

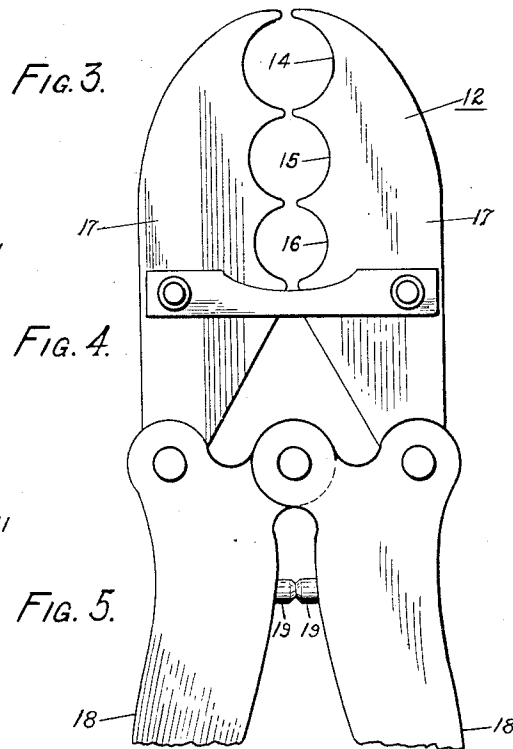
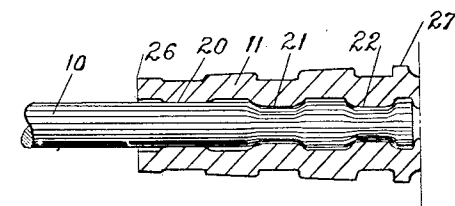
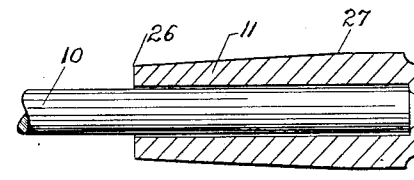
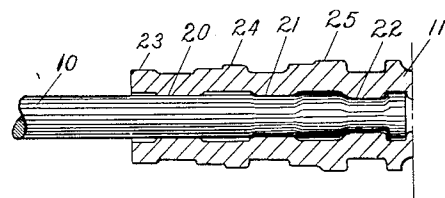
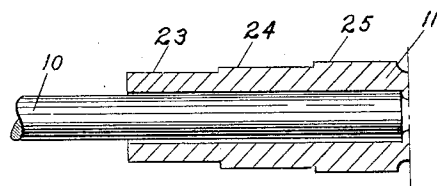
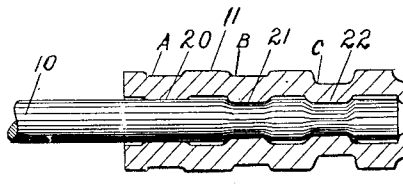
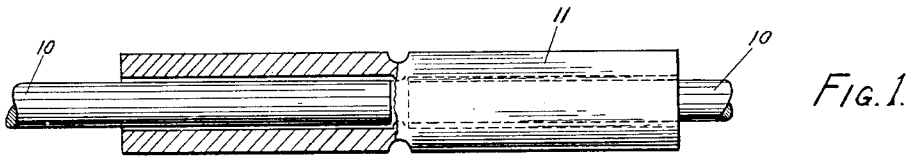
Aug. 24, 1943.

C. H. KLEIN

2,327,650

WIRE CONNECTING SLEEVE

Original Filed Jan. 4, 1940



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UNITED STATES PATENT OFFICE

2,327,650

WIRE CONNECTING SLEEVE

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Original application January 4, 1940, Serial No.
312,387, now Patent No. 2,272,244, dated February
10, 1942. Divided and this application
February 17, 1941, Serial No. 379,249

7 Claims. (Cl. 287-109)

My invention relates to sleeves for joining a wire thereto and more particularly to compression type sleeves for joining an electrical conductor thereto without reducing the breaking strength of the conductor and without decreasing the electrical conductivity of the joint by the use of an abrasive between the sleeve and the wire to be joined.

This application is a division of my pending application Serial No. 312,387, filed January 4, 1940, now Patent No. 2,272,244 dated February 10, 1942, for Sleeves and method of connecting a wire to same.

An object of my invention is to provide a joint between an electrical conductor wire and a sleeve which requires no abrasive to prevent the wire from pulling out of the sleeve when a force is put on the wire with respect to the sleeve.

Still another object of my invention is to anchor a wire in a sleeve by a combination of frictional engagement and "necking" engagement.

Another object of my invention is to provide a constant movement clamping tool which is adapted to squeeze a sleeve both into frictional engagement with a wire and into "necking" engagement with the wire.

Still another object of my invention is to provide a tool which will clamp a first portion of a sleeve into frictional engagement with a wire to establish a grip between the sleeve and the wire to transfer a portion of the wire's load to the sleeve, and which will clamp a second portion of the sleeve into a "necking" engagement with the wire to transfer a second portion of the wire's load to the sleeve, and to so construct the sleeve and the tool that the percent reduction in the total cross-sectional area of the wire caused by the "necking" engagement of the sleeve will be substantially proportional to the percent reduction in the total load caused by the frictional engagement.

