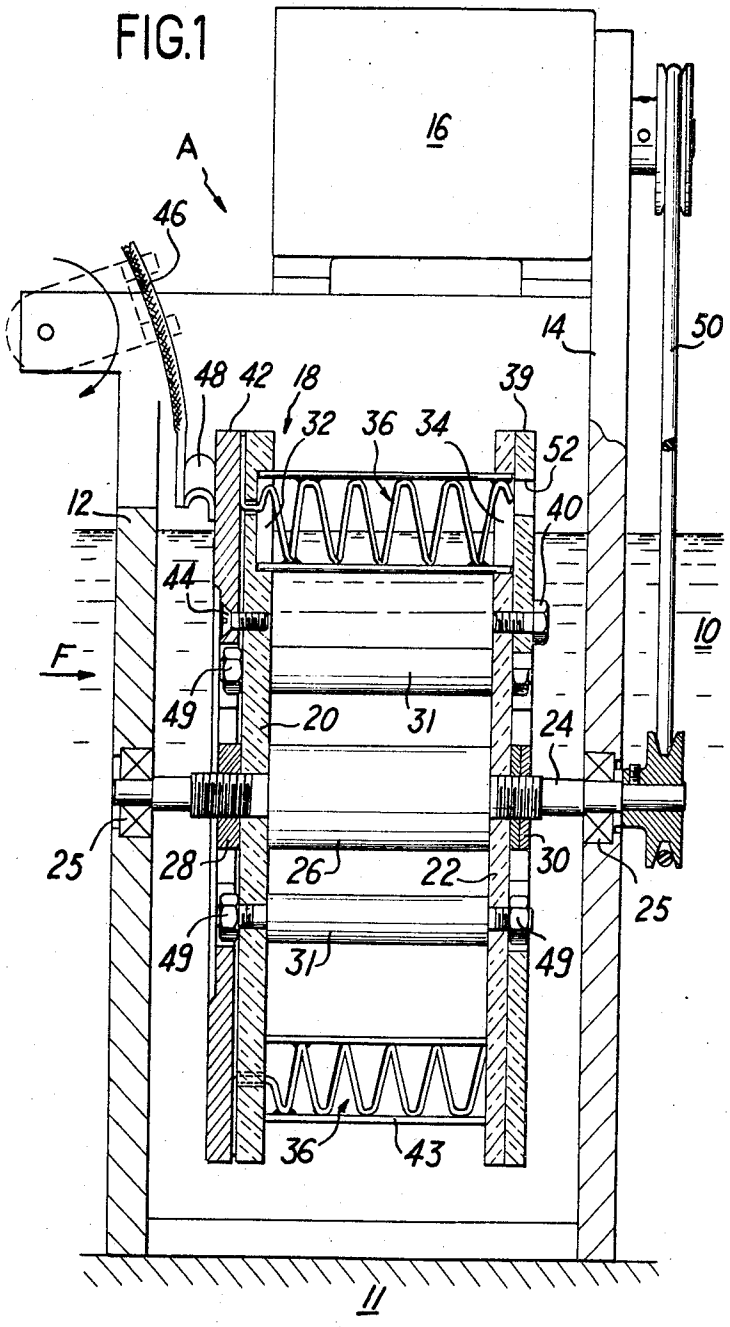
Jan. 20, 1970 G. CHAUVIN ET AL 3,491,013

