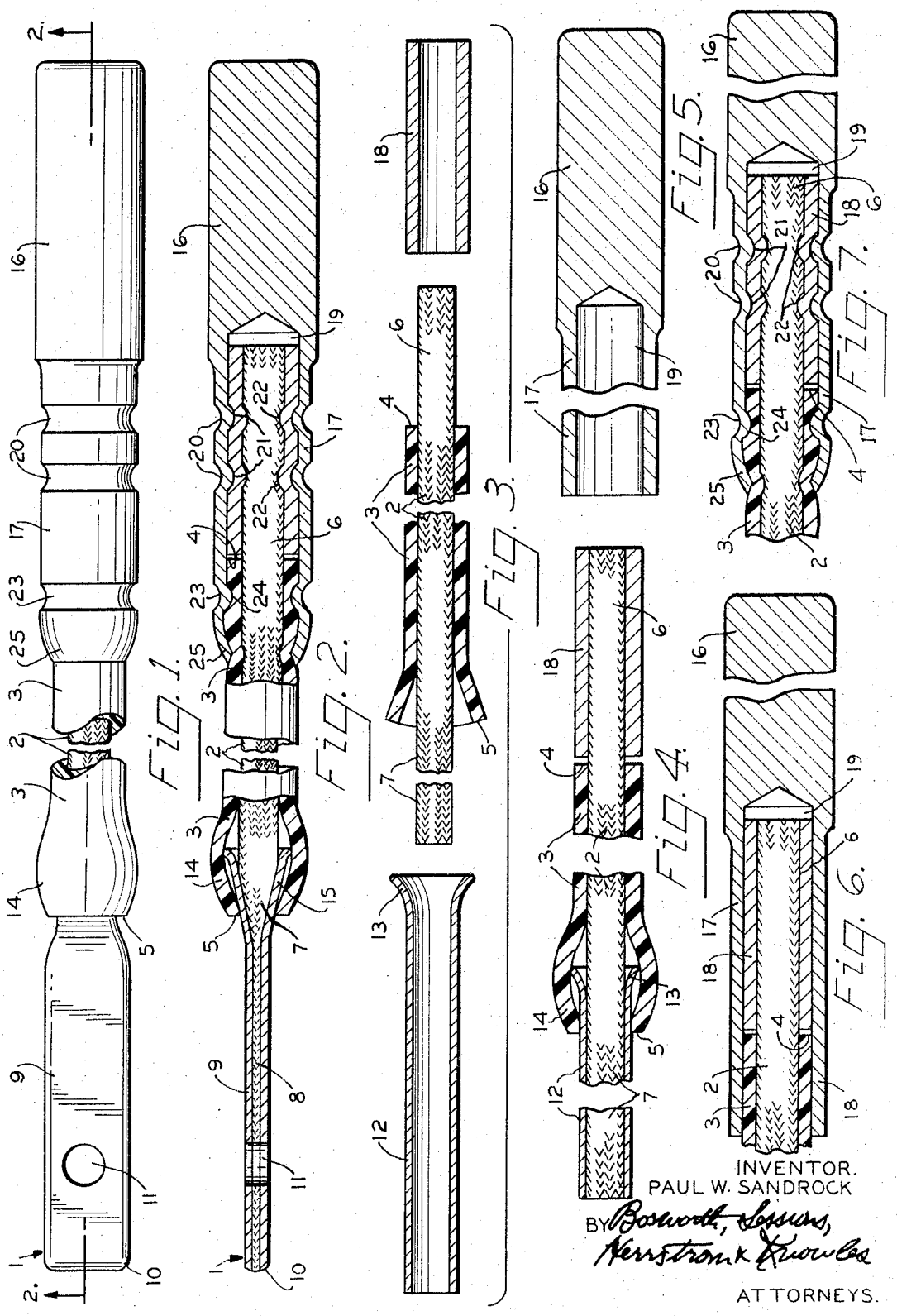
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DANGLER ASSEMBLY FOR ELECTROCHEMICAL INSTALLATIONS

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INVENTOR.
PAUL W. SANDROCK
BY Bosworth, Sessions, Herrstrom & Knowles
ATTORNEYS.

