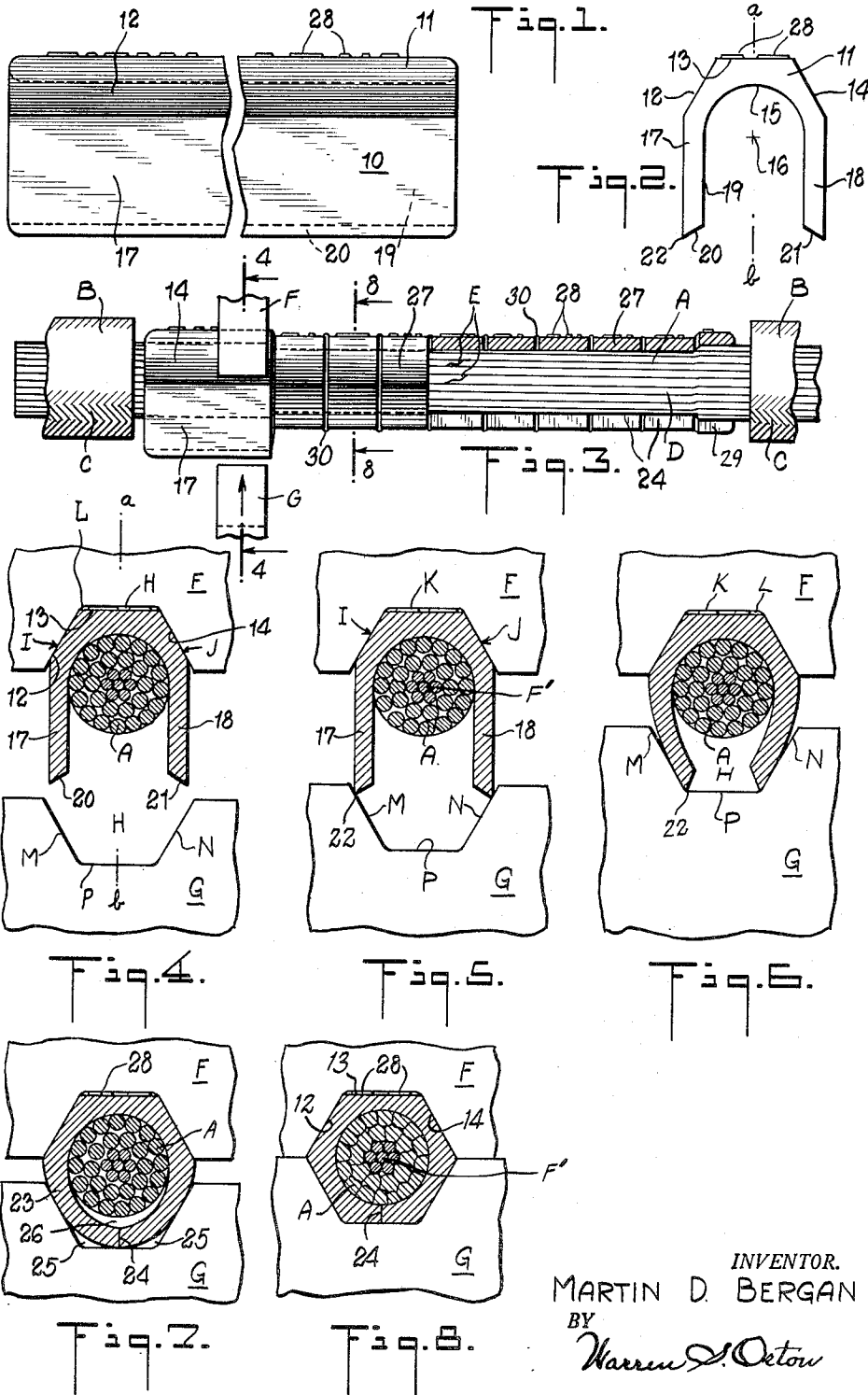


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METHOD AND BLANK FOR SECURING A CABLE
REPAIR SLEEVE TO A CABLE
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METHOD AND BLANK FOR SECURING A CABLE REPAIR SLEEVE TO A CABLE

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The invention relates to a cable repair tube or sleeve for use in reinforcing a worn, damaged or otherwise defective electric conductor and to the method of installing the sleeve in place on the conductor. The conductor cable is made up of a multiple of wires some of which at times are broken or damaged.