APPARATUS FOR TREATING THE SURFACE OF PRISMATIC BODIES

Filed Aug. 16, 1966 3 Sheets-Sheet 1

FIG.1



APPARATUS FOR TREATING THE SURFACE OF PRISMATIC BODIES

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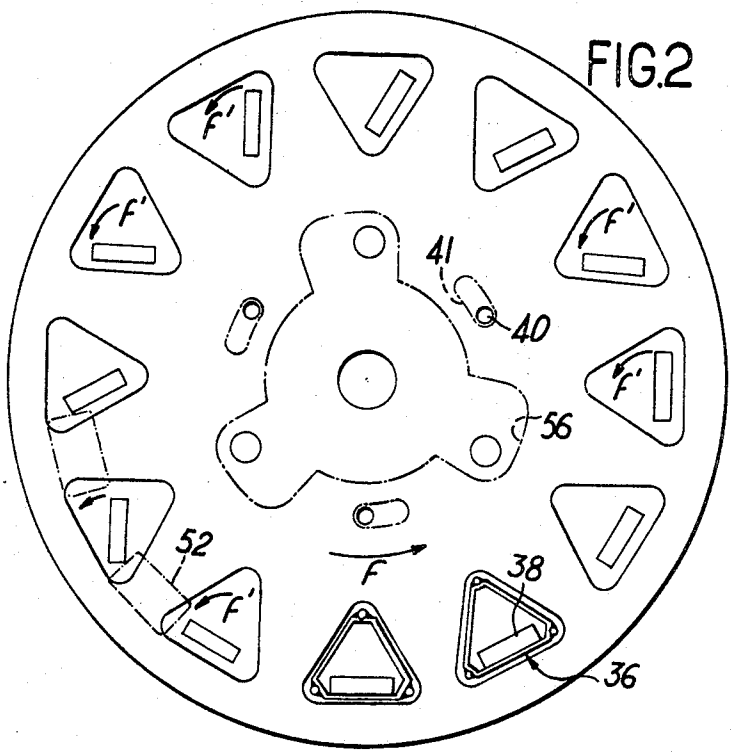
FIG.2



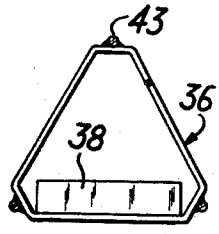


FIG.5

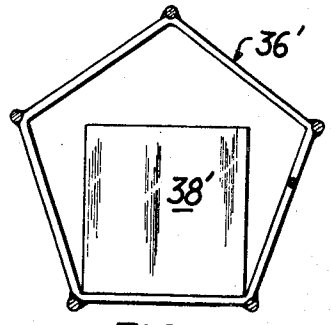


FIG.6

APPARATUS FOR TREATING THE SURFACE OF PRISMATIC BODIES

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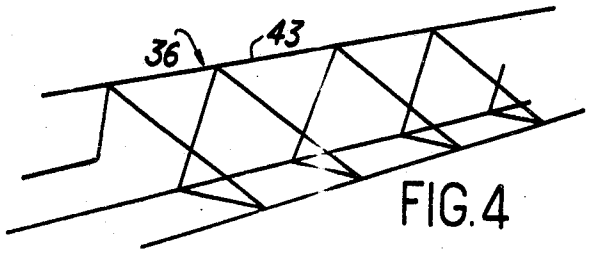

