

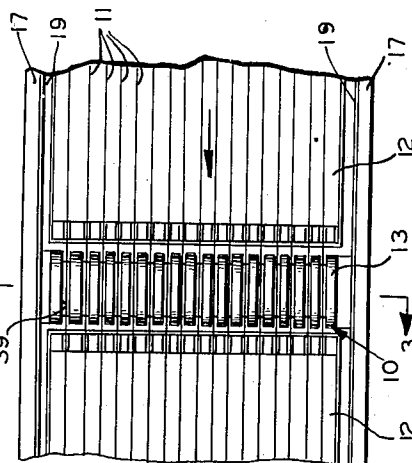
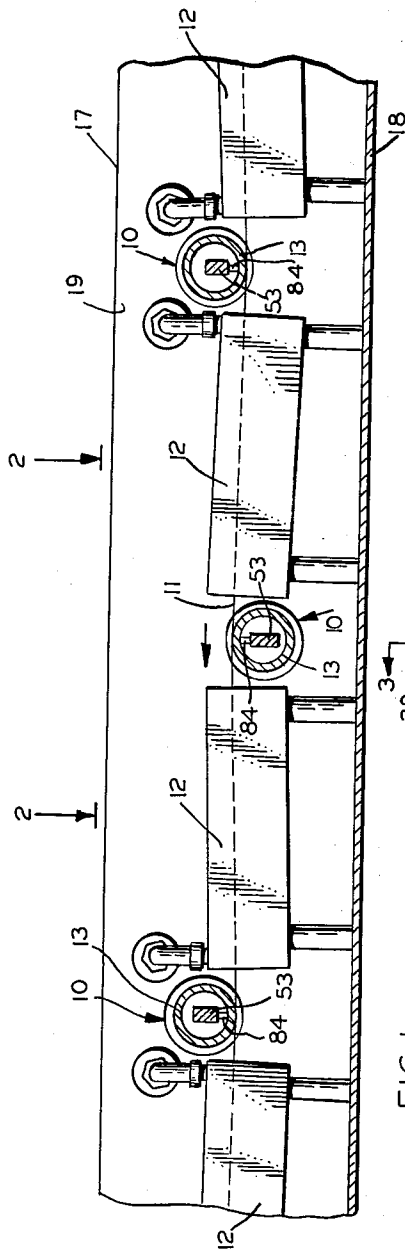
Jan. 24, 1961

V. A. RAYBURN
CONTACT ROLL ASSEMBLY

2,969,437

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4 Sheets-Sheet 1



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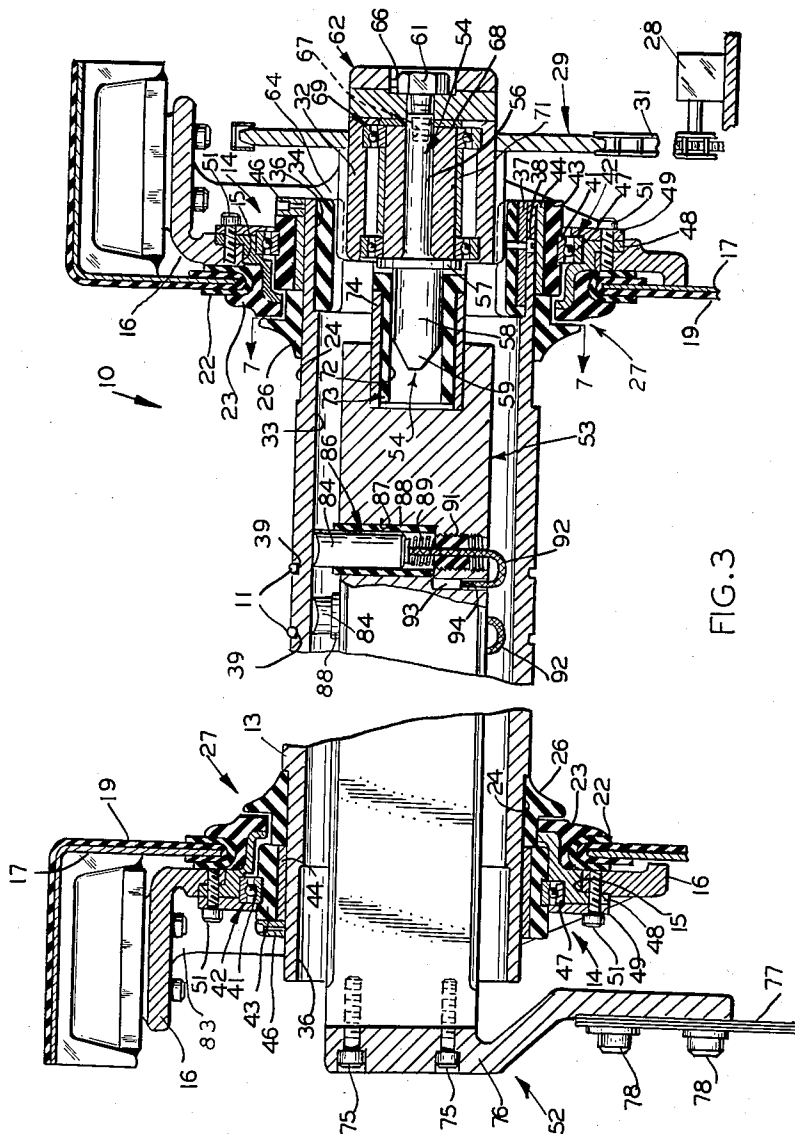


