

Sept. 25, 1956

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2,764,540

METHOD AND MEANS FOR ELECTROPOLISHING INNER SURFACES

Filed Sept. 10, 1952

3 Sheets-Sheet 1

Fig. 1

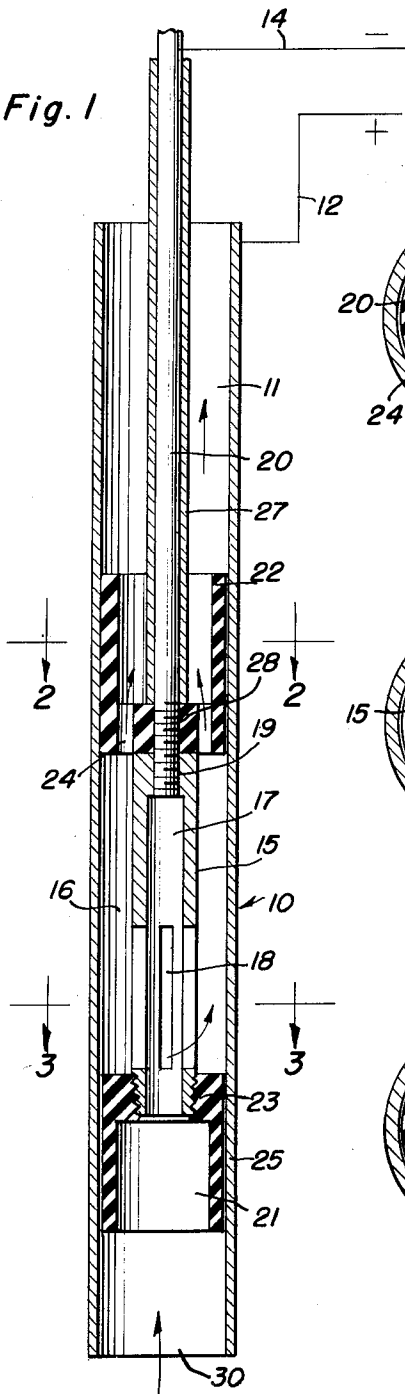


Fig. 2

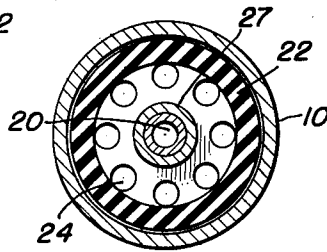


Fig. 3

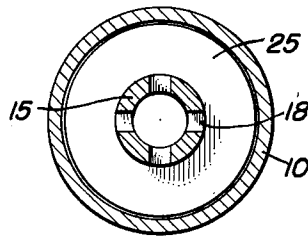


Fig. 5

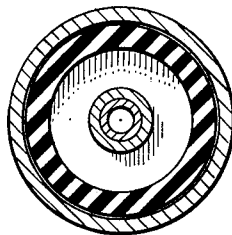
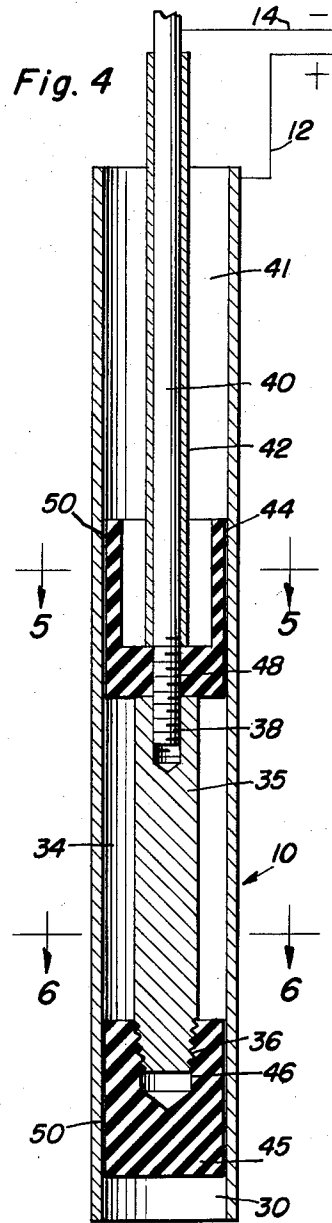


