

April 28, 1936.

O. W. BRENIZER

2,038,535

ART OF JOINING WIRES WITH SLEEVES

Filed Nov. 19, 1934

4 Sheets-Sheet 1

*Fig. 1.*

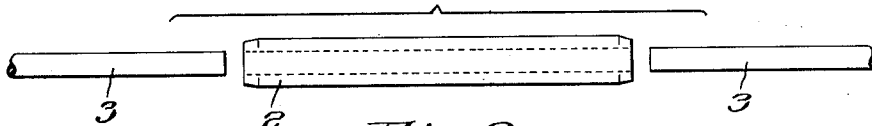


*Fig. 2.*

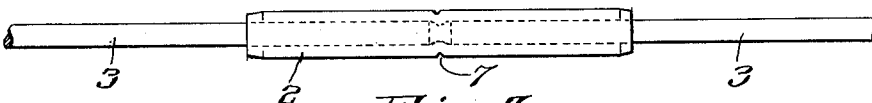


*Fig. 3.*

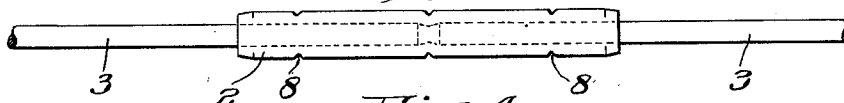


*Fig. 4.*

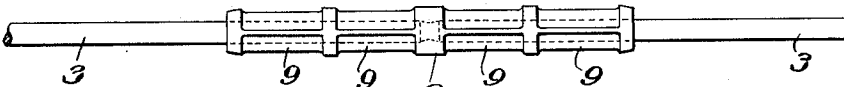


*Fig. 5.*

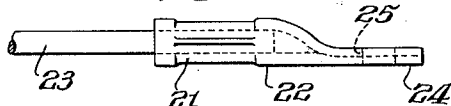


*Fig. 6.*

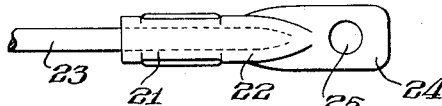


*Fig. 7.*

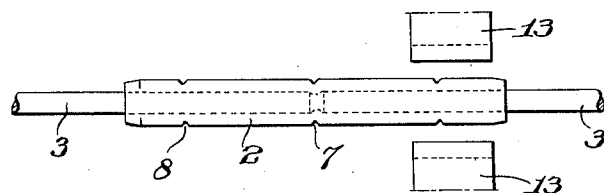


*Fig. 8.*

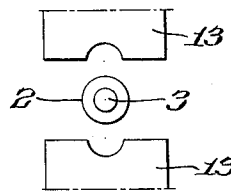


*Fig. 9.*

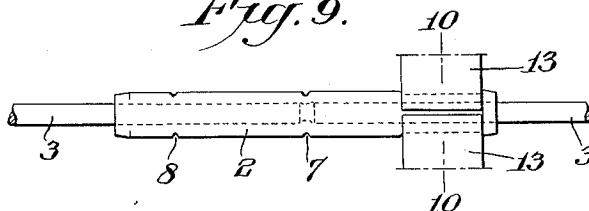
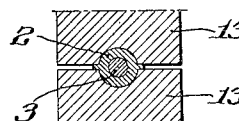


