

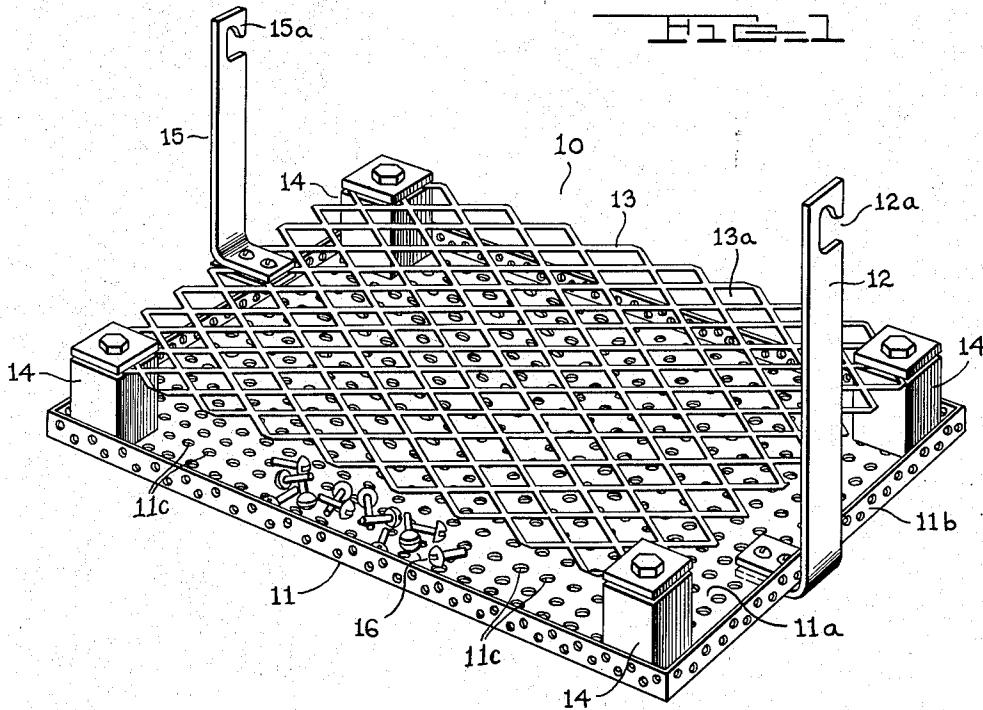
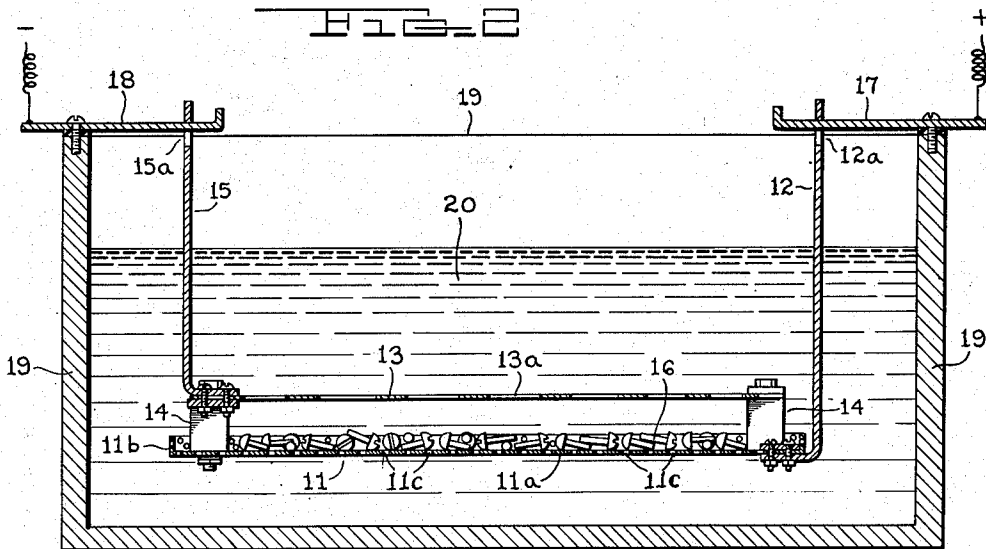
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ELECTROLYTIC POLISHING APPARATUS