FIG. 3

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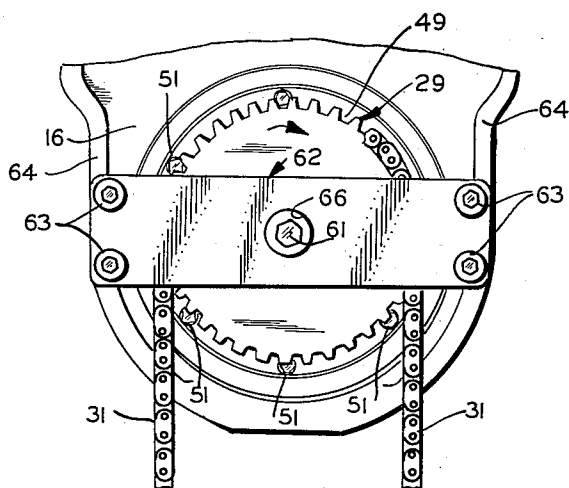


FIG. 4

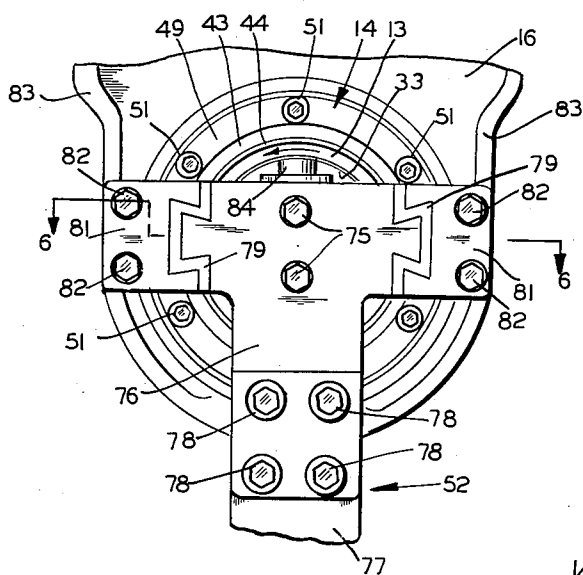


FIG. 5

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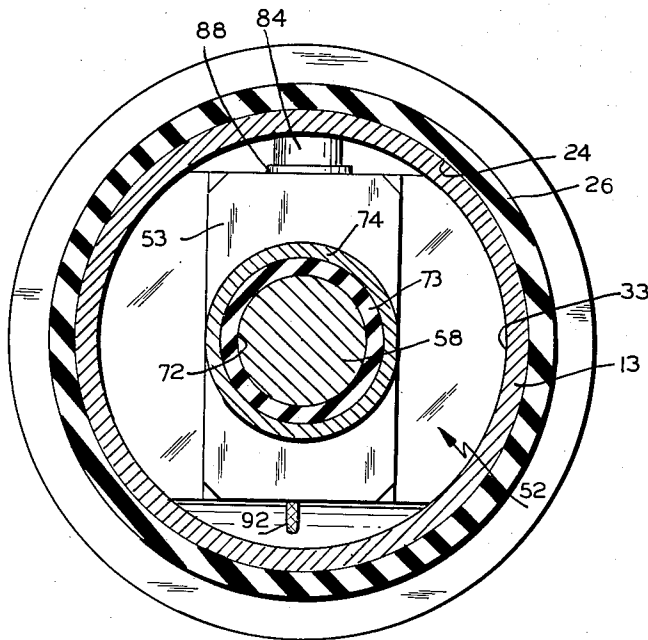
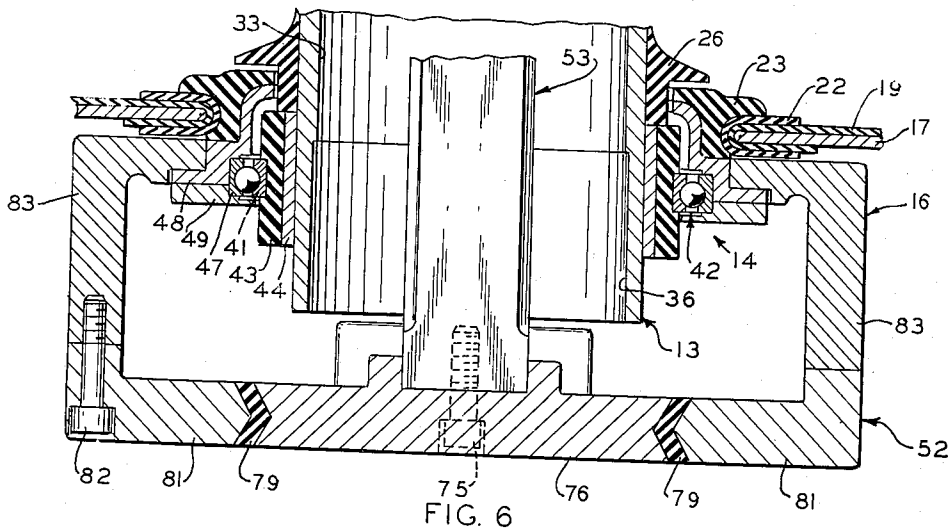
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CONTACT ROLL ASSEMBLY

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The present invention relates generally to contact roll assemblies, and more particularly to an improved contact roll assembly of the internal brush type designed so that a stationary brush bar carrying the brushes may be removed from within a rotary outer shell while the shell is rotating to facilitate replacement or cleaning of the brushes.

