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O. IMALIS ET AL
ELECTROLYTIC METAL SHAPING

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Fig. 1.

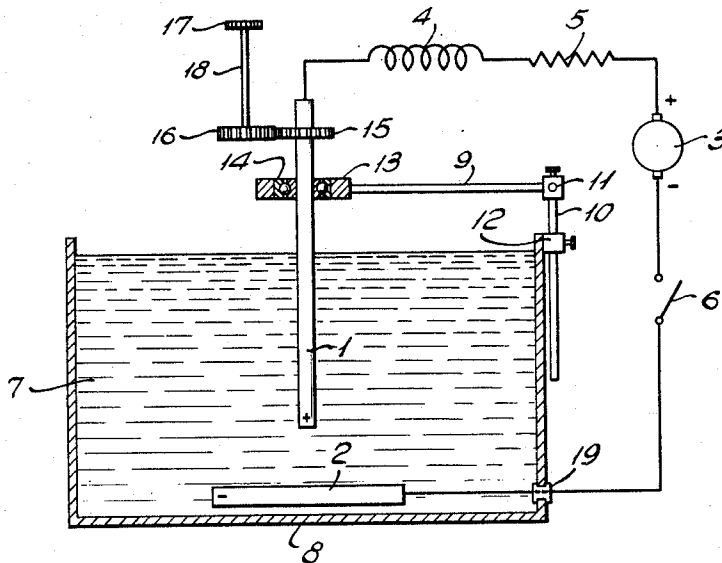
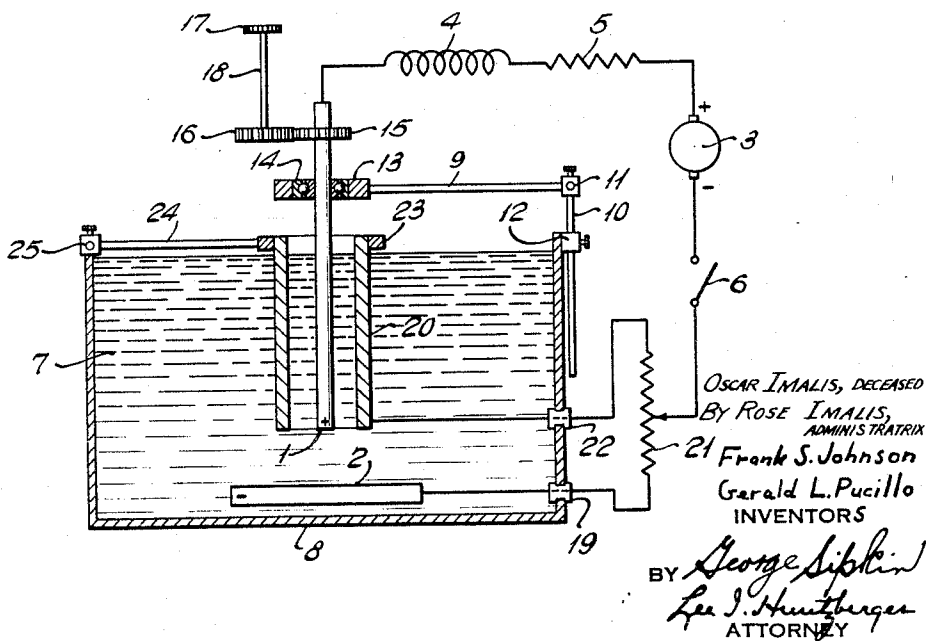


Fig. 2.



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ELECTROLYTIC METAL SHAPING

Oscar Imalis, deceased, late of New London, Conn., by Rose Imalis, administratrix, New London, Frank S. Johnson, Waterford, and Gerald L. Pucillo, Niantic, Conn., assignors to the United States of America as represented by the Secretary of the Navy

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6 Claims. (Cl. 219-69)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invention concerns the electrolytic shaping of metals.

The principal object of this invention is the provision of a method of electrolytic shaping for shaping metals in uniform and accurate fashion.

An object of this invention is the provision of a method of electrolytic shaping for shaping metals in desired configurations.

A further object of this invention is the provision of a method of electrolytic metal shaping initiated by pulsating direct current.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a preferred embodiment of the electrolytic metal shaping apparatus of the present invention; and

Fig. 2 is the electrolytic metal shaping apparatus of Fig. 1 modified to shape metals in cylindrical or related forms.

Fig. 1 is a preferred embodiment of the electrolytic metal shaping apparatus of the present invention.

