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APPARATUS FOR CONTINUOUS ELECTROLYTIC
TREATMENT OF ARTICLES

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2 Sheets-Sheet 1

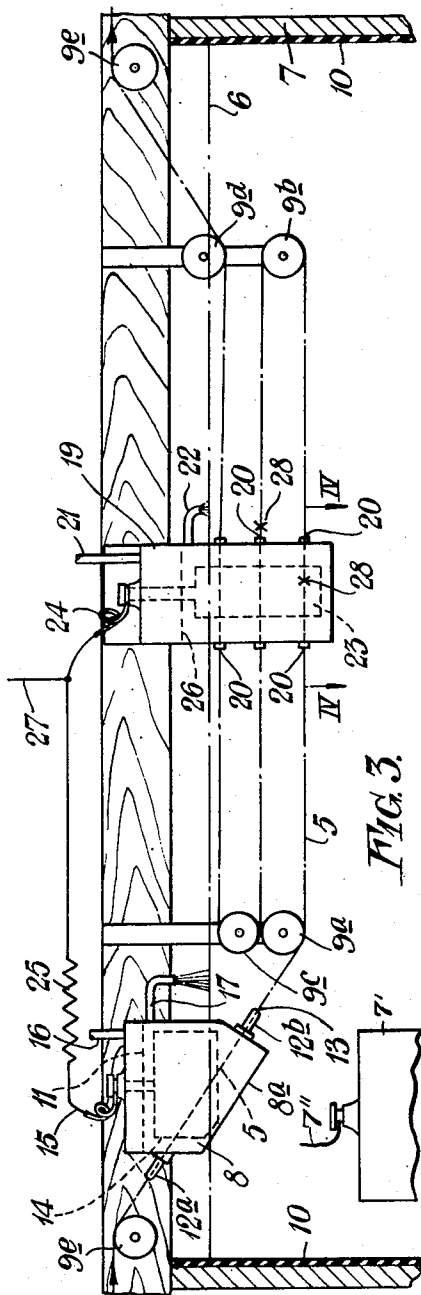


Fig. 3.

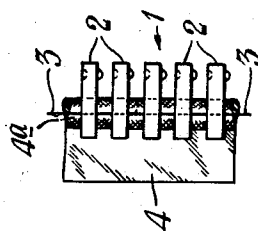


Fig. 1.

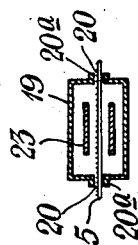


Fig. 4.

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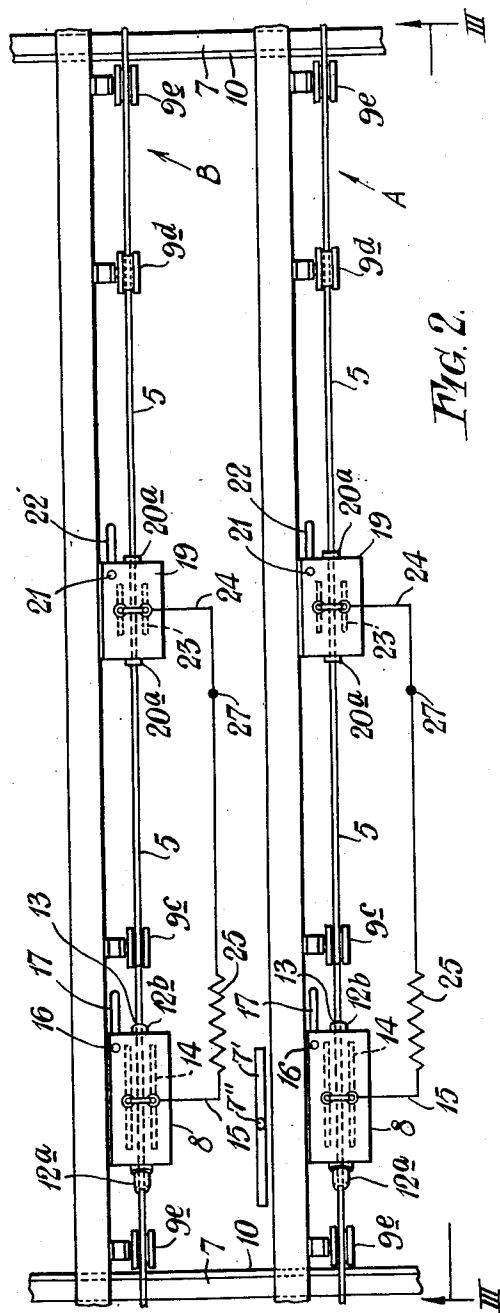
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APPARATUS FOR CONTINUOUS ELECTROLYTIC TREATMENT OF ARTICLES

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5 Claims. (Cl. 204—211)

This invention relates to the electrolytic treatment of metals and, while not being limited to the production of any particular type of coating nor to the treatment of any one particular metal, is of most value when utilised in the anodic treatment of aluminium articles. Consequently, for the sake of brevity, the following description will be directed to this application of the invention but it is to be understood that references therein to "anodising" and to "aluminium" are not intended in any limiting sense.