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DANGLER ASSEMBLY FOR ELECTROCHEMICAL INSTALLATIONS

Paul W. Sandrock, 15291 Triskett Road, Cleveland, Ohio 44111

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This invention relates to a dangler assembly for an electrochemical installation, the same constituting an improvement upon dangler assemblies of the types shown in U.S. Patents Nos. 2,562,084 to Collick and 2,886,505 to Singleton.

In the past, dangler assemblies have usually been subject to the criticism that the acids and other chemicals used in plating machines, stripping machines, etc., have tended, after a short period of use, to find their way through the joints where the connectors and contactors impinge on or approach the ends of the sheath of non-conductive material that ordinarily surrounds the electrical conductor over the greater part of its length. In many electrochemical installations, particularly in plating machines, dangler assemblies are subjected to extraordinarily difficult environmental conditions. Although one end is generally stationary, the other characteristically has a good deal of movement, partly because the contactor from time to time engages different parts of one or more work pieces being tumbled in a rotating barrel forming part of the installation.

It is a general object of the present invention to provide a durable, long-lived dangler assembly that is unusually sturdy, that is capable of standing up to good advantage under difficult environmental conditions, and that is especially designed, arranged and constructed to preclude the entry of deleterious chemicals into the interior of the assembly, particularly such as are commonly used in plating machines and the like. Another object of the invention is to provide a dangler assembly in which the contactor is so firmly affixed to the remainder of the assembly that it will not rotate thereon, loosen up or separate from it, as has often happened in the past with constructions of the types known to the prior art. A specific object of the invention is to provide a dangler assembly in which the joint or joints between the connector and/or contactor on one hand and, on the other, the intervening portions of the assembly may be sealed without relying on the use of tape and other vulnerable materials.

Other objects, advantages and features of the invention will be apparent from the description which follows and from the accompanying drawings in which:

FIGURE 1 is a plan of a dangler assembly constructed in accordance with the present invention.

FIGURE 2 is a central longitudinal section on line 2—2 of FIGURE 1.

FIGURE 3 is an exploded view showing in section the component parts of the dangler assembly other than the contactor.

FIGURE 4 is a section showing the intermediate product formed by assembling the separate components appearing in FIGURE 3.

FIGURE 5 is a central longitudinal section through the contactor blank.

FIGURE 6 shows the contactor blank as it appears when initially brought into engagement with the components at the right-hand end of FIGURE 4.

FIGURE 7, which is provided for purposes of comparison, is a view otherwise similar to FIGURE 6, showing the contactor as it appears after it has been permanently affixed to the components at the right-hand end of FIGURE 4.

FIGURES 1 and 2 show the dangler assembly **1** in its

entirety except where portions have been broken away to fit the available space. Near the middle of FIGURE 2 can be seen the core **2** of the assembly, which takes the form of a multi-strand electrical cable, usually of copper. This core extends from the extreme left-hand end of the assembly as a whole to a point approximately half way between the two ends of the contactor. Over most of this stretch, core **2** is surrounded by a sheath **3** of electrically non-conductive material such as rubber, synthetic rubber, plastic or the like. Sheath **3** is not coextensive with core **2** but terminates short of the extreme outer ends of the latter at the points where end faces **4** and **5** appear in FIGURES 1 to 4. Thus unsheathed portions of core **2** extend endwise from sheath **3** to the right and left of faces **4** and **5**, respectively, the right-hand extension or end portion being designated **6** and the left-hand extension or end portion being designated **7**. See FIGURE 3.