Various contact roll assemblies have been devised for use in the continuous electrotreating of advancing elongated material, wherein it is desired to apply an electrical charge to the material as it passes through a treating bath. Such assemblies are used, for example, in the electroplating of a coating of a dissimilar metal on a plurality of advancing metallic wires, such as in the plating of copper and other metals on steel wires in the communications industry.

A description of a general process for copper-cladding steel wire in the communications industry, in which the contact roll assembly of the invention may be used, is to be found in an article entitled "Development and Manufacture of Electroformed Conductor for Telephone Drop Wire," by A. N. Gray and G. E. Murray, appearing in The Bell System Technical Journal, vol. 32, pp. 1099-1135, dated September 1953.

In such electroplating operations, the advancing wires pass around portions of the periphery of a series of rotary contact rolls, which are cathodically charged to conduct the plating current to the wires and which guide the wires through the plating baths. A suitable anode is disposed in the plating bath to complete the circuit so as to enable deposition of a metal coating from the electrolyte bath onto the advancing wires.

According to certain prior arrangements, the contact roll assembly has included a rotary cylindrical shell of conductive material around which the wires pass and a stationary brush bar of conductive material, extending axially into the shell and about which the shell is journaled. The brush bar is connected to the negative terminal of a potential source and functions to conduct current to the shell. For this purpose, a number of brushes are carried by the brush bar in electrical contact therewith and in bearing contact with the inner surface of the rotating shell at points near the points of contact between the wires and the shell. The brush bar and shell are otherwise insulated from each other and from their surroundings.

In prior assemblies of this type, the brush bar has protruded from the shell on both sides thereof and has been secured to supporting members on either side of the shell. A pair of annular end-closure members have been provided, which are secured to the inner surface of the shell and surround the brush bar to seal off the assembly. In this instance, bearings are provided between the end-closure members and the brush bar to permit rotation of the end-closure members and the shell, as a unit, about the stationary central brush bar.

Such an assembly functions well in operation; however, when the assembly must be dismantled to replace

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or clean the brushes, the dismantling operation is laborious and time consuming. In addition, the rotation of the shell must be stopped and a number of threaded fasteners, such as bolts or the like, must be removed in order to remove the end closures and the bearings to allow separation of the brush bar from the shell so that work may be performed on the brushes. In a continuous operation as described in the above-cited article, wherein twenty-five parallel wires advance at one hundred feet per minute through a succession of more than fifty separate cleaning and plating baths, it is extremely disadvantageous to stop the continuous advancement of the wires and shut down the operation even momentarily.

For the foregoing reasons, it is highly desirable that a contact roll assembly be provided which will permit ready removal of the stationary brush bar carrying the brush assembly from within the shell while the shell is rotating to permit rapid replacement or cleaning of the brushes. It is also desirable to provide a contact roll assembly arranged so that the entire assembly may be removed without interrupting the advancement of the wires.

Accordingly, the general object of the present invention is to provide a new and improved contact roll assembly.

A more specific object of the invention is to provide a new and improved contact roll assembly of the internal brush type wherein a stationary brush bar carrying the brushes may be removed from within a rotary outer shell while the shell is rotating to permit rapid replacement or cleaning of the brushes.

A further object of the invention is to provide a contact roll assembly which may be removed without interrupting the advancement of a number of wires through an electroplating apparatus.

Another object of the invention is to provide an improved brush assembly wherein the brushes are slidably and insulatedly mounted in a brush bar and are electrically connected to the brush bar only through a conductor.

Yet another object of the invention is to provide bearings which are insulated from the shell but which provide a path to ground for static charges.

An apparatus according to the invention, may include an improvement in a contact roll assembly having a rotary cylindrical shell, an electrically conducting brush bar extending into the shell, and a brush extending between the brush bar and the inner surface of the shell to conduct current from the brush bar to the shell. An improved assembly, illustrating certain features of the invention, may include a stationary centering member extending into the shell from one end thereof and designed for supporting one end of the brush bar slidably thereon, and means for mounting the other end of the brush bar stationarily. With this arrangement, the brush bar may be removed from within the shell while the shell is rotating by disconnecting the mounting means and pulling the brush bar off of the centering member and out of the shell.

The brush bar and centering member may be provided with mating pin-and-socket ends permitting slidable reception of one end of the brush bar on the centering member. Preferably, one end of the brush bar is formed with a socket lined with an electrically insulating material and the mating end of the centering member is formed with a projecting pin having a tapered nose for receiving the socket.

According to other features of the invention, a pair of opposed support members are provided having aligned circular apertures therethrough for receiving the shell and a pair of ball-bearing assemblies are mounted between the support members and the shell permitting rota-

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tion of the shell. The bearing assemblies include electrically insulating material on the shell sides thereof while providing a path to ground on the support sides to permit static charges to leak off. Preferably, the shell is adjustable longitudinally in the bearings with a splined driving connection being used to permit such movement. The bearing assembly may further be constructed to facilitate removal of the shell from the contact roll assembly without interrupting the advancement of the wires.

According to still other features of the invention, an improved brush assembly may include a plurality of generally cylindrical brushes received slidably within a plurality of electrically insulated bores in the brush bar, and a plurality of springs mounted within the bores for biasing the brushes into contact with the shell. In this arrangement, a plurality of flexible electrical conductors connect the brushes electrically with the brush bar.

