March 2, 1971 W. D. KELLY 3,567,596

ELECTROLYTICALLY COPPER PLATING AN ALUMINUM WIRE

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Fig. 1.

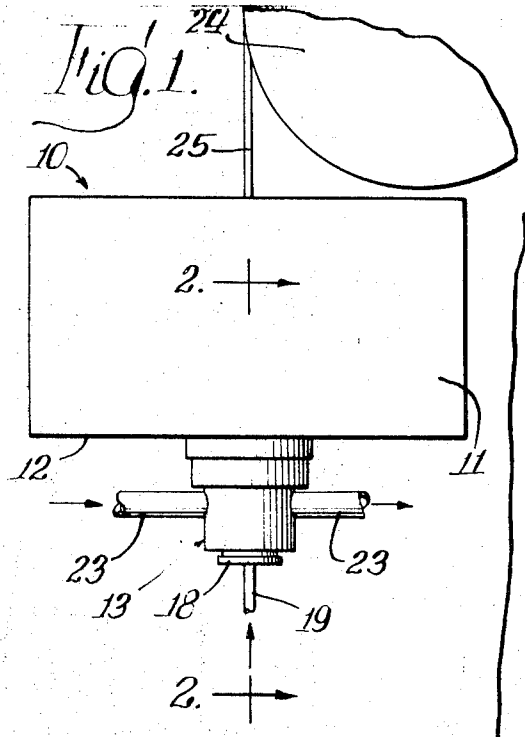


Fig. 2.

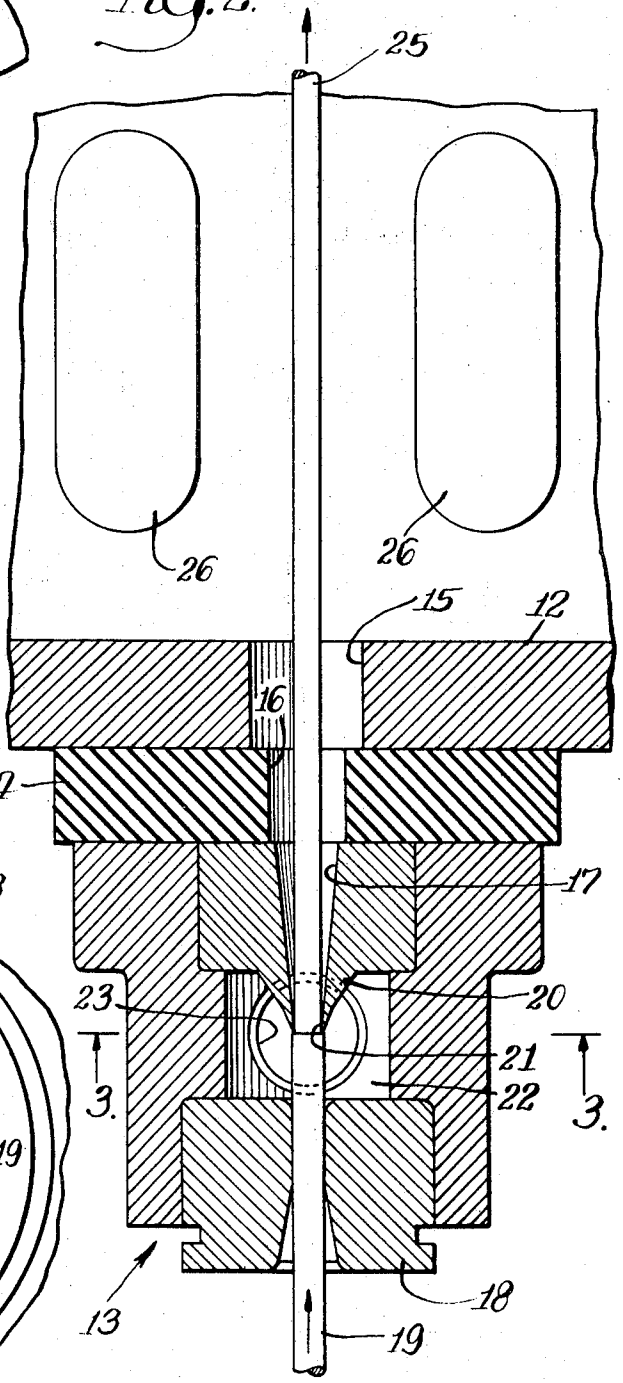
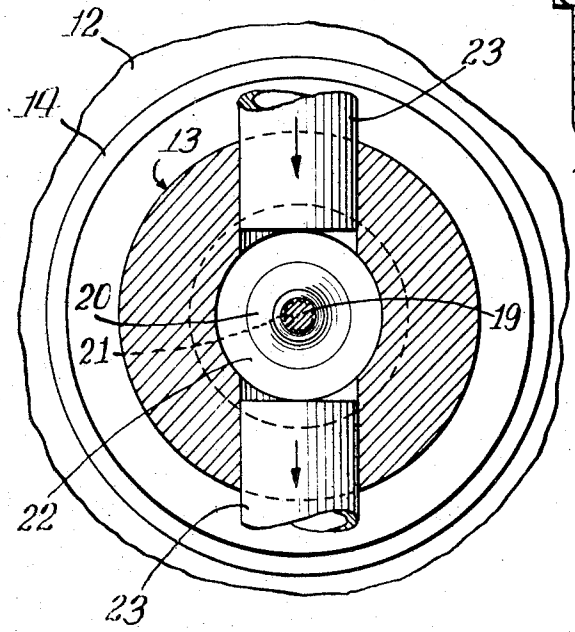