It is a practical and economic requirement of repair sleeves that they be manufactured complete as far as possible as a factory-produced article of manufacture and that they be designed so that in installing them on the conductor to be repaired they will require that the least possible work be done on them in the field installation to effect the requisite permanent connection with the conductor.

The securing of repair sleeves to conductors already in place and usually in an outside location often high in the air is usually effected by means of a hand-operated crimping tool which, of course, imposes a limitation on the power available to crimp the sleeve. The difficulty in making a secure connection between repair sleeve and the conductor increases, of course, with the size of the sleeve and with large size conductors and repair sleeves power-actuated crimping apparatus must be used.

The primary object of the invention is to provide a repair sleeve by means of which a defective cable or with broken wires may be reinforced and strengthened in its defective area and which sleeve may be installed by a manually powered crimping operation, even in the case of conductors which may be designed in the trade as of large size.

Broadly, this objective is attained by forming the repair sleeve as an article of manufacture, preferably as a casting, U-shaped in cross section and in which its crotch portion is preformed to the eventual configuration of the finally completed sleeve, and thus does not have to become involved in the subsequent crimping operation and wherein the available manual power of the operator or the power inherent in a small size power-operated tool is utilized solely to effect an in-wrapping of the relatively soft leg portions in binding the sleeve to the conductor.

In those cases where the available crimping pressures, either manually or power-actuated, acting on the sleeve are sufficient to do so, the invention contemplates the work-hardening of the legs as they are in-wrapped about the conductor seated in the preformed crotch portion of the sleeve.

In this art it has been found to be of advantage to form the completed sleeve hexagonal in cross section with the conductor therein circular in cross section and squeezed by the sleeve sufficiently to reduce the initial area of the conductor to a solid core of reduced cross section.

The invention in its method aspects features the dividing of the total operative length of the sleeve into areas sufficiently small in their length dimension so that each area can be deformed separately, one after the other, by a small size crimping tool of either the manually or power-actuated type, until the desired length of engagement with the conductor is had.

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Accordingly, in the reinforced structure herein disclosed, with its hexagon sleeve in crimped engagement with the conductor, the upper, initial crotch portion of the sleeve is in the relatively soft condition in which it was originally cast, and the lower, initial leg-forming portion is work-hardened and compressed so that the lower half of the hexagon is harder than the upper portion of the hexagon and, despite the fact that it is a split tube, it adheres fixedly to the conductor as if it were a solid tube.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and in part will be more fully set forth in the following particular description of one form of repair sleeve embodying the invention and of one method of forming the repair sleeve, and the invention also consists in certain new and novel features of construction and combination of parts hereinafter set forth and claimed.

In the drawings:

Fig. 1 is a view in side elevation of the stock repair sleeve with the central portion broken out and constituting a preferred embodiment of the article aspect of the invention;

Fig. 2 is a view in end elevation of the showing in Fig. 1;

Fig. 3 is a view partly in side elevation and partly in section in the vertical medial longitudinal plane of the assembly of sleeve and conductor, showing the stock sleeve of Figs. 1 and 2 in position on a horizontally extending cable with the left portion in its initial uncrimped form as shown in Figs. 1 and 2, with a pair of narrow crimping dies about to engage the same, and with the right portion deformed into a crimping engagement with the cable; and

Figs. 4 to 8, inclusive, are each explanatory views in cross section of the sleeve as in Fig. 2, showing succeeding portions of the dies and associated portions of the sleeve, and wherein Fig. 4 is taken on the line 4—4 of Fig. 3, and Fig. 8 is taken on the line 8—8 of Fig. 3.

