

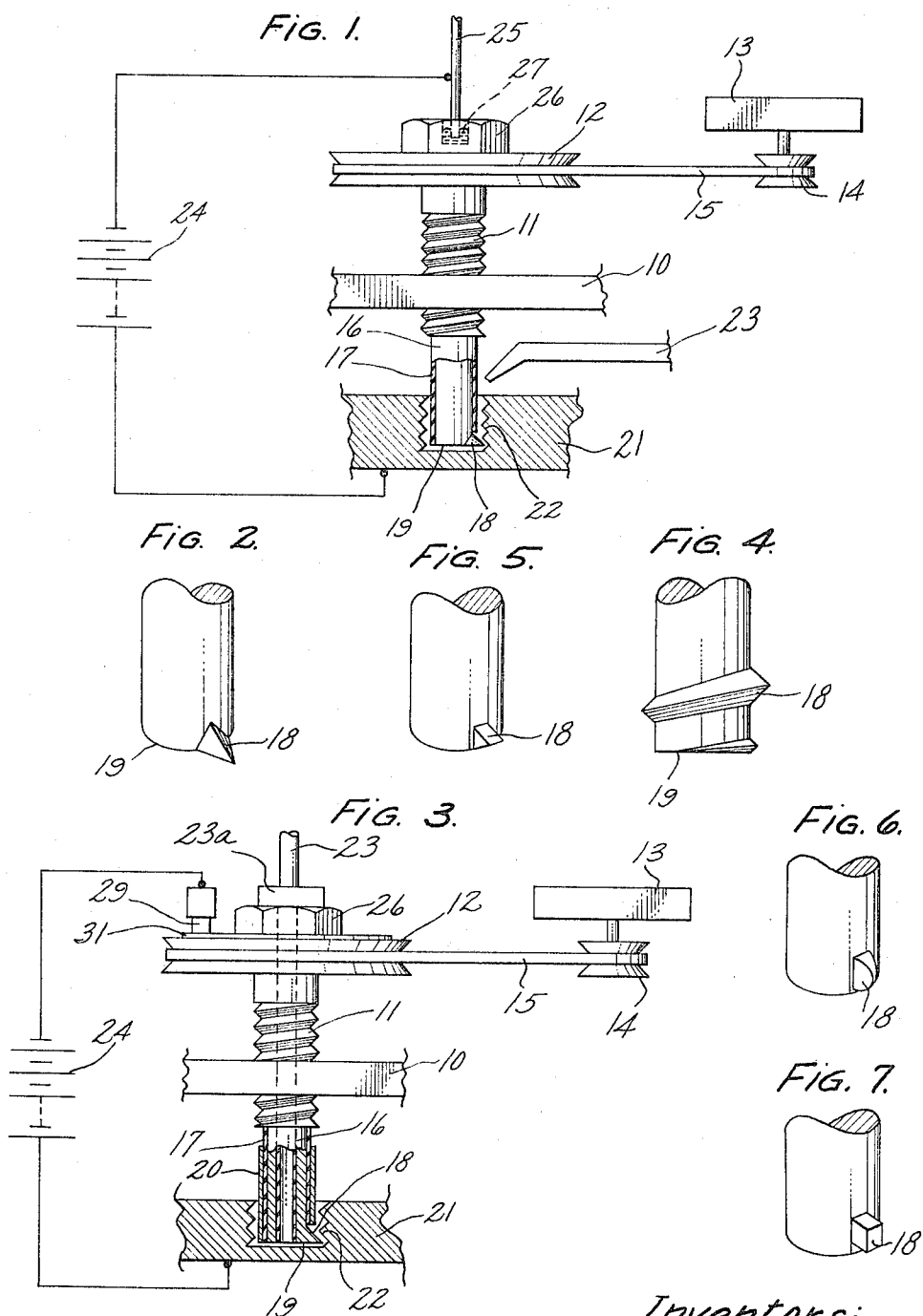
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ELECTROLYTIC DRILLING AND TAPPING APPARATUS

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ELECTROLYTIC DRILLING AND TAPPING APPARATUS

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1 Claim. (Cl. 204—212)

This invention relates to a method and apparatus for electrolytically drilling and/or simultaneously tapping holes in conducting materials including very hard metal alloys.

Crawford and Halverstadt application Serial No. 823,975, filed June 30, 1959, now abandoned, which is assigned to the same assignee as the present application, was directed to electrolytically drilled holes wherein an elongated cathode was brought nearly into contact with an anode workpiece over which electrolyte was flowing under high current density conditions. As the anode material went into solution, the elongated cathode was slowly advanced into the workpiece. Material removal was limited to the tip of the workpiece by an insulation coat on the stem of the cathode and in this manner it was found that the diameter of the hole could be closely maintained.

We have found that the cathode can be so shaped at the tip that a constant rate of rotation and feed will enable holes to be tapped at the same time that they are being drilled. Accordingly, one of the objects of this invention is to provide a method and apparatus for the simultaneous drilling and tapping of holes in conducting materials.

Another object of the invention is to provide a method and apparatus for electrolytically drilling and tapping holes in very hard metal alloys.

A further object is to provide a method for tapping stress-free threads in metals and alloys.

