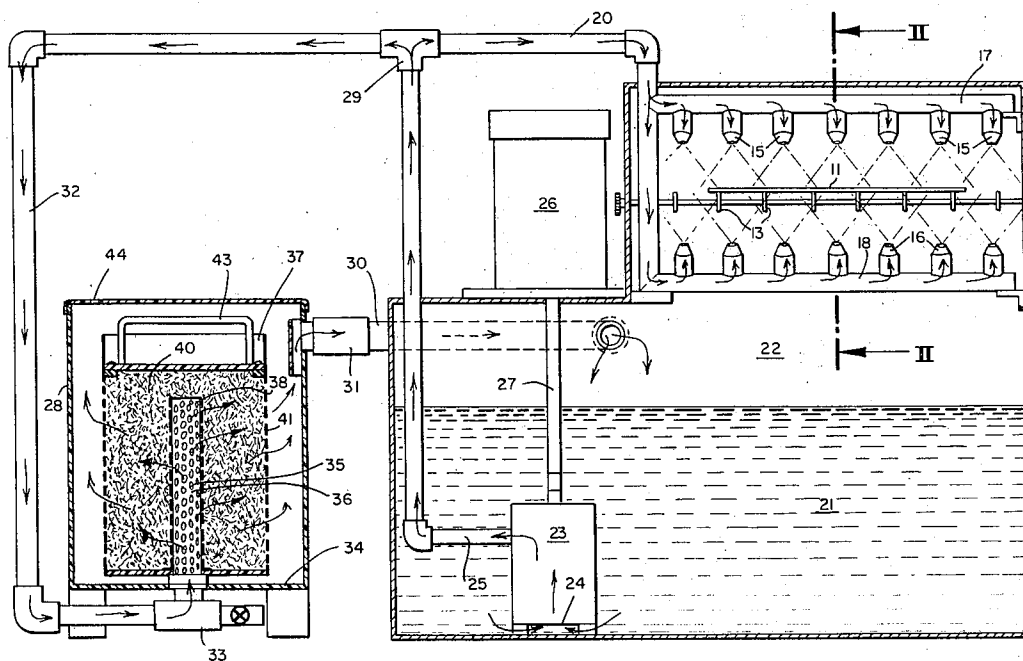
3,431,921	3/1969	Pesek.....	134/131 X
3,603,329	9/1971	White et al.	134/199 X
3,705,061	12/1972	King.....	134/10 X

Primary Examiner—Robert L. Bleutge
Attorney, Agent, or Firm—Paul & Paul

[57] **ABSTRACT**

Residual etchant, such as acid and the like remaining on articles such as printed circuit boards that have been etched, contains a metallic chemical component, such as copper. When this residual etchant is rinsed from the articles (such as printed circuit boards), it contaminates the water of the rinse. The chemical replacement of copper ions in the rinse with aluminum ions by passing the rinse through a basket filled with aluminum turnings, and recycling the rinse thus passed back for reuse at the rinsing station continuously renders the rinsing water free of copper, to permit periodic discharge of the rinse water to sewage or the like.