Fig. 4



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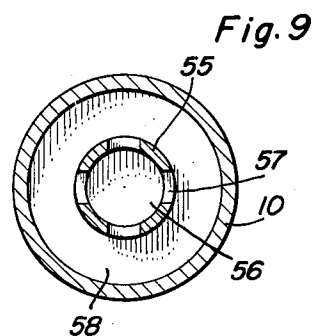
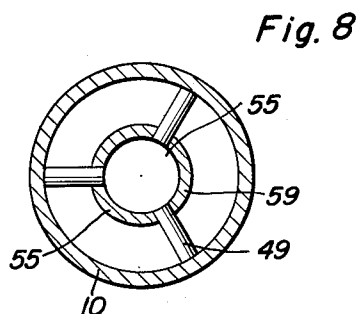
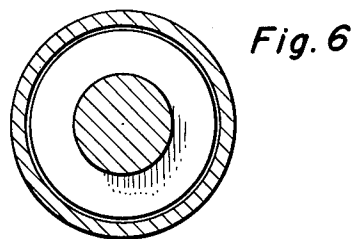
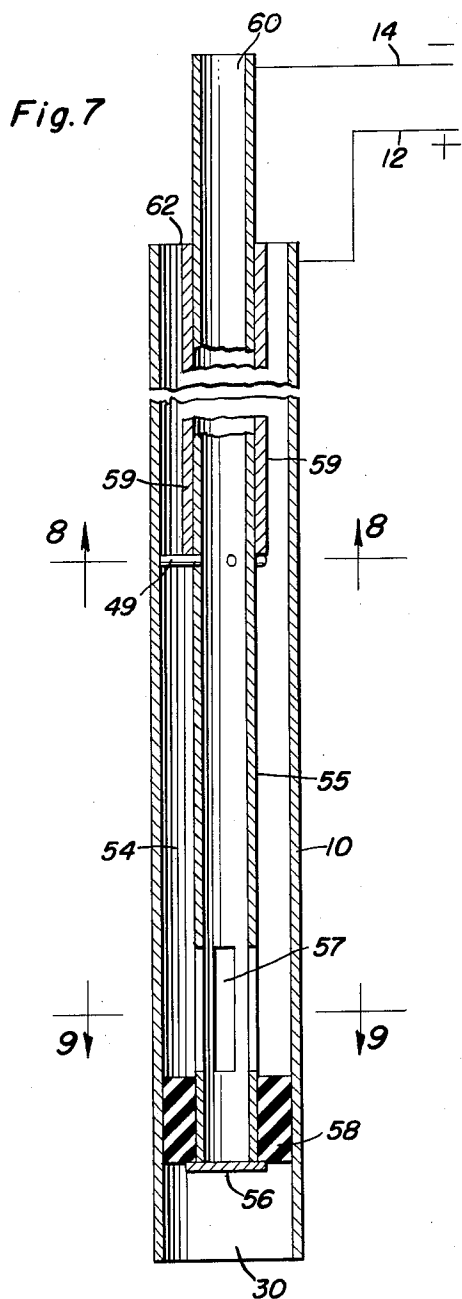
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Filed Sept. 10, 1952

3 Sheets-Sheet 2



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METHOD AND MEANS FOR ELECTROPOLISHING INNER SURFACES

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3 Sheets-Sheet 3

Fig. 11

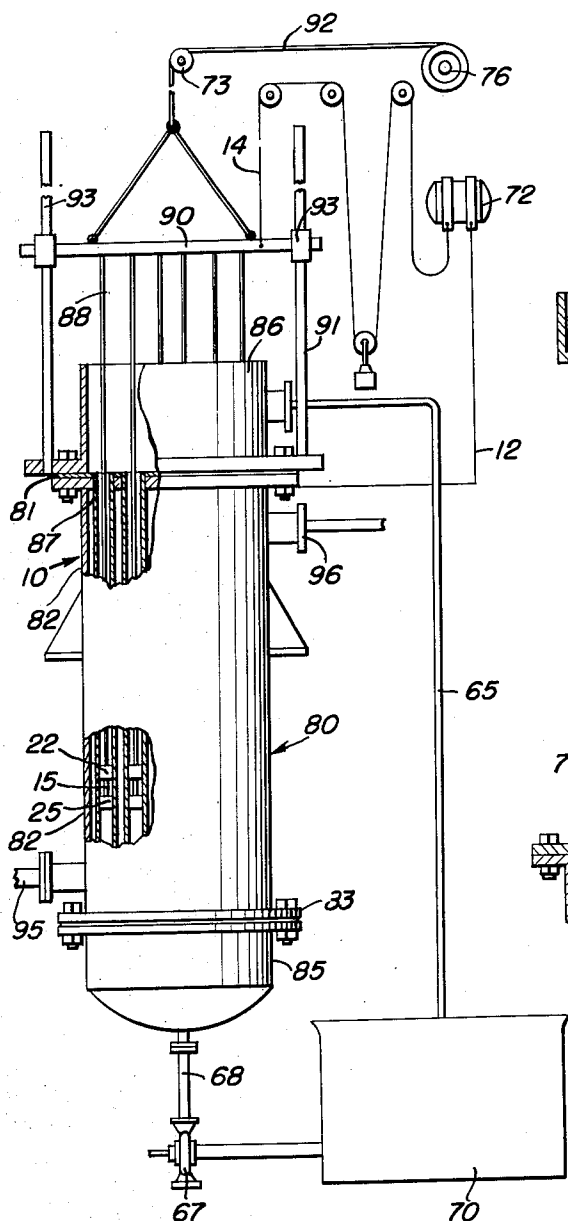
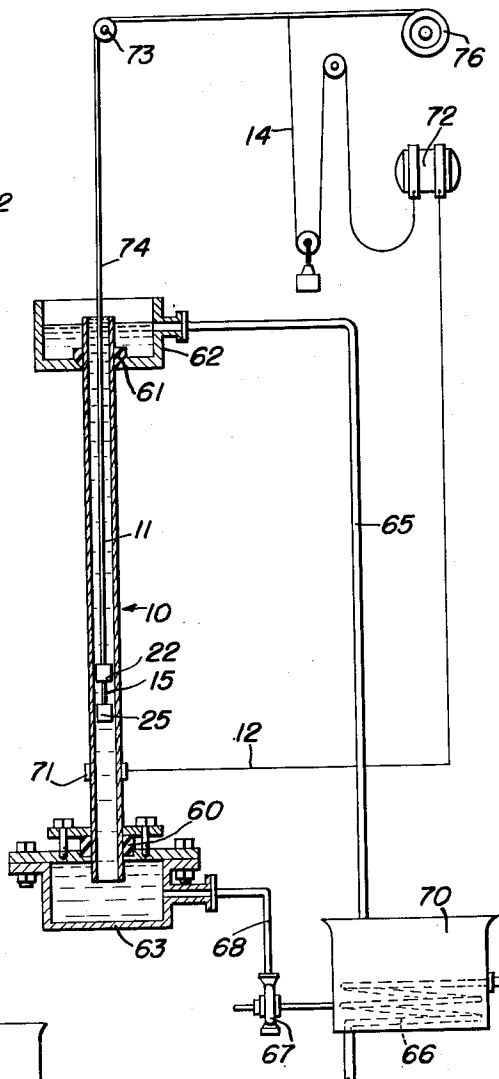