A further object of my invention is to provide an improved joint between a sleeve and a wire in which the sleeve "necks" into the wire at spaced points and at progressively increased depths to provide a plurality of increasing load resistant grips, and to proportion the percent reduction in the total cross-sectional area of the wire caused by one of the succeeding "necking" engagements to be substantially proportional to the percent reduction in the total load which the previous "necking" engagements of lesser depth take up.

Another object of my invention is to provide a

round sleeve having a hole of substantially constant diameter and having a plurality of different sized outside diameters which can be squeezed by a constant movement tool to engage a wire at a plurality of spaced points.

Still another object of my invention is to provide a sleeve having a hole of substantially constant diameter therethrough and having a gradually changing outside diameter.

Another object of my invention is to make a joint between a sleeve and a wire by progressively compressing the sleeve and causing the reduction in the cross-sectional area of the wire resulting from the compression to be substantially proportional to the load taken up by the preceding compressions.

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 shows the ends of two wires in position in a hollow sleeve and before a squeezing pressure has been applied to the sleeve;

Figure 2 shows a constant movement clamping tool which is adapted to squeeze each end of the sleeve into engagement with the wire;

Figure 3 is a longitudinal section through one wire and a half-portion of the sleeve shown in Figure 1 after the sleeve has been squeezed at three spaced points by the tool shown in Figure 2;

Figure 4 is a modified form of my sleeve shown in longitudinal cross-section and comprises generally a plurality of sections which have different sized outside diameters;

Figure 5 is a cross-sectional view of my modified sleeve shown in Figure 4 after each of the sections has been squeezed by a constant movement clamping tool;

Figure 6 shows another modified form of my invention; and

Figure 7 is a cross-sectional view of my modified sleeve shown in Figure 6 after a constant movement clamping tool has squeezed it at three spaced points.

My invention comprises an improved compression sleeve 11 for attaching a wire 10 therein and an improved means for securing the wire into the improved compression sleeve 11. As shown in the drawing, the wire may be freely inserted into the longitudinal opening of the sleeve until it abuts against the internal stop substantially mid-way of the sleeve.

It is known to those versed in the art of splicing electrical conductor wires that a wire 10 may be securely held in the sleeve 11 without the use of an

abrasive if a compression tool is used to severely squeeze the sleeve 11 and cause it to "neck" into the wire 10. "Necking" means that the compressed portion of the sleeve 11 reduces the cross-sectional area of the wire and establishes a shoulder against which the sleeve abuts. The shoulder prevents slippage between the wire and the sleeve. On the other hand, the reduction in the cross-sectional area of the wire weakens the wire so that it is apt to fail when an excessive load is put on the wire with respect to the sleeve. A further objection to "necking" is the fact that it cold-works the wire and vibrational fatigue is apt to cause an early failure. Figure 1 illustrates my sleeve 11 with the wires 10 inserted therein before it has been squeezed to neck the wire 10.

My device and method is adapted to secure the wire 10 in the sleeve 11 without an abrasive by "necking" the wire 10 without establishing a weakened cross-sectional area which may fail due to stress or vibrational fatigue.

Figure 3 illustrates in cross-section the left-half portion of the sleeve 11 shown in Figure 1 after it has been compressed upon the wire 10 by means of a tool indicated generally by the reference character 12 and shown in Figure 2. The tool 12 is of the constant movement type and has three clamping areas 14, 15 and 16. Each of the three areas comprises a substantially circular hole in the jaws 17 of the tool 12. Hole 15 is smaller in diameter than hole 14 and hole 16 is smaller than hole 15. Handles 18 are adapted through a double lever system to open and close the jaws 17 of the tool 12. Stops 19 are provided on the handles and adapted to engage each other when the jaws 17 of the tool 12 have been closed to a fixed position. Engagement between the stops 19 provides a constant movement to the closing of the jaws 17 of the tool.

Figure 3 shows areas A, B and C which have been squeezed between the jaws 17 of the tool 12. Sleeve area A having been squeezed by the clamping area 14, sleeve area B having been squeezed by the clamping area 15 and sleeve area C having been squeezed by the clamping area 16. The diameter of the tool clamping area 14 is designed to cause the tool 12 to squeeze the sleeve 11 into a frictional engagement 20 with the wire 10. A "necking" engagement is prevented by the stops 19 on the handles 18 engaging each other to prevent further squeezing action by the tool 12. The diameter of the tool clamping area 15 is designed to cause the tool 12 to squeeze the sleeve 11 into a slight "necking" engagement 21 with the wire 10. The "necking" engagement is not deep, that is, the sleeve 11 does not materially depress the wire 10, as the stops 19 engage each other and prevent an excess squeezing action. The diameter of the tool clamping area 16 is designed to cause the tool 12 to squeeze the sleeve 11 into a "necking" engagement 22 which is deeper than the preceding "necking" engagement 21.

The frictional engagement 20 is adapted to withstand part of the pull on the wire 10 with respect to the sleeve 11. The "necking" engagements 21 and 22 are adapted to withstand the remainder of the pull between the wire 10 and the sleeve 11. The depth to which the "necking" engagements 21 and 22 penetrate the wire 10 is carefully controlled to prevent too great a reduction in the cross-sectional area of the wire 10.