Other objects and advantages of the invention will appear from the following detailed description of a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary vertical section of a portion of an electroplating apparatus including a plurality of cells and utilizing the improved contact rolls of the invention;

Fig. 2 is a plan view of a portion of the apparatus illustrated in Fig. 1, looking along the line 2—2, of Fig. 1 and illustrating the position of a contact roll with respect to adjacent plating cells;

Fig. 3 is an enlarged vertical section through an improved contact roll assembly according to the invention, taken generally along the line 3—3 of Fig. 2 in the direction of the arrows and having portions broken away to reveal structural details;

Fig. 4 is a fragmentary end view of the assembly illustrated in Fig. 3, looking from the right of Fig. 3 and illustrating details of a mounting means for a centering member;

Fig. 5 is a fragmentary end view looking from the left of Fig. 3 and illustrating details of a mounting means for a brush bar;

Fig. 6 is a fragmentary horizontal section with parts removed for clarity, taken generally along the line 6—6 of Fig. 5 in the direction of the arrows and showing further details of the brush-bar mounting means, and

Fig. 7 is an enlarged vertical section, taken generally along the line 7—7 of Fig. 3 in the direction of the arrows and illustrating details of the brush bar, the centering member, and a rotary shell.

Referring now in detail to the drawings and in particular to Figs. 1 and 2, a plurality of cathodically charged contact rolls, designated generally by the numerals 10—10, are provided for advancing and guiding a number of parallel steel wires 11—11 through a series of electroplating cells 12—12 designed to deposit a continuous coating of copper onto the steel wires 11—11. The cells 12—12 may be of any suitable construction, preferably as described in the Gray et al. article mentioned hereinbefore. Preferably, the cells 12—12 are arranged in tandem and are alternately tilted in opposite directions as viewed in Fig. 1.

The contact rolls 10—10 are alternately disposed above and below the advancing wires 11—11 and are so positioned that the wire-engaging portions of the bottoms of the upper rolls fall in a plane extending below a plane defined by wire-engaging portions of the tops of the lower rolls. With this arrangement, the wires 11—11 follow a zigzag path in a vertical direction as they pass through the cells 12—12. Also, the wires 11—11 contact the rolls 10—10 under tension over a definite arc along the periphery thereof to insure good electrical contact between the wires 11—11 and the rolls 10—10.

Referring now to Fig. 3, illustrating details of an improved contact roll assembly 10 according to the prin-

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ciples of this invention, the assembly 10 includes a rotary, cylindrical shell 13 around which wires 11—11 advance in tight contact therewith over an arc on the periphery thereof. The shell 13 is made of a material which is both resistant to corrosion due to the electrolyte carried by the wires 11—11 and which is at least a fair conductor of electricity, such as stainless steel or Monel metal.

The shell 13 is journaled at either end in a pair of bearing assemblies, designated generally by the numerals 14—14, for rotation within a pair of aligned circular apertures 15—15 formed in an opposed pair of main support members or brackets 16—16. The two brackets 16—16 are identical but positionally reversed, being shown in elevation in Figs. 4 and 5 with the bracket 16 at the left in Fig. 3 being shown in horizontal section in Fig. 6. A trough having side walls 17—17 shown in Fig. 3, a bottom 18 shown in Fig. 1, and an inner lining 19 of corrosion-resistant material, such as Koroseal, is secured to the opposing support brackets 16—16.

A pair of annular retaining caps 22—22 of Koroseal or the like having a generally U-shaped cross section are fitted within aligned apertures in the trough walls 17—17 and have portions which extend radially outwardly of the apertures around the walls, and a pair of generally ring-shaped shield members 23—23 made of soft rubber or a similar material are fitted within the retaining caps 22—22 and each have portions thereof which extend radially outwardly of the associated cap 22 on both sides thereof, as illustrated in Fig. 3. The ends of the shell 13 are formed with reduced diameter portions 24—24 around which are received in rubber-band fashion a pair of slinger rings or splash-containing members 26—26, which cooperate with the shields 23—23 to form a seal, designated generally by the numeral 27, at each end of the shell 13 preventing seepage of the electrolyte or fumes through the trough walls 17—17 to the bearing assemblies 14—14.

The shell 13 is rotatably driven in any desired synchronism with the speed of advancement of the wires 11—11 by a suitable motor 28 which drives a sprocket wheel, designated generally by the numeral 29, through a chain 31. The sprocket wheel 29 includes an externally splined hub 32, which projects coaxially a short distance into an axial bore 33 of the shell 13 from the right as viewed in Fig. 3. The externally splined hub 32 meshes with an internally splined ring 34, which is secured within a counterbore 36 at the end of the shell 13 by means of a key 37 and a machine screw 38. The splined ring 34 is made of Micarta or other strong, electrically insulating material to prevent conduction of current from the shell 13 to the sprocket wheel 29. It should be noted that the left end of the shell 13 is provided with an identical counterbore 36, which permits driving of the shell 13 from either end thereof.

With the arrangement described, any rotation imparted to the sprocket wheel 29 by the motor 28 is transmitted to the shell 13 through the splined hub 32 and the splined ring 34. The meshing splines on the hub 32 and ring 34 allow longitudinal shifting of the position of the shell 13 and the ring 34 secured thereto with respect to the trough walls 17—17 and the sprocket wheel 29. The shell 13 is illustrated in its extreme leftward position in Fig. 3, but it can be seen that the shell 13 may be moved longitudinally a distance to the right almost equal to the spacing between adjacent parallel wires 11—11 while maintaining the splined driving connection between the hub 32 and the ring 34.

