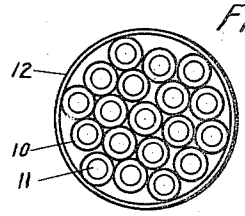
June 3, 1941. C. H. KLEIN 2,244,109

SLEEVE AND METHOD FOR MAKING SAME

Filed Jan. 4, 1940

FIG. 1



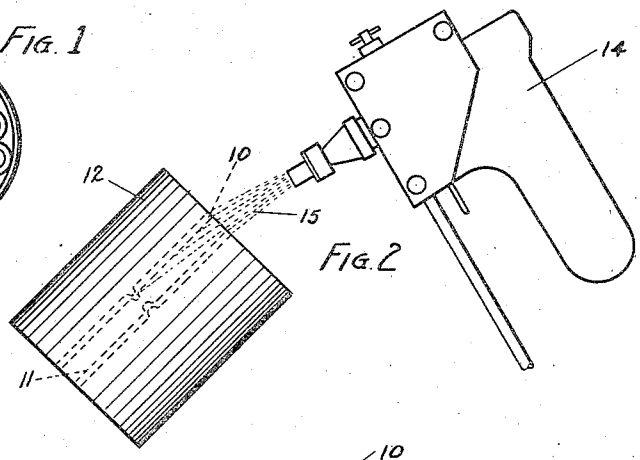
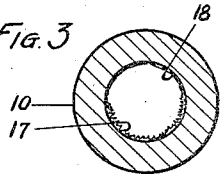


FIG. 2

FIG. 3



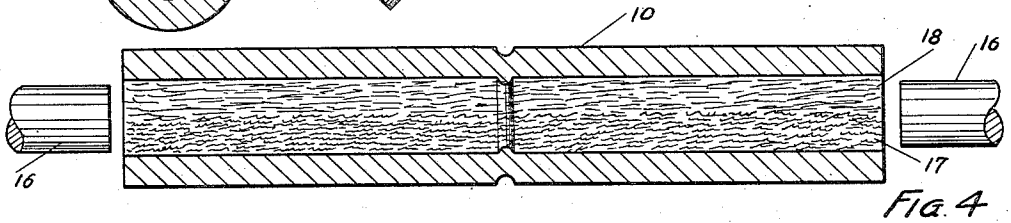


FIG. 4

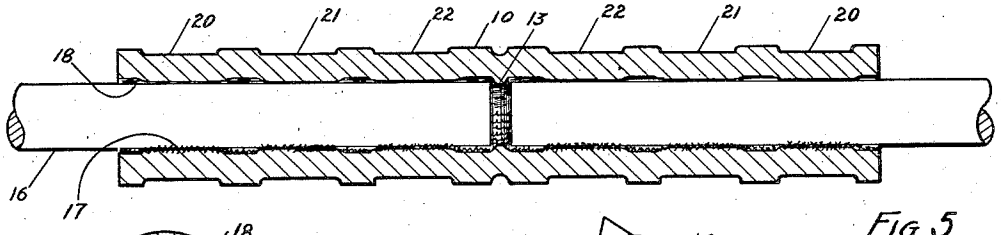


FIG. 5

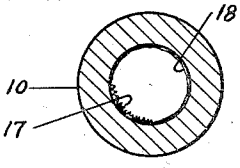


FIG. 6

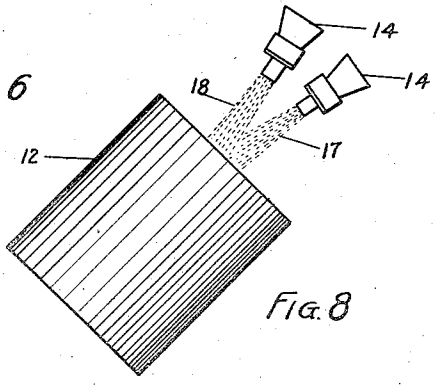


FIG. 8

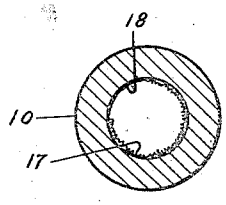


FIG. 7

INVENTOR.
Charles H. Klein

BY Stoddling and Kroat
ATTORNEY.