Fig. 10



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2,764,540

METHOD AND MEANS FOR ELECTROPOLISHING INNER SURFACES

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Application September 10, 1952, Serial No. 308,764

11 Claims. (Cl. 204—140.5)

This is a continuation-in-part of our earlier copending application Serial No. 28,466, now abandoned.

This invention relates to a method and means for electropolishing and it has for its principal object to provide a method for electropolishing in a continuous operation the interior or inner surface of hollow objects in such a manner that no finishing, smoothing or other operation is necessary after the application of the method, the latter resulting by itself in a completely finished product.

A further principal object of the invention consists in providing a method and means for electropolishing which permits the effective use of high current densities while simultaneously suppressing the accompanying disadvantages which are inseparable from high current densities and which consist in the development of gases in large quantities, said gases producing such irregularities in the electropolishing action that the result is impaired and that the maintaining of constant voltages and amperages which is the primary factor making for a uniformly electropolished product is prevented.

A further object of the invention consists in providing an electropolishing method and means for carrying said method into effect which permit to effectively suppress the development of high temperatures which usually accompany the use of high current densities and which produce a boiling of the electrolytic liquid with consequent additional gas development.

A further object of the invention consists in providing an electropolishing method and means so designed for carrying it into effect that a regular continuous discharge of any gas which may have been developed during the electropolishing process notwithstanding the use of counter measures may take place.

A further object of the invention consists in providing an electropolishing method and means for carrying out the electropolishing process on a continuously changing, but well defined and strictly limited area of unvarying size which, usually, is only a fraction of the entire area to be electropolished, but which is shifted along the inner surface to be electropolished so that every part of the surface is treated.

A further object of the invention consists in providing an electropolishing method and means for electropolishing the inner surfaces of cylindrical tubes of any length by subjecting a limited stretch of the cylindrical inner surface to the electropolishing action, using a centrally located cathode of an axial length corresponding to the stretch to be treated at any one moment, and further using means for limiting the anode surface which is treated by means of said cathode, said means including shields carried by the cathode and preventing any transmission of current to the anode outside of the shielded and encircled area, said cathode and shield being constantly and continuously moved relatively to and along the cylindrical surface to be electropolished.

A further object of the invention consists in providing a method and means for electropolishing the inner sur-

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faces of hollow objects, said method and means providing for the continuous circulation of the electrolyte solution along the entire surface to be electropolished at any one moment in a uniform and regular manner.

A number of further objects are connected with more specific features of the method and means used and will therefore be stated in the detailed specification describing these specific features.

The method according to the invention and the means used to carry the method into effect are described in detail in the following specification and are illustrated in the accompanying drawings showing three modifications of the said method and means. It is however to be understood that said method and means are illustrated and described by way of example only, in order to be able to explain the principle of the invention and the best mode of carrying into effect the said principle. The drawings and the specification do not attempt to give a survey of all the possible modifications of the invention and a departure from the examples which have been illustrated is therefore not necessarily a departure from the essence of the invention.

In the drawings:

Figure 1 is a sectional elevational view through an arrangement for electropolishing the interior of a cylindrical tube, the section being taken along the plane passing through the axis of the tube.

Figure 2 is a sectional plan view of the same arrangement the section being taken along line 2—2 of Figure 1.

Figure 3 is a sectional plan view through the same arrangement the section being taken along 3—3 of Figure 1.

Figure 4 is a sectional elevational view through an electropolishing arrangement which is a modification of the method and the means shown in Figure 1 the section being taken along the plane which passes through the axis of the tube.