6 Claims, 2 Drawing Figures



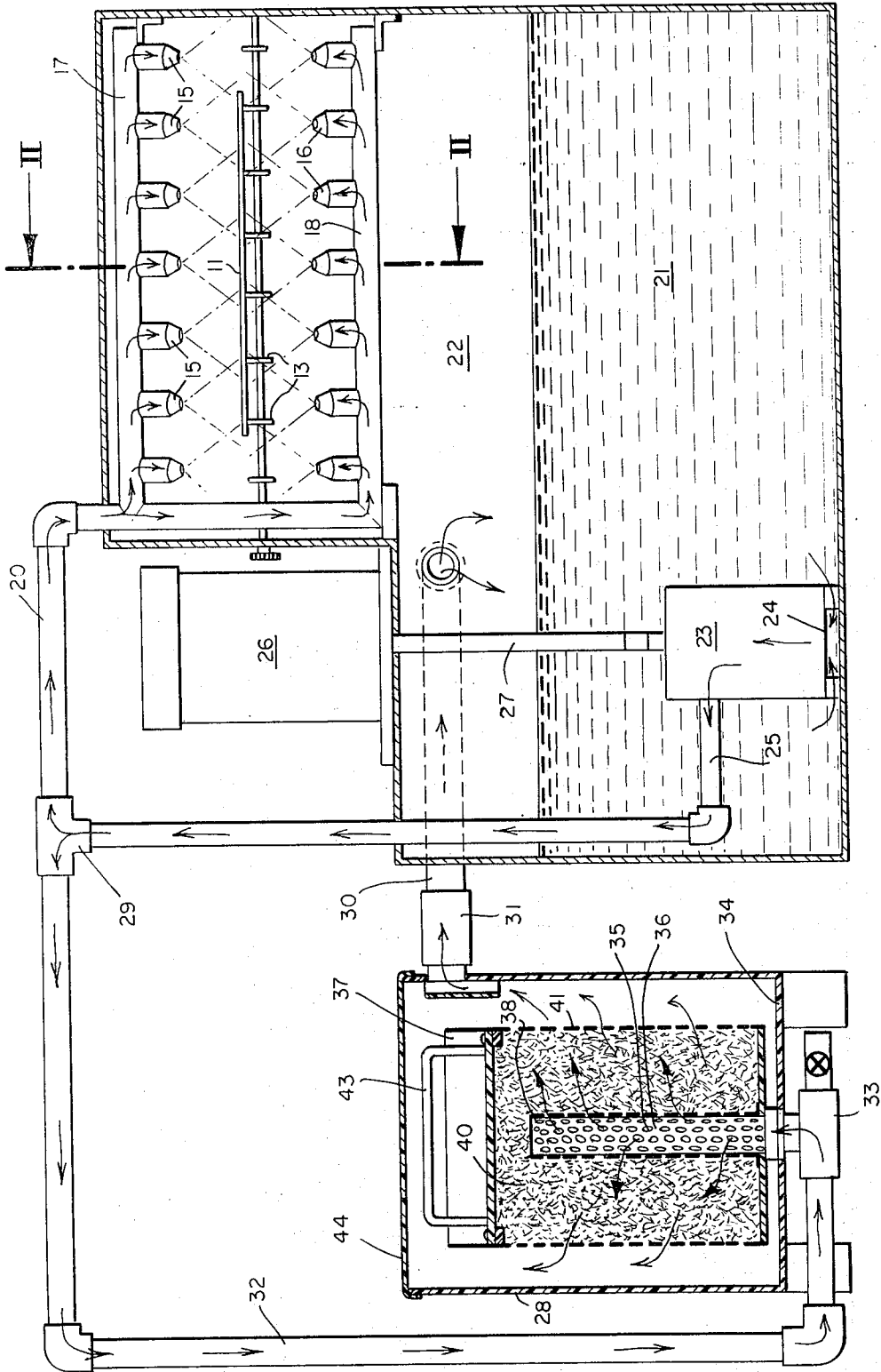
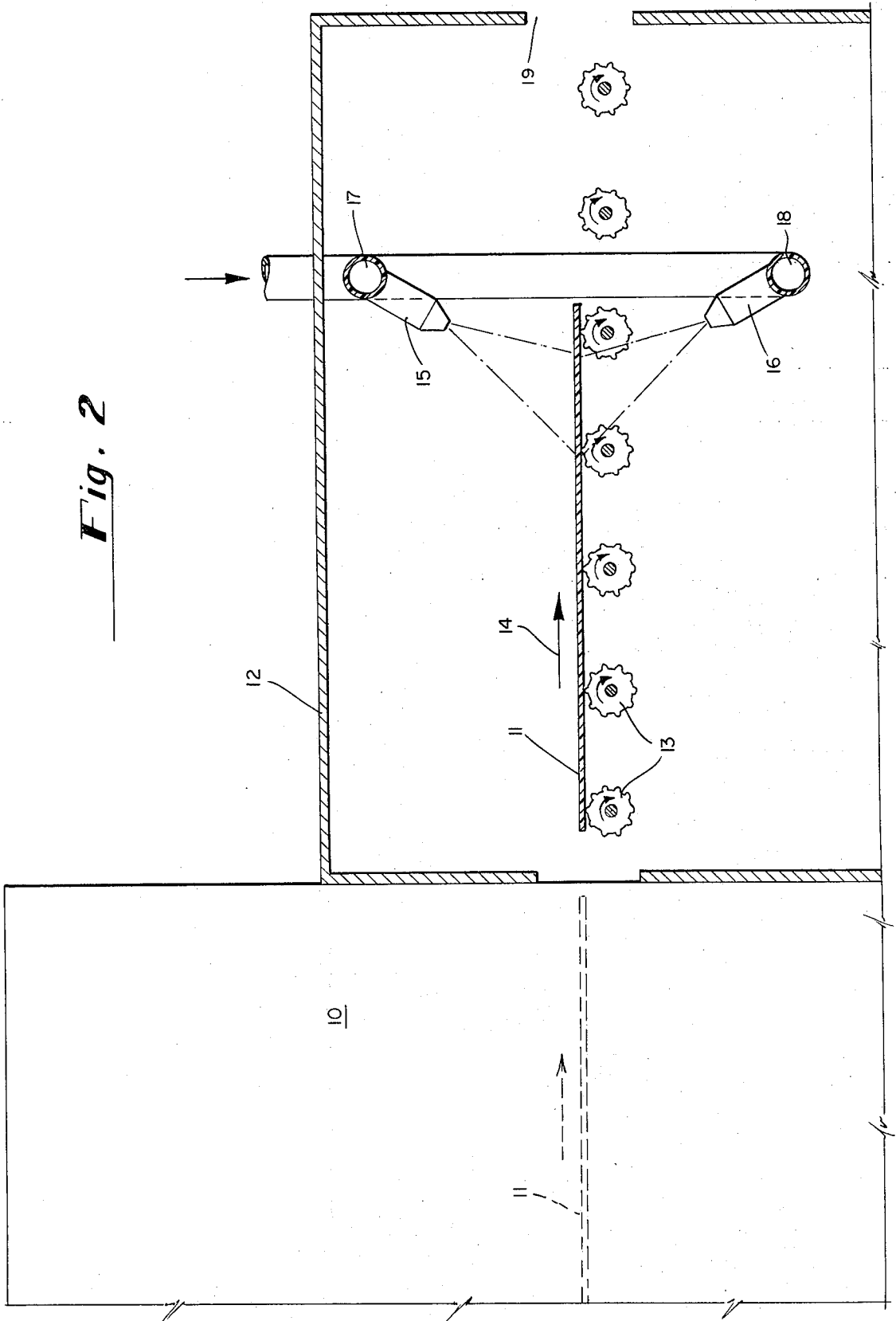