Fig. 3.



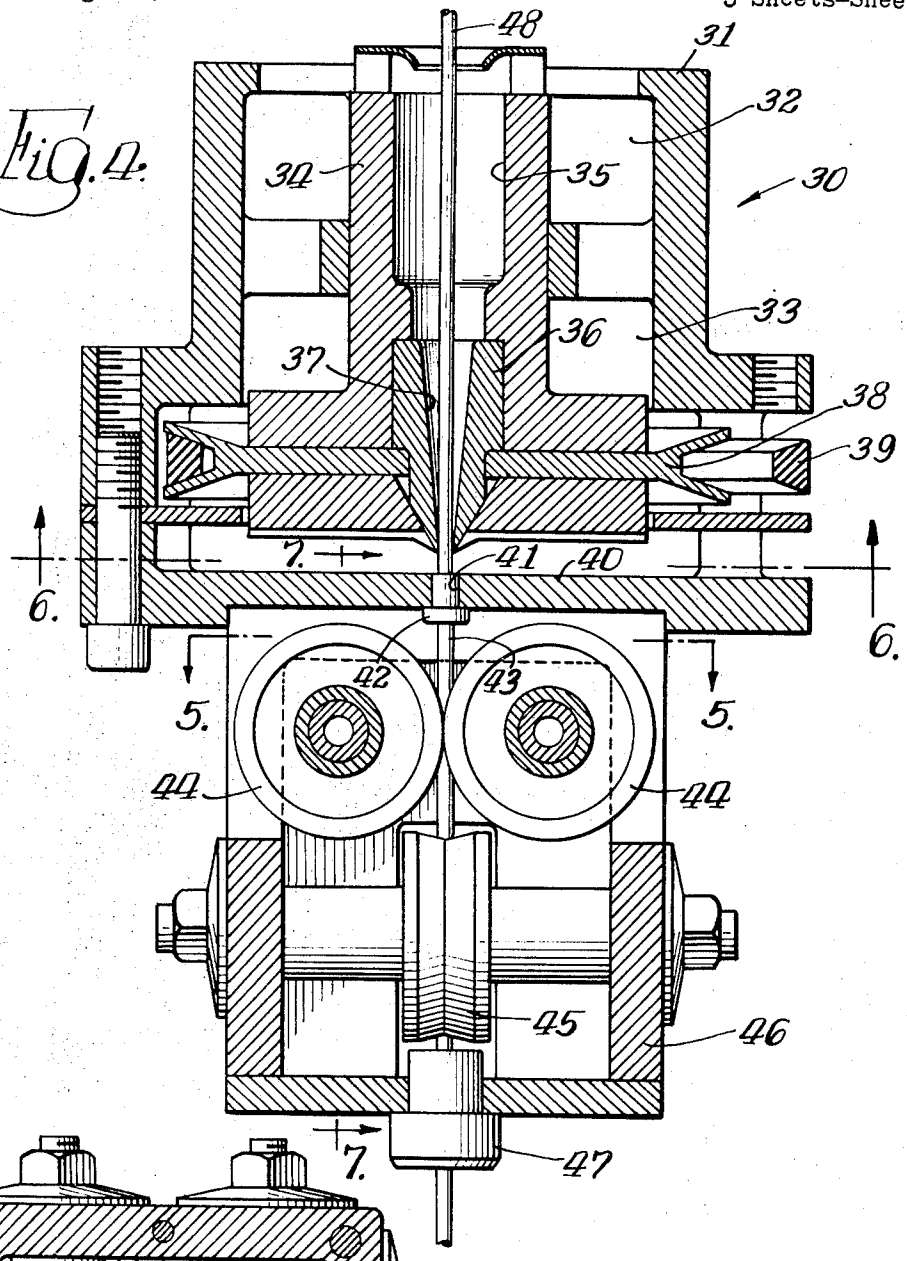
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Fig. 4.