Patented June 3, 1941 2,244,109

UNITED STATES PATENT OFFICE

2,244,109

SLEEVE AND METHOD FOR MAKING SAME

Charles H. Klein, Cleveland, Ohio, assignor to The National Telephone Supply Company

Application January 4, 1940, Serial No. 312,386

7 Claims. (Cl. 29—148)

My invention relates to a device for joining metal wires together and more particularly to a metal sleeve which is adapted to firmly grip the ends of the wires to be joined and which has a high electrical conductivity between the wires to be joined and the metal sleeve.

An object of my invention is to provide an internal coating for a sleeve which coating has an electrical conductivity equivalent substantially equal to that of the wire to be fastened in the sleeve.

An object of my invention is to provide a device for joining the ends of two wires together in a union which is sufficiently strong to withstand a pull on one wire with respect to the other and which has a high electrical conductivity.

Another object of my invention is to provide a metal sleeve for anchoring the end of an electrical conductor and to increase the electrical conductivity between the sleeve and the wire without materially decreasing the strength of the connection between the sleeve and the wire.

Still another object of my invention is to provide a wire attaching sleeve which has a coating on the inner surface thereof.

Still another object of my invention is to coat the inner surface of an attaching sleeve with a plurality of substances, one of which increases the holding power of the sleeve and another of which increases the electrical conductivity of the sleeve.

A further object of my invention is to furnish an attaching sleeve for connection to a conductor and to provide a method whereby the electrical conductivity of the joint between the sleeve and the conductor can be controlled during manufacture to assure that the conductivity of the joint is equal to or greater than the conductivity of the wire.

Another object of my invention is to provide an electrical connection for a wire which has the greatest strength commensurate with the conductivity desired in the connection.

Still another object of my invention is to provide an electrical connection for a wire which has the largest electrical conductivity commensurate with the strength desired in the connection.

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

Figure 1 is an end view of a plurality of my connecting sleeves arranged in a holding device preparatory for coating the inside surfaces thereof.

Figure 2 is a side view of the sleeves in Figure 1 with one connecting sleeve being more predominately shown than the others, together with a spray gun for coating the sleeves.

Figure 3 is a cross-sectional view of one of my connecting sleeves as coated.

Figure 4 is a longitudinal cross-sectional view of Figure 3 and shows a wire positioned to be inserted through an open end thereof.

Figure 5 is a longitudinal cross-sectional view showing the wire inside the sleeve and after compression has been applied to the outside of the sleeve.

Figure 6 is a cross-sectional view similar to Figure 3 but shows another variation in the internal coating of my device.

Figure 7 is a view similar to Figure 6 showing still another variation in the internal coating of my device; and

Figure 8 is a view similar to Figure 7 showing two spray guns coating the sleeves.

With reference to the drawing, my invention comprises coating the inner surface of a hollow metal sleeve 10 with several kinds of materials to increase the conductivity between the sleeve 10 and a wire 16 without materially reducing the holding power between the sleeve 10 and the wire 16.

One manner of coating the inner surface is illustrated in Figures 1 and 2 of the drawing and consists of grouping together a plurality of the sleeves to be coated and spraying them with a material 15 which is to cover the inside surface 11. For convenience, I employ a container 12 which has an open top and bottom to hold the group of sleeves while spraying them but other means such as any suitable fastening device may be used. After grouping the plurality of sleeves 10 in the container 12 the container is tilted at a slight angle for the operator's convenience and a spray of material is directed down the inside of the sleeves. The spray is projected by a spray gun 14 and the direction of the spray is at a slight angle to the axial direction of the sleeves within the container 12. By directing the spray at a slight angle with respect to the sleeves the operator assures that the material 15 strikes the inside wall surfaces.

After grouping the plurality of sleeves 10 in the container 12, the operator tilts the container at a slight angle for his convenience, as shown in Figure 2 and then he takes his spray gun and directs the spray of material at a slight angle to

the longitudinal axis of the inside surfaces of the sleeve so that the sprayed material impinges the sleeves for substantially one-half of their longitudinal length. The operator sprays all the sleeves within the container at this slight angle by sweeping the spray material over the entire end surfaces of the plurality of sleeves within the container. By directing the spray at a slight angle with respect to the longitudinal axis of the openings in the sleeves 10 the operator insures that the spray material impinges the inside surfaces of the sleeve to make a good coating which adheres firmly to the inside surfaces of the sleeves. Inasmuch as the spray is directed at a slight angle to the longitudinal axis of the sleeve, only a longitudinal arcuate portion of the inside surfaces of the sleeves is coated for each positional setting of the container 12 which holds the plurality of sleeves. To coat the entire inside surfaces 10 of the sleeves with the spray material, the operator rotates the container substantially 90 degrees for each spraying operation. In this manner the operator sprays a substantially 90 degree arcuate surface for substantially one-half of the length of the inside surfaces of the sleeves upon each positional setting of the container 12 which holds the plurality of sleeves. After spraying the upper end of the sleeves 10, the operator turns the container 12 end-for-end and repeats the spraying process. Turning the container 12 end-for-end and repeating the spraying process is necessary for long sleeves as the spray will not pass through the entire length of the sleeve 10 and strike the inside wall at an angle sufficient to cause it to stick.