Fig. 1

Fig. 2



ETCHANT RINSE APPARATUS

BACKGROUND OF THE INVENTION

In the art of etching printed circuit boards and the like, it has been commonplace to rinse acid etchants from the printed circuit boards, for purposes of "cleaning" the acid from the boards, in order that the boards may be subsequently handled by personnel, and also to assure the termination of the etching process, on copper components of the board. Such washing or rinsing has conventionally been done by spraying the boards with a water rinse, and either continuously or periodically replacing the water rinse, with used water rinse being discharged to sewage or the like. However, such used water rinse in accordance with the above-mentioned prior art techniques has contained copper ions therein, and such has been found to cause undesirable ecological effects upon streams, waterways and the like, into which the used rinse eventually finds its way from sewage.

Furthermore, the copper contained within the acid rinsed off the boards in accordance with these prior art techniques has been permanently lost.

SUMMARY OF THE INVENTION

The present invention is directed toward providing an apparatus whereby recycling of the rinse water is possible without building up an undesirable level of copper concentration in the rinse water, and whereby the rinse water is not contaminated by copper, so that the same may be discharged into conventional sewage lines, streams, etc., without producing damaging environmental effects. A portion of the rinse water being delivered to spray nozzles passes from the reservoir of rinse water to and through a particulate material (preferably aluminum turnings), and the rinse water is dispersed therethrough, eventually being returned to the rinse reservoir. During its passage through the aluminum turnings, a chemical replacement of copper ions in the rinse is effected, by replacement with aluminum ions, with the copper ions being reduced to metallic copper, and with the aluminum being oxidized and flowing into solution in the rinse water. The rinse water thus accumulates an aluminum ion concentration, which may periodically be discharged as desired, without producing undesirable environmental effects.

Accordingly, it is a primary object of this invention to provide a novel apparatus for treating etchant rinse water.

It is a further object of this invention to provide a novel apparatus for replacing copper ions in etchant rinse water with aluminum ions.

It is another object of this invention to provide a novel apparatus for rinsing etchant reactants from articles that have been etched, wherein such apparatus involves chemical replacement of unwanted metallic ions in the rinse medium.

Other objects and advantages of the present invention will be readily apparent to those skilled in the art from a reading of the following brief descriptions of the drawing figures, detailed description of the preferred embodiment, and the appended claims.

IN THE DRAWINGS

FIG. 1 is a transverse sectional view through the several components of a rinsing apparatus of this invention.