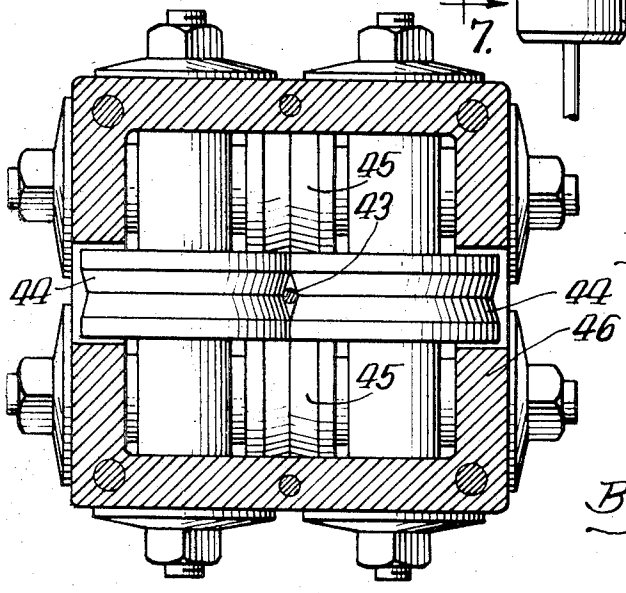


Fig. 5.

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Fig. 6.

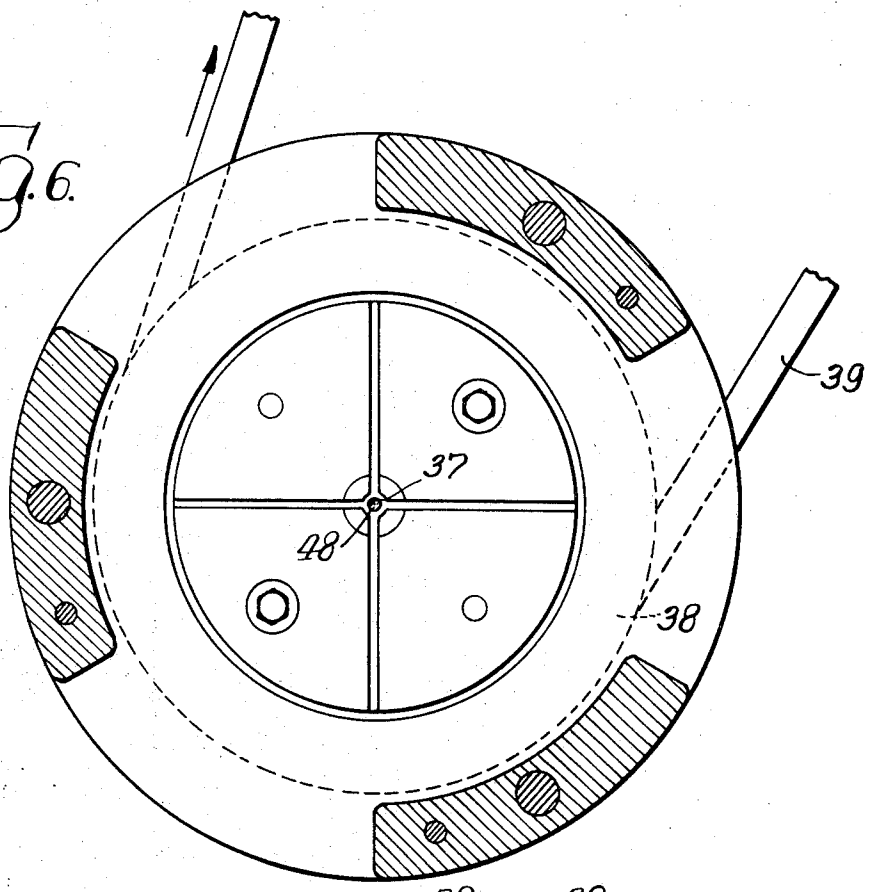
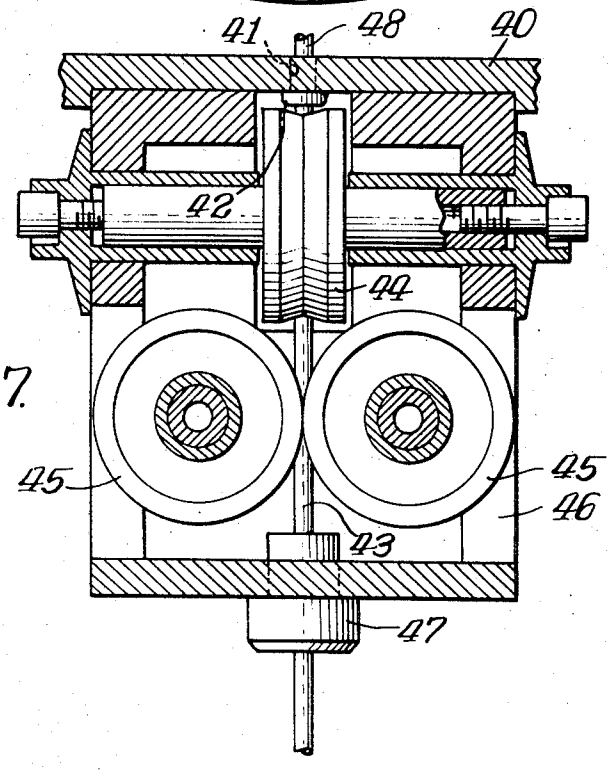