Figures 5 and 6 are sectional plan views through the arrangement which is shown in Figure 4 the sections being taken along the lines 5—5 and 6—6 respectively.

Figure 7 is a sectional elevational view through a further modification of the arrangement for electropolishing the inner surface of cylindrical tubes the section being taken along the plane passing through the axis of the tube.

Figures 8 and 9 are sectional plan views of the arrangement shown in Figure 7, the sections being taken along the lines 8—8 and 9—9 of Figure 7 respectively.

Figure 10 is a diagrammatic view of the general arrangement of the electropolishing device which may be used in connection with any one of the modifications illustrated.

Figure 11 is a diagrammatic view of an arrangement for simultaneously treating a number of tubes.

In order to understand the invention more fully the process of electropolishing and the difficulties which are encountered in connection with such a process may first be briefly explained.

Electropolishing is an electrolytic operation which cannot be merely considered as an electrolytic process which is the reverse of, but otherwise similar to electro-deposition and which differs from the latter only insofar as it is carried out with a reversed polarity. The electropolishing process requires the rigorous maintaining of certain current densities and the equally rigorous maintaining of voltage and amperage conditions to obtain uniform and smooth results. Current densities during such polishing operations must be maintained at a relatively very high level as low current densities lead to etching and dulling of the surface and to other phenomena which impairs uniform and smooth polishing

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conditions of the surface which should be the result of this process.

On account of these high current densities which must be maintained a very considerable amount of gas is produced, the volume being so large that special provisions must be made for the escape of the gas. This is especially a problem encountered in the case of the electropolishing of internal or interior surfaces of hollow objects, and especially of smaller objects, as on account of the location of the electropolishing means in the interior of the object the escape channels or the cross sections through which the gases must escape are limited. An accumulation of gas would displace the electrolyte in the area in which electropolishing is proceeding and this would interfere with the electropolishing operation and would not permit the maintaining of a strictly constant voltage and a strictly constant amperage and in many cases etching would be the result.

A further consequence of the high current densities which have to be used in connection with electropolishing operations is a large amount of heat which is produced and which must be carried off as it tends to produce excessive temperatures within the electrolyte leading to the boiling of the electrolytic liquid, which boiling in addition to other undesirable consequences produces further large quantities of gas which add to the above described difficulty.

As these difficulties increase with the area of the surface to be treated the usual procedure employed to obtain the electropolishing of large surfaces consists in confining the electropolishing to short lengths with small areas in which very high temperatures and large quantities of gas will not be built up.

Such a confinement of the electropolishing process to small areas has however the disadvantage that the electropolishing operation must be carried out in a step by step fashion and that therefore differences resulting from the shifting of operations from one area to another area and especially irregularities at the line of junction of two areas treated successively require an after treatment which removes these differences, which, after treatment, is a costly operation markedly reducing one of the main advantages of the electropolishing process.

Because of the necessary relative movement entailed by such a step by step electropolishing operation the confinement of the area can only be produced by limiting either the cathode or the anode area. While currents of very high densities thus do not occur except in the vicinity of the limited area which is to be electropolished the current transmission is nevertheless not confined to this area and currents with low densities flow between more distant points with the result that some of these currents produce a detrimental result of dulling or etching the surface.

The method according to the invention consists in electropolishing by means of a column of a constantly circulating electrolyte which column is enclosed within and supported by suitable insulating members. Within said column the electrolytic fluid circulates continuously, said circulating being produced by a forced flow carrying the electrolyte over the strictly limited treatment area formed by the surface of the column in contact with the electrodes, which limited treatment area changes slowly but constantly and continuously its position and moves over the entire inner surface of the object to be electropolished. The area to be treated is not only limited on the cathode side but also on the side of the anode and this area is always constant, as the column is of invariable size although shifting permanently and continuously. To produce the limited treatment area the extent of which does not vary, a cathode of limited area is used which carries insulating members or shields connected with said cathode which support the column in contact with the cathode area and anode area to be treated and completely separate it from the remainder of the hollow or interior

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space, the electrolytic action being thus confined to the space which is filled with the column of the electrolyte. This column, however, as above stated moves continuously along the surface treated until the entire surface has been covered. During this movement the electrolyte circulates constantly within this movable column which is of constant volume, fresh and cool electrolyte being supplied to the said column while heated electrolyte is withdrawn.

The treatment resulting in electropolishing of the interior of a hollow body may be completed after a single passage of the electrolytically treated area over the entire surface or may be only completed after a number of such passages.

The treatment can be applied to an area of any size for instance to the entire interior area of a tube of considerable length.

The continuous circulation and the forced flow of the electrolytic liquid through the confined space is best produced by means of a pump or by a similar device conveying the liquid to the restricted and confined area under some pressure. A cooling means may be connected with the said pump.

The examples shown in the drawings relate to the electropolishing of the interior surface of a cylindrical tube of considerable length which is treated while in a substantially vertical position.

The tube 10 the interior of which is to be polished forms the anode of the electrolytic arrangement and it is therefore connected with the positive side of a suitable source of current by means of the conductor indicated at 12.

