May 12, 1970 H. H. JENKINS 3,512,034

ELECTRODE AND ELECTRODE JOINT

Filed Sept. 19, 1967

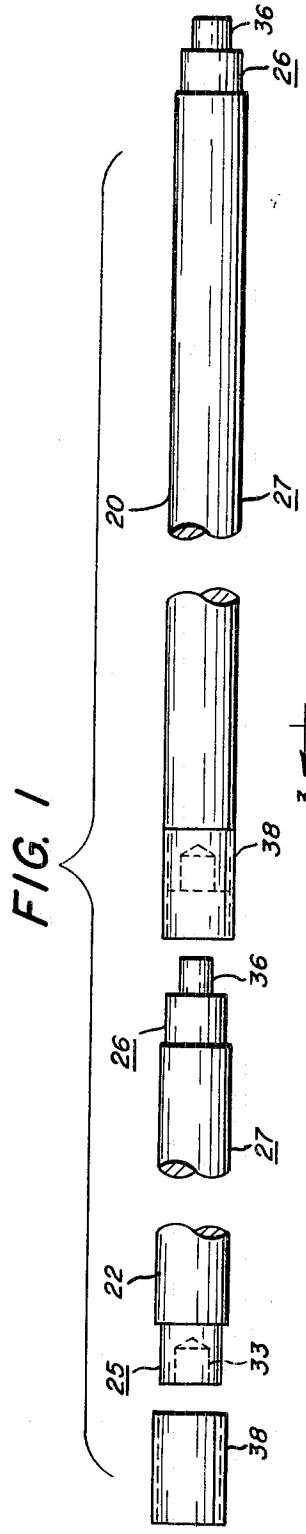


FIG. 1

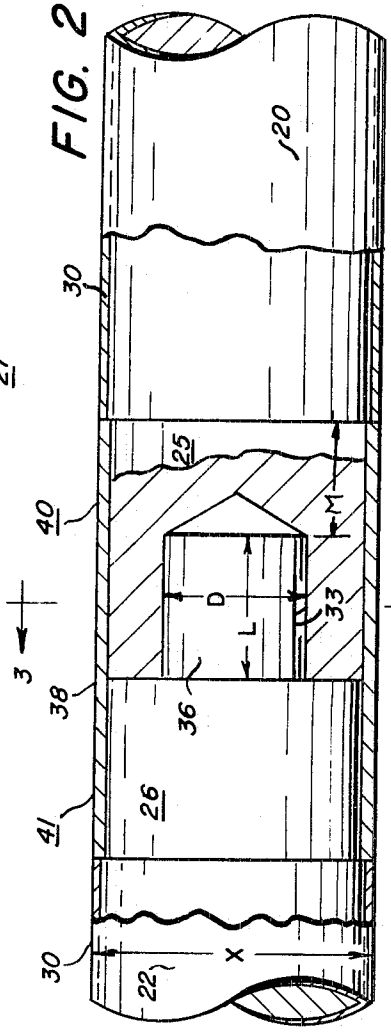


FIG. 2

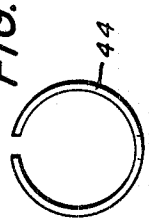


FIG. 5

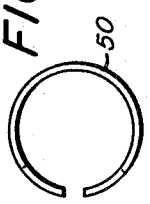


FIG. 7

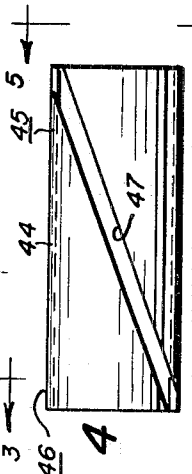


FIG. 4

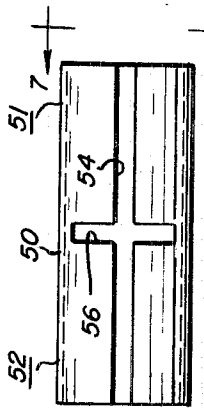


FIG. 6

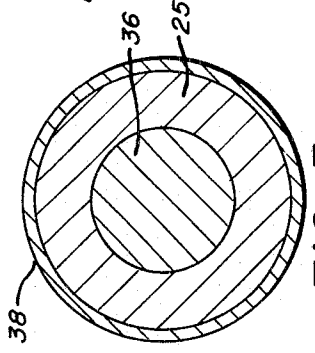


FIG. 3

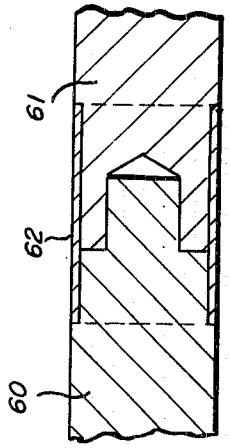


FIG. 8

INVENTOR.

HENRY H. JENKINS

BY

Woodling, Krost, Granger & Rust

Attys.

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ELECTRODE AND ELECTRODE JOINT

Henry H. Jenkins, 864 W. Hacienda Drive, Corona, Calif. 91720

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ABSTRACT OF THE DISCLOSURE

An electrode with first and second end portions of a smaller size than an intermediate portion therebetween and preferably comprised of an integral carbon member which may or may not be copper coated. The first end portion has an opening therein and the second end portion has an extension adapted to fit within an opening in another electrode. An annular joint member has a first end which fits on and around the first end portion and has an outer dimension the same size as the intermediate portion of the electrode. The joint member has a second end which is adapted to fit on and around the second end portion of another electrode and also has an outer dimension the same size as the intermediate portion of the electrode. The electrode joint is made by the interconnection of the hereinabove described first end portion of one electrode with the second end portion of another electrode by use of the corresponding opening and extension and the annular joint member. The annular joint member may be continuous or may be split by a generally axially extending slot as disclosed.

An object of the invention is to provide an electrode joint which is the same size as the adjacent electrodes whereby an electrode chuck may accommodate the joint as conveniently as the electrode proper.

Another object of the present invention is to provide an electrode joint which has very good electrical conductivity.

Another object of the present invention is to provide an electrode joint which is structurally very strong.

