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C. J. KLEIN

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CONDUCTOR ROLL FOR APPARATUS FOR ELECTROLYTICALLY TREATNG STRIP

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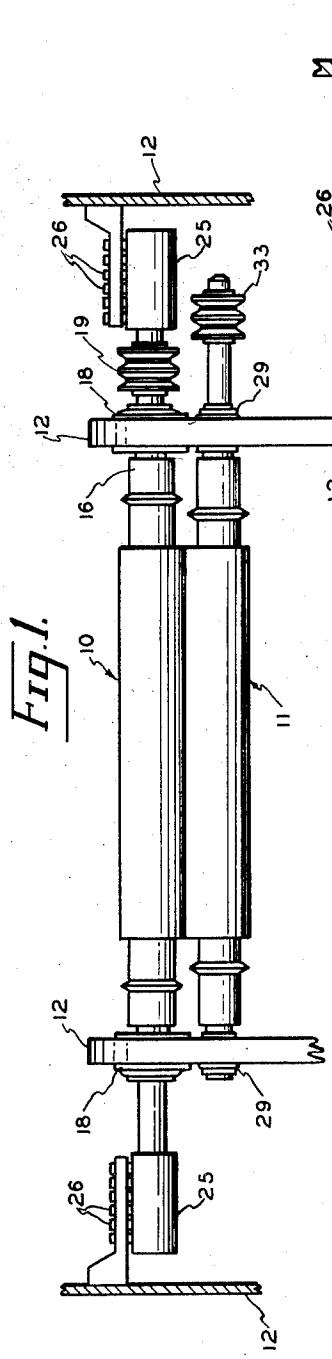


Fig. 1.

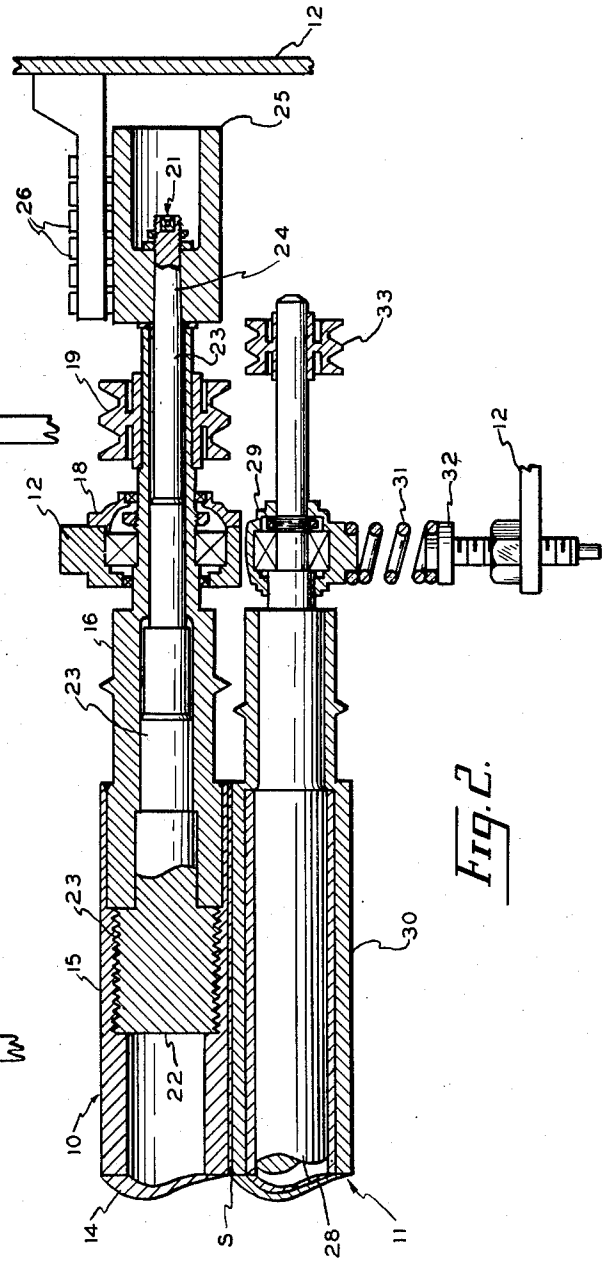


Fig. 2.