In the anodic treatment of aluminium articles which are of the nature of wire, tape and other long and flexible elements having current-conducting parts of relatively small cross-section, it is commercially desirable that the treatment be carried out as a continuous process at relatively high speeds of travel of the wire or the like through the electrolytic treatment vat. Since these high speeds entail the employment of high current densities, difficulties are encountered when the current-carrying capacity of the wire or the like is relatively low. A specific example of an aluminium article in connection with which these difficulties are most pronounced is that type of tape used in the production of sliding clasp fasteners which has fastener elements of aluminium clamped on the beaded edge of a textile braid or "stringer" having one or more fine wires or tinsel incorporated in the beaded edge in such manner that the fastener elements are all electrically inter-connected throughout the length of the tape. There is a limit to the size of the wire or tinsel which may be employed, since the fastener tape is required to have a high degree of flexibility, and this limitation also affects the current-carrying capacity of the wire or tinsel in such manner that normal methods of anodising, in which the current is supplied through one or both ends of the article to be anodised, become impossible or economically impracticable owing to the high current densities required.

The object of the present invention is to provide an improved method for the continuous electrolytic treatment of aluminium and like articles of the character referred to above which shall make it possible to overcome the difficulties which arise when the high current densities necessary for relatively high speed processes are employed.

A method for the continuous electrolytic treatment of wire of aluminium and the like, where similar difficulties occur, has already been described in which the current required by the length of wire being treated at any one time is supplied by means of a liquid contact in an electrode chamber situated at the entry end of the main treatment tank; that is to say, the wire at the point of liquid contact has to carry the whole of the current required. For unit length and a fixed voltage, the amount of such current is a function of the diameter of the wire and, within practical limits, does not exceed the critical cross-sectional current density with the wire totally immersed in cold liquid.

With fastener tapes and similar composite articles, however, the simple relationship between the diameter or

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cross-sectional area of the conducting wire (which governs its current-carrying capacity) and the surface area of the metal parts of the article over unit length (which determines the current required) no longer holds, the conducting wire now being required to carry a current considerably greater than that corresponding to its surface area. Another difficulty which is encountered is due to breaks or discontinuities in the conducting wire. Fastener tapes are produced in relatively short lengths, compared with unbroken lengths of several thousand feet such as are required for economic anodising, and must be joined together end-to-end both mechanically and electrically. The making of good electrical joints is by no means a simple matter and if it can be avoided so much the better.

According to one feature of the present invention, a method for the continuous electrolytic treatment of metal articles of the nature of wire, tape and other long and flexible elements having current-conducting parts of relatively small cross-sectional area is characterised in that the current is supplied to the article by way of at least two, and preferably several, liquid contacts spaced apart along the length of the article.

The spacing between successive liquid contacts is, with advantage, made relatively small, i. e. somewhat less than the minimum distance apart of any probable discontinuities in the electrically conducting portion of the article.

According to another feature of the invention apparatus for the continuous electrolytic treatment of metal articles of the nature of wire, tape and other long and flexible elements having current-conducting parts of relatively small cross-sectional area comprises an electrolytic treatment tank, at least two and preferably several liquid contacts within the tank below the normal level of the electrolyte for supplying current to the article and means for advancing the article through the tank so as to cause it to traverse the liquid contacts in succession.

Advantageously the liquid contacts are spaced apart by a distance less than the minimum distance apart of any probable discontinuities in the electrically conducting portion of the article.

Conveniently, the article is introduced into the electrolyte by way of a chamber containing a segregated volume of electrolyte and an electrode or electrodes may be immersed in this electrolyte so that the latter constitutes a first liquid contact and the remaining liquid contacts are preferably provided by an electrode chamber which also has one or more electrodes immersed in a segregated volume of electrolyte.