Another object of the present invention is to provide a joint member which has a spring effect at each axial end which effects are substantially independent of each other.

Another object of the present invention is to provide an electrode and electrode joint which is susceptible of conveniently being mass produced.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view of two of the electrodes of the present invention before their connection to produce the electrode joint;

FIG. 2 is an enlarged view partially in section of the joint produced between the two electrodes shown in FIG. 1;

FIG. 3 is a view taken generally along the line 3—3 of FIG. 2;

FIG. 4 is a view of a modified reinforcing joint member from that shown in FIGS. 1 and 2;

FIG. 5 is a view taken generally along the line 5—5 of FIG. 4;

FIG. 6 is a still further modified form of the reinforcing joint member;

FIG. 7 is a view taken generally along the line 7—7 of FIG. 6; and

FIG. 8 is an elevational view in section of an electrode joint constructed in accordance with the teachings of the present invention but wherein the electrodes are not

provided with the copper coating on the intermediate portions.

The two electrodes which have been illustrated in FIG. 1 have been indicated by the reference numerals **20** and **22** and it will be understood that these two electrodes are identical in construction. Since they are identical in their construction, the same reference numerals will be utilized in identifying the parts thereof. Each of the electrodes comprises an elongated integral cylindrical carbon member which has first and second end portions **25** and **26** respectively, and an intermediate portion **27** which extends therebetween. As will be seen in the enlarged view of FIG. 2, each intermediate portion **27** is provided with a copper coating **30** thereon. It will be seen from FIG. 2 that each of the first and second end portions **25** and **26** of each electrode is reduced or is smaller in diameter than the adjacent intermediate portion thus defining a shoulder between the first end portion and the adjacent intermediate portion and between the second end portion and the adjacent intermediate portion.