The purpose of the longitudinal shifting movement of the shell 13 is to permit precise alignment of a plurality of wire-carrying grooves 39—39 formed around the periphery of the shell 13 with similar grooves 39—39 formed around all of the other contact rolls 10—10 shown in Fig. 1. In addition, as many as three extra sets of grooves (not shown) may be cut between the

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grooves 39—39 shown in Figs. 2 and 3 so that, when one set of grooves becomes worn, the shell 13 may be shifted to bring a new set of the grooves into operation. When the position of the shell 13 is to be shifted, the slinger rings 26—26 are maintained substantially in place while the shell 13 is slid therepast. For this purpose, a greased spatula-like instrument is inserted between the shell 13 and the rings 26—26 to permit the sliding movement. The limit of this sliding movement is defined by the left edge of the reduced diameter portion 24 of the shell 13 at the right of Fig. 3.

In practice, the contact rolls 10—10 may be so driven that the peripheral speed thereof is substantially equal to the speed of advancement of the wires 11—11 to minimize frictional contact between the wires and the shells 13—13, or the rolls may be overdriven by preselected amounts to assist in carrying the wires 11—11 through the series of cells 12—12. Preferably, each roll 10 is driven both faster than the wire and slightly faster than the previous roll 10.

Considering now the construction of one of the bearing assemblies 14—14, the inner race 41 of a conventional ball-bearing unit, designated generally by the numeral 42, is bonded to the outer periphery of an insulating ring 43 of suitable material, such as an epoxy resin. A metallic sleeve 44 is bonded to the inner periphery of the insulating ring 43, and the sleeve 44 is secured around the shell 13 for rotation therewith by means of a plurality of set screws 46—46. When it is desired to adjust the longitudinal position of the shell 13, the set screws 46—46 are merely loosened to allow sliding movement of the shell 13 within the normally loose-fitting sleeve 44. The insulating ring 43 prevents passage of current from the shell 13 to the ball-bearing unit 42.

Each of the outer races 47—47 of the ball-bearing units 42—42 is secured to the adjacent support bracket 16 by means of an inner housing 48, an outer retaining ring 49, and a plurality of cap screws 51—51 passing through the members 48 and 49 and threadedly received in the bracket 16. One important feature of this assembly is that, although the inner race 41 of the bearing unit 42 is insulated from the rotating, current-carrying shell 13, the outer race 47 is connected to ground through the metallic mounting members 48 and 49 so that any static charges built up in the bearing unit 42 are grounded off harmlessly.

Another advantage of the particular bearing assembly 14 provided is that the shell 13 may easily be removed from the support brackets 16—16 to allow replacement thereof when the grooves 39—39 are worn or when it is otherwise desired to perform work on the shell 13. Removal of the shell 13 may be accomplished, as viewed in Fig. 3, by stopping the motor 28 or otherwise disconnecting the sprocket wheel 29 from the drive motor 28 as by lifting the chain 31 off of the sprocket wheel 29. Then, the set screws 46—46 at the right of the contact roll 10 are loosened to permit sliding movement of the shell 13 and the internally splined ring 34 out of contact with the sleeve 44 of the bearing unit 14 and the externally splined hub 32 of the sprocket wheel 29.

The bearing assembly 14 at the left of Fig. 3 is then dismantled. Before this may be done, a composite brush-bar mounting plate, designated generally by the numeral 52 and to be described in detail hereinafter, must be removed. Then, the set screws 46—46 at the left of Fig. 3 are loosened and the cap screws 51—51 are removed. Next, the retaining ring 49, the inner-race assembly including the ring 43 and the bearing unit 42 bonded thereto, and the inner housing 48 are pulled off of the shell 13 and away from the support bracket 16.

The shell 13 is then pulled out of the supporting assembly, from right-to-left as viewed in Fig. 3, with the outwardly projecting portions of the soft-rubber slinger rings 26—26 being deformed sufficiently to pass

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by the soft-rubber shield 23. The same shell 13 or a replacement therefor may readily be reassembled by repeating the dismounting steps in reverse. When a shell 13 is being removed, there is no need to stop the advancement of the wires 11—11 with the alternate over-and-under roll construction illustrated in Fig. 1, since the remaining rolls 10—10 will be sufficient to support the wires 11—11.

The plating current is conducted to the shell 13 by means of a rectangular, generally solid brush bar, designated generally by the numeral 53 and best seen in Figs. 3 and 7. The brush bar 53 is made of electrically conductive material, such as copper. The brush bar 53 is stationarily mounted by means of the mounting plate 52 and is loosely received within the central bore 33 in the shell 13, as illustrated in Fig. 7, extending over the major portion of the length thereof, as illustrated in Fig. 3. The brush bar 53 is supported within the shell 13 near the right end thereof on a centering member designated generally by the numeral 54. The centering member 54 extends axially into the shell 13 from the right end thereof and is designed for supporting the right end of the brush bar 53 slidably thereon, so that the brush bar 53 is precisely centered axially within the shell 13.

