April 10, 1934. E. M. CROUCH 1,953,955

MEANS FOR ELECTROPLATING INTERIOR SURFACES

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Fig. 1

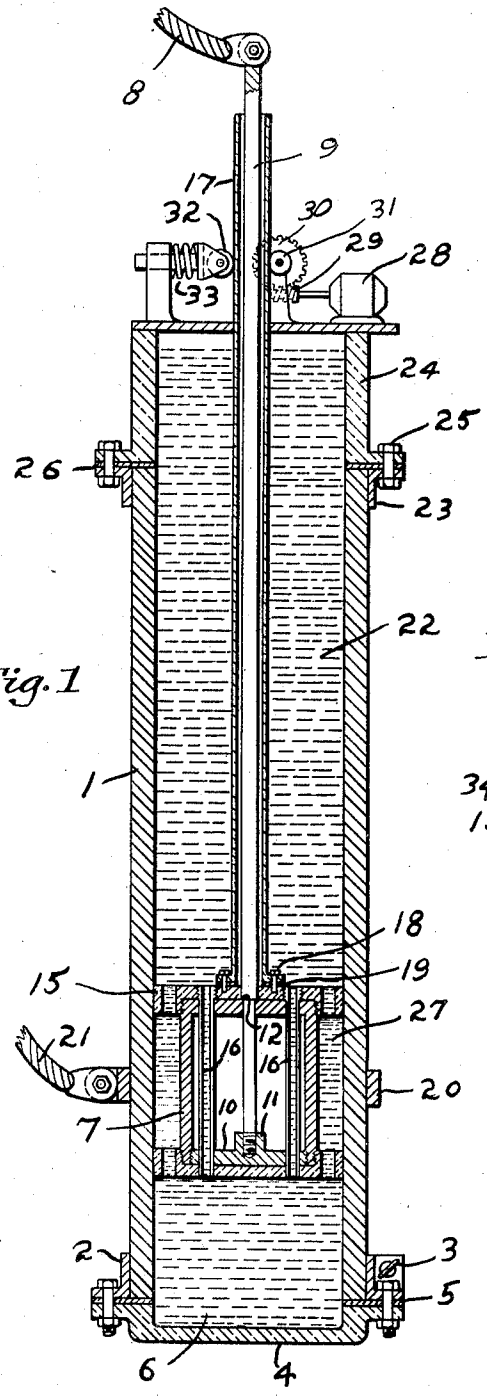
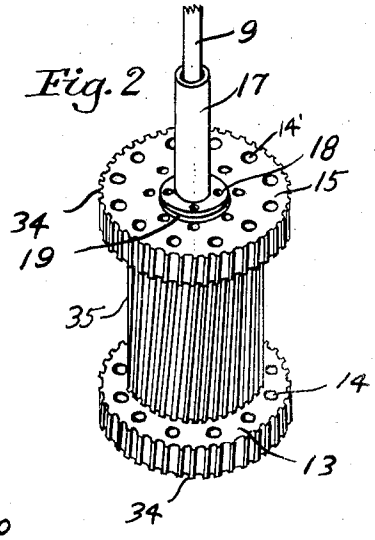


Fig. 2



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MEANS FOR ELECTROPLATING INTERIOR SURFACES

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7 Claims. (Cl. 204—5)

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This invention relates to an improvement in electro-plating large surfaces which are so shaped or positioned that the ordinary methods of surface plating cannot be applied. The inside surface of a cylinder, or the bore of a gun are typical examples of the surfaces which cannot be plated by ordinary methods.

Attempts to accomplish the difficult task of electro-plating bores of guns, for example, have heretofore involved methods which endeavor to plate the entire surface at the same time. This has resulted in the use of comparatively heavy electric current, which varies directly as the surface to be plated and has resulted in difficult problems of maintaining temperature control during the process of plating. Uniformity of temperature is vital to the successful deposition of metal and the necessity has resulted in elaborate precautions to minimize fluctuations during the process.

My invention makes it possible to do away with abnormally large electric current and with abrupt and difficultly controlled changes in temperature. My method consists in plating a small part of the work at a time and thus building up in sections, under easily controlled conditions, the final section to be plated, or alternatively to plate progressively by means of an anode moved at a given uniform rate until the complete surface is covered by a homogeneous deposit of metal.

These and other objects will be in part obvious and in part explained as the description of the preferred embodiment of my invention proceeds. It is to be understood that I do not limit myself to the precise construction illustrated.

Reference is to be had to the accompanying drawing forming a part of this specification, in which like reference characters indicate corresponding parts throughout the several views, and in which:

Fig. 1 shows a longitudinal section of a cylinder of which the bore is being plated by the method and with the anode that I employ;

Fig. 2 shows an isometric sketch of an alternative form of anode.