FIG.4

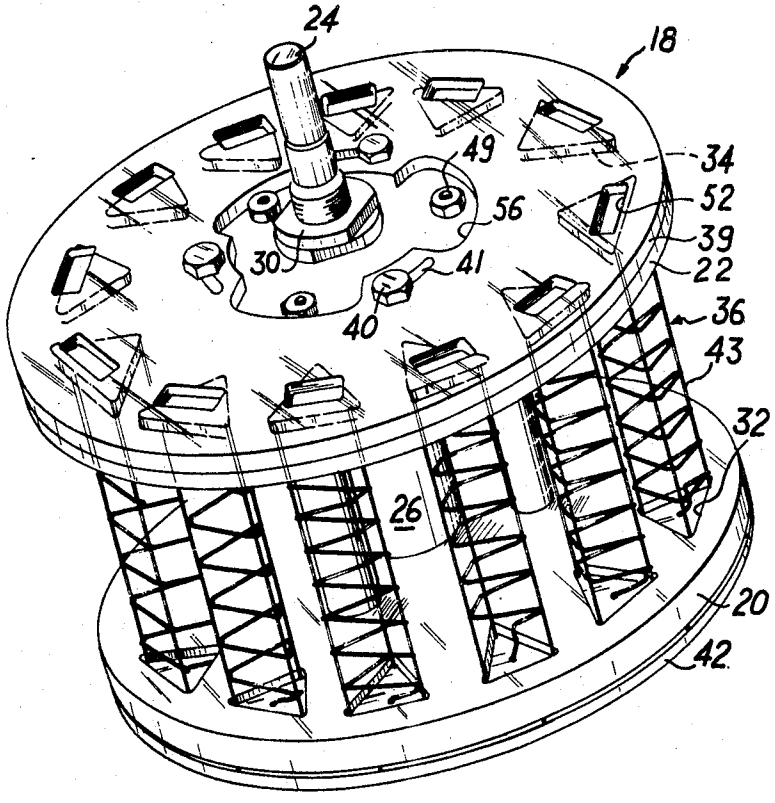

FIG.3

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APPARATUS FOR TREATING THE SURFACE OF PRISMATIC BODIES

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Claims priority, application France, Aug. 25, 1965, 29,414
Int. Cl. C23b 5/78
U.S. Cl. 204—213 5 Claims

ABSTRACT OF THE DISCLOSURE

Surface treatment of prismatic parts is obtained by mounting the parts in coil springs to which an electric potential is applied. The springs are rotated in an electrolytic bath and the parts periodically "flip-over" in the springs during rotation thereof.

The present invention is directed to a method whereby electrically conductive parts are subjected to an electrolytic or chemical surface treatment which is at least superficial and is further concerned with a device for the practical application of said method; both said method and said device are of interest for the complete treatment (degreasing, pickling, washing and metal coating) of uranium parts or parts formed of a uranium base alloy.

The principle of electrolytic surface treatment of electrically conductive parts is well known: the parts to be treated are immersed in a bath of suitable composition and constitute one of the electrodes of an electric circuit which is closed by electrodes placed in the bath. By sending an electric current through the bath, a number of different treatments can be carried out such as pickling, coating with metal and so forth.

French Patent No. 1,260,086 as granted to Commissariat a l'Energie Atomique describes a method for the electrolytic surface treatment of parts of revolution. This method consists in supporting the parts to be treated within a helical spring which is disposed horizontally in the bath and through which electric current is supplied to the part, and in causing said spring to rotate during the operation so as to modify the zones of contact between the spring and the part to be treated while ensuring uniformity of treatment over the entire surface of the part.

Unfortunately, this solution is not always applicable to the treatment of parts which are not of revolution. In particular, in the case of parts having a cross-section of polygonal configuration, the part which is placed inside the helical spring slides along the coils of the spring instead of rotating, which consequently destroys the advantage of the solution proposed by the French patent.

The present invention is directed to the basic concept of a method which can be applied to parts having a cross-sectional configuration which is not circular and especially to parts of polygonal cross-section. With this object in mind, the invention proposes a method of chemical and/or electrolytic surface treatment of prismatic parts each having in cross-section n long sides of substantially equal length, said method consisting in supporting the part to be treated on the lower portion of a coiled spring having a horizontal axis, the coils of which are placed around a prism, the transverse cross-section of which has the shape of a regular polygon having N sides which are of slightly greater length than the sides of the part, the number N being greater than n and preferably incommensurable therewith, in immersing in a bath at least that portion of said spring which contains the part to be treated and in imparting to said spring a rotational movement about its axis or about a line parallel thereto so as to produce the complete reversal of said part and the modification of its zones of contact with the spring.

The expression "long sides" which has been employed above is intended to refer to those sides on which the part can be supported. In the majority of cases (especially in the case of parts having a cross-section in the shape of a regular polygon), all of the sides must be considered as "long sides." In other instances, and especially in the case in which the part is constituted by a plate having small thickness compared to its width, only two sides of the cross-section out of four must be considered as "long sides."