*Fig. 10.*



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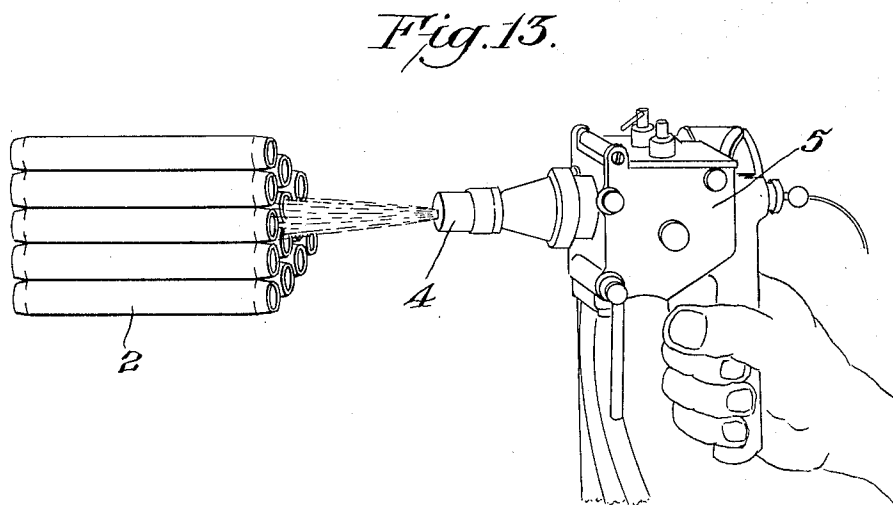
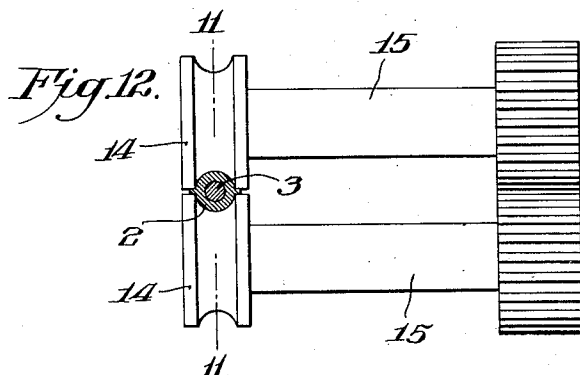
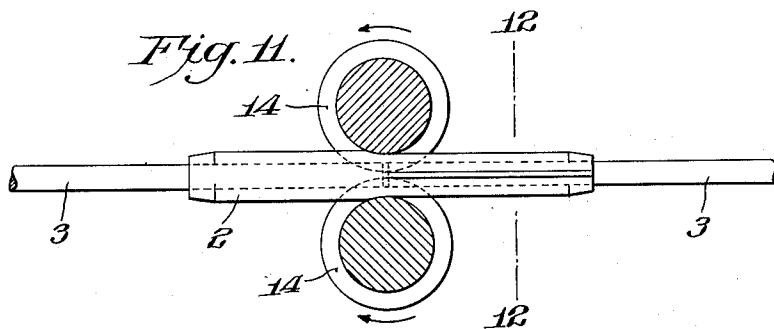
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ART OF JOINING WIRES WITH SLEEVES