Fig. 1, numeral 1, shows the cylinder whose bore is to be plated. The lower end of the cylinder carries a flanged band 2 which is tightly secured to the cylinder by means of the thumb screw 3 in a manner well known to the art of clamping split bands to round or approximately round surfaces. A closure cap 4 of bakelite or other suitable insulation is bolted to the cylinder by means of the flanged clamp 2, the joint being made water and acid tight by a gasket 5 of rubber or other suitable material. The cap 4 has a recess 6 which is either large enough to take the bottom head 13 of the anode 7 when the plating is done in stepped sections, or alternately the recess is deep enough to take the whole anode 7 as far as its upper head 15, when the method of plating comprises the uniform movement of the anode through the length of the bore. Electrical current is led to the anode by means of the lead 8, thence through the copper anode spindle 9.

The anode itself is a short copper cylinder 7 open at one end, the outside surface of which is so shaped as to be equidistantly spaced from the surface to be plated. The outside surface of anode 7 is lead-plated in the customary manner to facilitate the plating operation. The open end of the anode receives the threaded closure 10 which has an internally threaded boss 11 in its center which permits the anode spindle 9 to be securely screwed in place in the anode, the spindle shoulder 12 bearing tightly against the top of the anode and the threaded end of the spindle bearing tightly against the bottom of the aperture in boss 11.

Carefully machined disks 13 and 15 of bakelite or other suitable insulation are screwed onto the top and bottom of the anode in such a manner that the anode itself is maintained concentric with the bore to be plated. The bottom head 13 just described has a series of holes 14 bored through it between the outside of the anode and the outer edge of the bushing and likewise the upper head 15 has similar holes correspondingly placed shown at 14'. Through both the anode and its heads there are pierced a number of vertical holes arranged circumferentially between the spindle and the inner side of the anode in which are inserted the insulation tubes 16 which thus form water tight channels from the upper part of the anode through its interior and down to the bottom part of the anode. A tube of bakelite or other suitable insulation material 17 surrounds a spindle 9 and has a flanged end securely fastened to the upper bushing 15 by the screws 18, the joint being made water and acid tight by a gasket 19 of rubber or other suitable material.

The electro-plating current is led away by means of the split copper band 20 that is tightly clamped to the cylinder 1 and also carries the electric lead 21. Additional copper bands may be clamped at short intervals along the cathode 1 in order to maintain electrical conditions uniform throughout the bore. These additional rings may be interconnected by means of a com-

mon vertical bus bar or the lead 21 may be multiple branched, each branch leading away from a single ring, as desired.

In the practice of my invention the electrolyte 22 is placed in the bore to be plated, the level of the liquid being kept somewhat below the top of the container in order to allow for ebullition caused by the gases formed during plating. If it is desired to plate the whole length of the cylinder, the top of the container is built up by means of the split flanged ring 23 which is clamped onto the cylinder in a manner similar to ring 2 and the flanged ring 24 of bakelite or other suitable insulation is bolted thereto by a series of bolts 25, the whole being maintained water and acid tight by the gasket 26 of rubber or other suitable material. By this means the anode can be maintained in the path of electrolyte until it has acted evenly on the entire interior surface of the cylinder.

The plating operation is as follows:— The anode being placed in the bottom of the cylinder, and current turned on in proportion to the surface exposed to the anode, the plating operation takes place in the annular space 27 accompanied by the formation of gases. These gases rise and are conducted through the openings 14', to the surface of the electrolyte, fresh electrolyte entering through the channels 16 and the openings 14. The surface receiving the plating is confined to that area between the lower head 13 and upper head 15, the clearance between these heads and cylinder 1 being merely enough to permit easy motion through the bore of the cylinder. When this annular surface has been plated, the anode is moved up to the next section to be plated and the process is continued until the whole cylinder is adequately plated. During this time the evolution of heat is small as compared to the large quantity of electrolyte and the mass of the work being plated at one time and the whole can be maintained at the proper working temperature, within narrow limits, by means of a bath of water or other liquid surrounding the cylinder and maintained at a given temperature, as is well known in the art. It is apparent that the insulation tube 17 shields the anode spindle and prevents any undesirable plating action from this source.

In the alternative method of plating the anode is first dropped into the recess 6 of the cap 4 and as the anode is moved upward at a slow, uniform rate, the current is gradually turned on in proportion to the surface of the cylinder exposed to plating action, until the entire anode is moved within the cylinder in which case the current is brought up to its full strength and kept at the same until the anode begins to emerge from the cylinder when the current is tapered off in the reverse manner.