In order to prevent any lack of uniformity in the surface treatment, it is necessary to ensure that the number N is incommensurate with the number n, thereby preventing any periodicity of contact between the same zones of the part. The easiest method of satisfying this condition is of course to give N a value which is equal to $n+1$ although this expedient would only be applicable if the spring were endowed with a continuous movement of rotation which would bring the plate successively against the N sides. On the other hand, if the movement of rotation were reciprocal or, in other words, if the spring were endowed with an alternating motion, the number of contact sides would in that case have to be greater than n. However, this solution is much less satisfactory than the continuous movement of rotation of the spring by reason of the periodicity which it entails.

A very wide choice of different methods is available for the purpose of driving the spring in rotation; it is possible in particular to make use of a prismatic rod to which the spring is fastened, the said rod having a width of the same order as the length of the side of the polygon. The movement of rotation of said rod initiates the rotation of the spring.

The disadvantage of this solution, however, lies in the fact that it cannot readily be carried into practice when the transverse cross-section of the part to be treated has a small number of long sides n (n=2 or 3). In this instance also, there is a danger that the part will slide instead of rotating, especially by virtue of the fact that the overall size of the rod in addition to that of the part itself makes it necessary to employ a spring having a large diameter and a large number of sides.

One expedient which proves much more satisfactory, especially when the parts to be treated have relatively small dimensions and/or a small number of sides, consists in mounting a plurality of springs in parallel relation on a rotating system which is adapted to rotate about an axis parallel to that of the springs: the rotation of the springs about their axes is then accompanied by a movement of translation along a circle, but this combination of movements does not present any disadvantage.

This invention also has for its object a device for the practical application of the method aforesaid. The device in accordance with the invention comprises, within an electrolytic treatment tank which contains a bath, at least one spring having a horizontal axis, the coils of which are placed around a prism having a transverse cross-section in the shape of a regular polygon with N sides and the lower portion of said spring which contains the part being immersed in said bath, means for driving said spring in rotation about its axis and means for supplying said spring with electric current.

The invention also has for its object by way of novel industrial products the prismatic parts of polygonal transverse cross-sectional configuration which are treated in accordance with the method hereinabove defined.

The invention also consists in other arrangements which are preferably employed in conjunction with the preceding

but which can also be employed independently thereof. All of these arrangements will become more readily apparent by perusal of the following description of one mode of application of the invention which is given by way of non-limitative example, reference being had to the accompanying drawings, in which:

FIG. 1 is a view in elevation of a nickel-plating apparatus in accordance with the invention, as shown in cross-section along a diametral vertical plane;

FIG. 2 is a view in the direction of the arrow F of FIG. 1 which shows diagrammatically one of the flanges of the drum and the successive positions which are taken up by the parts to be treated as the drum rotates, said parts being constituted by strips having a flat rectangular cross-section;

FIG. 3 is a view in perspective of the complete drum;

FIG. 4 is a diagrammatic detail view showing one of the springs of the drum of FIG. 3;

FIG. 5 is an end view of the spring of FIG. 4 and of the strip which is placed therein;

FIG. 6 which is similar to FIG. 5 shows a spring for the treatment of parts having a square cross-sectional configuration.

The device A in accordance with the invention is disposed during operation in an electrolytic bath **10** contained in a tank, only the bottom **11** of which is shown in FIG. 1. Electrodes which are not shown in the drawings are immersed in the bath **10** which is constituted by a solution of a nickel salt when the operation to be performed on the parts to be treated is a nickel-plating process.

The device A comprises a support frame constituted by two parallel side-plates **12** and **14** which are placed on the bottom **11** of the tank, the side-plate **14** being adapted to carry a motor **16** for driving the device. The moving portion of the device A is constituted by a drum **18** which is rotatable about a horizontal shaft composed of two flanges **20** and **22** carried by a shaft **24** which is carried by roller-bearings **25** mounted in the side-plates **12** and **14**. Said roller-bearings are of plastic or metallic material which affords resistance to the corrosive action of the solutions contained in the tank. The flanges **20** and **22** are maintained assembled together by means of a central spacer tube **26** and by means of nuts **28** and **30** which are screwed on threaded portions of the shaft **24**, provision being additionally made if necessary for lateral spacer members **31**.