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*Fig. 14.*

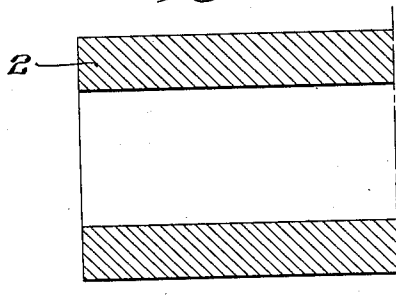


*Fig. 16.*

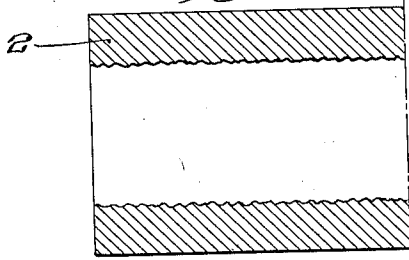


*Fig. 18.*

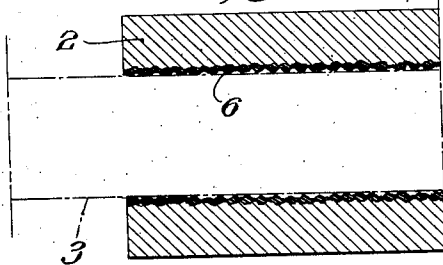


*Fig. 20.*

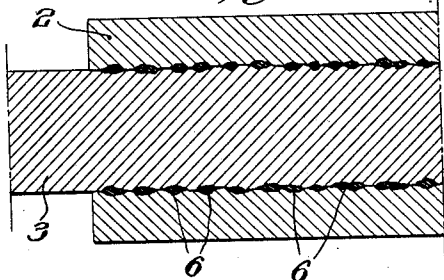


*Fig. 15.*

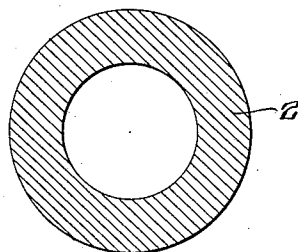


*Fig. 17.*

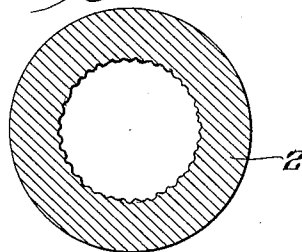


*Fig. 19.*

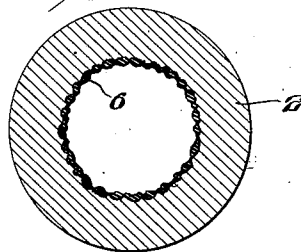
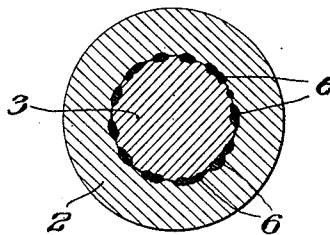


*Fig. 21.*



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*Fig. 22.*

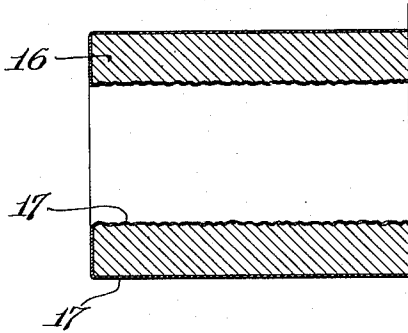


*Fig. 23.*

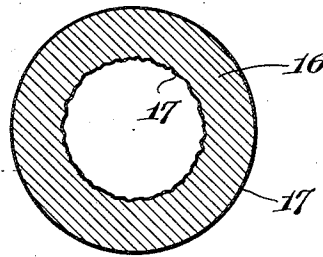


*Fig. 24.*

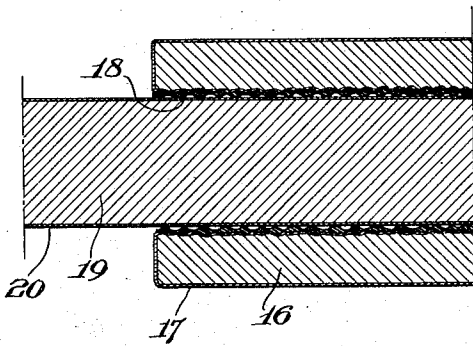


*Fig. 25.*

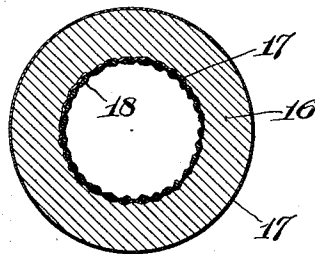


*Fig. 26.*

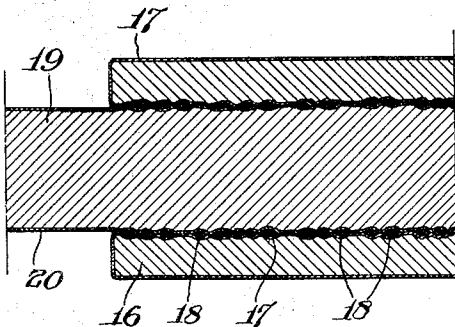
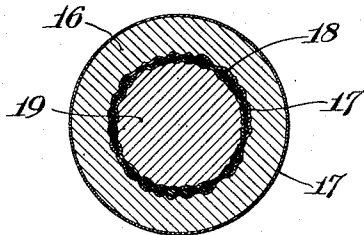