The confinement of the area to be electropolished is produced by using a cathode 15 of limited length which is preferably only a fraction of the total length of the tube to be electropolished and which is movable relatively to the tube 10. The cathode 15 is arranged concentrically within the cylindrical tube forming the anode. In the example shown in Figures 1, 2 and 3 the cathode consists also substantially of a hollow tube and its hollow interior 17 communicates with the outside by means of the longitudinal slots 18.

The cathode member 15 is threaded at both ends, one of the threaded portions 23 being provided on the lower end of the cathode on the outside while at the upper end an internal thread is provided along a bore 19 leading to the hollow interior 17 of the cathode. This bore 19 engages the threaded end of a conducting rod 20 by means of which the current is carried to the cathode and said rod 20 is therefore connected with the negative conductor 14 of the source of current. The rod 20 may also serve the purpose to impart to the cathode a constant and continuous movement relatively to the tube 10, or, if the tube 10 is moved, to hold the cathode at the intended place.

The rod 20 is insulated by means of the insulating sleeve 27 surrounding completely that portion of the rod which enters the tube.

In order to confine the area of the anode surface facing the cathode to the column of electrolyte, the latter is provided with members or shields 22, 25 of insulating material which members or shields, in the example shown, are of cylindrical shape and fit into the hollow interior of the tube 10.

The shield 25 has essentially the shape of a hollow piston, the hollow interior 21 of which is turned outwardly and its head or disk portion is provided with a threaded bore into which the threaded portion 23 of the cathode fits. It will be noted that the slots 18 of the hollow cathode are so positioned that they are located directly above the shield 25 when the latter has been screwed onto the end of the cathode.

The shield 22 likewise has the shape of a hollow piston fitting into the hollow interior of the tube 10 and its head portion is in this case provided with a threaded bore 28

which engages the threads at the end of the conducting rod 20, so that the said shield is thereby firmly held by the rod with its end face applied against the end of the hollow cathode 15.

This end or head portion of the shield 22 is provided with a number of axial bores forming channels 24 which permit fluid circulation between the space 16 surrounding the cathode and contained between the two shields and the space 11 above the shield.

During operation the entire aggregate consisting of the cathode tube 15 and the two shields 22 and 25 mounted on and in fixed connection with the cathode tube, and the rod 20 which holds the cathodes is continuously moved relative to the tube 10, either by holding the rod and moving the tube 10 downwardly or by moving the aggregate upwardly within the tube. The electrolytic solution is supplied at the lower end and is kept in circulation by means of a pump. The movement of the aggregate or of the tube obviously occurs at a rate which is much lower than that of the circulation of the electrolytic fluid in order to maintain the circulation during the relative movement of the aggregate and tube. The solution, under some pressure, enters at the open end 30 of the tube and moves in the direction indicated by the arrows through the hollow interior 21 of the shield 25 and then through the hollow interior 17 of the cathode tube and through the slots 18 into the space 16. After having passed through the slots 18 the electrolytic solution fills the space 16 between the cathode tube and the tube 10 and then passes through the channels 24 of shield 22 into the upper space 11. The general arrangement showing the circulation of the electrolyte and the means for moving the cathode in a diagrammatic manner is illustrated in Figure 10.

The tube 10 in the example shown is tightly held by means of sealing cones or sleeves 60, 61 between the two circulation receptacles or tanks 62, 63 during the electropolishing operation. The upper receptacle 62 has an opening in its bottom which is provided with a conical sealing means 61 through which the tube 10 projects and by means of which the tube is held while the lower receptacle has a corresponding sealing sleeve 60 in its cover or lid through which the tube reaches into the receptacle and by means of which it is held.

The two receptacles or tanks 62, 63 form part of the circulation system for the electrolyte which includes the pipe line 65 leading from the upper receptacle to the accumulator and cooling tank 70. This tank may be provided with a pipe coil 66 through which a cooling fluid is circulated, so that the electrolyte is always delivered with a predetermined temperature to the lower tank 63. This delivery is obtained by means of pump 67 and pipe line 68.

The generator or other source of current is indicated at 72. This generator is connected with the anode by means of wire 12 which leads to a suitable clamping sleeve 71 seated on the tube 10. The negative pole of the generator or source of current is connected by means of a wire 14 with the cable 74 leading to the cathode.

This cable which may be attached to the rod 40 runs over pulley 73 to a drum or reel 76 on which it is reeled by driving means which are not shown. It may be preferably also used to carry the current from the generator if suitable provisions for insulation are made.

Operation preferably starts when the cathode is at the lowermost end and is slowly lifted within the tube, the electrolyte being circulated continuously by means of the pump 67 through the space subjected to electrolytic action by means of the slots 18 and the channels 24. When penetrating into space 11 the electrolyte is discharged into the upper receptacle 62 and reenters circulation by means of pipe 65 carrying it to the accumulating and cooling tank 70.