In order that the invention may be more clearly understood one way of carrying it into effect will now be described by way of example as applied to the anodising of fastener tape having aluminium fastener elements inter-connected electrically by a wire or tinsel incorporated into the bead of the textile braid or stringer, reference being made to the accompanying drawings in which:

Fig. 1 shows a short portion of a fastener tape such as is concerned in the present example,

Fig. 2 is a fragmentary plan view to a smaller scale of a vat or treatment chamber, part of which is broken away, in which the method according to this invention is being applied simultaneously to the anodising of the fastener elements of two runs of such a tape,

Fig. 3 is a section taken on the line III—III of Fig. 2, and

Fig. 4 is a section on the line IV—IV of Fig. 3.

In the present example the fastener tape, indicated generally at 1 (Fig. 1) has a number of fastener elements 2 inter-connected electrically by a wire or tinsel 3 woven into the surface of the bead 4a of the textile braid or stringer 4. A number of stringers 4 are connected end-to-end into a continuous strip 5 of very considerable

length and this strip is passed at a relatively high speed through the electrolyte the level of which is indicated at 6 in Fig. 3 in a treatment tank 7. In the example chosen two runs of continuous strip 5 suitably spaced from each other are being treated simultaneously in the same tank 7 and these are indicated generally at A and B respectively in Fig. 2. Both strips A and B are treated by means of similar apparatus and like references are used throughout for similar parts. The strip 5 is led into the electrolyte by way of an electrode chamber 8 and then passes around pulley wheels 9a, 9b, 9c and 9d so arranged that the strip 5 will be formed into a number of loops before reaching the exit from the tank. Further pulleys 9e are provided to lead the wire into and out of the tank 7. The loops are contained in a vertical plane with the runs of the strip extending substantially horizontally from the one set of pulleys 9a, 9c to the other set 9b, 9d all the runs of the strip being submerged in the electrolyte in the tank 7. The tank 7 is made of a suitable material such as, for example, mild steel and is lined internally with an electrically non-conductive material 10 such as polyvinyl chloride. An insoluble electrode 7' is provided in any suitable position within the electrolyte tank 7 and is connected by wire 7'' to one pole of a source of electric current. The electrode chamber 8 (Figs. 2 and 3) is designed to carry a current of the order of 200 amperes and contains a volume of electrolyte 11 which is segregated from the main volume of electrolyte in the tank 7. The chamber 8 is in the form of a box of insulating material which is open at the top and which slopes at the base 8a at an angle corresponding to that of tubular inlet and outlet guides 12a and 12b both of insulating material through which the strip 5 passes. The guide 12a leads into the electrode chamber near the bottom of one end wall and the other guide 12b leads out from the chamber 8 at a corresponding part of the opposite end wall which is suitably shaped for this purpose. The other guide 12b is provided with a construction 13 at its lower end which is below the surface 6 of the main electrolytic bath and which is of such cross-sectional area to permit the passage therethrough of the wire strip 5 with but little clearance. The constriction 13 forms the connection between the segregated volume of electrolyte 11 contained in the chamber 8 and the main volume of electrolyte outside it. An insoluble electrode 14 for electrifying the wire 3 is provided in the chamber 8 and is constituted by a pair of insoluble electrodes such as carbon plates immersed in the electrolyte 11 and spaced apart on either side of the strip 5 so that the latter is capable of passing therebetween with clearance. Current is supplied to the electrode 14 by a conductor 15. The level of the electrolyte 11 within the chamber 8 is maintained by continuously supplying electrolyte to the chamber 8 through an inlet pipe 16 and providing a waste pipe 17 to convey the excess electrolyte from the chamber into the main volume of electrolyte within the tank 7. The strip 5 enters the electrode chamber 8 through the guide 12a which is of comparatively small bore and in this way there is a thorough wetting of the wire 3 before film formation occurs. Current is supplied to the wire 3 of the strip 5 through a liquid contact constituted by the segregated volume of electrolyte 11 between the carbon plates constituting the electrode 14 and the strip 5 passing through the guide 12b into the main volume of electrolyte.

At a point substantially midway between the two sets of guide pulleys 9a, 9c and 9b, 9d there is provided a second electrode chamber 19 which depends into the electrolyte in the tank 7 and is formed in opposed walls with apertures 20 of a size and shape such that the strip 5 may pass through them with but little clearance. The strip 5 leaving the first electrode chamber 8 passes under a guide pulley 9a and is threaded through the first pair of inlet and outlet apertures 20 formed in the opposed walls of the second electrode chamber 19 then to con-

tinue to a second guide pulley 9b. From this pulley the strip 5 returns to be threaded through another pair of apertures 20 located substantially vertically above the first mentioned pair of apertures in the second electrode chamber 19 and then to pass around a further guide pulley 9c located substantially vertically above the pulley 9a. The strip after passing around the upper pulley 9c is again threaded through a pair of opposed apertures 20 located substantially vertically above the previously mentioned pairs of apertures in the walls of the second electrode chamber 19 and then passes beneath a fourth guide pulley 9d located substantially vertically above the second pulley 9b before passing in an upwardly inclined direction out of the electrolyte in the treatment tank 7.