In the drawing and referring first to the stock part or split tube 10 shown in Figs. 1 and 2, there is disclosed a one-piece article of manufacture constituting a casting formed of malleable metal of channel structure and U-shaped in all cross-sections thereof. The crotch portion 11 of the channel structure is defined exteriorly by three upwardly-facing flat faces marked 12, 13 and 14 in Fig. 2, with the outer inclined faces 12 and 14 forming an angle of sixty degrees, with the top or middle face 13 to form exteriorly a half-hexagon. The crotch portion of the channel is defined interiorly by a semi-cylindrical surface-forming seat 15 for the cable to be repaired. It is intended that the seat be dimensioned to receive that size of conductor for which the sleeve was formed so that the conductor has a fairly snug but easily running fit in the seat. The center of the arc of the surface 15 is at 16 in the line of die thrust *a—b* which line also bisects and extends normal to the face 13 as hereinafter described.

A pair of long, narrow, flange-forming legs 17 and 18 extend integrally from the crotch portion in parallel relation. The inner faces 19 of the legs merge roundly into and are tangent to the semi-cylindrical seat 15. The free ends of each of the legs are beveled inwardly as shown at 20 and 21 at an angle of about thirty degrees to the adjacent face 19. In this way the most advanced point of each leg is defined by a sharp bevel edge 22 which is the line of initial engagement with the lower power die hereinafter described. The sum of the lengths of the inner faces 19 of the legs is slightly greater than the arc length of the cable seat 15 and thus are longer than the exposed under side of the cable when in engagement with the seat as hereinafter explained.

The metal forming the sleeve 10 is apportioned between the crotch and legs so that its center of mass is approximately at the center 16, so that when hanging on the cable the legs 17 and 18 will depend perpendicularly from the crotch portion; the flat top face 13 will be horizontal; and the flat side faces 12 and 14 will be more or less equally inclined to the vertical line of thrust $a-b$.

The stock article as thus far described is generally designated as a compression type cable repair sleeve, but actually it does not repair the cable; it supplements or bridges across and thus reinforces a damaged, worn or otherwise weakened portion of a cable. In the case illustrated in Fig. 3, the sleeve is crimped about a portion of the stranded wire core A of an insulated cable B having an insulating jacket C and wherein one or more of the wire strands D are broken at the points E. In the case illustrated the cable includes a steel core F' and its wire strands D are made of a soft grade aluminum. The sleeve 10 is made of the same metal as the strands D to provide about the same coefficient of expansion and to avoid any electrolytic reaction between the metals. However, it is within the scope of the disclosure to make the sleeve 10 of copper or copper alloys when used with copper cables.

It is a feature of this disclosure that the crotch portion 11 be preformed with the accuracy which is possible in factory production to have the same configuration as is intended for the finished product when crimped onto the cable. This means that the upper portion of the sleeve within the outlines defined by the faces 12, 13 and 14 of the sleeve when in use as shown in Fig. 8 is preformed and these faces are maintained substantially in their factory-formed relation. Also, as there is very little working of the crotch portion during the crimping operation it retains its initial unworked and relatively soft condition compared to the legs which become worked as they are wrapped inwardly about the cable and compressed by the squeeze action of the crimping dies.

The sleeve is intended to be installed on the cable either by a hand-operated crimping tool, in the case of small size sleeves, or by a power-actuated crimping machine, in the case of large size sleeves. In either case the crimping is had by means of a pair of coating dies F and G whose work faces are provided with opposing recesses H which are of identical semi-hex configuration and disposed symmetrical with reference to the line of thrust $a-b$. It is the intent in the situation illustrated to deform the stock sleeve into a crimping engagement with the cable by successive crimping operations, in each case involving only a limited length of the cable and sleeve at any one time, and for this reason the dies F and G are shown in Fig. 3 to be relatively narrow compared to the area of sleeve to be crimped. The upper die F, referred to sometimes as the holding die, is relatively stationary after it has been lowered from its inoperative position to engage the sides 12 and 14 of the sleeve. The lower die G, referred to sometimes as the forming die, is movable along the line $a-b$ as indicated by the long arrow in Fig. 3. The sides of the recess H of the stationary holding die F, and particularly its inclined sides I and J, conform to the preformed sides 12 and 14 of the stock article. The side K forming the bottom (actually the top) of the upper recess H is spaced slightly above the face 13 to form a clearance L therebetween. This is to compensate for any irregularities in the angular relation of the preformed faces 12 and 14 and where lettering is present to avoid contact therewith. Similarly, the recess H of the lower die is defined by a pair of inclined side surfaces M and N and a connecting bottom surface P, and otherwise is identical with the opposing recess H of the upper die.