INVENTOR.

CLARENCE J. KLEIN

BY

James J. Shawley

ATTORNEY

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CONDUCTOR ROLL FOR APPARATUS FOR ELECTROLYTICALLY TREATING STRIP

Clarence J. Klein, Weirton, W. Va., assignor to National Steel Corporation, a corporation of Delaware

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3 Claims. (Cl. 191—1)

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The present invention relates to improvements in apparatus for electrolytically treating strip material and provides an improved conductor roll particularly adapted for use in such an apparatus to connect the strip to a source of electric current.

In electrolytically treating moving strip, the strip is passed across a bath of electrolyte solution containing an electrode connected to a source of electric current. A rotatable conductor roll engages the moving strip and is connected to the source of electric current to complete the electric circuit through a portion of the strip. The electrolytic treatment to which the strip is subjected may be electrolytic cleaning where the strip is cathodic or anodic, electrolytic pickling, or electroplating. The present invention is primarily concerned with and will be described in connection with the progressive electroplating of a moving steel strip with tin where the strip is made cathodic, although the present invention is not limited to these metals or to electroplating.

One object of the present invention is to provide an improved apparatus for electrolytically treating strip material that includes a novel conductor roll for connecting the strip to a source of electric current.

Another object of the present invention is to provide such a conductor roll which will offer a minimum resistance to the flow of electric current to the strip.

Another object of the present invention is to provide such a conductor roll which combines maximum strength and resistance to attack by the electrolyte with minimum resistance to the flow of electric current to the strip.

These and other objects and advantages will become more apparent when considering the following description, taken with the accompanying drawings in which:

Figure 1 is a view in elevation of apparatus embodying the principles of the present invention; and,

Figure 2 is an enlarged, fragmentary longitudinal section of a portion of the apparatus of Figure 1.

In electroplating lines, the strip is supported and progressively moved across the electroplating cell which contains one or more anodes submerged in the electroplating solution of the cell. The electroplating cell may be of any suitable type or may be of the type shown and described in Patent No. 2,399,254 issued to Rieger et al. on April 30, 1946. The anodes are connected to a generator or other source of electric current. In

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present day practice, a low voltage, high amperage current on the order of, for example, 12 volts is used to electroplate steel strip with tin.

Referring to the drawings, the strip S which is supported and propelled along a predetermined path through the electroplating line by means of power-actuated rolls of the type customarily used in steel mills, or in any suitable manner, progressively passes between an upper conductor roll 10 and a lower back-up roll 11 which holds the strip S in contact with the conductor roll 10. Both rolls 10 and 11 are rotatably mounted in the frame 12. The conductor roll 10 includes an elongated, hollow, substantially cylindrical body portion 14 having a cylindrical external surface 15 which contacts the strip S. The body portion 14 is formed of conductive metal and is preferably formed of a steel alloy or other metal which is relatively strong and which is resistant to attack by the electroplating solution. Each end of the body 10 is mounted on a casing or sleeve 16 which, preferably, is formed of steel to provide the maximum strength and life for the conductor roll. Each sleeve 16 is rotatably mounted in a corresponding bearing 18 carried by the frame 12 so that the conductor roll is free to rotate about the longitudinal axis of the roll. On the outer end of one sleeve 16, there is mounted a pulley 19 adapted to be connected through a belt to a motor (not shown) for rotating the conductor roll at the same peripheral speed as the strip. The pulley may be eliminated, but it is preferred to rotate the conductor roll to prevent slippage between the conductor roll and the strip S.