*Fig. 27.*



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## UNITED STATES PATENT OFFICE

2,038,535

## ART OF JOINING WIRES WITH SLEEVES

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Application November 19, 1934, Serial No. 753,751

10 Claims. (Cl. 29—148)

The object of this invention is to provide a novel, simple, inexpensive and advantageous art or method of joining metal wires with metal sleeves in a manner to form a strong and durable connection one with the other for the purpose of connecting wires with other devices, and for the purpose of forming a connection between two wires, and for analogous purposes, for electrical and other uses.

With the foregoing and related objects in view the invention resides in the novel art or method of joining a metal wire or wires with a metal sleeve hereinafter described and claimed.

In the accompanying drawings illustrating the invention,

Figure 1 is a side view of a sleeve and the end portions of two wires to be inserted into the same in making a joint in accordance with my invention.

Figure 2 is a side view of the parts shown in Fig. 1, showing the end portions of the wires inserted into the sleeve.

Figure 3 is a side view of the parts shown in Fig. 2, showing the sleeve and wires therein indented to prevent accidental withdrawal of the wires from the sleeve.

Figure 4 is a side view of the parts shown in Fig. 3, showing a complete wire and sleeve joint made in accordance with my invention.

Figure 5 is a side view of a wire joined with a sleeve of a modified form.

Figure 6 is a top view of the joint shown in Fig. 5.

Figure 7 is a view of the parts shown in Fig. 3, showing the sleeve placed between two open dies as a convenient means to be employed in compressing the same.

Figure 8 is an end view of the parts shown in Fig. 7.

Figure 9 is a view similar to Fig. 7, showing the dies in the closed position and a part of the sleeve compressed thereby.

Figure 10 is a transverse section on line 10—10 of Fig. 9.

Figure 11 is a view of the parts shown in Fig. 3, showing the sleeve being passed between two rollers as another means for compressing the same, the rollers being shown in section, on line 11—11 of Fig. 12.

Figure 12 is a section on line 12—12 of Fig. 11.

Figure 13 is a perspective view illustrating the spraying of the molten metal upon the inner walls of a number of sleeves.

Figure 14 is a longitudinal section, greatly enlarged, of one end portion of a plain metal sleeve

used in making a joint in accordance with my invention.

Figure 15 is a transverse section of the sleeve shown in Fig. 14.

Figure 16 is a view of the portion of the sleeve shown in Fig. 14 after the roughening of the inner surface thereof.

Figure 17 is a transverse section of the sleeve shown in Fig. 16.

Figure 18 is a view of the portion of the sleeve shown in Fig. 16 after the application of the sprayed molten metal to the inner surface thereof, and showing, by the dot-and-dash lines, a portion of wire inserted therein.

Figure 19 is a transverse section of the sleeve shown in Fig. 18.

Figure 20 is a view of the sleeve and wire shown in Fig. 18, showing the wire in section and in full lines, and showing the relation of the parts after the sleeve has been compressed upon the wire.

Figure 21 is a transverse section of the sleeve and wire shown in Fig. 20.

Figure 22 is a view of the portion of the sleeve shown in Fig. 16, showing the same coated with tin.

Figure 23 is a transverse section of the sleeve shown in Fig. 22.

Figure 24 is a view of the portion of the sleeve shown in Fig. 22 after the application of the sprayed molten metal to the inner surface thereof, showing a part of a metal wire coated with zinc inserted into the same.

Figure 25 is a transverse section of the sleeve shown in Fig. 24.

Figure 26 is a view of the sleeve and wire shown in Fig. 24, showing conventionally the relation of the parts after the sleeve has been compressed upon the wire.

Figure 27 is a transverse section of the sleeve and wire shown in Fig. 26.

