May 6, 1930. A. O. LANGSETH 1,757,671

METHOD AND MEANS OF ELECTROPLATING

Filed March 31, 1927

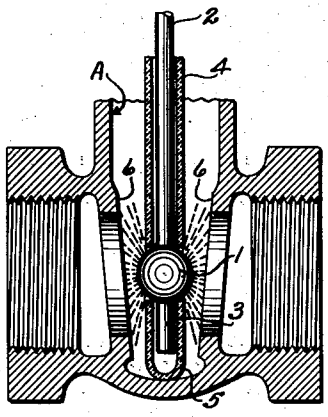


FIG. 1.

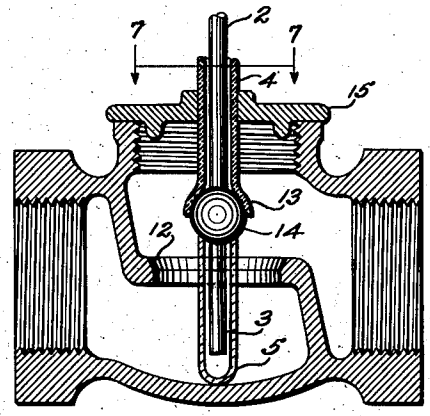


FIG. 2.

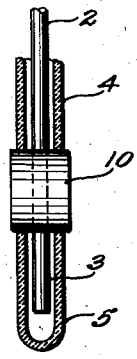


FIG. 3.

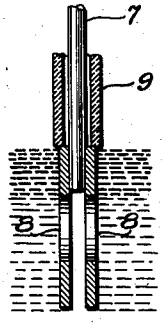


FIG. 4.

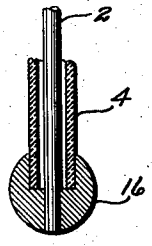


FIG. 5.

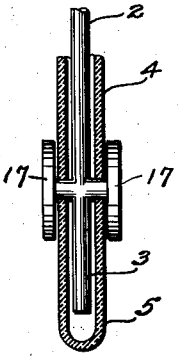


FIG. 6.

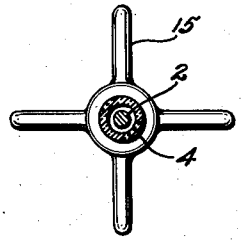


FIG. 7.

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UNITED STATES PATENT OFFICE

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METHOD AND MEANS OF ELECTROPLATING

Application filed March 31, 1927. Serial No. 179,866.

My invention relates to the deposition of a metallic coating upon the interior surface of bodies and by what is known as the electrolytic process.

It is quite an easy and simple matter to deposit metal electrolytically from an electrolyte upon the exterior surface of a body, but in many cases such deposit cannot be carried out simultaneously and satisfactorily upon the interior surface of the body, and in some cases it is practically impossible to get a deposit of any character upon the interior surfaces without special apparatus, although no special difficulty is found in making such deposit upon the exterior surface.

I find that the deposit of chromium uniformly upon the interior surface of an article by the usual methods is practically impossible, at least where it is desired to have such coating reasonably uniform, unless a special anode is used and special precautions taken during the operation.

It has been found quite desirable to place a layer of chromium upon the surface of a valve seat and valve disc where they contact with each other, for the reason that the valve seats made of iron or brass are found to cut very badly or roughen up under ordinary service, thereby permitting the valves to leak, but with a coating of chromium upon the surfaces of such seats and discs, the cutting and roughening action is avoided or, at least, delayed for a considerable length of time, therefore, giving the valve a longer term of service before it is necessary to remove it from the line. This increased life of the valve is due to the fact that the layer of chromium, although very thin, is of extreme hardness as compared with that of the iron, brass or bronze, of which the valves are usually made.

With this in view, I have confined the description of my process to valves entirely, although it may be applied to other articles.

If it is desired to plate the seats of a valve body, I find that it cannot be done by merely placing the body in an electrolyte of chromium salts and between proper anodes, as is the usual case in plating, for the reason that the deposition of chromium takes place only on the exterior surface and even then special care must be used, but if I use a special anode, which it is possible to insert into the interior of the valve body and adjacent the seat or seats to be plated, I find I can secure a uniform deposit of chromium upon the surface of the seats of the valve body.