The centering member 54 includes a cylindrical shaft 56, a circular flange 57 formed therearound, and a pin 58 which projects from the flange 57 to the left as viewed in Fig. 3 and has a tapered nose portion 59. The centering member is secured by means of a nut 61 to a mounting plate designated generally by the numeral 62. As illustrated in Fig. 4, the mounting plate 62 is in turn secured at either end by means of a number of cap screws 63—63 to a pair of projecting web portions 64—64 of the right-end support bracket 16. The nut 61 is received in a recess 66 in the mounting plate 62 and is threadedly received within a tapped aperture 67 in the shaft 56.

The mounting plate 62 also includes an inwardly projecting hub 68, which is axially bored for slidable reception over the shaft 56 up to stopping engagement with the flange 57. An inner bearing assembly, designated generally by the numeral 69 and including a spacer sleeve 71, is positioned between the outer periphery of the stationary hub 68 of the mounting plate 62 and the inner periphery of the rotating geared hub 32 of the sprocket wheel 29 to permit rotation of the sprocket wheel 29 about the hub 68 and thus rotation of the shell 13 about the stationary brush bar 53.

As best seen in Figs. 3 and 7, the projecting pin 58 of the centering member 54 is designed to receive slidably thereon a circular socket 72 formed in the right-hand or inner end of the brush bar 53. The socket 72 is defined by a bore in an insulating bushing 73 of suitable material such as nylon, which is mounted within a projecting circular sleeve 74 welded to the end of the brush bar 53. The insulating bushing 73 prevents the conduction of current from the brush bar 53 to the centering member 54 and thus to the mounting plate 62 or the inner bearing assembly 69.

With this mating pin-and-socket construction, it will be apparent that the inner end of the brush bar 53 is supported on the stationary centering member 54 coaxially within the rotary shell 13 during operation, but that the brush bar 53 may readily be pulled off of the stationary centering member 54, from left to right as viewed in Fig. 3, when it is desired to remove the brush bar 53 from within the shell 13. The same or another brush bar 53 may later be inserted into operating position by merely sliding the brush bar 53 back into the shell 13 until the socket 72 passes over the pin 58, the tapered nose 59 facilitating the inserting step.

It should be understood that the exemplary construction illustrated in Figs. 3 and 7, with a locating pin 58 provided at the end of the centering member 54 and an insulated socket 72 formed at the end of the brush bar 53, is only a preferred arrangement for supporting the inner

end of the brush bar 53 slidably and coaxially within the rotary shell 13 but out of contact therewith for ready removal therefrom. It will be obvious that the brush bar 53 might have been formed with a terminal pin or pins and the centering member 54 with a socket or sockets to accomplish the same result, and that other arrangements might be devised permitting slidable reception of the brush bar 53 on the centering member 54 for the purposes of the invention.

In any event, the brush bar 53 is made of sufficient length so that the left-hand or outer end thereof projects a short distance out of the shell 13 when the bar 53 is in operating position supported on the centering member 54, as illustrated in Figs. 3 and 6. The outer end of the brush bar 53 is secured by means of a pair of cap screws 75—75 to the composite brush-bar mounting plate 52, previously mentioned in general as being required to be removed before the shell 13 can be dismounted.

As best seen in Fig. 5, the composite plate 52 is provided with a generally T-shaped central section 76 of electrically conductive material such as copper, which operates as a brush-bar feeder to conduct the plating current from a laminated, flexible negative bus bar 77 to the brush bar 53. The conductive central section is mounted near the top thereof by the cap screws 75—75 to the brush bar 53 and is mounted near the bottom thereof by four cap screws 78—78 to the bus bar 77.

The central section 76 is bonded by means of a pair of insulating layers 79—79 of an epoxy resin or similar material on either side thereof to a pair of end sections 81—81 of the composite mounting plate 52, as best seen in Figs. 5 and 6. The end sections 81—81 are fastened by means of a plurality of cap screws 82—82 to a pair of projecting web portions 83—83 of the left-end support bracket 16. It should be noted that the connection of the plate 52 to the webs 83—83, as illustrated in Fig. 6, is substantially identical with the connection of the mounting plate 52 to the webs 64—64 of the right-hand support bracket 16, described hereinbefore. The composite mounting plate 52 permits current to travel from the bus bar 77 through the central section 76 to the brush bar 53, while preventing the passage of current to the end sections 81—81 and the support bracket 16 because of the intermediate insulating layers 79—79.

Referring again to Figs. 3 and 7, the plating current is conducted from the stationary brush bar 53 to the rotating shell 13 by means of a plurality of generally cylindrical, copper-graphite brushes 84—84 carried by the rod 53 in electrical contact therewith and engaging the inner surface of the shell 13, which is highly polished to reduce friction, in the vicinity of each wire-carrying groove 39 along the outer surface thereof. With this arrangement, a relatively short conducting path is provided through the stainless steel shell 13 between the brushes 84—84 and the wires 11—11 to minimize the resistive effects of the steel, the length of the path being limited only by the thickness of the shell 13 required for strength.

The shell 13 could be made of a more conductive material such as copper, in a situation where the electrolyte carried by the wires 11—11 is noncorrosive to copper; however, a material must be selected which is not corroded substantially by the electrolyte and which is at least a fair conductor of electricity. For some applications, the shell may comprise an inner shell of copper with a thin sleeve of a more corrosion resistant metal such as steel secured therearound, but deleterious electrical effects may be encountered at the juncture line between the copper and the steel.

