June 27, 1967 G. T. MARSHALL 3,328,281

APPARATUS FOR CONTINUOUS STRIP PLATING

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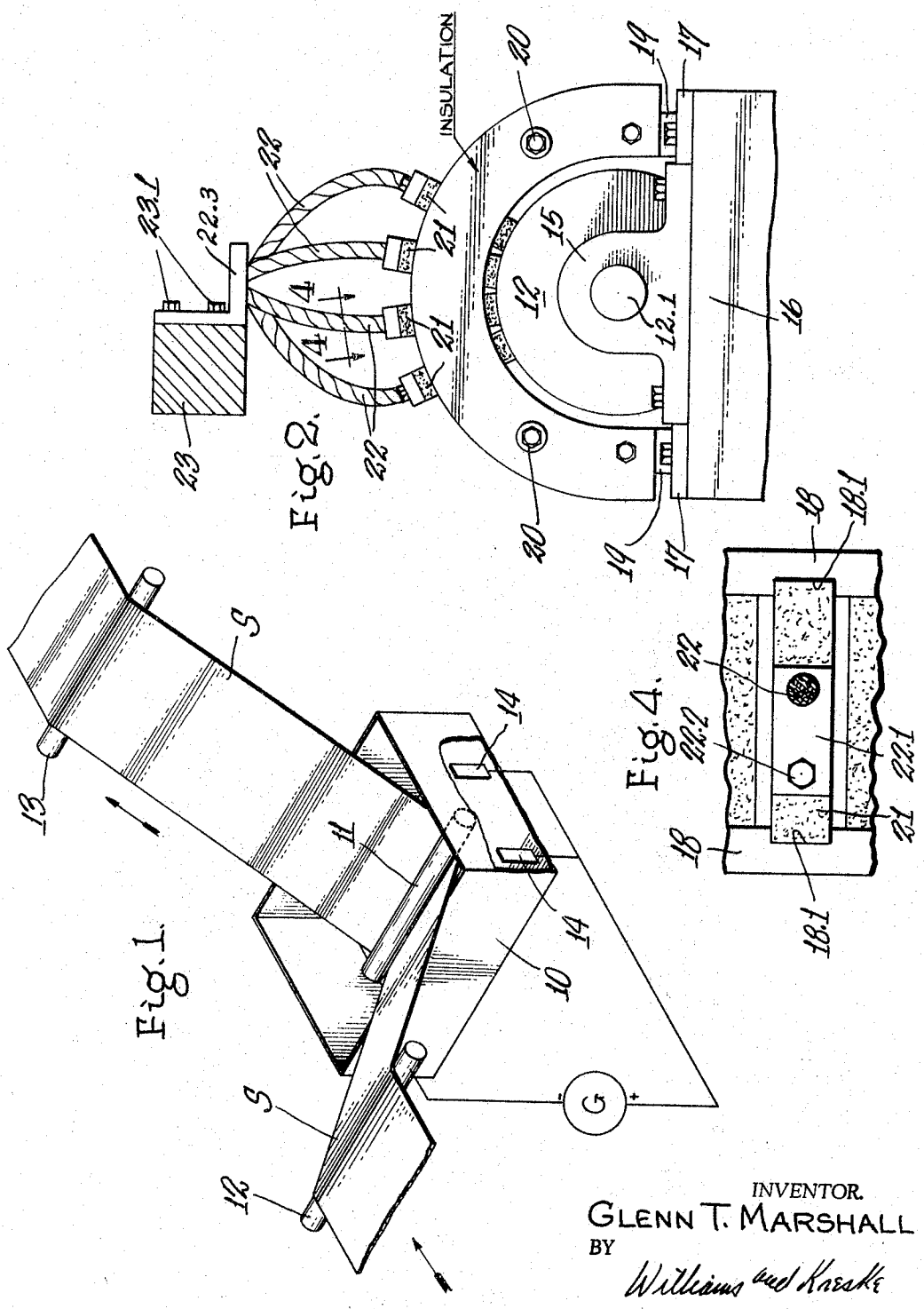


Fig. 1.