In making a wire and sleeve joint in accordance with my invention, and as illustrated in Fig. 4 of the drawings, I provide a sleeve 2 of suitable malleable metal, such as copper, and I provide two wires 3, 3 of suitable metal, such as copper, and I roughen the inner wall of the sleeve 2 by a sand blasting operation, with the aid of any suitable sand blasting apparatus. During this roughening operation, the sand is directed into the tube, first from one end thereof and then from the other end thereof, in a manner to cause the sand grains to strike against the inner wall of the sleeve.

After the inner wall of the sleeve has been roughened, it is coated with particles of a metal which is harder than the sleeve. This metal is sprayed in a molten condition upon the roughened inner wall of the sleeve by the aid of any approved apparatus for spraying molten metal, a portion of one form of which is illustrated in Fig. 13, wherein the spray issues from a discharging nozzle 4 projecting from a part 5 which may be manipulated by hand to direct the spray where desired. The molten metal spray is directed into the sleeve, first from one end thereof and then from the opposite end thereof, and, for economy in time and material a convenient number of laterally adjacent sleeves are assembled and sprayed at the same time, as illustrated in Fig. 13. During this spraying operation the part of the apparatus carrying the nozzle 4 is manipulated by hand to direct the spray into contact with all parts of the inner walls of the sleeves, with the result that the particles of molten metal are deposited upon such inner walls and upon one another until the desired coating has been applied to the sleeves. The coating thus formed is brittle and of uneven thickness and of somewhat uneven formation, as shown at 6 in the tube 2 in Figs. 18 and 19.

After the inner wall of the sleeve 2 has been provided with the coating 6, I insert the end portions of the wires 3, 3 into the respective end portions of the sleeve, the central portion of the sleeve 2 having been previously indented at 7, by a suitable tool to form a central obstruction therein to limit the extent to which the wires may be inserted, so that each wire will be inserted substantially the same distance when they are thus applied to the sleeve. The sleeve 2, the coating 6 therein and each wire 3 are related to each other as shown conventionally in Fig. 18.

After the wires 3, 3 have been inserted into the sleeve 2, as shown in Fig. 3, the respective end portions of the sleeve are indented slightly, at 8, by a suitable tool to create sufficient pressure upon the wires therein to prevent accidental withdrawal thereof during subsequent operations in making the joint.

The sleeve 2 with the wires 3, 3 therein, as shown in Fig. 3, is now forcibly compressed circumferentially upon the portions of the wires therein in a manner to cause the coating 6 of hard metal to break into fragments and the fragments to be embedded in the sleeve and in the wires, as shown conventionally in Figs. 20 and 21, to form effective locks or anchors for resisting any longitudinal pull which tends to withdraw the wires from within the sleeve.

When the sleeve 2 is compressed, it is expanded longitudinally and lengthened somewhat and any suitable means may be employed to compress the same. In Fig. 4 of the drawings, I have shown a finished joint in which the sleeve 2 with the wires 3, 3 therein is provided with four compressed portions 9, 9, 9, 9, two for each wire end portion 3; and in Figs. 7, 8, 9 and 10 I have shown two dies 13, 13 by means of which the compressed portions are produced. In producing the compressed portion 9, 9, 9, 9 with the aid of the dies 13, 13, an end portion of the sleeve 2 shown in Fig. 3 is placed between the open dies, as shown in Figs. 7 and 8. The dies are then forced toward each other to the closed position, shown in Figs. 9 and 10. The dies are so shaped that when they are forced to the closed position they will circumferentially compress the part of the sleeve 2 placed between them. After one of the com-

pressed portions 9 has been thus produced, the dies are opened and the sleeve 2 is moved longitudinally between them into position for the production of another compressed portion 9 and the dies are again closed and so on until the four compressed portions 9, 9, 9, 9 have been produced.