The above and other objects are accomplished in accordance with the following specification considered in conjunction with the attached drawing wherein FIG. 1 illustrates in schematic form partially sectioned apparatus for electrolytically drilling tapped holes in accordance with this invention;

FIG. 2 is an enlarged perspective view of the cathode tip of the apparatus illustrated in FIG. 1;

FIG. 3 illustrates apparatus for electrolytically drilling tapped holes wherein electrolyte is introduced to the workpiece through the cathode;

FIG. 4 is an enlarged perspective view of an alternative cathode tip wherein annular threads of increasing thread depth are used to effect the tapping; and

FIGS. 5-7 are perspective views of alternative cathode tips for cutting various types of thread.

Briefly stated, in accordance with one of its aspects, this invention enables the simultaneous drilling and tapping of holes in a workpiece by the passage of electric current through an electrolyte between the apparatus and the workpiece by using an elongated cathode member having a radially extending thread-forming projection at the tip thereof and by moving the cathode along its longitudinal axis and rotating the cathode about this axis in order to bring the rotating cathode to the surface of a workpiece over which electrolyte is flowing.

Referring to the drawing, a supporting base 10 is equipped with a threaded aperture with which a feed screw 11 is threadably engaged. The feed screw 11 may be slowly rotated by means of a pulley 12 mounted thereon, which is driven by an arrangement consisting of an electric motor 13 and its pulley 14, and a belt 15 or other suitable driving means.

Extending from the lower end of the feed screw 11 is

an elongated cathode 16, the shank of which is coated with an insulating layer 17. The extending tip end of the cathode 16 is equipped with a radially extending thread-forming projection 18 which is uninsulated as is the leading tip surface 19 of the cathode 16. The projection 18 has a profile such that as it is advanced axially toward a workpiece 21 and rotated slowly, it will undercut the metal of the workpiece 21 in the form of continuous threads 22.

During the material-removing operation, electrolyte is constantly introduced to the work surface of the workpiece 21 through a tube 23. In general, the nature of the electrolyte solution is not critical, an example of a satisfactory electrolyte for many applications being ordinary sea water. Power is provided by a D.C. source, as indicated at 24, which is normally at a potential of about 20 volts. The D.C. source is not critical and may vary within a range of 5 to 50 volts, depending on the composition, age, and temperature of the electrolyte as well as the anode-cathode gap. The positive side of the D.C. source is connected to the workpiece 21 and the negative to a bus bar 25 electrically connected to a head portion 26 of the feed screw 11 through a pool of mercury 27 or other conducting media in a cup-shaped hollow of the head portion 26.

The apparatus shown in FIG. 3 is similar to that illustrated in FIG. 1 except that the cathode 16 is hollow and the electrolyte is introduced through a swivel connection 23a on the head portion of the feed screw 11. Non-corrosive electrolytes can be used at pressures of the order of 200 p.s.i.g. and the swivel connection allows such pressure to be maintained. The electrical circuit in the embodiment of FIG. 3 is made by means of a brush 29 in contact with a pick-up ring 31 around the perimeter of the head portion 26. The tip portion of the cathode of FIG. 3 is equipped with an anode shield 20 which is a "floating" conducting sleeve overlying the outer insulation layer 17. The anode shield 20 neutralizes any charged flow passing over the cathode that otherwise might cause uncontrolled metal removal from the threads already cut.

In FIG. 4, the extending tip end of the cathode 16 is shown with the thread-forming member in the form of an annular projection in which the radial depth increases as the distance from the tip increases. This construction is particularly advantageous for deep-cut threads as the thread cutting continues around the entire perimeter of the cathode 16 as it is being advanced into the workpiece.

FIGS. 5-8 illustrate cathode tips having alternative shapes of projections 18 for cutting Wittworth, square, and acme threads. Obviously, eccentric thread contours are easily obtainable by means of the present invention.

While the invention has been described with particular reference to a combined drilling and tapping operation, it is obvious that holes already drilled could be tapped by means of the invention. In the case of holes of sizable diameter, the drilling rate can be increased by leaving a central core in place. This core can be removed to provide a rod of hard metal which can be threaded by providing the cathode with an internal thread-cutting projection during the metal-removal operation.

The aforementioned Crawford and Halverstadt application described the drilling of holes in highly refractory alloys at rates as high as sixteen inches per hour at current densities of the order of 10,000 amps. per square inch. Similar feed rates and current densities can be maintained in the present invention and long, thin tapped holes can be produced by a simultaneous drilling and tapping operation. The "tap" threads are not worn by this operation since they do not come into contact with the workpiece.

While the invention has been described with reference

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to particular embodiments thereof, it is obvious that there may be variations which still fall within the true spirit of the invention. Therefore, the invention should be limited in scope only as may be necessitated by the scope of the appended claim.

What we claim as new and desire to secure by Letters Patent of the United States is:

In an apparatus for the drilling and tapping of holes in a workpiece by the passage of electric current through an electrolyte between the apparatus and the workpiece, an elongated cathode having a radially extending thread-forming projection at a tip end thereof, a layer of insulation over the portions of said cathode exposed to electrolyte except for the tip surface and thread-forming projection, a conducting sleeve overlying said layer of insulation, means for moving said cathode along its longitudinal axis and rotating said cathode around said axis, and means for introducing electrolyte to the tip portion of said cathode.

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