The first end portion **25** of each electrode is provided with a counter bore **33** which extends axially thereinto a given depth and as seen is of a given diameter. The second end portion **26** of each electrode is provided with a cylindrical extension **36** which is of a length corresponding to the depth of the counter bore **33** and is of a corresponding diameter.

A cylindrical metal reinforcing joint member **38** which is provided with first and second end portions **40** and **41**, respectively, is provided and the outer diameter of the member **38** substantially corresponds to the outer diameter of the intermediate portion **27** of the electrodes. The first end portion **40** of the joint member normally is carried on and surrounds the first end portion of the electrode with which it is associated prior to the connection of two electrodes. The joint member **38** which has been shown in FIGS. 1, 2 and 3 is a cylindrical member which is completely continuous in nature and variations in this joint member are illustrated in FIGS. 4 through 7. The connection between the first end portion of the joint member and the first end portion of the electrode is a very snug fit and as noted the joint member abuts the shoulder which is formed between the first end portion and the intermediate portion of the electrode. This provides protection for the female part of the electrode to keep the same from becoming damaged during shipment and other handling. The second end portion **41** of the joint member **38** has an inner diameter which is of such a size that it will reside on and surround the second end portion **26** of another electrode to complete the joint between the two electrodes as seen in FIG. 2. As will be noted, FIG. 1 shows the two electrodes **20** and **22** separated and a joint member **38** is shown in position on the first end portion of the electrode **20** whereas the cylindrical joint member which is to be associated with electrode **22** has been shown prior to its insertion onto the first end portion **25** of electrode **22**.

The completed joint has been shown in FIG. 2 and corresponding elements have been numbered in the same manner as in the discussion of FIG. 1. It will be seen in the construction of the assembled joint that the joint provides a substantially continuous electrode and of a diameter at the joint which is the same as the outside diameter of the intermediate portions of the electrode. The joint member is made of a metal having good electrical conductivity and it will be seen that an excellent electrical connection is made between the mating male and female parts of the joint. It has been discovered that highly advantageous electrical characteristics are obtained in the joint of the present invention when the diameter of the extension **36** indicated by the letter D is equal to or greater than the diameter of the intermediate portion

indicated by the letter X divided by two. Also, L, the length of the extension, should be equal to or greater than D.

The present invention is, as suggested above, as highly advantageous when using electrodes which are not copper coated, or in other words, which are comprised solely of an integral carbon member. This has been shown simply for the sake of illustration by the view shown in FIG. 8. It is completely understood that the joint is constructed in exactly the same manner with the exception that the copper coating is omitted from the electrodes which are to be connected and the outside diameter of the reinforcing joint member **62** is of the same outside diameter as the largest diameter of the carbon members **60** and **61** so as to provide a continuous electrode of the same diameter.

FIG. 4 illustrates a reinforcing joint member **44** of different construction from that shown in FIGS. 1, 2 and 3. This joint member is provided with first and second end portions **45** and **46** and a slot **47** extends between the first and second end portions in a generally helical direction. This joint member **44** is designed so that the inside diameter is such that when it is pushed onto either of the first and second end portions **25**, **26**, the metal of the joint member will be forced to a very slightly larger diameter, thus exerting a gripping effect upon the end portion of the electrode with which it cooperates so as to be reliably held thereon. The purpose of the helically extending slot is to provide this spring or gripping effect in each end portion and so that the two spring or gripping effects will be essentially independent of each other. In other words, the slight enlarging of one end will not have the corresponding effect on the other end until it is connected to the other electrode.

FIGS. 6 and 7 illustrate a still further modification of the joint members hereinabove described. In this case a joint member **50** has been shown which has first and second end portions **51** and **52**, respectively, and an axially extended slot **54** extends from one end to the other. A circumferentially extending slot **56** intersects slot **54** so as to provide the spring or gripping effect in each end of the joint member which effects are substantially independent of each other.

The joint members **44** and **50** are used in the same way as the joint member **38** and the completed joint with the use of these members is identical to that shown in FIGS. 1, 2 and 3 with the exception that the slots are provided in the joint members.