The treatment which I subject the inside surface 10 to consists of spraying two kinds of material 15 thereon. One material is harder than the metal of the sleeve 10 and the metal of the wire 16 to which the sleeve 10 is to be attached. This material is indicated by the reference character 17 and may be nickel and chromium such as "Nichrome." If the sleeve 10 and the wire 16 are soft copper any harder metal such as hard copper, bronze, stainless steel, or "Nichrome" could be used. If the sleeve 10 or the wire 16 is made of hard copper the coating material 17 could be of bronze, stainless steel or "Nichrome." If the sleeve 10 or wire 16 is made of bronze then only those metals which are harder than bronze, i. e., stainless steel, and "Nichrome," could be used. The other material which is sprayed on the inside surface 11 of the sleeve 10 is preferably a metal having a high electrical conductivity. This high conductivity metal is designated by the reference character 18.

In sleeves having the entire inside surface coated with the hard material 17 I have found that the conductivity from the wire 16 to the sleeve 10 is low as the metals which are best for their gripping qualities are poor in conductivity.

To produce a sleeve which is good in gripping and high in conductivity, therefore, I coat the inner surface 11 with two kinds of metals, one for strength or gripping qualities and one for conductivity.

To form my improved sleeve, a portion of the inside surface of the sleeve is sprayed with a hard metal such as "Nichrome" and the remaining portion is sprayed with a metal having a higher conductivity. The proportionate share of the inside surface of the sleeve which is sprayed with the hard material and with the material having a high conductivity is governed by the balance between the gripping action and the conductivity between the wire and the sleeve. Thus, in the spraying operation, the operator may spray a hard metal, for example, for two 90 degree positions of the container 12 and then spray a high conductivity metal for the other two 90 degree positions of the container, as shown in Figures 3, 4 and 5. In the above described method, two spray guns are used successively so that one side of the inner wall of the sleeve is covered with a hard metal for holding and the other side of the sleeve covered with a high conductivity metal for electrical conductivity between the sleeves and wire. The metal coatings 17 and 18 sprayed inside of the sleeve are not smooth like electro-plating but consist of hills and valleys which key themselves into the wire and sleeve when the sleeve 10 is squeezed into engagement with the wire 16.

In connecting the sleeve and the wire, the wire is inserted in the sleeve until it abuts the central stop 13, and then the sleeve is compressed by any of the well known methods of rolling, drawing, or squeezing. For a squeezing operation, a constant movement clamping tool may be used to compress the sleeve 10 and the coatings therein upon the wire 16 and force the coatings into intimate engagement with the wire. The pressure may be applied over spaced areas 20, 21 and 22 thereby causing substantially the entire inside surface 10 to engage the wire 16. The hard coating 17 which lies on the surface of the sleeve 10 as is shown in Figure 4 is forced to dig into both the sleeve 10 and the wire 16 by the squeezing of the clamping tool as may be seen in Figure 5. A pull on the wire 16 with respect to the sleeve 10 will not cause the wire to pull out as the hard coating firmly grips both the sleeve and the wire.

Electrical current flowing through the wire 16 will pass to the sleeve 10 with a minimum of conduction loss as the high conductivity coating 18 lies between the wire and the sleeve and is in close contact with each of them.

In the installation of current carrying wires where low loss by resistance is of importance my device has great utility. A wire which is to be connected to the sleeve has a known resistance and must withstand a known pull. With these values known the area inside the sleeve which must be covered by each of the coatings in order to meet the service conditions can readily be determined. I have illustrated in Figures 3, 6 and 7 several variations in the amounts of the hard coating 17 and conducting coating 18. Figure 3 shows half of the inside area covered with each of the different coatings. Figure 6 shows three-quarters of the inside area covered with a metal of high conductivity and one-quarter covered with the metal 17 which increases the gripping power between the wire 16 and the sleeve 10. This type may be used where high conductivity is essential and the stress between the sleeve and the wire is low. Figure 7 shows a sleeve having three-quarters of its inner surface 11 covered with the hard metal 17 and only one-quarter covered with high conductivity metal 18. This type of sleeve is to be used in connections where great strength is required to resist stress on the wire with respect to the sleeve and where the conductivity requirements are low.