Fig. 2.

Fig. 4.

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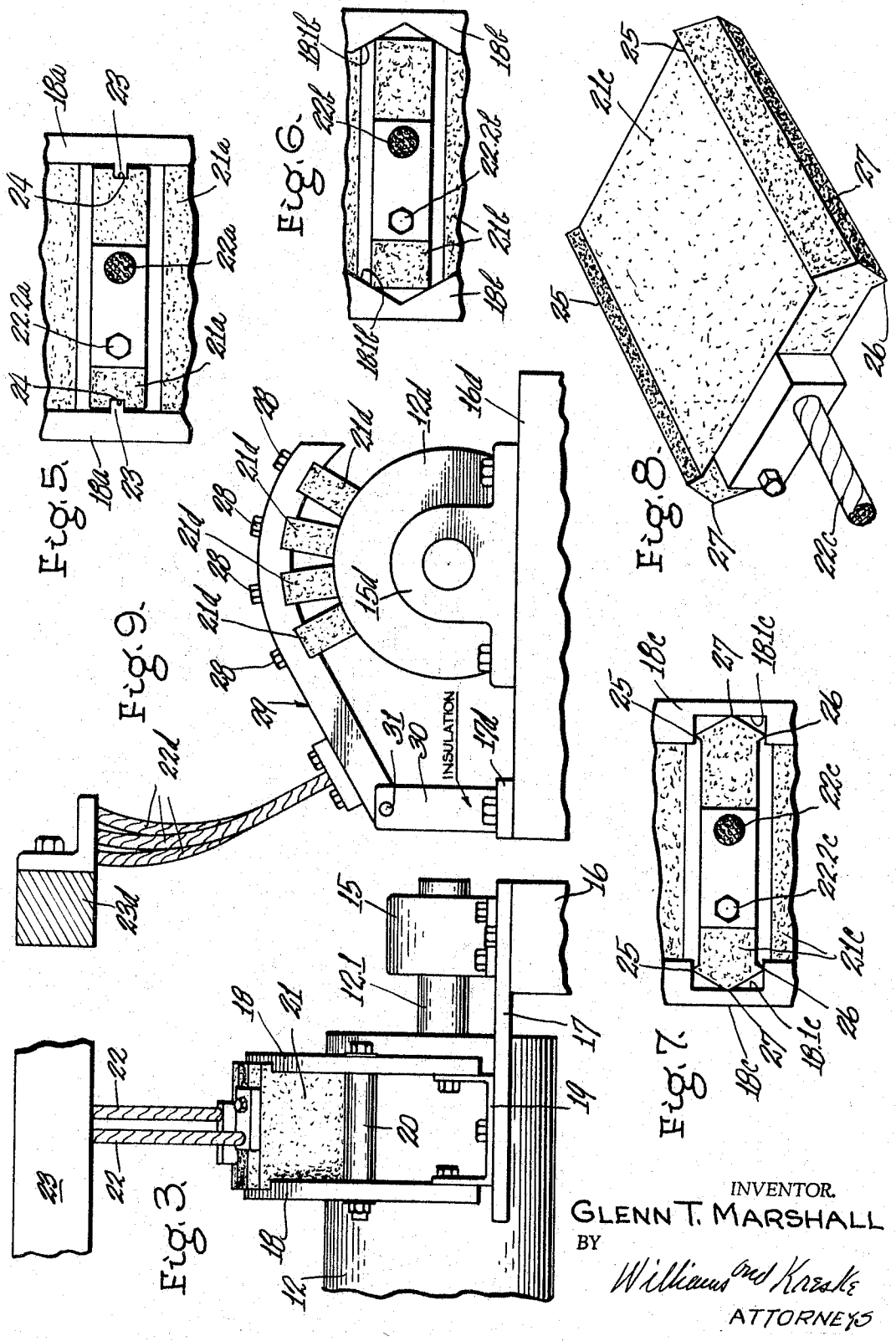


Fig. 3.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

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APPARATUS FOR CONTINUOUS STRIP PLATING

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7 Claims. (Cl. 204—279)

The present invention relates to methods of and apparatus for conducting electrical energy to a rotating member such as, for example, a roll which guides strip material during continuous electrolytic plating thereof, and the principal object of the invention is to provide new and improved methods and apparatus of the character described.