An anode member 1 is comprised of metal, such as tungsten, which is to be shaped by the apparatus of the present invention. A cathode member 2 comprises an inert metal, such as lead. A potential difference of about 100 volts is impressed between the anode member 1 and the cathode member 2 by a D.C. source 3.

A high inductance 4 and a resistance 5 are placed in series between the anode member 1 and the positive terminal of the D.C. source 3. A switch 6 is placed in series between the cathode member 2 and the negative terminal of the D.C. source 3. The anode member 1 and the cathode member 2 are immersed in an aqueous solution of electrolyte 7, such as sodium hydroxide. The electrolyte 7 is held in a tank 8 which is comprised of electrically non-conducting material. Such electrically non-conducting material may be selected from the many suitable materials known in the art.

The anode member 1 is preferably of rod-like configuration and is supported in axially rotatable position by a bushing 14. The bushing 14 is mounted in an anode ring 13 which is comprised of electrically non-conducting material. An anode arm 9 is radially affixed at one end to the periphery of the anode ring 13 and is adjustably supported at its other end by an anode pivotal clamp joint 11. The anode pivotal clamp joint 11 is affixed to a tank arm 10. The tank arm 10 is adjustably supported, in substantially vertical position, by a tank pivotal clamp joint 12. The tank pivotal clamp joint 12 is affixed to the tank 8.

The gear 15 is coaxially affixed to the anode member 1 and engages the gear 16. The gear 16 is rotatably

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controlled by the rotation control wheel 17 and the control shaft 18.

For applications where the anode member 1 may remain in substantially vertical position throughout the metal shaping operation, the anode may be supported by bushings affixed in a cylinder composed of electrically non-conducting material, such as glass.

The water-tight seal 19 permits the connection of an electrical conductor from the switch 6 to the cathode member 2, through a hole in the tank 8.

The entire unit operates as an electrolytic cell to shape the anode member 1 by the well known metal-removing action of electrolytic cells. The operation of the metal shaping apparatus of the present invention depends upon a pulsating direct current which is applied to the anode member 1.

The high inductance 4 produces a pulsating direct current of a voltage higher than that of the D.C. source 3. The pulsating direct current initiates the removal of material from the anode member 1. The distance between the anode member 1 and the cathode member 2 is not critical but is determined by adjustment during the operation of the apparatus.

Before the initiation of the electrolytic metal shaping operation the anode member 1 is properly positioned in the electrolyte 7, with reference to the cathode member 2, in accordance with the configuration to be produced. The tank pivotal clamp joint 12 permits the positioning of the anode arm 9 at any point on the circumferences of a family of circles of varying radii originating from the axis of the tank arm 10 as a radial center, and/or at any distance above the cathode member 2. The anode pivotal clamp joint 11 permits the anode arm 9 to be adjusted in length. The anode pivotal clamp joint 11 permits the anode arm 9 to be positioned at any point on the circumferences of a family of circles of varying radii originating from the various axes of rotation of said anode pivotal clamp joint.

The anode arm 9 may be adjusted in height by adjustment of the anode arm 10. The anode member 1 may thus be positioned as desired by adjustment of the anode arm 9, the tank arm 10, and of the anode pivotal clamp joint 11 and the tank pivotal clamp joint 12.

The anode member 1 is supported by the bushing 14 which is mounted in the insulating ring 13 in such a manner that it is rotatable about its own axis. Thus, if, in the course of the metal shaping operation, it is so desired, the anode member 1 may be axially rotated. This is accomplished by manual or mechanical rotation of the rotation control wheel 17, which rotates the gear 16 through the control shaft 18. The gear 16 engages the gear 15 to rotate the anode member 1 about its axis. By this rotation, the anode member 1 may be axially positioned at any point less than a complete revolution by appropriate control of the rotation control wheel 17.

After the anode member 1 is properly positioned, in accordance with the configuration to be produced, the electrolytic metal shaping operation is initiated by the closing of the switch 6. The high voltage pulsating direct current produced by the high inductance 4 initiates the electrolytic action of the cell to remove material from the anode member 1. During the metal shaping operation the anode member 1 may be positioned, and/or rotated or positioned about its axis as necessary, without interrupting the operation.

The apparatus of Fig. 1 is especially adaptable for the production of needle shapes from the anode member 1.

Fig. 2 is the electrolytic metal shaping apparatus of Fig. 1 modified to shape metals into cylindrical or related forms.

The components of Fig. 2 are identical to the corresponding components of Fig. 1 and are similarly num-

bered. Additional components are the control electrode member 20, the potentiometer 21, the water-tight seal 22, the control ring 23, the control arm 24 and the control pivotal clamp joint 25.