It is thus seen that the electropolishing process is characterized by a constant change of the electrolytic solution

by means of which fresh solution at a relatively low temperature is continuously substituted for the solution in the fluid body through which the current is passed. Gas produced by the electrolytic process is therefore constantly carried away as fast as it is formed. The heating of the solution during the electrolytic process even with very high current density cannot reach excessive temperatures on account of the constant change of the solution and any gas which may be produced is rapidly carried away with the solution. The current consumption is limited because the anode area as well as the cathode area is limited. No current can pass from the cathode to the anode outside the confined area which is filled by the electrolytic solution and which is contained between the two shields. The areas of the cathode and of the anode are both confined to the same unchanging value during the entire process; the area which is polished is merely a fraction of the entire area and changes continuously its location, but never changes its extension. Further, no crests or other irregularities can be produced as the cathode and anode both change their position gradually, continuously and constantly.

The low current densities which occur in most electropolishing arrangements on account of the spreading of the current and which lead to dulling and etching are completely eliminated as the anode surface facing the cathode surface receives only currents of predetermined value, and is of constant area, so chosen that the current densities show suitable values. Further, the speed of circulation of the electrolytic fluid is so chosen that the desired condition at the points of electrolytic action are maintained. The method thus produces a constant definite value of the current in every part of the surface to be electropolished; it eliminates the possibility that conditions other than those intended may prevail and it keeps the values of the voltage and amperage, in spite of the high current densities, on such a level that the disturbing influences associated with high current densities cannot develop.

The equipment used may be so modified that it can be used in connection with a plurality of tubes electropolished simultaneously. Figure 11 diagrammatically illustrates such an arrangement.

This multiple polishing process is preferably carried out within a heat exchanging container 80 which may be divided into three compartments or zones by means of cover plates and insulating gaskets 81, the middle compartment 82 forming the heat exchange proper while the upper and lower compartments 85, 86 are circulation compartments which are provided with lids and gaskets having openings holding the tubes 10 during the electropolishing process.

A number of tubes 10 is arranged between the two compartments 85 and 86 each being provided with the movable cathode equipment as above described. Each cathode equipment is supported by a cable or wire 88 which is fixed to cathode member 15 either directly or by means of a rod, as shown in Figure 1.

All the cables or rods 88 are suspended on a cross beam structure 90 which is slidable on vertical guide rods or posts 91 by means of insulated bushings 93 and which is supported by a cable 92 attached to it. The cable may be paid out or reeled in by means of a drum driven by a suitable driving means (not shown).

The generator 72 is again connected by means of wires 12 with the cover member 87 in contact with the tubes 10 on one side and with the cable or rod carrying cross beam structure 90 by means of wire 14 on the other side. The beam structure is in contact with the cathodes 15 by means of the rods or cables 88.

The circulation of the electrolyte through the tubes 10 and through the two compartments 86 and 85 is obtained by means of pipes 65, 68, leading to and from an accumulator or reservoir tank 70 and by means of pump 67. A cooling fluid circulation may however in this case be pro-

duced through the middle compartment 82 of the container 80, the entrance and exit nipple for such circulator being indicated at 95 and 96 respectively. The cooling fluid (normally cold water) therefore may act directly on the tubes 10 which are in contact with the electrolyte.

A modification of the equipment for carrying out the method according to the invention is illustrated in Figures 4, 5 and 6.

The cylindrical tube 10 the interior surface of which is to be electropolished surrounds a movable cathode member 35 which has the shape of a cylindrical rod and which is provided with external threads 38 at the bottom end and with internal threads at its top end. The cathode 35 is again placed coaxially with the tube 10 and is held by the conducting rod 40 which has a threaded end engaging the threads of the bore 38 and which is insulated by means of an insulating sleeve 42.

The tube 10 is connected with conductor 12 leading to the positive side of the source of current, while the conducting rod 40 is connected with a negative conductor 14.

The confinement of the treated surface value is again obtained in the first place by the limited size of the cathode, the area of which is merely a fraction of the total area to be treated. The cathode, as already stated, is movable relatively to the anode surface either by moving the rod 40 upwardly or downwardly by moving the tube 10 upwardly or downwardly while holding the cathode member in its position.

The cathode 35 carries the two shields 44 and 45, the bottom shield 45 being provided with a threaded bore 46 which engages the threads of bore 36. The shield is again of insulating material and has the shape of a piston which is loosely fitted into the outer tube 10 with a predetermined clearance, as indicated at 50. This clearance serves as a means for circulating the solution between the shield and the tube 10. The clearance space 50 therefore must be very accurately determined.

The upper shield 44 also consists of insulating material and has the shape of a hollow piston, the head portion of the piston being provided with a bore 48 which engages the sides of the conducting rod 40 which are above the threaded bore 38. This shield 44 is likewise fitted into the tube with a clearance 50 which permits the outflow of a certain quantity of the electrolytic solution.

In all other respects the arrangement shown in Figures 4, 5 and 6 is similar to the arrangement which has already been described in connection with Figures 1, 2 and 3.