The full strength of the current needed by this method is a mere fraction of that required for the plating of the cylinder simultaneously as a unit, and its strength is regulated in accordance with the distance of the anode surface from the cathode cylinder, the rate of speed of the anode, and the ability to maintain the desired temperature conditions.

One method of maintaining uniform movement of the anode through the cylinder is by means of a small electric motor 28 driving a worm 29 which engages the gear wheel 30. This gear wheel is on the same shaft as, or may be geared to, the friction wheel 31 which has a grooved face suitable for frictionally engaging the insulated tube 17. On the opposite side of the tube 17 is the idling wheel 32 which revolves on a shaft parallel to the shaft of the wheel 31 and is constantly urged toward the wheel 31 by means of a spring 33 or other suitable tension device, in order to facilitate the engagement of the wheel with the tube 17.

If the cylinder to be plated has a longitudinal keyway or other equally spaced irregularities, such as rifling with a uniform twist, the anode 7 with its bushings 13 and 15 may be suitably shaped in order to maintain the surface of the anode at all points equidistant from the surface of the cathode. Where this is possible or approximately possible, it will be found that the character of the plating at the bottom of the keyway or in the bottom of the grooves of rifling, is not materially different from the character of the plating on the rest of the cylinder, thus making for greater uniformity in performance.

Fig. 2 shows an anode considered suitable for the plating of a rifled gun bore, the corrugations 34 of the bushings 13 and 15 acting as guides to present the ribs 35 of the anode continuously in the proper relation to the cathode so that the distance the electric current must travel through the electrolyte to all parts of the cathode surface is as nearly constant as may be and there are no paths of least resistance through the electrolyte which will materially interfere with the uniform thickness of plating.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiment of my invention, and that various changes in construction, proportion and arrangement of parts may be made within the scope of the appended claims without sacrificing any of the advantages of my invention.

The herein described invention may be manufactured and used by or for the Government of the United States for governmental purposes without the payment of any royalties thereon.

I claim:

1. Means for electroplating the interior surface of a rifled gun barrel, comprising a split ring adapted to clamp about an end of said barrel, a cap securable to said ring, said cap having in it a recess of diameter equal to the bore of said barrel, a substantially cylindrical anode having on its surface lands and grooves corresponding to those of the barrel, a peripherally grooved head secured to each end of said anode of a diameter substantially to form closures in said barrel but to move freely therein, the grooves in said heads being adapted to receive the lands in said barrel and so related to the lands of said anode as to maintain the last mentioned lands opposed to the grooves in said barrel, an electrically conducting spindle connected to said anode, an insulating cylinder surrounding said spindle, means securable to said barrel to contain electrolyte in addition to that in said barrel, and mechanism to move said anode longitudinally of said barrel.

2. Means for electroplating the interior surface of a rifled gun barrel, comprising means to form a closure for an end of said barrel, a substantially cylindrical anode having on its surface lands and grooves corresponding to those of said barrel, means carried by said anode to maintain the lands of said anode opposed to the grooves of said barrel, a member to carry current to said anode, insulating means around said member, and mechanism to move said anode longitudinally of said barrel.

3. Means for electroplating the interior surface

of a rifled gun barrel, comprising an anode having a surface complementary to the rifling of such barrel, means to maintain said anode so positioned that all parts of the said surface are equidistant from the surface being plated, said means being adapted to rotate said anode about its longitudinal axis when the anode is moved longitudinally in the barrel and means to move said anode longitudinally of said barrel.

4. An electroplating electrode assembly, comprising a substantially cylindrical body having uniformly spaced helical lands and grooves thereon, and a peripherally grooved circular head at each end of said body, the grooves in said heads and the adjacent ends of the grooves in said body lying in the same radial lines.

5. In means for electroplating the bore of a rifled gun barrel, a substantially cylindrical anode having on its surface lands and grooves corresponding to those of said barrel, means carried by said anode to maintain the lands of said anode opposed to the groove of said barrel, a member to carry current to said anode, and insulating means around said member.

6. In means for electroplating the bore of a rifled gun barrel, a substantially cylindrical anode having on its surface lands and grooves corresponding to those of said barrel, and means carried by said anode to maintain the lands of said anode opposed to the grooves of said barrel.

7. Means for electroplating the interior surface of a rifled gun barrel, comprising an anode having a surface complementary to the rifling of such barrel, means to maintain said anode so positioned that all parts of the said surface are equidistant from the surface being plated, said means being adapted to rotate said anode around its longitudinal axis when said anode is moved longitudinally in the barrel and to prevent longitudinal conduction of current beyond the ends of the anode.

EDWIN M. CROUCH.