During the continuous, electrolytic plating of strip material, longitudinally moving strip is guided by rollers through a tank containing a suitable plating solution. Plating current is passed through the plating solution and to the moving strip thus depositing a plating thereon in the well-known manner. For the purpose of disposing the moving strip in the electrical plating circuit, current is usually fed to the strip through a roll, outside of the plating solution tank, about which the strip passes.

Heretofore, considerable difficulty has attended to the passage of the plating current by means of a suitable brush construction to the rotating roll aforesaid. The reasons for this difficulty is primarily threefold: Firstly, very high current densities must be fed to the roll, one specific installation requiring as much as 8500 amperes at 6 to 12 volts. Secondly, the corrosive atmosphere in the vicinity of the plating operation tends to build up deposits on all the nearby machine parts thus "freezing" the brushes in their holders. When this occurs, current passage to the roll is impaired and severe arcing between the roll and the brushes takes place with resulting damage to both. Thirdly, in prior art assemblies, current can flow between the brushes and the holders in which they are slidable. This current flow tends to cause arcing which in turn tends to impair free brush movement in their holders. This impairment of free brush movement is cumulative with both the aforesaid deposit build-up and with the resulting damage to the brushes and the roll.

The present invention provides an improved method and apparatus for passing electrical energy to the rotating roll aforesaid which is far simpler and lower in cost than that heretofore known and which operates for protracted periods with a 90% reduction in maintenance. These and other advantages will readily become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this specification and forming a part of this application there is shown, for purpose of illustration, embodiments which the invention may assume, and in these drawings:

FIGURE 1 is a generally diagrammatic perspective view illustrating a convenient arrangement of parts for the continuous plating of strip material,

FIGURE 2 is an enlarged, detailed, end elevational view of a portion of the apparatus seen in FIGURE 1,

FIGURE 3 is a fragmentary side elevational view of the apparatus seen in FIGURE 2,

FIGURE 4 is an enlarged, fragmentary sectional view generally corresponding to the line 4—4 of FIGURE 2,

FIGURES 5, 6 and 7 are views similar to FIGURE 4 but of somewhat modified structures,

FIGURE 8 is an enlarged perspective view of a detail seen in FIGURE 7, and

FIGURE 9 is a view similar to FIGURE 2 but of still another embodiment of the invention.

With reference to FIGURE 1, a conventional arrangement for the electro-plating of moving strip S comprises a tank 10 which contains the usual plating solution. The

strip S passes beneath a roll 11 rotatably supported within the tank below the plating solution level and the strip passes over rotatably mounted rolls 12 and 13 disposed above and on opposite sides of the tank. Assuming the strip to be traveling in the direction of the arrows, the strip passes over the roll 12, into the tank 10 and beneath the roll 11 for immersion in the plating solution, and out of the tank and over the roll 13 for passage to subsequent processing or manufacturing operations. Within the tank and immersed in the plating solution are anodes 14 of suitable material. Anodes 14 are connected to one side of the plating circuit shown while the roll 12 is connected to the other circuit side, the source of electroplating current being represented by a direct current generator G.

It will be understood that with the strip S engaged with roll 12, the strip will be at one potential while the anodes 14 are at another potential. Accordingly, current will flow between the anodes and the strip, through the plating solution, thus depositing plating on the strip.

With reference now to FIGURES 2 and 3 wherein one end of roll 12 is shown in detail, such roll is presently provided with a reduced diameter end portion 12.1 mounted in a suitable bearing 15. While only one end of roll 12 is shown in detail and will herein be specifically described, it is to be understood that the roll ends and their associated structures are preferably identical. Bearing 15 is secured in any conventional manner to a support 16.