The solution in this case is introduced, as before, at the lower end 30 of the tube 10 by means of a pump and is forced through the clearance space 50 into the space 34 which surrounds the cathode 35 and which is in its turn surrounded by the tube 10. This space is limited at the top and bottom by the shields 44, 45. The clearance space must be so determined that there is a constant forced circulation of the electrolytic solution along the treated surface which replaces the overheated solution at a spot at which the electrolyte is in contact with the surface and therefore high current densities prevail. On the other hand, the clearance space must be sufficiently small to keep any possible current which passes from the cathode towards the anode through the liquid in the clearing space. The current density for such a current passing through the clearance space must be so low that dulling or etching of the surface cannot occur. Any current which passes in this way must be below the density which may cause damage to the surface.

It has been experimentally determined that the last named condition usually prevails when the clearance space is selected in accordance with the desired circulation speed and the above described method of circulating the fluid has therefore proved to be very efficient provided the clearance space is properly chosen.

The above described arrangement is specially suitable for a slower circulation of the solution. Also in this

arrangement the cathode (or the anode) is slowly but continuously moved relatively to the tube the inside of which is to be polished (or relatively to the cathode respectively). The electrolytic solution flows up through the clearance space 50 between the bottom shield 45 and tube 10 into the space 34 and from there flows up again through the clearance space 50 between the top shield 44 and the tube 10 to the upper space 41 of the tube. The area which is exposed to the electrolytic action is constantly continuously and gradually changed during such movement, but the entire area on the inner side of the tube 10 is treated absolutely uniformly so that no irregularity may result.

The treatment may be completed when the cathode has reached the upper end of the tube or the treatment may be completed in any number of passes.

A further and much simplified electropolishing method is illustrated in Figures 7, 8 and 9 which again shows the application of the invention to the electrolytic polishing of the interior of the tube 10. Into this outer tube 10 a second tube 55 forming a cathode which is of smaller diameter than the tube 10 is inserted in such a manner that it is coaxial with the tube. The cathode tube 55 is closed at its ends by means of a stopper 56 or by means of a sealing plate and the said cathode is moreover provided with slots 57 near but above the closed end. The cathode tube 55 is held within the anode formed by the tube 10 the interior of which is to be electropolished by means of the spacing shield 58 of insulating material which surrounds the lower end of the cathode tube.

The cathode tube 55 is in this case of such a length that it projects at the upper end of the tube 10, even when the lower end of the cathode is near the bottom end 30 of the tube 10.

At a height which corresponds to that of the desired active area of the cathode outwardly projecting pegs 49 of insulating material are provided which form a seat for an insulating sleeve or shield 59 resting on said pegs which covers the entire upper part of the cathode tube 55 which is contained within the tube 10. The area within which the electrolytic process therefore takes place is thus confined to the area between the shield 58 and the pegs 49 on which the insulating shield 59 rests. The clearance space between the tube 55 and the shield 59 is selected according to conditions. The cathode tube 55 is again connected with the negative conductor 14 leading to the negative side of the source of current while the outer tube 10 is connected with the positive conductor 12 leading to said source.

The electrolyte in this case circulates through the inner or cathode tube flowing in from above at the upper end 60 of the tube 55. The electrolytic solution then flows through the slots 57 in the cathode tube 55 into the space 54 between cathode and anode in which electropolishing takes place and then flows out through the tube 10 and through the space surrounding the shielding sleeve 59 through the upper end 62 of the tube 10.

During the electropolishing process the cathode tube 55 is slowly moved within the tube 10 thus permanently and gradually changing the exposed area of the anode. The general arrangement for single tube polishing or multiple polishing for all modifications is practically the same as that illustrated in Figures 10 and 11.

It will thus be seen that the method according to the invention permits to eliminate completely the interference of the gas quantities produced during the process and due to high current densities and to high temperatures with the electrolytic process, while at the same time completely cutting out by confinement of the electrolytic action, all possibility for an electrolytic action performed with low current values which may result in damage to the surface to be polished. At the same time the method according to the invention provides a stable and regular circulation of the electrolytic solution and of the gases in the same direction so that the latter as far

as they are formed are carried away by the former. It is thus possible to conduct a process with constant voltage and amperage, to keep the current density within the desired values using relatively high current densities and to avoid by gradual constant and continuous displacement of a well-defined area all irregularities which usually accompany the carrying out of the process in a step by step fashion.

It will be clear that the examples which have been described and the steps of the method forming the essential part of the invention may be changed in many ways; especially unessential changes and additions may be made without in any way departing from the principle of the invention as defined in the annexed claims.

Having described the invention, what is claimed as new is:

1. A method of electropolishing interior surfaces of elongated hollow objects of approximately constant cross-section forming the anode of an electrolytic system which method consists in keeping the interior of the hollow object which is to be electropolished filled with an electrolyte, in partitioning the electrolyte filled interior of the hollow object, forming therein an annular electrolytic chamber, occupying an elongated limited section of the hollow object to be electropolished between the interior surface of the said section of the hollow object and a concentric substantially equidistant surface axially extending through the said chamber, said parallel equidistant surface forming the cathode of the electrolytic system, in substantially closing the annular chamber at its bottom end by an electrically insulating partition, confining the electrolytic polishing action to the electrolyte contained within said chamber which forms an annular column supported on the closed bottom end, in circulating the electrolyte within said hollow object and through said chamber, forcing the electrolyte under sufficient pressure into the chamber at the bottom end of the column to constantly replace the electrolyte in the annular space, and in moving said chamber gradually and constantly along the hollow interior surface of the object to be electropolished.