Fig. 7.



United States Patent Office 3,567,596 Patented Mar. 2, 1971

3,567,596

ELECTROLYTICALLY COPPER PLATING AN ALUMINUM WIRE

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Continuation-in-part of application Ser. No. 718,399, Apr. 3, 1968. This application Aug. 19, 1968, Ser. No. 755,504

Int. Cl. C23b 5/18, 5/48, 5/68

U.S. Cl. 204—28 3 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to an apparatus for electrolytically plating wire. The apparatus is particularly useful in copper plating of aluminum wire and includes means whereby the outer layer of aluminum oxide may be stripped from the aluminum wire immediately prior to immersion of the wire into the electrolytic solution so as to inhibit the formation of aluminum oxide coating on the stripped wire.

This application is a continuation-in-part of my copending application Ser. No. 718,399, filed Apr. 3, 1968, now abandoned.

This invention relates to electroplating apparatus and more particularly to apparatus for electroplating wire.

It is a general object of the invention to produce a new and improved electroplating apparatus of the character described.

Wire of materials other than copper are coming into increasing use primarily because of the shortage of copper. The most commonly used substitute metal is aluminum. Because of the lower conductivity of aluminum, wires made of that material must be of larger diameter than copper wires capable of carrying the same amount of electrical current. While it may have occurred to seekers of solutions for the problem that possibly aluminum wire could be provided with a more conductive coating, the fact is that aluminum wire upon formation immediately acquires a coating of aluminum oxide when exposed to air. Aluminum oxide is quite inert and hence inhibits or even prevents the application of a coating of more conductive material thereover by layering or otherwise.

According to the present invention, however, means are provided for producing a copper coating on aluminum wire by use of the electrolytic plating method. In order to make such a system workable, the apparatus of the present invention is arranged so that the coating of aluminum oxide present on aluminum wire is stripped from the underlying aluminum and the stripped wire is immediately immersed in electrolytic solution without being exposed to oxygen. By virtue of the foregoing, a coating of aluminum oxide is not re-formed on the aluminum wire and hence it is in condition to receive the electrolytic coating of copper, with the result that a highly conductive wire composed of a layer of aluminum and a coating of copper thereover is formed.

Accordingly, it is a more specific object of the present invention to produce an apparatus for depositing electrolytically a coating of copper over aluminum wire, wherein the aluminum wire has been stripped of its aluminum oxide coating prior to the plating operation, and wherein the reformation of an aluminum oxide coating prior to the plating step is prevented.

Other and further objects of the invention will become readily apparent from the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of apparatus embodying the invention;

FIG. 2 is an enlarged fragmentary vertical sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a horizontal section taken along line 3—3 of FIG. 2;

FIG. 4 is a view like FIG. 1 of a modified form of construction;

FIG. 5 is a horizontal section taken along line 5—5 of FIG. 4;

FIG. 6 is a horizontal section taken along line 6—6 of FIG. 4; and

FIG. 7 is a vertical section taken along line 7—7 of FIG. 4.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail several embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to FIGS. 1–3 in the drawings, there is shown a container **10** having side walls **11** and a bottom **12**. A fixture **13** is secured to bottom **12**, there being a liquid-proof gasket of resilient material **14** interposed between the fixture and the bottom **12** of the container.