In the dangler assembly in its finished form, the outer unsheathed left-hand end portion **8** of core **2** is flattened, conforming in this respect to the side walls of connector **9**. Nominally oblong in shape, the latter is provided with a rounded end **10** and a mounting hole **11** that extends through both the connector itself and the enclosed conductor. In general, connector **9** is formed by expanding one end of a generally cylindrical copper tube **12**, thereby flaring it sharply outward at **13**; urging the unsheathed end portion **7** of core **2** through flared portion **13** until such time as the outer ends of the tube and core are in lateral alignment; and flattening the tube and core. Before the flattening step is performed, the proximate end **14** of sheath **3** is urged over the flared portion **13** of tube **12**, thus telescoping the two to the extent indicated in FIGURE 4. In the finished product, shown in FIGURES 1 and 2, the proximate end **14** of sheath **3** overlies the flattened but still flared end **15** of connector **9**.

In dangler assemblies of the types known to the prior art, it has been commonplace to cause the circular inner end of an unflared cylindrical tube used as a connector to align itself with and butt up squarely against the circular end face at the near end of the cut-back portion of a non-conductive sheath surrounding a core of conductive material. Where this has been the practise, the custom has been to apply electrical tape to the cylindrical joint so formed, this in an effort to keep acids and other chemicals from entering the dangler assembly in this zone. However, it has seldom if ever been possible to provide a satisfactory seal, certainly not one comparable in its effectiveness to the seal formed by the type of construction illustrated in FIGURE 2 of the accompanying drawings. In this construction, the incompletely flattened end portion **15** on connector **9** intervenes between core **2** and sheath **3**, overlying one and underlying the other. The extensive surface contact that comes about between end portion **14** of sheath **3** and end portion **15** of connector **9**, coupled with the stresses introduced into the former where the circumferentially flared portion of the latter projects outward into engagement with it, makes for a highly efficient seal.

The opposite end of the dangler assembly, which may be seen in FIGURES 1, 2, 6 and 7, comprises the contactor or "ball," as it is sometimes called. Made of an electrically conductive metal such as stainless steel, the contactor blank of FIGURE 5 consists of a massive body portion **16** of cylindrical shape provided with an inwardly directed extension that is approximately as long as the body portion itself, such extension taking the form of an integral sleeve **17** of reduced diameter. Preparatory to locating and mounting the contactor blank, particularly sleeve **17** thereof, on unsheathed end portion **6** of core **2**, a liner for sleeve **17** consisting of a sturdy aluminum or copper tube **18** is slipped over unsheathed end portion **6**: compare, for example, FIGURES 3 and 4.

The dimensions of liner 18 are preferably such as to make for a snug fit on core 2 and in sleeve 17. The length of liner 18 may conveniently be such as to make it possible, without undue difficulty, to achieve substantial lateral alignment of core 2 and liner 18 at the ends thereof: see FIGURE 4. The component parts may, if desired, be soldered together, but if they are assembled in the manner herein described the incomplete product illustrated in FIGURE 4 is ready without more for the application to it of sleeve 17 and body portion 16. In the contactor blank, best seen in FIGURE 5, bore 19 is preferably a trifle longer than sleeve 17, extending a short distance into body portion 16.

With the contactor and various other components of the dangler assembly brought together to the extent already described, the next step is to secure the contactor to liner 18 and sheath 3. This can be done to particularly good advantage by using powerful cold-rolling equipment suitable for producing in sleeve 17 deep circumferential channels 20. In the zone in which the twin channels 20 appear in FIGURE 1, three or more such channels may be introduced into sleeve 17. In some circumstances, a single channel may be all that is necessary.

Within sleeve 17 itself, each such channel or primary groove, as it may be called, produces by deformation of the wall of the sleeve a primary bead or rib of circular shape that projects into the interior of the sleeve. It is this physical distortion of the wall of sleeve 17, more especially the metal of which the wall is formed, that gives rise to the primary beads 21 seen in FIGURES 2 and 7. These in turn operate on liner 18, forming a like number of secondary grooves in its outside surface and a corresponding number of secondary beads 22 on its inside surface. In turn, the secondary beads 22 so formed inside liner 18 displace part of the material of unsheathed end portion 6 of core 2, forming therein the tertiary grooves appearing in FIGURE 7.