The conductor roll 10 includes means for connecting the body portion 14 to a source of electroplating current. An elongated copper member 21 has an enlarged end portion 22 inside of the strip contacting body portion 14. The enlarged end of member 21 has a threaded external surface threadedly engaging a threaded internal surface of the body portion 10 at 23. With this threaded connection at 23, the member 21 and the strip contacting body portion 14 are in electrical contact with each other throughout a relatively great area, and the connection between these parts is tight. The copper member 21 includes a portion 23 of reduced size which extends through the steel sleeve 16 with an outer end portion 24 outside of the sleeve. On the end portion 24 of member 21, there is mounted a copper slip ring 25 which is engaged by a plurality of brushes 26 supported by part of the frame 12 and connected to the source of electroplating current (not shown). With this arrangement, the current

flows from the brushes through the copper slip ring and the copper member 21 to the strip contacting body portion 14. Copper has a relatively high conductivity and with the relatively great area of close engagement between the copper member 21 and the body 14 at the threads 23, there is a minimum of resistance to the flow of electric current from the brushes to the strip contacting portion 14. It will be noted that the area of engagement at the threaded connection 23 is larger than the maximum cross sectional area of the copper member 21. Preferably, each end of the conductor roll is connected to a source of electric current to provide more uniform distribution of current throughout the length of the body portion 14 and across the strip.

The sleeves 16 at opposite ends of the strip contacting body portion 14 are formed of steel or other metal of relatively lower conductivity than copper which provides the maximum strength. With the slip ring mounted on the outer end of the copper member 21, the electric current flows through the copper member 21 which offers a relatively lower resistance and there is less voltage drop than there would be if the slip ring were mounted on the outer end of the sleeve 16 which has a relatively lower conductivity. This is particularly important where low voltage current is used as is customary in present day tin electroplating lines. In addition, the steel sleeve 16 has a relatively high resistance to attack by the electroplating solution. For various reasons, such as the strip dragging solution out of the electroplating cell, electroplating solution comes in contact with the body portion 14 and sleeve 16 so that it is important that these members be resistant to attack by the solution to increase the life of the conductor roll. The steel sleeve 16 and the body portion 14 cover and protect the copper member 21 which would be readily eroded by the electroplating solution.

Beneath the conductor roll 10, there is rotatably mounted a back-up roll 11, the back-up roll 11 includes a metal shaft 28 rotatably mounted at each end in a bearing 29 carried by the frame 12. The shaft is covered with a protective layer of rubber 30, and the bearings 29 resiliently urged upwardly to press the back-up roll and the strip S upwardly against the conductor roll 10. As shown more clearly in Figure 2, each bearing 29 is urged upwardly by a spring 31 which is, in turn, mounted on the upper end of a pin 32 carried by the frame 12. The pin 32 is threaded for vertical adjustment for varying the compression of the spring 31 and the pressure of roll 11 upwardly against conductor roll 10. On the outer end of the back-up roll 11, there is preferably mounted a pulley 33 or other suitable means for connecting the roll to a motor (not shown) for rotating the roll at a peripheral speed the same as the lineal speed at which the strip moves along its path through the electroplating line. Preferably, both rolls 10 and 11 are rotated by means of pulleys 19 and 33 so that the surfaces of the rolls are moving at the same lineal speed as the strip so that there is no slippage between the rolls and the strip.

In the present conductor roll, there is a minimum of resistance to the flow of electric current between the slip ring 25 and the body portion 14. The member 21 has relatively low electrical resistance and the tight fitting threads at 23 provide an electrical connection of relatively large area that offers a minimum resistance to flow of electric current between members 14 and 21. The supporting sleeve or shaft provides maximum strength and protects the copper member 21 against attack by the electrolyte from the electrolytic cell which increases the life of the roll. The roll 10 is relatively easily constructed which lowers its cost. Reducing the initial cost and the maintenance cost of conductor rolls is important as a single electroplating line will contain, for example, twenty six of these rolls.