With chromium plating, with the ordinary method of placing the articles in the electrolyte and the anodes exterior to the article, I find that the interior surface, especially the seats of a valve, are substantially devoid of any coating of chromium.

The solution or electrolyte used in the process of depositing chromium can be any well known solution, but I have found that an aqueous solution, as follows, gives excellent results:

	Ounces per gallon
Chromic acid (chromium trioxide CrO_3)	32.8
Chromium sulphate	0.4
Chromium carbonate	0.93

With this solution it is preferable to use anodes of steel or lead, as they are not affected by the solution to the extent of other metals, or an alloy of chromium and iron may be used, and, as the solution becomes impoverished through the deposition of metallic chromium, its strength can be maintained by the addition of the above salts in the proper proportion.

For an anode, I employ one of special shape and construction, as I have found that if I employ a bare rod as an anode inserted within the interior of the valve body that deposition takes place on the valve body at the nearest point where the rod enters the valve body, at least this is where the maximum deposition takes place, and while the deposition extends within the body somewhat, it tapers off very rapidly, but by the use of a special anode, I am enabled to get a uniform coating upon the surface desired, namely; the seat of the body.

The application of a coating to the surface of the valve gate or disc is not a difficult matter, as these are exposed or exterior surfaces and, of course, are plated by the usual process before being assembled with the body.

In Fig. 1 I show a valve body of the "gate" type with my improved form of special anode in position.

In Fig. 2 I have shown a valve body of the "globe" type with a special anode in position.

Figs. 3, 5 and 6 are modifications of my special anode, which may be employed.

Fig. 4 is an anode which I have tried, but is not satisfactory for the specific purpose herein described, but may be applicable for some purposes, and is shown and described herein for explanatory reasons.

Fig. 7 is a section on the line 7—7 of Fig. 2, and shows a lateral guide secured to the anode.

The anode which I have found most suitable for the uniform deposition of chromium to the seat or seats of a gate valve, or similar article, is shown in Fig. 1. It comprises a ball or anode element 1, preferably of lead. Projecting upwardly from the ball 1 is a metallic stem 2, which is preferably of lead, but may be of other metal, so long as it is non-corrosive in the electrolyte or its contact with the solution is avoided. By means of the stem 2, which is an integral part of or secured to the ball, current is conducted to the ball 1 from the positive pole of the source of supply. Projecting downwardly from the ball 1 is a stem 3. The stems 2 and 3 are provided with insulating coverings 4 and 5 respectively and these coverings 4 and 5, I find, are of extreme importance in carrying out the deposition of chromium successfully as hereinafter explained.

The lower stem 3 with its insulating covering 5 is used to position the anode element 1 in proper longitudinal relation to the valve surfaces to be coated, and is of such length as to position the ball 1 as near the center of the area of the surfaces to be coated as possible. As stated before, I have found that if a bare rod is inserted within the valve body and used as an electrode, that the deposition takes place on the valve body at the point where the electrode enters the body, and which point in Fig. 1, if the insulating covering 4 were not present, would be the point A, that is, the heaviest coating would take place there, and the deposition would rapidly decrease toward the interior of the valve body, and practically no deposition would take place on the valve seat where desired. By use of the insulating covering 4, however, which preferably extends from the electrode element and along the stem, and may extend throughout the length of the rod 2, if desired, or a sufficient distance above the entrance of the anode to the valve body to prevent the flow of current from the stem 2 to the valve body the flow takes place between the anode element 1 and the valve seats 6, and such flow is uniformly distributed and hence the deposit of chromium is uniform on the seats 6. The insulating covering 5 performs the same function with respect to the rod 3, but has an added function, as it acts as an insulating medium between the valve body, which is connected to the negative pole of the source of current supply, and the anode, which is connected to the positive pole, and hence prevents contact of the stem 3 with the valve body. If desired, the insulating elements 4 and 5 may be made to fit the rods 2 and 3 very closely, or the space between the insulating coverings and rods may be filled with an insulating compound such as bakelite.