Simultaneously, or, if desired, independently thereof, one or more circumferential grooves 23 and one or more circular beads 24 may be formed in the portion of sleeve 17 overlying the end of sheath 3. In the construction shown in the drawings, a single primary groove 23 and a single primary bead 24 are shown in this zone; however, it is possible to provide more than one of each if such appears to be desirable. Any primary grooves 23 so formed in sleeve 17 result in the formation of a corresponding number of inwardly projecting primary beads 24, the same extending into secondary grooves formed in the rubber, synthetic rubber or plastic of which sheath 3 is made. Because sheath 3 is more or less pliable, secondary beads are not formed on the inside face of sheath 3. Thus in ordinary circumstances the contiguous parts of end portion 6 of core 2 remain substantially undistorted.

Contemporaneously, or, if preferred, in a separate operation, the outer end of sleeve 17; i.e., the end remote from body portion 16, may be rolled or otherwise formed so as to arrive at the configuration illustrated in FIGURE 7, in which such outer end portion is shown as turned sharply inward toward and into sheath 3. The joint so formed must be impervious to acids and other chemicals; accordingly, in the production of inturned lip 25 a particularly heavy pressure is employed in this zone. Inwardly thereof, sheath 3 is very drastically compressed, giving rise to a condition comparable to that which characterizes a compressed rubber gasket. It will be observed that the material of which sheath 3 is formed is so severely compressed as to produce considerable distortion of core 2 inwardly of lip 25: see the left-hand end of FIGURE 7. Thus acids and other chemicals are very effectively kept from reaching and attacking core 2.

If not performed in some different way that may happen to be more convenient, the rolling operation or operations can be expeditiously accomplished on a Reed cylindrical thread rolling machine. In the final product, however produced, the contactor is anchored firmly to the remainder of the dangler assembly, this being accomplished to particularly good advantage by means of the combination of lip 25 and grooves 20 and 23 formed as described in sleeve 17. Ordinarily, neither soldering nor brazing is required; accordingly, except for such heat as is produced incidentally in the step of performing mechanical work on the contactor, no heat is supplied in the process of manufacture to cause deterioration of the material of which sheath 3 is made.

Notwithstanding the fact that the dangler assembly when in use is subject to severe impact and bending stresses, the contactor, speaking generally, does not manifest any appreciable tendency to separate from the rest of the dangler assembly. As a rule, it does not tend to rotate on core 2 and sheath 3. The problem of breakage almost invariably plays a prominent part where a welded construction is employed. In the present invention, on the other hand, this problem is almost invariably absent. What is even more important, acids and other chemicals that seek to find their way into the contactor and the dangler assembly are effectively precluded from doing so by the sharply turned-in lip 25 at the end of sleeve 17.

It is probable that, in practice, modifications may be made from time to time without departing from the spirit of the invention. For example, integral ribs or beads may be provided initially on the inside surface of sleeve 17, not merely in the portion thereof that engages liner 18 but also in the portion that engages sheath 3. In the connector, an integral rib or bead may be provided exteriorly of the tube in lieu of the flared configuration shown in the drawings. Other comparable changes are likely to suggest themselves to those skilled in the art to which the invention relates.

It is intended that the patent shall cover, by summarization in appended claims, all features of patentable novelty residing in the invention.

What is claimed is:

1. A dangler assembly for an electrochemical installation comprising (1) an elongated electrical conductor; (2) a surrounding sheath of electrically non-conductive material, said sheath terminating short of the conductor itself at each of the two ends of the conductor; (3) a metal connector engaging the unsheathed end of the conductor at one end of the assembly, said connector

(a) extending lengthwise of the conductor in a direction leading toward the proximate end of the sheath,

(b) intervening between the conductor and sheath in a zone at the end of the sheath, and

(c) overlying the former and underlying the latter within said zone;

and (4) a contactor at the opposite end of the assembly taking the form of a hollow metal body, a soft metal liner with a bore for the reception of the conductor, and one or more internal beads in said hollow metal body at least one of which extends bodily into said metal liner, said hollow metal body comprising a solid body portion with an extension of the nature of a sleeve projecting from it.