The electrode chamber 19 is continuously supplied with electrolyte by way of an inlet tube 21 and the overflow passes to the main tank by way of an overflow pipe 22, the electrolyte 26 within the chamber 19 being segregated from the main volume of electrolyte in the tank 7, the only connection being by way of the apertures 20. The main supply of current is effected in the second electrode chamber 19 by way of insoluble electrodes 23, for example, of carbon immersed in the electrolyte 26 in the chamber and spaced one on either side of the plane containing the runs of strip 5. The current passes to the strip 5 undergoing treatment via the electrolyte 26. Current is supplied to the electrodes 23 by a conductor 24 which is connected to one pole of the current supply source by a conductor 27. A secondary connection is also made from the electrodes 23 to the conductor 15 of the electrode 14 in the first chamber 8, a resistance 25 of a suitable value being included in this connection in order to limit the surge of current which may tend to occur as the strip 5 enters the electrolyte.

The current supply to the treatment tank may be either A. C. or D. C. although the former is preferred. In the case of an A. C. supply the conductor 27 associated with the run of strip A is connected to one pole of the supply source and the conductor 27 associated with the run of strip B is connected to the other pole of the supply source. It will be appreciated that this method enables any number of even runs of strip to be treated simultaneously, the conductor 27 associated with each alternate run of strip being connected to one pole of the current supply source and the conductors 27 associated with the remaining runs of strip being connected to the other pole of the current supply source. If a D. C. supply is used, however, any odd or even number of runs of strip may be treated simultaneously, the conductor 27 associated with each run of strip being connected to the positive side of the supply and a number of insoluble electrodes (not shown) which are arranged within the main volume of the electrolyte being connected to the negative side of the supply.

It will be understood that the strip 5 during its passage through the electrolyte in the treatment tank may be formed into more than two loops the number of the apertures 20 in the walls of the second electrode chamber 19 being suitably increased. These apertures may be surrounded by lips or tubular extensions 20a (Fig. 4) defining passages for the strip 5 or the like undergoing treatment which are of a shape and cross-sectional area such that the strip or the like will pass through them with but little clearance.

It will be appreciated that each run of the strip 5 passing through the submerged constrictions 13, 20 is only required to carry a fraction of the total current being supplied. Consequently, the current-carrying capacity of the wire or tinsel 3 in the bead of the stringer 4 may be reduced considerably, as compared with previous practice, for example to one-seventh in the specific case where the total number of submerged constrictions 13, 20 is seven.

Moreover, since there are several spaced points of contact with the strip 5 undergoing treatment, the whole of

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the immersed strip remains energised irrespective of electrical discontinuities indicated at 28 (Fig. 3) in the conducting wire or tinsel 3, except where two such discontinuities occur within the length of strip forming a loop outside the second chamber.

The chamber 8 may, if desired, be used solely as a pre-wetting chamber in which case the electrodes 14, conductor 15 and resistance 25 may be dispensed with.

What I claim is:

1. Apparatus for the electrolytic treatment of articles composed of a plurality of metal elements of relatively large surface area electrically connected one to another by a metal wire of relatively small cross-sectional area comprising in combination an electrolytic tank for containing a main volume of electrolyte, at least one electrode being located within said tank, means electrically connecting said electrode to one pole of a source of electric current, a chamber for containing a segregated volume of electrolyte and adapted for passage therethrough of a run of articles, said chamber having a wall in contact with the main volume of electrolyte and apertured for passage of the articles therethrough with clearance and directly into the main volume of electrolyte within the tank, at least one electrode in said chamber and means connecting said electrode to the other pole of said source, an electrode chamber for containing a further segregated volume of electrolyte and adapted for passage of said articles therethrough, said electrode chamber located at least partly within said tank and having a pair of opposed walls each of which is apertured for passage of the articles therethrough with clearance and directly into the main volume of electrolyte within the tank and at least one other wall being spaced from the wall of the tank and, at least one electrode located within said electrode chamber and means connecting said electrode to said other pole of said source, and means for advancing said metal elements through the apertures in said walls of said first-mentioned chamber and the electrode chamber in succession, said chambers each constituting a liquid contact whereby a fraction only of the total electric current supplied from said source is supplied to said metal elements at each liquid contact.