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ELECTROLYTIC POLISHING APPARATUS

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3 Claims. (Cl. 204-242)

1

This application is a companion to my co-
pending application, Serial No. 724,912, filed Jan-
uary 12, 1947 and entitled Electrolytic Polishing
of Stainless Steel and the invention relates to
the electrochemical treatment of metal and more
especially to a method and apparatus for elec-
trolytically polishing stainless steel articles and
products.

An object of my invention is the provision of
a simple, direct and thoroughly practical method
for electrolytically polishing stainless steel arti-
cles, such as quantities of small screws, bolts, nuts
or rivets, the method assuring batch treatment
of the products, being rapid in effect, and giving
a highly satisfactory polish to the various prod-
uct surfaces.

Another object is that of providing an efficient
and reliable method for electrolytically batch-
polishing articles of stainless steel with good
throwing power in the electrolyte and without ap-
preciable shielding effect or etching of the metal.

A further object of my invention is to provide
reliable, highly effective and easily operated ap-
paratus for electrolytically batch-polishing quan-
tities of small stainless steel articles.

A still further object of my invention is the
provision of a simple, efficient electrolytic pol-
ishing rack for holding a number of individual pieces
for polishing treatment, which apparatus op-
erates with good electrical contact to the several
pieces and assures easy batch handling of the
same.

Other objects of the invention in part will be
obvious and in part pointed out hereinafter.

The invention accordingly consists in the com-
bination of elements, composition of materials
and features of construction, and in the several
steps and the relation of each of the same to one
or more of the others as described herein, the
scope of the application of which is indicated in
the following claims.

In the accompanying drawing, representing an
embodiment of the apparatus of my invention:

Figure 1 is a perspective view of an electrolytic
polishing rack; and

Figure 2 is a sectional representation of the
rack in Figure 1 supported in operating position
in an electrolytic polishing vat.

As conducive to a clearer understanding of cer-
tain features of my invention, it may be noted
at this point that stainless steel by general defini-
tion is a steel which contains about 10% to 35%
chromium, with or without nickel, and with or
without supplemental additions of manganese,
silicon, cobalt, copper, molybdenum, tungsten,
vanadium, columbium, titanium, sulphur, and
the like, for special purposes, and the remainder
substantially all iron. These steels heretofore
have been put into use, either in the polished or
unpolished conditions, as desired, to meet a
variety of needs frequently involving resistance
to corrosion. When left unpolished, the steels
usually are dull gray in appearance which for
many purposes is satisfactory. In the polished
conditions, the steel is bright and mirror-like at
the surface. The bright, polished finish fre-

2

quently enhances the corrosion-resistance of the
metal and, for example, thus sometimes is de-
sired for reasons even other than appearance.

The prior art offers two important general
classes of polishing techniques for effecting a
bright finish on stainless steel, one of these con-
sisting principally of mechanical operations such
as grinding, rubbing and buffing, and the other
depending upon electrolytic treatment of the steel
surface. The electrolytic polishing class of treat-
ment offers many advantages. It effects an elec-
trochemical removal of a minute thickness of
metal from the stainless steel surface whether
one or more products are under treatment. With
proper operating conditions, this leaves a bright
finish even where peculiar or intricate shapes of
the metal are encountered. Many of these shapes
perhaps could not be mechanically followed and
polished to any appreciable degree of satisfac-
tion.