In one form of the invention the clearance L was reduced to the extent that it practically was non-existent but still the lettering was legible even though crushed.

In operation and having located the breaks E in the cable, the insulation jacket C is cut away as shown in Fig. 3 to expose the damaged part of the core A and that length of repair sleeve is cut off from stock sufficient to fill in the space between the adjacent ends of the insulation C remaining on the cable. With the dies out of the way the sleeve 10 is then hung at any point desired onto the core A, overhanging the breaks E therein and the cable is received in the seat 15 with the legs 17 and 18 dangling in space as shown in Fig. 4. The sleeve tends to locate itself rotatively on the cable with its side 13 more or less horizontally disposed by reason of the weight of the pendulous legs 17 and 18.

The open sides of both of the die recesses H are slightly wider than the width of the sleeve and this means that with the sleeve centered by the upper die the sharp edges 22 defining the lower ends of the legs will come just within the recess H of the lower die as the lower die is elevated from the position shown in Fig. 4 into the position shown in Fig. 5. As the lower die bears upwardly on the legs 17 and 18 the first noticeable effect is that the flat sides 12 and 13 of the crotch portion are driven firmly against the downwardly-facing die sides I and J and conform to the same and some of the clearance L may be taken up, but when lettering is present on the side 13 care is exercised to avoid mutilating the lettering. Thereafter the crotch portion 11 is retained immovable in the upper or holding die and presumably is not thereafter affected to any material extent by the squeeze action of the dies.

As the lower or forming die continues to move upwardly the free ends of the legs slide down the inclined sides M and N of the lower die recess and tend to curl inwardly towards each other as shown in Fig. 6, and along the bottom surface P. This action continues until the free ends of the legs contact mid-width of the surface P to form the split sleeve into an annular ring 23 with a closed joint 24 as shown in Fig. 7, with vacant spaces 25 formed on opposite sides of the joint 24 between the recessed part of the lower die and the under side of the sleeve. A lunar-shaped space 26 forms between the core A and the under side of the sleeve. Up to this point there has been no material change in the density of the metal forming the bottom of the ring 23 in Fig. 7.

As the dies reach their point of nearest approach or up to the point where they are in squeezed-together contact as shown in Fig. 8, the lower portion of the ring 23 is crowded in on itself to fill up the spaces 25 and 26 and to give a half-hexagonal form to the lower portion of the sleeve until finally the resulting cross-sectional configuration is a complete hexagon in its exterior outline as shown in Fig. 8. As the legs are of equal length this action brings the closed joint 24 at the mid-width portion of the surface 29 forming the lower face of the completed hexagon. During the final stages of compressing the lower portion of the ring it bears onto the stranded core A; squeezes the same; the strands become compacted to their limit; and the individual strands lose their initial round character as indicated in Fig. 8.

Another action takes place between the Figs. 7 and 8 stages of the crimping operation. The legs become worked by reason of the bending and squeezing operation, which results in at least the lower portion of the sleeve as viewed in Fig. 8 becoming harder and more rigid than the factory-formed upper portion opposite the joint 24.

As soon as the crimp has been made the dies are separated conventionally and if necessary the crimped sleeve is knocked away from whichever die it may be adhering.

As soon as a crimping is so formed at one point, the dies are shifted to another point along the uncrimped portion of the sleeve as suggested in Fig. 3, and the operation repeated as often as is necessary. In the show-

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ing in Fig. 3 eight areas of crimps 27 have been made on the right side of the showing, with the left side remaining intact as originally cast. As the several crimps are formed narrow ridges 30 are formed, between succeeding crimps by reason of the slight spacing apart of the crimping dies in their succeeding crimping acts. As shown in Fig. 3 the original diameter of the core A as it still exists exteriorly of the right end of the sleeve is of slightly greater diameter than the portion which has been condensed by reason of the several crimping operations herein featured.

It is suggested that the extreme right end of the sleeve have its legs infolded as above described to form a closed ring 29 encircling the uncompressed core, but not compressed thereon, to provide a loose connection with the cable at the point where it emerges from the repair sleeve. This tends to defeat possibility of the repair sleeve abraiding the core A.