The control electrode member 20 is immersed in the electrolyte 7 and coaxially positioned about the anode member 1 at a separation therefrom. The control electrode member 20 is in envelope form; in open or closed cylindrical or related configuration. The control electrode member 20 is supported in substantially vertical position by the control ring 23. The control arm 24 is radially affixed at one end to the periphery of the control ring 23 and is adjustably supported at its other end by the control pivotal clamp joint 25. The control pivotal clamp joint 25 is affixed to the tank 8.

The control electrode member 20 may be supported in exactly the same way that the anode member 1 is supported, if it is necessary to position the control electrode as multifariously as the anode. Furthermore, either the anode member 1 or the control electrode member 20, or both the anode and the control electrode, may be rotatably supported and/or supported in a manner which permits great diversity in positioning. For purposes of clarity of illustration, only the anode member 1 is shown in Fig. 2 as being rotatably supported and supported for diversity in positioning.

A potentiometer 21 permits the control of the relation between the voltages applied to the cathode member 2 and the control electrode member 20. The potentiometer 21 operates in a manner well known in the art. The movable contact of the potentiometer 21 is joined to one terminal of the switch 6 by an electrical conductor. One fixed terminal of the potentiometer 21 is joined by an electrical conductor to the cathode member 2 and another terminal of the potentiometer 21 is joined by an electrical conductor to the control electrode member 20.

The water-tight seal 22 permits the connection of an electrical conductor from the potentiometer 21 to the control electrode member 20, through a hole in the tank 8.

If the control electrode member 20 is of cylindrical form it produces a uniform potential gradient about the anode member 1. The anode member 1 or the control electrode member 20 may be rotated about its axis to insure the production of a uniform finish on said anode member. If it is desired to shape the anode member 1 into other than uniform cylindrical form, any suitable envelope type of control electrode member 20 may be utilized in the apparatus of Fig. 2.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

We claim:

1. Electrolytic metal shaping apparatus comprising an electrolyte, an anode workpiece and a cathode spaced apart in said electrolyte to form a spark gap therebetween in said electrolyte, an electric circuit having in series therein a source of direct current connected across the electrodes with said anode workpiece being at positive potential, and a high inductance and a ballast resistor in series in said circuit to generate pulsating direct current of high voltage with sparking across said gap.

2. Electrolytic metal shaping apparatus comprising an electrolyte, a metallic anode workpiece and an inert cathode spaced apart in said electrolyte to form a spark gap therebetween in said electrolyte, an electric circuit having in series therein a source of about 100 volt direct current connected across the workpiece and cathode with said anode workpiece being at positive potential and a high

inductance and ballast resistor also in series in the circuit to generate pulsating direct current of high voltage with sparking across said gap, said circuit being free of any added capacitance.

3. A method of electrolytically shaping a metallic anode member comprising immersing said anode member and a cathode in an electrolyte in spaced relation to form a spark gap, and connecting a source of direct current and a high inductance in series across the electrodes with said metallic anode member being at positive potential to generate pulsating direct current of high voltage with sparking across said gap.

4. A method of electrolytically shaping a tungsten anode member comprising immersing said anode member and an inert metallic cathode in sodium hydroxide electrolyte in spaced relation to form a spark gap, and connecting a source of about 100 volt direct current and a high inductance in series across the electrodes with said tungsten anode member being at positive potential to generate pulsating direct current of high voltage with sparking across said gap.

5. Electrolytic metal shaping apparatus comprising a container with an electrolyte therein, a metallic workpiece and an inert cathode disposed in said electrolyte in spaced relation to one another, an electric circuit including a source of direct current connected to include in series therein said workpiece and said cathode, with a positive potential on the workpiece, a high inductance and a ballast resistor also in series in said circuit to generate a pulsating current of high voltage sufficient to cause arcing between the workpiece and cathode in addition to current flow between them through the electrolyte, with sputtering removal of the metal from the exposed surface of the workpiece, said circuit being free of any added capacitance.

6. The apparatus as set forth in claim 5, and a tubular control electrode surrounding and spaced from said workpiece in said electrolyte, said circuit having a potentiometer therein with its slide connected to the negative side of said source, one branch of the potentiometer being connected to said cathode and the other branch being connected to said control electrode, whereby the voltage potential between the workpiece and the cathode and control electrode may be varied by operation of said potentiometer to regulate the extent of metal removal at different zones along the workpiece and the surface of the workpiece can be finished for substantial distances along it at the same time.

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