Projecting axially of the roll 12 from the support 16 and disposed on opposite sides of the roll are brackets 17 which support the about to be described structure for passing the plating current to the roll 12. Secured in parallelism to brackets 17 and spaced-apart axially of the roll 12 are two arcuate, brush-holder members 18 which are preferably of a rigid, dielectric material such as, for example, "Micarta." Any suitable means may be employed to secure the brush holders to the brackets, channel members 19 herein being shown secured to respective brackets and to the adjoining brush holder ends by screws or the like. To increase rigidity of the brush holders 18, a tie bar and spacer sleeve assembly 20 may extend therebetween at circumferentially spaced places therealong.

Extending between the brush holders 18 and slidably supported thereby for movement toward and away from the roll 12 are brushes 21 herein shown to be four in number. For a purpose to appear, brushes 21 are all disposed above the roll 12 and each is slidably carried by the brush holders for movement radially of the roll.

It is of vital importance in the present invention that each brush 21 be movable relative to the brush holders 18 with minimum friction; accordingly, in the embodiment illustrated in FIGURES 2 and 3, the following structure is employed: As best seen in FIGURE 4, the brush holders 18 are provided with pairs of grooves 18.1 for closely but slidably receiving respective brushes 21. As will be evident, the grooves of each pair are in parallel, facing relation with each groove pair extending radially of the roll axis. In order to minimize friction, the brush holder grooves 18.1 are relatively shallow to reduce as much as possible the area of engagement between the brush and the brush holder.

It is necessary that each brush 21 be flexibly connected to a source of electrical energy and for this purpose, flexible leads 22 are connected to each brush. As herein disclosed, the lower end of each lead 22 carries a foot 22.1 which is adapted to be removably secured to the upper end of a respective brush by any suitable means such as a bolt 22.2. The upper ends of leads 22 are suitably anchored to an angle fitting 22.3 which is in turn removably secured to a bus bar 23 by means of bolts 23.1.

In operation, the plating current will be fed to the bus bar **23**, to the brushes **21** through the flexible leads **22**, and from the brushes **21** to the engaged roll **12**. Since the brushes **21** are nearly frictionlessly carried by the brush holders **18** and since all of the brushes are disposed above the roll, gravity alone biases the brushes to and maintains the latter in roll engagement even after brush length has been reduced because of wear.

In the embodiment of the invention seen in FIGURE 5 wherein similar parts are identified with the same reference characters as before but with the suffix *a* added, the brush holders **18***a* are formed with opposed ribs **23** rather than the opposed grooves previously described while the brushes are formed with opposed grooves **24** for closely but slidably receiving respective opposed ribs. With this construction, the area of interengagement between the brushes and the brush holders is even further reduced with a consequent further reduction in friction therebetween.

In the embodiment of the invention seen in FIGURE 6 wherein similar parts are identified with the same reference characters as before but with the suffix *b* added, the brush holder grooves **18.1***b* are V-shaped to provide inclined surfaces for engagement with respective corners of the brushes **21***b*. Since, in this embodiment, the brushes **21***b* have but line contact with the brush holders **18***b*, friction therebetween is reduced to an even lower value.

The embodiment of the invention seen in FIGURES 7 and 8 combines certain of the features of the embodiments seen in FIGURES 4 and 6 and, here again, similar parts are identified by the same reference characters but with the suffix *c* added. In this embodiment, the brush holder grooves **18.1***c* are similar to grooves **18.1**; however, they will preferably be slightly larger. Brush **21***c* differs from brush **21** in that the portions thereof engaged with respective brush holders **18***c* are enlarged to provide three ribs **25**, **26** and **27** (see especially FIGURE 8) adjacent each brush holder. Ribs **25** and **26** are adapted to slidably engage the opposed sides of a respective brush holder groove **18.1***c* while the ribs **27** slidably engage respective groove bottoms. Since the ribs **25**, **26** and **27** provide line contact of the brush **21***c* with the brush holders **18***c*, friction therebetween is less than in the structures of FIGURES 4 and 5 while the brushes **21***c* are held more rigidly than in the structure of FIGURE 6.