It will be readily understood that the only part of the anode which affects the uniformity of the chromium deposition, since the stems 2 and 3 are insulated. is the anode element or ball 1. I make this ball relatively small in size, and find that for the average size of valves a ball of not over one-half inch diameter is quite suitable, and the rods 2 and 3 may be approximately one-eighth inch in diameter, but, as a rule, the element 1 should have dimensions not to exceed one-half the diameter of the valve seats.

Of course, it will be understood that with relatively larger valves an anode with a larger ball can be employed, but the uniformity of the coating seems to depend upon having the current emanate from an exposed point or relatively small surface located as near the center of the area or areas to be coated as possible.

It might appear to one that if an anode as shown in Fig. 4 were used in connection with the valve body shown in Fig. 1, that a uniform coating would be deposited upon the seating surfaces 6 of the body. This anode comprises a rod 7 connected to the source of power and to one or two annular discs 8, which are of such diameter as to present a surface opposite the entire seating surfaces 6, but with an anode of this character and with the rod 7 protected with the insulating tube 9, I find that the deposition is greatest at the upper surface of the seat 6 and diminishes toward the bottom of the seat.

This phenomenon, and that which takes place when the stems 2 and 3 are not insulated, seems to be due to the electrolyte having what is known as a poor "throwing power," in which the current from the anode through the electrolyte to the cathode or valve seats has its greatest density at the point where the anode is first exposed to the electrolyte and adjacent the valve body, and it is for this reason that I protect the rod conveying the current from the source of power to the anode element 1. The flow of current from the anode elements 8 in Fig. 4, when used in connection with the valve body, in Fig. 1, might be indicated by the dotted lines, in which it will be seen that the greatest density of current is at the upper portion of the anode elements 8, and the deposition of chromium will vary on the valve seat, as indicated by the dotted lines in Fig. 4.

With the form of anode element 1, the density therefrom to the surface 6 of the valve body is very much more uniformly distributed, as shown by the dotted radiating lines, and I find that with a relatively small anode element the distribution can be made very uniform, and I attribute it to the fact that the anode surface exposed to the electrolyte is of limited area and concentrated within close limits and centrally located with respect to the surfaces to be coated.

It is not possible to say what the limit of diameter of the element 1 should be, as this could vary with different sizes of valves, or other surfaces to be coated, and this will be understood when it is realized that some valves are made to take a one-half inch pipe, while other valves are made to take three, four and five inch pipes, and even greater, but it is necessary, I find, to use an anode element 1 of comparatively limited diameter, as compared with the diameter of the valve seats to be plated to insulate all other parts of the anode and to so place the element 1 that the current therefrom to the surfaces to be coated shall be as uniformly distributed as possible and this seems to depend upon the relative position of the anode element and the surfaces coated.

In Fig. 3 I have shown a modification of the anode shown in Fig. 1, in which I have substituted an anode element 10 of cylindrical formation, in which more than one half of the cylindrical surface and all the end surfaces are exposed.

Fig. 6 is a modification of Fig. 3, in that there are two disc members 17 connected to the stem at a central point on each disc which feeds current to the center of the disc, and which distributes uniformly to all points from the center. This might be said to be an improvement of Fig. 3 and especially where the diameter of the disc increases.

In Fig. 2 I have shown a valve body which is used in connection with a globe valve having the seat 12 upon which a coating of chromium would be of advantage. In this case, I have shown an anode of substantially the same formation as that in Fig. 1, excepting that I have shown the insulating tube 4 as provided with a bell extension 13 to prevent the flow of current from the upper portion of the anode element 14 thereby concentrating the coating and directing the current more nearly uniformly upon the seat 12. If desired, the same supporting members 3 and 5 can be used as in Fig. 1, or the elements 3 and 5 may be eliminated and the portion of the member 14 below the member 13 be entirely exposed.

In the anode shown in Fig. 2, I have shown a means of positioning the anode laterally with respect to the valve body so as to maintain a relative position against lateral displacement, and this means 15 may consist of a metallic frame secured to the insulating sheath or tube 4, as shown in Figs. 2 and 7, or it may be of insulating material itself.

In Fig. 5 I have shown a further modification of my anode in which the insulating tube 4 is inserted within the anode element 16.