FIG. 2 is a longitudinal sectional view through a portion of the rinsing apparatus illustrated in FIG. 1, and illustrating the manner in which the rinse is sprayed onto printed circuit boards or the like passing through a rinse chamber from an etching chamber or the like.

Referring to the drawings in detail, reference is first made to FIG. 2, wherein an upstream chamber 10 is illustrated, as comprising an etching chamber, or if desired, a chamber for first physically removing etchant from printed circuit boards 11 or the like conveyed therethrough, by means other than water spraying. The printed circuit board 11 for which this apparatus has been developed, is then delivered into a rinsing chamber 12, passing along a plurality of driven rollers 13, which rotate in a clockwise direction as viewed in the illustration of FIG. 2, for movement of the printed circuit board 11 in the direction of the arrow 14 of FIG. 2, through the chamber 12 for eventual discharge through the outlet 19, thereof, to a drying station or the like.

The board 11, upon its delivery to the chamber 12 may have residual components of an etching acid, such as ferric chloride thereon, that has been used to etch unmasked copper portions of the printed circuit boards, and such residual etchant thus contains a certain copper content.

The board 11 then passes between upper and lower sets of spray nozzles 15 and 16, that are supplied with water under pressure, for spraying the board 11 through a certain zone such as that indicated in FIG. 2, with the zones of spray of the nozzles combining transversely of the machine, in order to completely spray a board 11 carried therebetween as will be more clearly apparent with reference to the illustration of FIG. 1. The upper spray nozzles 15 are connected to rinse water header 17, and the lower spray nozzles 16 are each connected to a lower rinse water header 18, with the headers 17 and 18 being supplied with rinse water from a common delivery line 20. After spraying of the board 11 with rinse water passing through the nozzles 15 and 16, the rinse water 21 drops into a reservoir 22, and such rinse water 21 and the reservoir 22 now has a slight concentration of copper ions therein. Rinse water 21 is delivered from a chamber 22, by a pump 23, or other suitable device, which receives the rinse water 21 at a lower inlet 24 thereof, and delivers the same through an outlet line 25, with the pump 23 being driven by an electrical motor 26 or the like disposed outwardly of the chamber 22, but connected to the pump 23 through a rotatable shaft 27 that passes into the chamber 22 from outside thereof, to drive the submerged pump 23.

Rinse water is thus delivered through the line 25, outwardly of the chamber 22, with the delivery line 25 being bifurcated at the piping tee 29, with some of the rinse water being delivered to the spray nozzles 15 and 16, through the line 20, and some of the rinse water being delivered through a replacement chamber 28, and back into the reservoir 22 through a return line 30, selectively openable upon actuation of a switch 31 or the like, as desired, whereby rinse water is delivered to the replacement chamber 28, as a parallel loop to that delivered to the spray nozzles 15 and 16. Thus, rinse water enters the replacement chamber 28, being delivered thereto by a suitable piping line 32, and passing through a generally open shut-off switch 33, entering the replacement chamber 28, through the bottom 34

thereof, at a central opening thereof, for passage outwardly of a plurality of holes 35, or other suitable perforations in the outer surface of a hollow cylindrical upstanding standpipe 36, as illustrated in FIG. 1.

A removable tank 37 is provided, inwardly of the replacement chamber 28, the bottom of which has a blind hole therein for facilitating the disposition of the tank 37 over the standpipe 36, and with the sides of the blind hole 38 in the tank 37 facilitating the passage inwardly of rinse water into the interior 40 of the tank, as such rinse water passes through perforations 35 of the standpipe 36. The tank 37 is constructed as a basket, with the outer cylindrical surface 41 thereof also being perforate, and with the basket being filled with a particulate material such as aluminum turnings whereby the rinse water 21 delivered through the line 32 will pass through the aluminum turnings, to be discharged through the tank 37, but passing through perforations in the outer wall 41 is spaced inwardly of the inner surface of the chamber 28, to form an annular void therein, for passage of water upwardly, inasmuch as the water is under pressure from the pump 23, and with the water thus being redelivered through the line 30 as aforesaid, into the chamber 22.

The tank 37 is also provided with a handle 43 whereby the same may readily be grasped and removed from its position over the standpipe 36, upon opening the lid 44 of the chamber 28, whenever the concentration of copper within the aluminum turnings necessitates replacement of the tank 37, or of the turnings carried therein.