2. The method as claimed in claim 1 wherein the chamber is closed at the top and at the bottom except for a circulatory free cross-sectional area and wherein the electrolyte is circulated through the chamber from bottom to top passing into the chamber at the bottom end and out of the chamber at the top end through the circulatory free cross-sectional areas.

3. The method as claimed in claim 1 wherein the electrolyte is circulated through openings in the surface forming the cathode of the electrolytic system.

4. A method as claimed in claim 3 wherein a cooling fluid is circulated around the outside of the substantially tubular bodies during the relative movement of said bodies with respect to the chambers on their inside.

5. The method of electropolishing the inside of an elongated substantially tubular body the ends of which occupy different heights which consists in circulating an electrolytic liquid under pressure through the substantially tubular body to be electropolished and through fluid storage spaces in communication with the ends of the tubular body and through a pipe system joining said fluid storage spaces, in pumping the electrolyte under pressure into the said tubular body at the lower end of the same and in driving it through the said tubular body to the upper end, in dividing said electrolyte filled substantially tubular body into sections, in substantially insulating one elongated tubular section with respect to electrolytic action, forming a chamber substantially closed at its ends through which the electrolyte may however circulate, in applying to the substantially tubular body a voltage adapted to produce operation thereof as an anode of the electrolytic system, in applying to an inner axially extending surface contained within the insulated elongated tubular section forming a chamber a voltage adapted to produce operation of the surface as a

cathode of the electrolytic system, the electrolytic polishing process being thus confined to the insulated section, in relatively moving the said tubular body and the said insulated elongated chamber and axially extending cathode surface along the interior surface of the substantially tubular body through the electrolyte filling the same, the electrolyte circulating constantly through the chamber confining the electrolytic polishing action.

6. An electrolytic system for electropolishing the interior surfaces of hollow elongated metallic objects filled with an electrolyte and acting as the anode of the system, comprising an elongated cathode member arranged within the metallic object to be electropolished and provided at each end with insulating shields extending transversely from said cathode member substantially adjacent to the interior surface of the said object to be electropolished, substantially filling the cross-sectional area between the anode and the cathode, said shields and cathode member thus forming a substantially closed chamber limiting the electropolishing action to the space between the shields, means for producing a relative movement between said shield carrying cathode member and the elongated metallic object to be electropolished, and means for producing a constant forced circulation of the electrolyte through the space between the shields to maintain a confined electropolishing process within a circulating electrolyte passing constantly through the substantially closed chamber moving within the electrolyte filling the object to be electropolished.

7. An electrolytic system for electropolishing the interior surfaces of hollow elongated metallic objects filled with an electrolyte and acting as the anode of the system as claimed in claim 6, wherein the cathode member has a hollow end portion provided with an axial opening and with a radial opening for the circulation of the electrolyte and wherein the insulating shield held near the other end portion of the cathode member is likewise provided with openings for the circulation of the electrolyte, said openings thus providing passages for the circulation of the electrolyte from the hollow interior of the object to be electropolished at one side of the closed chamber through the hollow portion at one end of the cathode member, through the space enclosed by the insulating shields and through the opening in the shield at the other end of the cathode, to the hollow interior of the object on the other side of the closed chamber.

8. An electrolytic system for electropolishing the interior surfaces of hollow elongated metallic objects filled with an electrolyte and acting as the anode of the system as claimed in claim 6, wherein the insulating shields have the shape of pistons fitted into the interior of the object to be electropolished with a clearance, the electrolyte being circulated through the space contained between the insulating shields carried by the cathode member through the clearance spaces between the said shields and the object to be electropolished.

9. An electrolytic system for electropolishing the interior surfaces of hollow elongated metallic objects filled with an electrolyte and acting as the anode of the system as claimed in claim 6, wherein the hollow elongated object to be polished is stationary in a vertical position and wherein the cathode member and the insulating shields carried thereby are moved upwardly along the said stationary object, and wherein the means for producing a constant forced circulation moves the electrolyte upwardly through the hollow interior of the object to be electropolished and through the chamber between the insulating shields carried by the cathode member.

10. An electrolytic system as claimed in claim 9 comprising in addition a closed pressure container at the lower end of the elongated hollow object to be electropolished and an open container surrounding the upper end of the said object, a circulating pipe system between the two containers including a cooling means, the said means for producing a constant forced circulation of the electrolyte producing a hydraulic pressure moving the

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electrolyte into the closed pressure tank and from the pressure tank through the hollow object to be electropolished into the open tank.

11. An electrolytic system as claimed in claim 9 further comprising a container surrounding the elongated axially symmetrical metallic object to be electropolished, and means for circulating a cooling fluid through the last named container for cooling the object to be electropolished during the electropolishing action.

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