It will therefore be appreciated from a review of the above that an electrode construction is provided which results in a highly desirable and convenient joint between two electrodes and the joint is further enhanced by the convenient constructions of improved reinforcing joint members shown in FIGS. 4 through 7. The dimensions L and D vary for different X dimensions, for example X dimensions of ¼ inch and ½ inch; however, it is preferred that the dimension M be constant for all sizes and be at least about .187 inch. This is to provide a minimum reinforcement on the female side of the joint.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. An electrode including in combination an elongated generally cylindrically shaped integral carbon member having first and second end portions and an intermediate portion therebetween, a copper coating over said intermediate portion of said carbon member, said first and second carbon end portions having a smaller diameter than said copper coated intermediate portion, said first carbon end portion having a counterbore therein, said second carbon end portion having a reduced diameter cylindrical axial extension of a length and diameter corresponding to the depth and diameter respectively of said counterbore, a cylindrical metal reinforcing joint member having first and second end portions, said first end portion of said joint member residing on and surrounding said first carbon end portion and having an outside diameter of substantially the same diameter as said copper coating on said intermediate portion, said second end portion of said joint member being of a diameter to reside on and surround a second carbon end portion of another electrode and having an outside diameter of substantially the same diameter as said copper coating on said intermediate portion.

2. An electrode as claimed in claim **1** wherein said reinforcing joint member is split by a helically extending slot.

3. An electrode as claimed in claim **1** wherein said reinforcing joint member is split by an axially extending slot and a circumferentially extending cross slot intersects said axially extending slot.

4. An electrode including in combination an elongated generally cylindrically shaped integral carbon member having first and second end portions and an intermediate portion therebetween, said first and second carbon end portions having a smaller diameter than said intermediate portion, said first carbon end portion having a counterbore therein, said second carbon end portion having a cylindrical axial extension of a length and diameter corresponding to the depth and diameter respectively of said counterbore, a cylindrical metal reinforcing joint member having first and second end portions, said first end portion of said joint member residing on and surrounding said first carbon end portion and having an outside diameter of substantially the same diameter as said intermediate portion, said second end portion of said joint member being of a diameter to reside on and surround a second carbon end portion of another electrode and having an outside diameter of substantially the same diameter as said intermediate portion.

5. An electrode as claimed in claim **4** wherein said reinforcing joint member is split by a helically extending slot.

6. An electrode as claimed in claim **4** wherein said reinforcing joint member is split by an axially extending slot and a circumferentially extending cross slot intersects said axially extending slot.

7. An electrode joint between opposite ends of first and second electrodes each of which has first and second end portions and an intermediate portion therebetween, each said first and second electrodes comprising an elongated integral cylindrical carbon member, a copper coating on each said intermediate portion, each said first and second end portions having a smaller diameter than each said intermediate portion thereby defining a shoulder between said first and second end portions and said intermediate portion therebetween, said first end portion of said first electrode having a counterbore extending axially thereinto of a given depth and diameter, said second end portion of said second electrode having a cylindrical extension thereon residing in said counterbore and being of a corresponding diameter and the length of said extension corresponding to said counterbore depth, a cylindrical metal reinforcing joint member having first and second end portions and having an outside diameter substantially equal to the diameter of said intermediate portions of said electrodes, said first end portion of said joint member residing on and surrounding said first end portion of said first electrode and engaging said shoulder between said first end portion of said first electrode and the adjacent intermediate portion, said second end portion of said joint member residing on and surrounding said second end portion of said second electrode and engaging said shoulder between said second end portion of

said second electrode and the adjacent intermediate portion.

8. An electrode joint as claimed in claim 7 wherein said joint member is axially separated by a slot which extends in a helical direction.

9. An electrode joint as claimed in claim 7 wherein said joint member is axially separated by an axially extending slot and a circumferentially extending slot intersects said axially extending slot at an intermediate portion of said joint member.

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JOHN W. HUCKERT, Primary Examiner

A. J. JAMES, Assistant Examiner

U.S. Cl. X.R.

287—127; 313—332, 334, 354