While electrolytic polishing far surpasses the
heretofore known mechanical techniques as from
the standpoint of offering savings in time and
labor and in giving better appearing products,
the art as previously practiced nevertheless pre-
sents a number of problems. There is, for ex-
ample, the problem of immersing and holding the
stainless steel products to treating position in the
electrolytic polishing system. The conventional
supports employed for this purpose frequently are
more susceptible to the action of the electrolytic
current than the stainless steel work and, accord-
ingly, soon are spent in the electrolyte and re-
quire too frequent replacement. Then, too, there
are instances where the stainless steel products
are so small or are so numerous as to render in-
dividual support in the bath impracticable.
Where the products are collectively supported and
immersed in the electrolyte for batch treatment,
it is difficult, according to previous practices, to
achieve efficient bath conditions including good
throwing power of the electrical current and to
avoid shielding of one product by another. One
prior art practice has been to tumble the collec-
tively supported products as in a drum-type
anode during the polishing operation. While this
is intended to avoid shielding and partial pol-
ishing, other difficulties develop by this measure.
For example, it is not easy, if at all possible, to
achieve a uniform current density in the bath,
using the drum electrode, and accordingly uni-
formity of the polish usually suffers. Also, the
stainless steel articles, when tumbled, often suf-
fer an etching effect in the electrolyte.

An outstanding object of my invention, there-
fore, is the provision of an efficient and reliable
method for electrolytically polishing a plurality
of stainless steel articles in batches, the method
giving reasonably uniform current density of
treatment, long life of the product-supporting
apparatus employed in the electrochemically
active solution, and giving substantially uniform-
ly polished products throughout the batch with
substantial freedom from etching of the stainless
steel surfaces.

Referring now more particularly to the prac-

tice of my invention, I electrolytically polish batches of any of a wide variety of stainless steel products or articles, such as bolts, nuts, washers, screws, rivets, or the like, with the batch or batches immersed in an electrolytic bath preferably comprising substantial amounts both of glycolic acid and sulphuric acid and at least some water. For retaining the several stainless steel products and holding the same collectively immersed for treatment, I provide a support preferably having a substantially flat, riddled bottom, and make this bottom, and consequently the products retained thereon, the anode of the electrolytic polishing bath. The openings in the riddled bottom importantly assure admission of the electro-polishing solution to the work and circulation of this fluid at the point of polishing, all contributing to a more effective polish. Any of the glycolic acid, sulphuric acid electrolytes disclosed in my copending application, Serial No. 724,912, filed January 28, 1947, for example, are satisfactorily used for present purposes.

The work support which I employ, advantageously takes the form of an electrolytic polishing rack 10 (see Figures 1 and 2) wherein a shallow riddled pan or tray 11 having a flat bottom 11a, and perforated raised sides 11b, and preferably made of copper or copper-base alloy sheet, is the product supporting anode. The copper, as used, I find not only is a good conductor of electricity, but is especially resistant to electrochemical effects in certain electrolytes and particularly in the glycolic acid-sulphuric acid bath already mentioned. I therefore prefer copper in one form or another for increased rack life. Of course, I sometimes use anodes of other metals or materials without copper, providing they are satisfactory conductors of electricity and are appreciably resistant to attack and effects in the electrolytic polishing media. Sometimes, I mask the underside of the anode, or for that matter all but the article-contact surface of this electrode, with stop-off lacquer, thus to afford greater resistance to the electrolyte and the electropolishing effect, and to achieve prolonged life of the rack.

An electrical lead 12 illustratively connects the anode to a suitable source of electrical supply. At times, the anode which I provide is without the sides 11b and, for example, is only a perforated flat metal piece serving the function of the bottom 11a. The inclusion of sides 11b, however, is preferred, especially when small stainless steel parts are to be electropolished. The perforations importantly are smaller than the stainless steel pieces to be electropolished, and have close enough spacing and frequency to permit ready access of the polishing solution to the work. These holes usually also tend to keep the work pieces separated from each other, a helpful function toward ensuring uniform polish. Where, for example, small screws or bolts are to be treated on the tray, the holes illustratively are round and $\frac{1}{8}$ inch wide spaced on $\frac{1}{4}$ inch centers. The size of spacing of the holes, however, is not extremely critical and thus may differ within reasonable limits even for a given size of work.