2. Apparatus for the continuous electrolytic treatment of an even number of runs of articles composed of a plurality of metal elements of relatively large surface area electrically connected the one to the other by a metal wire of relatively small cross-sectional area, which comprises in combination an electrolytic tank for containing a main volume of electrolyte, an even number of runs of articles being carried in said tank for treatment, a chamber for each run of articles for containing a segregated volume of electrolyte, each chamber adapted for passage therethrough of a run of articles and each chamber being located at least partially within the tank and having a wall apertured for passage of a run therethrough with clearance and directly into the main volume of electrolyte within the tank, at least one electrode located within each of said chambers, means electrically connecting the electrodes in half the total number of chambers to one pole of a source of alternating current and means connecting the electrodes in the remaining chambers to the other pole of the source of alternating current, an electrode chamber for each of said runs of articles for containing a segregated volume of electrolyte, each electrode chamber adapted for passage therethrough of a run of articles and each of said electrode chambers being located at least partly within said tank and having a pair of opposed walls each apertured for passage of a run therethrough with clearance and directly into the main volume of electrolyte within the tank, at least one electrode located in each electrode chamber, the electrodes in the respective electrode chambers each being connected to the same pole of the source of alternating current as the electrodes in the corresponding first-mentioned chamber which receives therethrough the same run and means for advancing each

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run through the apertures in the walls of the first-mentioned chamber and the electrode chamber receiving said run therethrough, said chambers each constituting a liquid contact whereby a fraction only of the total electric current supplied from said source is supplied to said associated run of articles at each liquid contact.

3. Apparatus according to claim 2 including means for guiding each of said runs into said tank through said first-mentioned chamber, means for guiding each of said runs through said tank and an electrode chamber along a path comprising a plurality of loops each threading with clearance one aperture in each of said opposed walls of an electrode chamber, and means for guiding each of said runs out of said tank.

4. Apparatus for the continuous electrolytic treatment of articles composed of a plurality of metal elements having a relatively large surface area electrically connected one to the other by a metal wire of relatively small cross-sectional area which comprises in combination an electrolytic tank for containing a main volume of electrolyte, at least one electrode located within said tank and means connecting said electrode to one pole of a source of electric current, a chamber for containing a segregated volume of electrolyte and adapted for passage therethrough of a run of articles to be treated, said chamber being located at least partially within the tank and having a wall apertured for passage of the articles therethrough with clearance and directly into the main volume of electrolyte within the tank, at least one electrode located within said chamber and means connecting said electrode to the other pole of said source, means for advancing said articles in the direction of length of said material into said tank through the apertured wall of said chamber for an electrode chamber containing a further segregated volume of electrolyte and adapted for passage of said articles therethrough, said electrode chamber being located at least partly within said tank and having a pair of opposed end walls apertured to permit the passage therethrough with clearance of said articles at a plurality of points, at least one electrode located in said electrode chamber and means connecting said electrode to the other pole of said source, means for guiding said articles through said tank and said electrode chamber along a path comprising a plurality of loops each threading one aperture in each of the end walls of said electrode chamber, said first-mentioned chamber and said electrode chamber each constituting a liquid contact whereby a fraction only of the total electric current supplied from said source is supplied to said articles at each liquid contact, and means for guiding said articles out of said tank.

5. Apparatus for the continuous electrolytic treatment of articles composed of a plurality of metal elements having a relatively large surface area electrically connected one to the other by a metal wire of relatively small cross-sectional area which comprises in combination an electrolytic tank for containing a main volume of electrolyte, at least one electrode located within said tank and means connecting said electrode to one pole of a source of electric current, an electrode chamber for containing a segregated volume of electrolyte and adapted for passage of said articles therethrough, said electrode chamber being located at least partly within said tank and having a pair of opposed end walls apertured to permit the passage therethrough with clearance of said articles at a plurality of points, at least one electrode located in said electrode chamber and means connecting said electrode to the other pole of said source, means for advancing and guiding said articles into and through said tank and said electrode chamber along a path comprising a plurality of loops each threading one aperture in each of the end walls of said electrode chamber and a liquid contact provided at each of said apertures in said end walls of said electrode chamber whereby a fraction only of the total electric current supplied from said source is

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supplied to said articles at each such liquid contact, and
means for guiding said articles out of said tank.

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