2. A dangler assembly according to claim 1 wherein said sleeve accounts for approximately half of the overall length of the contactor.

3. A dangler assembly according to claim 1 wherein said sleeve and said solid body portion are in axial alignment with each other.

4. A dangler assembly according to claim 1 wherein said sleeve and said solid body portion are integral with each other.

5. A dangler assembly according to claim 1 wherein said sleeve incorporates the beads that extend into the liner from the hollow metal body.

6. A dangler assembly for an electrochemical installation comprising (1) an elongated electrical conductor; (2) a surrounding sheath of electrically non-conductive material, said sheath terminating short of the conductor itself at each of the two ends of the conductor; (3) a metal con-

nector in engagement with the unsheathed end of the conductor at one end of the assembly, said connector

(a) extending lengthwise of the conductor in a direction leading toward the proximate end of the sheath,

(b) intervening between the conductor and sheath in a zone at the end of the sheath, and

(c) overlying the former and underlying the latter within said zone;

and (4) a metal contactor at the opposite end of the assembly for engaging the work processed in the installation, said contactor taking the form of a hollow body comprising a solid body portion with an extension of the nature of a sleeve projecting from it.

7. A dangler assembly according to claim **6** wherein the connector takes the form of a flared metal tube the flared portion of which underlies the proximate end of the sheath.

8. A dangler assembly according to claim **7** wherein the unsheathed end of the conductor fills what would otherwise be an elongated void in the tube.

9. A dangler assembly according to claim **8** wherein throughout most of its length the tube has a flat, generally rectangular appearance.

10. A dangler assembly for an electrochemical installation comprising (1) an elongated electrical conductor; (2) a surrounding sheath of electrically non-conductive material, said sheath terminating short of the conductor itself at each of the two ends of the conductor; (3) a metal connector engaging the unsheathed end of the conductor at one end of the assembly; and (4) a contactor at the opposite end of the assembly comprising a massive body portion taking the form of an outer metal element, an inner metal element with a bore therein for reception of the conductor, and a plurality of internal beads in said outer metal element at least one of which extends into a correspondingly located deformation in said inner metal element.

11. A dangler assembly according to claim **10** wherein there are at least two internal beads in said outer metal element that extend into correspondingly located deformations in said inner metal element.

12. A dangler assembly according to claim **10** wherein at least one of the beads in said outer metal element extends into a correspondingly located deformation in the near end of the sheath of non-conductive material surrounding the conductor.

13. A dangler assembly according to claim **10** wherein the internal beads in said outer metal element are themselves of the nature of deformations in said outer metal element.

14. A dangler assembly according to claim **12** wherein the deformations in said outer and inner metal elements take the form of circumferential grooves.

15. In an electrochemical installation, a contactor comprising an electrical conductor; electrical insulating material sheathing all but the end portion of the conductor; a cylindrical metal tube in engagement with the unsheathed end portion of the conductor; a massive body portion including a metal sleeve in engagement with said cylindrical tube; and a plurality of channels in said sleeve at least one of which extends into a groove in said cylindrical tube.

16. In an electrochemical installation, a contactor comprising an electrical conductor; electrical insulating material sheathing all but the end portion of the conductor; a cylindrical metal tube in engagement with the unsheathed end portion of the conductor; a massive body portion including a metal sleeve in engagement with said cylindrical tube; and a plurality of channels in said sleeve at least one of which extends into a groove in said cylindrical tube and at least one of which extends into a groove in the insulating material sheathing the conductor.

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HOWARD S. WILLIAMS, *Primary Examiner.*

D. R. JORDON, *Assistant Examiner.*