Each of the individual brushes 84—84 is a part of a brush assembly, designated generally by the numeral 86, one of which is illustrated in detail in Fig. 3. The brush assembly 86 is carried within a bore 87 drilled through the bar 53 from top to bottom, as viewed in Fig. 3. A nylon sleeve 88 is secured within the bore 87 and the brush 84 is slidably received therein. The nylon

material of the sleeve 88 functions both to insulate the brush 84 from direct electrical contact with the brush bar 53 and to minimize friction between the brush 84 and the sleeve 88, thus facilitating sliding movement of the brush 84. Other materials than nylon might be employed for the sleeve 88, provided they are good electrical insulators and are also relatively frictionless to sliding movement of the brush 84, having regard to the particular material of which the brush is made.

The brush 84 is biased upwardly with respect to the brush bar 53 into bearing engagement with the inner periphery of the shell 13 by means of a coil spring 89 positioned within the bore 87 and supported on an adjustable threaded plug 91 of insulating material such as polyvinyl chloride. Electrical connection is made between the brush 84 and the brush bar 53 by means of a flexible pigtail conductor 92, which is connected at one end to the brush 84 and which assumes the U-shape illustrated in Fig. 3. The other end of the conductor 92 is provided with a plug 93, which is received in a socket 94 formed in the under surface of the brush bar 53.

The mounting of the brushes 84—84 out of direct electrical contact with the brush bar 53 by means of the insulating sleeves 88—88 permits current to flow to the brushes 84—84 only through the plugs 91—91 and the conductors 92—92, thus providing substantially equal potentials at the several points of contact between the wires 11—11 and the shell 13.

It will be understood that the roll 10 particularly illustrated in Fig. 3 is one of the lower rolls 10—10 illustrated in Fig. 1, over which the wires 11—11 advance. The upper rolls 10—10 under which the wires 11—11 advance are constructed exactly the same, except that the brush bar 53 is mounted upside down with respect to the mounting illustrated in Fig. 3, with the brushes 84—84 extending downwardly from the bar 53 into bearing contact with the lower, inner surface of the shell 13. For this reason, the cap screws 75—75 are made of different sizes so that the brush bar 53 may not be inserted in any unit 10 in incorrectly oriented position.

When the brushes 84—84 have become worn or are otherwise ineffective to conduct the desired current to the advancing wires 11—11, the brush bar 53 may be removed from within the rotating shell 13 without interrupting the rotation thereof. This is accomplished simply and conveniently by first disconnecting the current to the negative bus bar 77; second, unfastening the cap screws 78—78 and 82—82 (Fig. 5) which secure the mounting plate 52 to the brush bar 53 and the support bracket 16, respectively; third, lowering the plate 52 away from the brush bar 53, which motion is permitted by the provision of the flexible bus bar 77; and, finally, pulling the brush bar 53 off of the centering member 54 and out of the rotating shell 13, from left to right as viewed in Fig. 1.

When the brush bar 53 has been removed, the brushes 84—84 may be cleaned, replaced, or otherwise operated upon. Later, the same or a replacement bar 53 may be reinserted into the rotating shell by reversing the dismounting steps just described. When a brush bar 53 or a shell 13 is being removed, with the power supply disconnected from one of the cells 12—12, the current applied to the remaining cells 12—12 in the series is automatically stepped up by that amount necessary to counterbalance the effect of losing one cell in order to provide for continuous plating even though one cell has been disconnected.

It will be obvious that this invention is not limited to the specific details described in connection with the above embodiment of the invention, but that various modifications may be made without departing from the spirit and scope thereof.

What is claimed is:

1. In a contact roll assembly having a rotary cylin-

drical shell, an electrically conducting brush bar extending into the shell, and a brush extending between the brush bar and the inner surface of the shell to conduct current from the brush bar to the shell; the improvement which comprises a stationary centering member extending into the shell from one end thereof and designed for supporting one end of the brush bar slidably thereon, and means for mounting the other end of the brush bar stationarily, whereby the brush bar may be removed from within the shell while the shell is rotating by disconnecting said mounting means and pulling the brush bar off of said centering member and out of the shell.

2. In a contact roll assembly having a rotary cylindrical shell of electrically conductive material which contacts an advancing wire, an electrically conducting brush bar extending into the shell and a brush carried by the brush bar in electrical contact therewith and engaging the inner surface of the shell to conduct current from the brush bar through the shell to the advancing wire; the improvement which comprises a stationary centering member extending into the shell from one end thereof, the brush bar and centering member being provided with mating pin-and-socket ends permitting slidable reception of one end of the brush bar on said centering member with the brush bar centered axially within the shell, bearing means permitting rotation of the shell about said centering member, and means for mounting the other end of the brush bar stationarily, whereby the brush bar may be removed from within the shell while the shell is rotating by disconnecting said mounting means and pulling the brush bar off of said centering member and out of the shell.

3. In a contact roll assembly having a rotary cylindrical shell of electrically conductive material which contacts a plurality of advancing parallel wires, an electrically conducting brush bar extending axially into the shell and a plurality of brushes carried by the brush bar in electrical contact therewith and engaging the inner surface of the shell near the points of contact between the wires and the shell to conduct current from the brush bar through the shell to the advancing wires; the improvement which comprises a pair of opposed support members, a centering member including a generally cylindrical pin projecting therefrom and having a tapered nose, means for securing said centering member to one of said support members so that the pin projects axially into the shell from one end thereof, one end of the brush bar being formed with a socket therein lined with an electrically insulating material and designed for slidable reception over the pin of said centering member in order to support one end of the brush bar axially within the shell, bearing means permitting rotation of the shell about said centering member and the securing means therefor, and means for securing the other end of the brush bar to the other support member, whereby the brush bar is mounted stationarily and coaxially within the shell out of contact therewith and may be removed from within the shell while the shell is rotating by unfastening the last-mentioned securing means and pulling the brush bar off of said centering member and out of the shell.