Figure 8 shows a modified manner of applying molten metal 17 and 18 or other coating to the inside of the sleeves 10. Two spray guns 14

are used simultaneously, one to spray the sleeve with the hard coating 17 and the other to spray the sleeve with the conducting coating 18. Each of the operators directs his spray to strike the container 12 at different angles and attempts to avoid spraying the same sleeves at the same time as they each sweep the spray over all the sleeves. As illustrated in Figure 8 the two spray guns 14 are held laterally apart and are directed at the sleeves in the container from different sides thereby assuring that the metals 17 and 18 do not impinge on the same arcuate portion of the inside surface of the sleeves.

Although I have described my invention as spraying molten metal in a manner to cause it to stick to the inside of a hollow sleeve it is to be understood that any means of coating the sleeve is within the purview of my application and that a sleeve on which a plurality of metals has been painted or otherwise affixed is deemed a coated sleeve and within the scope of this disclosure.

I claim as my invention:

1. The method of making a wire and sleeve joint of high strength and of high electrical conductivity which comprises coating a portion of the inner wall of the sleeve with a molten metal comprised of nickel and chromium and which is harder than the metal of the sleeve or the metal of the wire to be joined, coating another portion of the inner wall of the sleeve with a molten metal which has a higher coefficient of electrical conductivity than the said nickel chromium metal, inserting an end portion of the metal wire into an end portion of the sleeve and compressing the sleeve and the coatings therein upon the wire.

2. The method of making a wire and sleeve joint of high strength and of high electrical conductivity which comprises spraying a portion of the inner wall of the sleeve with a molten metal comprised of nickel and chromium, spraying another portion of the inner wall of the sleeve with molten bronze, inserting an end portion of the metal wire into an end portion of the sleeve and compressing the sleeve and the sprayed metal therein upon the wire.

3. The method of making a wire and sleeve joint of high strength and of high electrical conductivity which comprises simultaneously spraying the inner wall of the sleeve with a molten metal comprised of nickel and chromium and with molten bronze, inserting an end portion of the metal wire into an end portion of the sleeve and compressing the sleeve and the sprayed metal therein upon the wire.

4. The method of making a wire and sleeve joint of high strength and with a high electrical conductivity substantially equal to the electrical conductivity of the wire comprising spraying an area of the inner wall of the sleeve with a material which has high electrical conductivity, said area and said wire having substantially equal conductivity, spraying the remaining area of the inner wall of the sleeve with a material which is harder than the material which has a high electrical conductivity and which is harder than the metal of the sleeve or the metal of the wire to be joined, inserting an end portion of the wire into an end portion of the sleeve and compressing the sleeve and the sprayed material therein upon the wire to establish an electrical connection which has a conductivity substantially equal to the conductivity of the wire which is joined.

5. A metal sleeve for joining an electrical conductor wire thereto comprising a hollow tubular sleeve having an inner surface, an area of said inner surface being coated with a gripping material which is harder than the metal of the said sleeve and harder than the metal of the wires to be joined and an area of said inner surface being coated with a material which is softer than said gripping material and which has a high coefficient of electrical conductivity, said second area having a conductivity substantially equal to the conductivity of the wire to be joined thereto.

6. A metal sleeve for joining an electrical conductor wire thereto comprising a hollow tubular sleeve having an inner surface, an area of said inner surface being coated with a gripping material which is harder than the metal of the said sleeve and harder than the metal of the wires to be joined and an area of said inner surface being coated with a material which is softer than said gripping material and which has a high coefficient of electrical conductivity, said inner surface of the sleeve having a resultant conductivity substantially equal to or better than the conductivity of the wire to be joined thereto.

7. A metal sleeve for joining an electrical conductor wire thereto comprising a hollow tubular sleeve having an inner surface, an area of said inner surface being coated with a gripping material comprising nickel and chromium which is harder than the metal of the said sleeve and harder than the metal of the wires to be joined and an area of said inner surface being coated with a material which is softer and which has a higher coefficient of electrical conductivity than the said nickel and chromium gripping metal.

CHARLES H. KLEIN.