Instead of using the dies 13, 13 shown in Figs. 7, 8, 9 and 10, to compress the sleeve 2, the sleeve may be compressed by passing it between two grooved rollers 14, 14, as shown in Figs. 11 and 12. The shafts 15, 15 carrying the rollers are supported in suitable bearings and actuated by suitable means to cause the rollers to forcibly compress the sleeve circumferentially throughout its length and elongate the same as the sleeve is passed completely through the space between the rollers.

Any suitable metal or alloy which when sprayed in a molten condition will form a brittle coating on the inner wall of the sleeve 2, which is harder than the sleeve, may be employed in forming the coating 6. For this purpose I preferably employ an alloy of nickel and chromium of approximately eighty parts nickel and twenty parts chromium. This alloy is non-corrodible and I have found that the employment thereof produces very good results in making a strong and durable joint for any purpose, and also in making a strong and durable joint in electrical conductors, such joint having all the desired characteristics as to electrical conductivity and resistance, because the breaking of the coating 6 into fragments when the sleeve 2 is compressed upon the wire 3 not only provides effective locks or anchors, as previously stated, but permits parts of the inner wall of the sleeve to be pressed into firm contact with parts of the wire between the fragments of the hard metal coating, as shown in Figs. 20 and 21.

When steel wire is employed in the joint it is desirable that the entire wire be coated with zinc or galvanized for the prevention of oxidation and corrosion. Any suitable malleable metal, such as copper or steel, may be employed in the sleeve in making the joint with the zinc coated steel wire. It is necessary, however, in this form of joint that the entire sleeve be provided with a coating of tin or its equivalent for preventing the sleeve from corroding when it is made of steel and for preventing galvanic action within the joint by contact of the body of the sleeve with the zinc coating on the wire when the body of the sleeve is made of copper. The usual well known methods are employed in coating the sleeves with tin and in coating the wires with zinc.

In Figs. 22 to 27, inclusive, I have illustrated steps in the making of a joint in accordance with my invention, in which the body of the wire is made of steel, and, in making this joint, I provide a sleeve 16 of suitable malleable metal, such as copper or steel and I roughen the inner wall thereof by a sand blasting operation and I coat the entire sleeve with tin 17, as shown in Figs. 22 and 23. I then subject the tin coated inner wall of the sleeve 16 to an additional sand blasting operation, sufficient to roughen the tin coating but not to expose any of the metal forming the body of the sleeve beneath the coating. I then provide the tin coating 17 on the inner wall of the sleeve with a brittle coating 18 of particles of metal harder than the metal of the sleeve 16, the same as the sleeve 2 was provided with the coating 6, as hereinbefore described. A steel wire 19 with a zinc coating 20 is then provided and an end portion of the coated wire

19 is inserted into the sleeve 16, as shown in Fig. 24. After the wire 19 has been inserted into the sleeve 16, the latter is circumferentially compressed upon the wire 19 the same as the sleeve 2 was compressed upon the wire 3, as hereinbefore described, thereby completing the making of the joint.

The extent to which the fragments of hard brittle metal are embedded in the sleeve and the wire therein is dependent upon the hardness of the wire and the sleeve as related to the hardness of the anchoring fragments of metal interposed between the sleeve and the wire, and also upon the degree of force applied to the sleeve when it is compressed upon the wire. This relationship as to hardness and the degree of force applied to the sleeve may each be varied to suit different conditions and to make wire and sleeve joints of different materials in which the joints shall be strong enough to withstand the application of pulling forces which equal or substantially equal the strength of the wires and the sleeves.

When the sleeve is coated with tin and the wire is coated with zinc, the thickness of the coatings and the force applied to the sleeve to compress it upon the wire may be such as to cause the fragments of harder metal between the coatings to be embedded in the coatings alone or to be embedded in the bodies of the sleeve and the wire as well as the coatings thereon. In either case the union of the tin coating with the body of the sleeve and the union of the zinc coating with the body of the wire are important factors in forming strong and durable joints. In some cases the metal forming the body of the sleeve or that forming the body of the wire or both may be harder than the tin and zinc coatings thereon. The force applied to the tin coated sleeve to compress it upon the zinc coated wire may be great enough to cause some of the anchoring fragments of metal interposed between them to break through either or both of the coatings thereon. If this should occur in cases where the body of the sleeve is formed of copper the anchoring fragments of metal would prevent the copper of the sleeve from coming into contact with the zinc coating on the wire at the places where such fragments broke through the tin coating.