In the embodiment of the invention seen in FIGURE 9 wherein similar parts are identified by the same reference characters previously used but with the suffix *d* added, a somewhat different structure is employed. In this embodiment, the brushes **21***d* are affixed by means of bolts **28** to the arcuate, free end portion of a current-conductive arm **29**. This arm is secured between spaced, uprights **30** of dielectric material by means of a pin **31** about which the arm is freely pivotable, the uprights **30** being secured to the single bracket **17***d* in any suitable manner. Flexible leads **22***d* extend between the bus bar **23***d* and the arm **29**, such leads preferably being secured to the arm closely adjacent the arm pivot pin **31** so as to minimize lead flexure during pivotal arm movement.

Operation of the embodiment seen in FIGURE 9 should readily be apparent, current being fed from the bus bar **23***d* to the roll **12***d* through the leads **22***d*, the arm **29** and the brushes **21***d*. As a result of the weight of arm **29** and the attached brushes **21***a*, the latter will be continually biased by gravitational forces to close engagement with the periphery of roll **12***d*. Such close engagement will attend, even as the brushes **21***d* wear, because of the free pivotal mounting of the arm **29**.

While reference is made herein to the plating of strip material, it is to be understood that the invention is equally applicable to electro-cleaning or any other type of operation wherein heavy current is to be passed to longitudinally moving strip material.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiments herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described; hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that my invention is not limited thereto.

I claim:

1. Apparatus for passing electrical energy through longitudinally moving strip material, comprising a rotatably mounted roll about which the moving strip travels, a current-conductive gravity-biased brush engaged with said roll for conducting electrical energy thereto, insulating support means adjacent said roll and with which said brush is slidably engaged, said support means guiding movement of said brush toward and away from said roll in a direction radially thereof and interengagement between said brush and said support means being limited to radial line contact to minimize frictional resistance to brush movement aforesaid, and means flexibly connecting said brush to a source of electrical energy.

2. The construction of claim **1** wherein intersecting brush surfaces provide relatively sharp edges extending in the direction of brush movement and wherein such brush edges have sliding engagement with said support means to provide the line contact aforesaid therebetween.

3. The construction of claim **2** wherein said brush sharp edges are in opposed relation.

4. Apparatus for passing electrical energy through longitudinally moving strip material, comprising a rotatably mounted roll about which the moving strip travels, a pair of insulating arcuate supports at one side of said roll and in side-by-side, axially spaced-apart relation, a plurality of gravity-biased current conductive brushes engaged with said roll and spaced from each other circumferentially thereof, said brushes being disposed between said supports and having sliding engagement therewith for guided radial movement toward and away from said roll, and means flexibly connecting said brushes to a source of electrical energy.

5. The construction of claim **4** wherein interengagement between said brushes and said supports is limited to line contact to minimize frictional resistance to brush movement aforesaid.

6. The construction of claim **4** wherein pairs of radially extending grooves are formed in the facing sides of said supports, wherein the grooves of each pair are in opposed relation, and wherein said brushes are disposed within respective support groove pairs.

7. The construction of claim **6** wherein each brush has intersecting surfaces providing relatively sharp edges adjacent respective supports and extending in the direction of brush movement, and wherein such brush edges have sliding engagement with the defining margins of respective support grooves to provide the line contact aforesaid.

References Cited

UNITED STATES PATENTS

1,078,174	11/1913	Smoot	310—247 X
1,268,293	6/1918	Stanley	339—5
1,495,657	5/1924	Wagner	339—5
1,693,319	11/1928	Simmons	310—247
2,652,461	9/1953	Klein	191—1.1
2,702,320	2/1955	Stock et al.	191—1.1
2,753,298	7/1956	Gray	204—28
2,754,485	7/1956	Wick et al.	204—279
2,825,831	3/1958	Franck	310—247
3,066,091	11/1962	Reid et al.	204—206
3,201,739	8/1965	Caldwell	339—5

FOREIGN PATENTS

11,547	1895	Great Britain.

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