I claim:

1. A conductor roll for making electrical contact with and conducting electrical current to a moving strip comprising an elongated integral tubular body member formed of a conductive metal having an internal substantially cylindrical surface and an external substantially cylindrical surface for making electrical contact with the surface of the moving strip, the internal surface of the body member including a threaded surface portion, supporting means mounted at the ends of the body member for rotatably supporting the body member for rotation about its longitudinal axis, the supporting means including a supporting member at one end of the body member having a longitudinal bore concentric with the longitudinal axis of the body member, and an integral electrical current conductor member formed of conductive metal having a relatively lower electrical resistance than the supporting member for connecting the body member to a source of electrical current, the integral conductor member including a first portion extending outside the supporting member and adapted to be connected to a source of electrical current, a second portion extending through the bore of the supporting member and an enlarged portion extending into one end of the body member, the enlarged portion including an external threaded substantially cylindrical surface having a diameter substantially equal to the diameter of the threaded surface portion of the internal surface of the body member, and the external threaded surface on the enlarged portion of the integral conductor member threadedly engaging the threaded surface portion of the body member to form a mechanical connection and a low resistance electrical connection between the integral conductor member and the body member.

2. A conductor roll for making electrical contact with and conducting electrical current to a moving strip comprising an elongated integral tubular body member formed of a conductive metal having an internal substantially cylindrical surface and an external substantially cylindrical surface for making electrical contact with the surface of the moving strip, the internal substantially cylindrical surface including a threaded surface portion spaced from one end of the body member and an increased diameter substantially cylindrical surface portion between the threaded surface portion and the one end of the body member, an integral electrical current conductor member for providing a path of low electrical resistance from a source of electrical current to the external cylindrical surface of the body member, the integral conductor member including an enlarged substantially cylindrical end portion and a second substantially cylindrical portion having a diameter less than the diameter of the enlarged end portion extending axially of one end of the enlarged portion, an external threaded surface on the enlarged end portion of the conductor member, the external threaded surface of the conductor member having a diameter substantially equal to the diameter of the threaded surface portion of the body member, the con-

ductor member extending into the one end of the body member with the external threaded surface on its enlarged end threadedly engaging the threaded surface portion of the internal surface of the body member, and supporting means mounted at the ends of the body member for rotatably supporting the body member for rotation about its longitudinal axis, the supporting means including a rotatably mounted sleeve member extending over the second portion of the conductor member and within the increased diameter portion of the body member, the integral conductor member having a relatively lower electrical resistance than the sleeve member.

3. A conductor roll for making electrical contact with and conducting electrical current to a moving strip comprising an elongated integral tubular body member formed of a conductive metal having an internal cylindrical surface and an external cylindrical surface for making electrical contact with the surface of the moving strip, the internal cylindrical surface including a threaded portion spaced from each end of the body member and an increased diameter portion between each threaded portion and an end of the body member, an integral electrical current conductor member at each end of the body member for providing a path of low electrical resistance from a source of electrical current to the external cylindrical surface of the body member, each of the integral conductor members including an enlarged cylindrical end portion and a second cylindrical portion of a diameter less than the diameter of the end portion extending axially of one end of the enlarged end portion, an external threaded surface on the enlarged end portion of the conductor members, the external threaded surface on the conductor members having a length and diameter substantially equal to the length and diameter of the threaded portion of the internal surface of the body member, each conductor member extending into an end of the tubular body member with the external threaded surface of its enlarged end portion threadedly engaging the threaded portion of the internal surface of the body member and with its second

portion extending through the region of the increased diameter portion of the internal surface of the body member in concentric relation therewith and terminating beyond the end of the body member, a rotatably mounted cylindrical sleeve member positioned at each end of the body member for rotatably supporting the body member for rotation about its longitudinal axis, each of the sleeve members having a cylindrical bore of a diameter substantially equal to the diameter of the second portion of the conductor member and including an enlarged end portion provided with an external cylindrical surface of a diameter substantially equal to the diameter of the increased diameter portion of the internal surface of the body member, the enlarged end portion of each sleeve member being mounted in an end of the body member with the second portion of the conductor member passing through the cylindrical bore of the sleeve member, the external cylindrical surface of the sleeve member contacting the increased diameter portion of the body member and the end of the enlarged portion of the sleeve member abutting the one end of the enlarged portion of the conductor member, and a third portion extending integrally from the second portion of the conductor member outwardly beyond the sleeve member and adapted to be connected to a source of electrical current, the conductor member being formed of a conductive material having a lower electrical resistance than the sleeve members.

CLARENCE J. KLEIN.

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