I usually provide the rack 10 with a cathode, this illustratively being a stainless steel sheet 13 supported an effective distance from the anode, such as directly over the same, and preferably having sieve-like openings 13a. In one embodiment, the cathode 13 simply is an open mesh of stiff or reasonably rigid expanded metal

sheet fixed above the anode pan 11, there presenting mesh openings which are appreciably larger than the size of the work. The cathode openings accordingly allow free ingress and egress of the stainless steel work pieces, assist the distribution of these articles over the anode pan, and encourage unrestricted flow of the polishing solution. Yet, to promote better electrical activity between the electrodes during my polishing treatment, the cathode openings preferably are as small as is consistent with free ingress and egress of the work pieces. In general, the cathode is as close to the anode as considerations of work piece size and good electro-functioning permit. Usually, about $\frac{1}{2}$ inch to 2 inch spacing of the electrodes is satisfactory for most small articles treated. The anode and cathode conveniently are electrically insulated from each other by any one of a number of non-conducting materials, such as wood, Bakelite, quartz, porcelain, or the like. For example, I employ spaced insulating posts 14 for this purpose, these interconnecting the outer extremities of the anode and cathode.

The rack 10 has a lead 15 extending from the cathode for connection with a suitable source of electrical power. This lead, and the anode lead 12 for example, are heavy bars which conveniently have hooks 12a and 15a or other fastening means, for suspending the rack in the polishing bath, as from electrical terminals 17 and 18, both of the latter illustratively being rigidly secured to the polishing vat 19 (see Figure 2), or, for example, suitably supported to travel with the rack along the vat walls during the polishing operations.

In employing the rack such as for the polishing of a batch of stainless steel screws, I usually dump the articles from a bag, conveyer, or from a scoop, onto the top of the cathode 13 before immersing the rack in the polishing bath. These articles sift through the openings 13a of the cathode and fall onto the top surface of the anode bottom 11a, there scattering and some rolling and lodging at the head in the anode perforations 11c against further movement. In certain instances, I subject the rack to a light bouncing or shaking operation to achieve passage through the cathode or to spread or relieve stacking of the articles on the anode. The screws illustratively cover substantially the entire product supporting area of the anode, there establishing good electrical contact. Some touch each other and in many instances remain on top of, or crossed over, others.

I then immerse the rack including the anode and cathode and the supported screws 16 into a glycolic acid, sulphuric acid electrolyte 20, in the polishing vat 19, this solution illustratively containing, by weight, about 20% to 80% glycolic acid, 10% to 60% sulphuric acid, and 2% to 35% water.

Lead hooks 12a and 15a, with the rack immersed, fit in proper relation upon the corresponding electrical terminals 17 and 18, thus establishing electrical connection for the polishing treatment. Upon energizing the vat terminals from electrical supply, the electrolytic polishing operation begins. The temperature conditions of the glycolic acid, sulphuric acid electrolyte for this operation preferably are around 150° up to 200° F., and the optimum current density about 0.1 to 4.5 amperes per square inch of article surface exposed for polishing. This treatment involves the electrolytic removal of an

extremely thin layer of metal from the immersed product surfaces. During this action, I avoid breaking the electrical connections or contact of the screws with the anode. A substantially continuous electrical connection I find assures a more uniform polish. When the contact is interrupted it seems that an oxide film is formed at the point of contact which thereafter results in poor conductivity and subsequent poor polishing. Continued contact in my method and apparatus is encouraged by the holes in the anode pan, which help lodge the screws. Both electrodes while exerting their electrical functions, in being open or perforated assist circulation and effectiveness of the polishing fluid and avoid entrapment of gas which might cut down the prevailing current density. Good throwing power is achieved.