In applying a coating of chromium to the seat or seats of valves, the seats are first machined to dimensions and then thoroughly cleansed of impurities and oxides, as by dipping in acid solutions, potash or cyanide solutions, scouring, etc., or by electrolytic cleansing, all of these methods being well known to those skilled in the art.

While I have shown my invention as applied to a valve body, still the same principle involved in the construction of the anode and steps of the process can be applied to the coating of interior surfaces of other articles and of other shapes, as for instance, the anode shown in Figs. 2 and 5 could well be used in coating the interior surfaces of parabolic and concave reflectors.

Due to the very corrosive action of the electrolyte, the composition of which will give a suitable coating, I find it preferable to make the insulating members 4 and 5 of glass, as the solution is very destructive to organic materials. I also find that while the anode element may be made of a ferrous metal or lead, that lead is preferable for the reason that the iron is attacked, to some extent, by the electrolyte and goes into the solution as a chromate of iron and sulphate of iron, both compounds being soluble in the solution, but when the anode element is made of lead, there may be formed chromate of lead or sulphate of lead, which are insoluble compounds and settle to the bottom of the tank where they can be removed by filtration. There may also be formed lead dioxide, but this adheres to the anode element.

The advantages of a layer of chromium upon a valve seat will at once be recognized for the reason that a brass body valve with a valve seat of the same metal and which is used to a very large extent in the manufacture of brass body valves, will have a Brinell hardness of 50 to 60, while the hardness of chromium has been variously given by different experimenters as ranging from 600 to 900 Brinell hardness. As a matter of interest, a piece of hardened tool steel, having 1.1 carbon, will have a Brinell hardness of about 600, and it is stated that neither hardened tool steel or chromium can be filed.

The current density used with the above electrolyte and in connection with the plating of valves is about 1 ampere per square inch of surface plated, but can be varied to meet different conditions.

There are, of course, modifications to both the method and apparatus herein disclosed, which will be apparent to those skilled in the

art, but I wish to be limited only by my claims.

I claim:

1. An anode for plating valve seats comprising an exposed portion of spherical shape and composed of a metal unaffected by an electrolyte, means projecting from the exposed portion to connect it to a source of current supply and a covering of insulating material upon the projecting portion.

2. An anode comprising a stem adapted to be connected to a source of current supply and having an enlarged portion, insulating means on the stem and extending from the enlarged portion along the stem, and insulated means projecting from the enlarged portion and having its axis extending in the same general direction as that of the stem to engage the cathode and hold the anode and cathode in predetermined relation to each other.

3. An anode comprising a stem, an exposed portion at one end, an insulating tube surrounding the stem to prevent current passing from the stem to the cathode through the electrolyte, insulated means to engage the cathode and maintain the anode and cathode in predetermined longitudinal relation and means projecting from the tube to engage the cathode and maintain a predetermined transverse relation of the anode and cathode.

4. An anode for use in chromium plating of valve seats comprising a stem, an exposed portion at one end of symmetrical shape and uniform diameter, an insulating tube surrounding the stem to prevent current passing from the stem to the cathode through the electrolyte, and means projecting from the tube to engage the cathode and maintain a predetermined transverse relation of the anode and cathode.

5. An anode comprising a stem, an exposed member at one end of the stem, an insulating element on the stem to prevent the stem effecting a deposition of metal on the cathode, and means projecting in the same general direction as the stem to maintain the cathode and anode in a predetermined relative position.

6. An anode comprising a stem, an exposed member secured to one end of the stem and having a curved surface and insulating means on the stem and the adjacent portion of the curved surface to prevent the stem effecting a deposition of metal on the cathode.

7. An anode for plating the adjacent seats on the interior of valve bodies comprising a stem, insulating means on the stem to prevent the stem effecting a deposition of metal on the valve body, an exposed member at one end of the stem and means to locate the exposed member at the center of and equidistant from each of the valve seats.

8. A spherical anode element of lead and having an insulated supporting stem connected thereto.

9. An anode for plating the adjacent seats on a valve body comprising a stem, an anode element secured to the stem and having exterior dimensions not to exceed one-half the diameter of the valve seats.

10. A spherical anode element of a current conducting material substantially insoluble in an electrolyte and having an insulated supporting stem connected thereto.

In testimony whereof I affix my signature.

AXEL O. LANGSETH.