The bottom of the container is provided with an opening **15** communicating with an opening **16** in the gasket **14**, in turn communicating with an opening **17** in the fixture. Wire **19** to be treated is guided into the fixture **13** by guide means **18** and then is led into a die member **20** having an opening **21** less than the diameter of the wire **19**. The fixture is arranged to provide a space **22** between the guide means **18** and the die member **20**, and air conduits **23** communicate with this space and are adapted to conduct air under pressure therethrough so as to blow chips of wire removed by the die **20** out of the space **22**. Means in the form of a drum **24** are provided upon which the treated wire **25** is rolled after passing through the container **10**. Preferably, the drum **24** is powered so as to draw the wire from a drum or reel (not shown) beneath the container through the fixture **13**, the container **11**, and then onto the drum **24**.

A pair of anodes **26** is located in the container **11** adapted to be immersed in the electrolytic liquid therein and attached to the negative terminals of a source of electrical energy while the wire **19**, suitably insulated from ground, is connected so as to be the cathode of the plating system.

In operation, with power applied to the drum **24**, the wire **19**, guided by the guide means **18**, is drawn through the opening **21** in the guide member **20** thereby stripping off the outer aluminum oxide surface of the aluminum wire. Emerging from the die **20**, the wire passes immediately into the electrolytic solution in the aligned openings **17**, **16**, and **15**, and then directly into the solution in the container **10**. While passing between the electrodes **26**, the wire is given a plating of copper and upon emerging from the plating bath is wound up on the drum **24**.

The air conduits **23** serve to remove the aluminum oxide stripped from the wire from space or cavity **22**. Inasmuch as the wire is not exposed to the atmosphere after the outer aluminum oxide coating is stripped therefrom, no new coating of such material is permitted to form thereon and the surface is ready to receive the plating of copper thereover.

Referring now to FIGS. 4–7, there is shown a fixture **30** the upper edge **31** of which is to be secured in fluid-tight relation in a container (not shown) such as the container **10**. Positioned within the fixture **30** is a pair of bearings **32** and **33** rotatably supporting a die carrier **34** provided with a central opening **35**. Secured within the opening **35** is a die **36** having an opening **37** aligned with the opening **35**. A drive pulley **38** is secured to the die carrier and arranged

to be rotated by a V-belt **39** driven by a source of power (not shown).

The fixture **30** is provided with an end wall **40** having an opening **41** in which a wire guide **42** is positioned for guiding a wire **43** therethrough and into the die **36**.

It is often advisable to straighten the aluminum wire before the same is presented to the opening in the die and for this purpose there is provided two pairs of straightening rollers, the first pair **44** being positioned above the second pair of rollers **45**, with both pairs of straightening rollers being rotatably mounted within a housing **46** secured to the end wall **40**. Wire from a drum or reel, or other source of supply, is fed through a wide **47** in the end of the housing **46**, and the finished plated wire **48** is wound upon a take-up drum or other means in a fashion similar to that described in connection with the first embodiment of the invention.

It will be understood, of course, that a container provided with anodes and an electrolytic solution is to be used in connection with the fixture **30** and the rotatable die therein contained.

By using a rotatable die in the manner shown and described, complete removal of the aluminum oxide coating normally found on aluminum wire is assured and inasmuch as the wire is then immediately immersed in the electrolytic solution, there is no possibility of re-formation of the aluminum oxide coating thereon. Therefore, the copper plating which occurs in the electrolytic bath is directly upon the exposed pure aluminum surface of the wire.

While the invention has been shown in several embodiments relating to the copperplating of wire, it will be clear to those skilled in the art that the principles of the invention may be used for plating aluminum tubing. Suitable adjustment in the dies to accommodate tubing, either seamless or otherwise, can be effected to make the illustrated method usable to plate aluminum tubing.

I claim:

1. The method of electrolytically copperplating aluminum wire which comprises, stripping the aluminum oxide coating from aluminum wire and then passing the stripped wire out of contact with the atmosphere directly into an electrolytic solution, and then electrolytically plating copper on the stripped exterior surface of the wire.

2. The method of electrolytically copperplating aluminum wire which comprises, passing the wire through a rotating die member to strip the aluminum oxide coating from the wire, passing the stripped wire out of contact with the atmosphere directly into an electrolytic solution, and then electrolytically plating copper on the stripped exterior surface of the wire.

3. The method of electrolytically copperplating a substantially endless aluminum member having a circular cross-section which comprises, continuously passing the member through a die to strip the aluminum oxide coating from the member, passing the stripped member out of contact with the atmosphere directly into an electrolytic solution, and then electrolytically plating copper on the stripped exterior surface of the member.

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F. EDMUNDSON, Primary Examiner

U.S. Cl. X.R.

204—207