After a time period of about $\frac{1}{2}$ minute to 5 minutes, for example, I shut off the electrolytic treating current and withdraw the rack from the bath. I find it convenient to rinse the rack with the polished screws in clear water. Thereafter, I dump the batch into a suitable receptacle or the like such as by inverting the rack. My electrolytically polished stainless steel products thus are illustratively achieved.

The electrolytic polishing process which I provide is economical and capable of being carried out under operating conditions which are easy to control as during the expeditious mass production of stainless steel articles of outstanding surface quality. The batch-polished stainless steel articles achieved are substantially uniform from product to product of the batch, and are substantially free of etching, burns, and blemishes. Further, the electrolytic polishing apparatus which I provide is easily operated and facilitates the handling of a plurality of articles to the end of achieving a thoroughly satisfactory polish.

Thus it will be seen that in this invention there are provided an electrochemical process and apparatus for electrolytically polishing metal articles in which the various objects hereinbefore noted together with many thoroughly practical advantages are successfully achieved. It will be seen that both the method and apparatus contribute to successful batch-polishing of articles and call for minimum attention to the individual components of the batch.

While my invention has been described as being particularly useful for the electrochemical treatment of stainless steel articles, it will be understood that I also employ my method and apparatus in conditioning or polishing a wide variety of other products, among these being aluminum, nichrome and inconel.

It will also be understood that while I regard glycolic acid, sulphur acid electrolytes as being especially beneficial in conjunction with the use of my method and apparatus for polishing of stainless steel and other metals, I sometimes use other acid electrolytes such as a solution containing citric acid and sulphuric acid, or a solution containing phosphoric acid and sulphuric acid, in the electrolytic polishing treatment or with the apparatus.

Also, it will be appreciated that while my electrolytic polishing apparatus may take the form of a rack such as described hereinbefore, or even a plurality of racks stacked one above or beside the other, my anode-cathode arrangement and features of providing the same in perforated condition at times are embodied in other physical arrangements, such as an arrangement involving

an endless conveyer-anode, beneath a fixed cathode, to achieve the polishing function.

As many possible embodiments may be made of my invention and as many changes may be made in the embodiment hereinbefore set forth, it will be understood that all matter described herein is to be interpreted as illustrative and not as a limitation.

I claim:

1. Electrolytic polishing apparatus for top-loading comprising, in combination, flat anode means for supporting a batch of products to be polished and having openings therein smaller than the individual products, cooperating flat open mesh cathode means above the anode and having openings therein of sufficient size to admit the products to the anode when charged onto the cathode, electrical insulating spacers fixedly secured to said anode and to said cathode and maintaining said open mesh cathode at effective electrolytic polishing distance above the product supporting zone of the anode, an electrolytic polishing solution, a container therefor, and means supporting said anode and cathode in substantially horizontal position in said solution.

2. An electrolytic polishing rack for top-loading comprising, in combination, flat tray-anode means for supporting a batch of products in electrolytic polishing position and having openings therein smaller than the individual products but sufficiently large for the products to partially lodge therein and give firm electrical contact, a cooperating flat open mesh cathode above the anode and having openings therein of sufficient size to admit the products to the polishing position on the anode when charged onto the cathode, and electrically insulating posts fixedly secured to said anode and to said cathode and uniformly maintaining said cathode at effective electrolytic polishing distance over the product supporting zone of said anode.

3. An electrolytic polishing assembly for top-loading comprising, in combination, flat anode means for supporting a batch of products and having openings therein smaller than the individual products, cooperating flat open mesh cathode means above the anode and having openings therein of sufficient size to admit the products to the anode when charged onto the cathode, electrical insulating spacers fixedly secured to said anode and to said cathode and maintaining said open mesh cathode at effective electrolytic polishing distance above the product supporting zone of the anode, and electrically conductive means, one secured to the anode means and the other to the cathode means for supporting the same in substantially horizontal position.

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The following references are of record in the file of this patent:

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