There are formed at equal angular intervals in the flange **20** recesses **32** which are located in oppositely-facing relation to openings **34** of corresponding shape which are pierced in the flange **22**. The recesses **32** are designed to accommodate springs **36** which are inserted through the openings **34** and secured in position by means of a retaining plate **39** which is fixed to the flange **22** by means of screws **40** which engage in the ovalized holes **41** of the plate so as to permit a slight angular displacement of this latter with respect to the flange. Said angular displacement is intended to permit the insertion of the parts to be treated in the springs and to maintain said parts within said springs during treatment as will be explained below.

The springs **36** which are shown and which are intended for the treatment of strips **38** which have a transverse cross-section of flattened rectangular configuration (as shown in FIGS. 2 and 5) are made up of three straight wires such as the wire **43** (as shown in FIGS. 4 and 5) which delimit the angles of a virtual parallelipiped having a cross-section in the shape of an equilateral triangle and around which are wound the coils of the spring proper.

In order to prevent the direct passage of electric current between the spring **36** and the bath, or rather in order to limit the current transmission zone to that portion of the surface of the coils which comes into contact with the strip to be treated, the wire which constitutes the spring **36** is provided with an insulating covering except on the internal face of the coils. The simplest solution consists in

forming the spring of wire which is insulated by a covering of polyvinyl chloride, for example, and in removing this covering within the coils after the spring has been formed.

Electric current can be supplied to the springs in a number of different ways. In the embodiment which is illustrated, the terminal portion of the wire which constitutes the coils of the spring traverses the flange **20** and is clamped between said flange **20** and a nickel ring **42** which is secured to the flange by means of screws **44**. The ring **42** is supplied with current by means of a conductor **46** terminating in a friction-contact brush or collector-brush **48** which is applied against the ring, as shown in FIG. 1. The other components of the drum and of the frame must of course be insulated. For this purpose, an acrylic polyester can be employed such as methyl methacrylate so as to form the flange **22** and the retaining plate **39**, and another plastic such as polyvinyl chloride can be employed so as to form the shaft **24**, the spacer members **26** and **31**, the flange **20** and the nuts **28** and **30**. That portion of the current supply ring **42** which is not in contact with the collector-brush **48** as well as the screws **44** and the metal nuts **49** which serve to secure the spacer members **31** can all be advantageously provided with an insulating covering. This precaution makes it possible to prevent leakage currents as well as excessive deposition of nickel on the ring **42**.

The drum **18** is driven in rotation from the motor **16** by any suitable means such as a driving belt **50** which is passed over pulleys respectively driven by the motor and fixed to the shaft **24**.

The device herein described is intended for the treatment of parts which have a cross-section of flat rectangular configuration, that is to say having two long sides: the coils of the spring are accordingly disposed along a parallelipiped having a triangular cross-section, although other shapes can be envisaged such as a pentagonal cross-section. However, the device is suitable not only for parts of flat rectangular shape but can very easily be adapted to parts having other shapes; by way of example, FIG. 6 shows a spring **36'** having a cross-section in the shape of a regular pentagon for the purpose of treating parts such as the part **38'** of square cross-sectional configuration.