Too great a reduction in the cross-sectional area increases the stress in pounds per square inch to a point where failure might occur. The ratio of reduction in the cross-sectional area of the wire

10 at the "neck" 21 to the total cross-sectional area of the wire shall not exceed the ratio of the load withstood by the frictional engagement 20 to the total load on the wire 10. In other words, the percentage of reduction in the cross-sectional area of the wire at the "neck" engagement 21 is substantially proportional to the percentage of load taken up by the frictional engagement 20. By so designing the size of the clamping holes 14, and 15 in the tool 12 the above ratios may be established. The "neck" 22 is also designed to prevent too great a reduction in the cross-sectional area of the wire 10. The percentage reduction at "neck" 22 is substantially proportional to the percentage of load taken up by the frictional engagement 20 and the "necking" engagement 21. By proportioning the frictional engagement 20 and the "necking" engagements 21 and 22 with respect to the load between the wire 10 and the sleeve 11 and with respect to the cross-sectional area of the wire 10 I can establish a joint between the wire 10 and the sleeve 11 which will not break or slide and which does not use an abrasive which is expensive and may reduce the conductivity of the joint.

Figure 4 is another embodiment of my sleeve 11 and is adapted to be used with a constant movement clamping tool having a fixed clamping area in its jaws. Figure 4 illustrates a sleeve having steps 23, 24 and 25. The diameter of the sleeve 11 at the step 23 is smaller than the diameter of the sleeve at the steps 24 and 25, and the diameter of the sleeve at the step 24 is smaller than the diameter at the step 25. Figure 5 shows the stepped sleeve 11 after a constant movement tool having a fixed squeezing diameter hole has squeezed the sleeve substantially in the center of each of the steps 23, 24 and 25 to form the frictional engagement 20 and the "necking" engagements 21 and 22. The "necking" engagements 21 and 22 are formed because of the increased diameters of the steps 24 and 25 over the diameter of the sleeve at the step 23.

Figures 6 and 7 illustrate another sleeve which is adapted to be used with a constant movement clamping tool having a fixed squeezing diameter hole. The diameter of the sleeve increases from the end portion 26 toward the center portion 27. Figure 7 shows the sleeve 11 after the constant movement clamping tool has squeezed it at three spaced points to form the frictional engagement 20 and the "necking" engagements 21 and 22. As in the stepped embodiment the "necking" engagements are caused by the increased diameters at the points 21 and 22 on the sleeve over the diameter at 20.

In all three embodiments of my invention, I provide for making a joint between a sleeve and a wire by progressively compressing the sleeve and causing the reduction in the cross-sectional area of the wire resulting from the compression to be substantially proportional to the load taken up by the preceding compressions.

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

I claim as my invention:

1. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the metal of the sleeve at spaced locations along the intermediate portion of the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into "necking" engagement with the periphery of each of the core-forming members, the metal of the sleeve at spaced locations in the region of the end portions of the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into frictional engagement with the periphery of each of the core-forming members.

2. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the metal of the sleeve at spaced locations along the intermediate portion of the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into "necking" engagement with the periphery of each of the core-forming members, the metal of the sleeve at spaced locations in the region of the end portions of the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into frictional engagement with the periphery of each of the core-forming members, the "necking" engagements ranging from a relatively slight radial depth to a relatively deep radial depth.

3. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the metal of the sleeve at spaced locations along the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into "necking" engagement with the periphery of each of the core-forming members, the "necking" engagements ranging from a relatively slight radial depth to a relatively deep radial depth.

4. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the

metal of the sleeve at spaced locations along the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into "necking" engagement with the periphery of each of the core-forming members, the "necking" engagements ranging progressively from a relatively slight radial depth to a relatively deep radial depth as they approach the longitudinal center of the sleeve.

5. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the metal of the sleeve at spaced locations along the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into "necking" engagement with the periphery of each of the core-forming members, the "necking" engagements ranging progressively from a relatively slight radial depth to a relatively deep radial depth as they approach the longitudinal center of the sleeve, the metal of the sleeve at the spaced upset locations having substantially the same external diameters and each having a greater wall thickness as they approach the longitudinal center of the sleeve.

6. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the metal of the sleeve at spaced locations along the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into engagement with the periphery of each of the core-forming members, the said engagements ranging from a frictional engagement to a "necking" engagement.

7. A joint structure comprising a malleable seamless metal sleeve having a longitudinal bore extending therethrough, and malleable metal core-forming members extending longitudinally into said sleeve and having adjacent ends spaced relatively close to each other in the region of the longitudinal center portion of the sleeve, the metal of the sleeve at spaced locations along the sleeve being annularly and radially inwardly upset and compacted against and around said core-forming members and forced into engagement with the periphery of each of the core-forming members, the said engagements ranging from a frictional engagement to a "necking" engagement, the metal of the sleeve at the spaced upset locations having substantially the same external diameters and each having a greater wall thickness as they approach the longitudinal center of the sleeve.

CHARLES H. KLEIN.