4. In a contact roll assembly having a rotary cylindrical shell of electrically conductive material which contacts an advancing wire, an electrically conducting brush bar mounted stationarily and extending into the shell and a brush extending between the brush bar and the inner surface of the shell to conduct current from the brush bar to the shell; the improvement which comprises a pair of opposed support members having aligned circular apertures therethrough, the shell being mounted between said support members so that the ends of the shell extend through the aligned apertures, and a pair of ball-bearing assemblies mounted between said support members and the shell for permitting rotation of the shell with respect to said support members, said ball-bearing assemblies including electrically insulating material on the shell sides

thereof to insulate the bearings from the shell but including electrically conductive paths to ground on the support sides thereof to discharge any static charges accumulated thereby to ground.

5. In a contact roll assembly having a rotatable cylindrical shell of electrically conductive material which contacts an advancing wire, an electrically conducting brush bar mounted stationarily and extending axially into the shell, and a brush extending between the brush bar and the inner surface of the shell to conduct current from the brush bar to the shell; the improvement which comprises a pair of opposed support members having aligned circular apertures therethrough, the shell being mounted between said support members so that the ends of the shell extend through the aligned apertures, a pair of ball-bearing units including inner and outer bearing races mounted between said support members and the ends of the shell for permitting rotation of the shell with respect to said support members, a pair of metallic sleeves having inner diameters slightly greater than the outer diameter of the shell for slidable reception thereover, a pair of rings of an electrically insulating material bonded between the inner bearing races and said sleeves, a plurality of set screws for securing said sleeves to the outer surface of the shell for rotation therewith, and driving connection means including a pair of splined gears at least one of which is made of electrically insulating material for rotating said shell from one end thereof, whereby the longitudinal position of the shell may be shifted by loosening said set screws and sliding the shell within said sleeves with the splined gears designed for retaining the driving connection for the shell.

6. The apparatus defined in claim 5 which comprises, in addition, a pair of bearing housings fitting against said support members and receiving portions of the outer races of said ball-bearing units, a pair of retaining rings fitting against said housings and receiving other portions of the outer races of said ball-bearing units, and a plurality of screws for securing said housings and said retaining rings to said supports, whereby the contact roll assembly may readily be dismantled by removing the driving connection for the shell, removing the brush bar from within the shell, loosening the set screws at the driving end of the shell, removing the bearing assembly at the other end of the shell, and then pulling the shell out of the contact roll assembly.

7. In a contact roll assembly having a rotary cylindrical shell of electrically conductive material which contacts an advancing wire, an electrically conducting brush bar mounted stationarily and extending axially into the shell and a brush extending between the brush bar and the inner surface of the shell to conduct current from the brush bar to the shell; the improvement which comprises a pair of opposed support members having aligned circular apertures therethrough, the shell being mounted between said support members so that the ends of the shell extend through the aligned apertures, a pair of ball-bearing assemblies mounted between said support members and the ends of the shell for permitting rotation of the shell with respect to said support members, said ball-bearing assemblies including electrically insulating material on the shell sides thereof to insulate the bearings from the shell but including electrically conductive paths to ground on the support sides thereof to discharge any static charges accumulated thereby to ground, a centering member, means for securing said centering member to one of said support members so that said centering member extends axially into the shell, the brush bar and centering member being provided with mating pin-and-socket ends permitting slidable reception of one end of the brush bar on said centering member with the brush bar centered axially within the shell, bearing means permitting rotation of the shell about said centering member, and means for securing the other end of the brush bar to the other support member.

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8. A contact roll assembly, which comprises a pair of opposed support members having aligned circular apertures therethrough, a rotatable cylindrical shell of electrically conductive material mounted between said support members so that the ends of the shell extend through the aligned apertures, a pair of bearing units including inner and outer bearing races mounted between said support members and the ends of the shell for permitting rotation of the shell with respect to the support members, a pair of bearing housings fitting against said support members and receiving portions of the outer races of said bearing units, said housings forming electrically conductive paths to ground on the support sides of the bearing units to discharge any static charges accumulated thereby to ground, means including a pair of splined gears for rotating said shell from one end thereof, one of said gears being made of electrically insulating material, a centering member including a generally cylindrical pin projecting therefrom and having a tapered nose, means for securing said centering member to one of said support members through said splined gears, said shell and one of said bearing units so that said pin projects axially into the shell, bearing means permitting rotation of the shell about said centering member, a brush bar having

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a plurality of bores formed therein transversely thereof, one end of the brush bar being formed with a socket therein lined with an electrically insulating material and designed for slidable reception over the pin of the centering member to support one end of the brush bar axially in the shell, means for securing the other end of the brush bar stationarily to the other support member, insulating sleeves in the bores in the brush bar, a plurality of brushes of electrically conductive material received slidably within the insulating sleeves in the bores in the brush bar, means for biasing said brushes outwardly with respect to the brush bar into contact with the internal surface of said shell, and a plurality of flexible electrical conductors for connecting said brushes electrically to said brush bar.

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