It will be apparent from all of the foregoing, that during the passage of the rinse water through the aluminum turnings within the tank 37, the dissolved copper content within the rinse is chemically replaced with aluminum from the aluminum turnings, and the copper ions removed from the rinse are reduced to metallic copper and aluminum is oxidized, going into solution in the rinse water. The water reservoir thus remains extremely low in copper ion concentration, but will progressively increase in aluminum ion concentration. Upon the reservoir 22 achieving an objectionable level of aluminum ion concentration, the rinse water 21 therein may be discharged to sewage or the like, without causing contamination of sewage lines, waterways, or the like.

The herein discussed invention is significant in that it provides a simple and low cost means of eliminating objectionable copper ions from etchant rinse water. Accordingly, a highly desirable anti-pollution feature is encompassed by the present invention, which replaces copper ion concentration in rinse water with more acceptable aluminum ions.

While displacement reactions themselves are previously known, for removing copper from solution generally, and wherein such processes are generally known as "cementation", in the mining industry, for example, the use of replacement ions to resolve a heretofore difficult pollution problem for the etching industry, and particularly for the industry relating to the etching of printed circuit boards is highly desirable.

It will also be apparent that other types of chemical replacement may be effected, in lieu of using aluminum particles within the tank 37. For example, iron filings, magnesium, or any other metal above copper in the electromotive series, or any other substance that will effect the desired ion exchange, preferably with regard

to its adaptability to achieving the other desired ends of this invention as set forth herein, may be utilized within the tank 37, if desired, for replacement of copper ions with iron ions in the solution.

Another feature of this invention is that the process permits continuous replacement of copper ions in the rinse water, by permitting continuous removal, by displacement reactions onto the aluminum surfaces of the particles within the tank 37. It will, however, be apparent that the parallel loop arrangement illustrated in FIG. 1 is not to be construed as limiting, in that rinse water 21 from the tank 22 may pass serially first to the tank 37, and then to the spray nozzles 15 and 16, if desired, or the converse.

It will be apparent from the foregoing that various modifications may be made in the details of construction of the apparatus of this invention, as well as in the method of use thereof, all within the spirit and scope of the appended claims.

What is claimed is:

1. A rinsing apparatus for rinsing etching reactant from articles that have been etched by a reactant comprising a rinsing chamber, means for conveying etched articles through the chamber, rinse dispensing members located in said chamber and positioned for dispensing rinsing liquid onto the articles in the chamber, a rinse reservoir for containing a rinsing liquid, means for delivering rinsing liquid from said reservoir to said dispensing members, a replacement chamber having an inlet connected for receiving rinse liquid from said reservoir and having an outlet connected for recycling the rinse liquid for delivery to the reservoir, said replacement chamber including a tank containing a displacing material and means for facilitating flow of rinse liquid from the inlet through the displacing material in the tank and to the outlet, with the displacing material comprising means facilitating an ion replacement of etchant ions in the rinse liquid with ions from the displacing material, wherein said means for delivering rinsing liquid includes pump means for delivery of liquid simultaneously to both the rinse dispensing members and the replacement chamber.

2. The apparatus of claim 1, wherein said displacing material is particulate material.

3. The apparatus of claim 2, wherein the articles being etched contain copper with the rinse containing a substantial concentration of copper ions, and wherein said particulate material comprises aluminum particles for chemical replacement of copper ions with aluminum ions.

4. The apparatus of claim 3, wherein said pump means includes a pump, having a discharge therefrom bifurcated for delivery both to the rinsing members and to the replacement chamber, wherein said tank is disposed within said replacement chamber centrally thereof, and spaced from the walls of the chamber thereof, and with said flow facilitating means including a central inlet of rinse liquid to the tank, and with tank walls being perforate for discharge of liquid there-through to the outlet of said replacement chamber, wherein said dispensing members comprise spray nozzles, and wherein said conveying means comprises means for moving the articles along a generally horizontal path, with said spray nozzles being disposed both above and below the path for spraying upper and lower sides of articles conveyed therealong.

5

5. The apparatus of claim 1, wherein said dispensing members comprise spray nozzles.

6. The apparatus of claim 1, wherein said tank is disposed within said replacement chamber centrally thereof, and spaced from the walls of the chamber

6

thereof, and with said flow facilitating means including a central inlet of rinse liquid to the tank, and with the tank walls being perforate for discharge of liquid there-through to the outlet of said replacement chamber.

* * * * *

10

15

20

25

30

35

40

45

50

55

60

65