In Figs. 5 and 6 I have shown a modified form of a sleeve joined with a wire by my improved method. In this modification, one end portion 21 of a sleeve 22 is compressed upon a wire 23 and the other end portion 24 of the sleeve is flattened and provided with a perforation 25 as a means for securing or attaching the sleeve to another object or device.

I claim:

1. The method of making a wire and sleeve joint which comprises coating a metal sleeve with tin, spraying molten metal upon the tin coating on the inner wall of the sleeve, inserting an end portion of a metal wire into an end portion of the sleeve, and compressing the sleeve and the coating and sprayed metal therein upon the wire.

2. The method of making a wire and sleeve joint which comprises coating a steel wire with zinc, spraying molten metal upon the inner wall of a metal sleeve, inserting an end portion of the wire into an end portion of the sleeve, and compressing the sleeve and the sprayed metal thereupon upon the wire and the coating thereon.

3. The method of making a wire and sleeve

joint which comprises coating a metal sleeve with tin, spraying molten metal upon the tin coating on the inner wall of the sleeve, coating a steel wire with zinc, inserting an end portion of the wire into an end portion of the sleeve, and compressing the sleeve and the coating and sprayed metal therein upon the wire and the coating thereon.

4. The method of making a wire and sleeve joint which comprises coating the inner wall of a metal sleeve with particles of a metal harder than the metal of the sleeve by spraying such harder metal in a molten condition upon the inner wall of the sleeve, inserting an end portion of a metal wire of less hardness than said particles into the sleeve, and compressing the sleeve and the coating therein upon the wire.

5. The method of making a wire and sleeve joint which comprises roughening the inner wall of a metal sleeve, coating said inner wall with particles of metal harder than the metal of the sleeve by spraying such harder metal in a molten condition upon the inner wall of the sleeve, inserting an end portion of a metal wire of less hardness than said particles into the sleeve, and compressing the sleeve and the coating therein upon the wire.

6. The method of making a wire and sleeve joint which comprises coating the inner wall of a metal sleeve with particles of metal harder than the metal of the sleeve by spraying an alloy of nickel and chromium in a molten condition upon the inner wall of the sleeve, inserting an end portion of a metal wire of less hardness than said particles into the sleeve, and compressing the sleeve and the coating therein upon the wire.

7. The method of making a wire and sleeve joint which comprises coating a metal sleeve with tin, applying particles of material of greater hardness than the tin to the coating on the inner wall of the sleeve, inserting an end portion of a metal wire of less hardness than said particles into an end portion of the sleeve, and compressing the sleeve and the coating and particles thereon upon the wire.

8. The method of making a wire and sleeve joint which comprises coating a steel wire with zinc, applying to the inner wall of a metal sleeve particles of material harder than the zinc and said wall, inserting an end portion of the wire into an end portion of the sleeve, and compressing the sleeve and the particles therein upon the wire and the coating thereon.

9. The method of making a wire and sleeve joint which comprises coating a metal sleeve with tin, coating a steel wire with zinc, applying particles of material of greater hardness than the tin and the zinc to the coating on the inner wall of the sleeve, inserting an end portion of the wire into an end portion of the sleeve, and compressing the sleeve and the coating and particles therein upon the wire and the coating thereon.

10. The method of making a wire and sleeve joint which comprises sand blasting the inner wall of a metal sleeve, coating said wall with particles of metal harder than the metal of the sleeve by spraying such harder metal in a molten condition upon said wall, inserting an end portion of a metal wire of less hardness than said particles into the sleeve, and compressing the sleeve and the sprayed metal therein upon the wire.