The operation of the device will now be described in reference to FIGS. 1, 2 and 3. When the device has been withdrawn from the nickel-plating bath and the current supply is switched off, the drum **18** is loaded with parts to be treated and which consist of strips **38**. In order to carry out this operation, the screws **40** are slackened off and the retaining plate **39** is moved into the end angular position thereof in which the elongated slots or passageways **52** which are provided in said plate (as shown in FIGS. 1 and 3) coincide with the openings **34**. The strips **38** are then inserted through these openings, whereupon the plate **39** is brought back into its locking orientation (as shown in chain-dotted lines in FIG. 2) and locked in position by means of screws **40**. Recessed portions **56** of suitable shape (as shown in FIGS. 2 and 3) which are formed in the plate **39** can also permit the insertion of nuts **49** for securing the spacer members **31**.

Once the drum has been loaded, the device is introduced successively in each of the degreasing, pickling and washing baths, then in the electrolytic coating bath (as shown in FIG. 1). The drum is set in rotation by means of the motor **16** and an electric supply voltage is applied between the springs **36** and electrodes which are placed in the bath, the springs being connected to the negative pole. During the rotation of the drum in the direction shown by the arrow *f* in FIG. 2, the strips **38** are subjected to a periodic "flip-over" motion (arrow *f'*) which ensures uniform nickel-plating over their entire surface. It is apparent in particular that each strip **38** has an orientation which is opposite to its initial orientation after one full revolution of the drum, any lack of uniformity being consequently avoided.

By way of example, it can be noted that a device which is constructed for the purpose of nickel-plating uranium strips measuring 15 mm. x 3 mm. in transverse cross-section and approximately 60 mm. in length comprises a drum 180 mm. in diameter which carries twelve springs of substantially triangular cross-section and formed of nickel wires 1 mm. in diameter. The small plates which are introduced within the springs are subjected to a treatment involving suitable surface preparation and washing followed by a nickel-plating process during which the drum rotates at a speed of 10 r.p.m.

The device which has just been described and the process which entails the utilization of said device are in no may limited to the metallic coating of parts and are applicable to any operation involving bath treatment; the term "bath treatment" is used here in a wide sense and includes within its scope such treatments as pickling, degreasing, washing, passivation and so forth which can either precede or follow the electrolytic coating process.

It will be readily understood that the invention is not limited in any sense to the single embodiment which has been illustrated and described and it must be understood that the scope of this patent extends to all alternative forms or all or a part of the arrangements described which remain within the definition of equivalent means.

What we claim is:

1. An apparatus for the surface treatment of prismatic parts, each having in transverse cross-section *n* long sides of substantially equal lengths, said apparatus comprising a tank containing an electrolyte, a rotatable support mounted horizontally in said tank, means to rotate said support so that at least part of said support is immersed in said electrolyte, means for supporting said prismatic parts in said support for causing periodic "flip-over" of the prismatic parts during rotation of said support, said means comprising at least one electrically conductive coil positioned sufficiently near the periphery of said support so that the coil becomes immersed, said coil defining a cylinder axially parallel to the axis of said support and having a transverse cross-section in the shape of a regular polygon with N sides which are of slightly greater length than said long sides of each part, the number N being greater than *n*, and means to effect an electrical potential on said coil to cause treatment of said parts.

2. A device as described in claim 1 wherein said support is a drum, a plurality of springs fixed at uniform regular intervals about the axes of said drum, said driving means rotating said drum.

3. A device as described in claim 2, said drum being partially immersed in the electrolytic bath, said means for supplying electric current comprising an electrically conductive ring integral with the peripheral portion of said drum and connected to each of said springs and a collector brush outside the bath and in sliding electrical contact with said ring.

4. A device as described in claim 2, said drum comprising two flanges of insulating material held together by spacer members, one of said flanges carrying said ring and having recesses for receiving the terminal portions of said springs, the other of said flanges having slots through which said springs are inserted and located opposite to said recesses and a plate for retaining said springs fixed to said second flange.

5. A device as described in claim 4, said retaining plate being fixed to the corresponding one of said flanges by connecting means providing an angular displacement of said plate between a first position for insertion of parts to be treated in said springs through said slots and a second position holding the parts in said springs.

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ROBERT K. MIHALEK, Primary Examiner

U.S. Cl. X.R.

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