It is suggested that the flat top surface 13 be utilized to contain embossed or upstanding lettering 28 which can be formed integral with the stock sleeve in the act of casting the same. This lettering may comprise trademark designations, sizes and like display matters.

By means of a form of repair sleeve as herein disclosed it is seen that all of the sleeve of Fig. 8 above the plane of contact between the dies is in the exact condition it was when originally cast and no deformation, or at least no material deformation, is imposed on this part of the sleeve during the installing of the same on the cable. All of the distorting effect has been localized on the thin and relatively easily bent legs. As the legs become compressed they lose their original soft character and become hard and rigid and thus tend to resist subsequent tendencies of the joint 24 to open.

As this joint faces downwardly this tends to avoid water creeping into the joint and in practice the inclined under sides of the hexagon form water drip surfaces.

I claim:

1. A one-piece casting formed of a soft malleable metal and possessing uniformly in all parts thereof the physical characteristics inherent in castings of such soft malleable metals, said casting forming a stock strip from which lengths may be cut as desired and the lengths thereafter mechanically formed into cable repair sleeves of hexagonal cross section, said strip being cast in the form of a channel, U-shaped in all cross sections thereof and its crotch portion defined on its outer side by three substantially flat surfaces, with its two outer surfaces forming an angle of about sixty degrees with the flat surface therebetween to thus preform a first-named one-half of a hexagon as part of the casting, and said crotch portion defined on its inner side by a half cylinder and said casting including two legs extending integrally from the crotch portion in spaced-apart and in substantially parallel relation with their inner faces tangent to the half cylinder, and said legs being relatively thin, having a thickness less than that of the crotch portion and each capable of being bent when die-pressed mechanically towards the other to close the initial opening therebetween, and said legs collectively having a mass and volume capable when die-pressed to form a companion one-half hexagon to the first-named cast half hexagon.

2. An article of manufacture constituting a stock article from which a hexagonal compression type cable repair sleeve may be formed, said stock article being of one piece, formed of soft aluminum, U-shaped in cross section for its entire length and whose crotch portion defines externally one-half of a hexagon and adapted to fit into the similarly shaped recess of a holding die and internally a semi-cylinder, and a pair of parallel and spaced-apart legs projecting integrally from opposite sides of the crotch portion, said legs being ductile with their free ends bendable under squeeze pressure inwardly towards each other to close the opening therebetween,

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said legs having a length and aggregate mass sufficient when crowded into a suitable semi-hexagonal recess in a squeeze die and about a mandrel of cylindrical form fitting in the semi-cylinder internally to complete the circle defined by the perimeter of the semi-cylinder and externally to complete the hexagon.

3. An article of manufacture from which a cable repair sleeve may be formed in situ when hung on the cable, said article being an unworked casting formed from a malleable metal and including as part of the casing a crotch-forming portion providing on its inner side a recess of semi-cylindrical form and on its outer side the three adjacent flat sides of a half-hexagon, and said casting including two parallel and spaced-apart legs projecting integrally from the opposite sides of the crotch portion, said legs having less thickness of material than the crotch portion and adapted to be die-pressed about a cable in the semi-cylindrical recess as a mandrel to cause the legs to wrap about the cable and also to form the legs into a companion half hexagon thereby to form the repair sleeve as a complete hexagon in cross section.

4. A repaired cable including a core-forming section of a cable, a one-piece split sleeve of malleable metal encircling the core and at least in part permanently deformed into a crimping engagement with the core, and at its split forming a closed joint extending longitudinally of the sleeve, said sleeve formed in effect of two integral half hexagons of similar size and configuration, one of the half hexagons being bisected by the closed joint, being worked and thus more rigid and harder than the other half hexagon, and said other half section being a casting made from said malleable metal and thus unworked and softer than the first-named half hexagon.

5. A one-piece split repair sleeve of malleable metal externally hexagonal in cross section and at its split forming a closed joint, said sleeve formed in effect of two integral half sections each defined by three adjacent flat sides of a half-hexagon of which one half section contains the closed joint, the half section containing the closed joint being worked and thus stronger, more rigid and more compact than the other half section and said other half section being a casting having the density characterizing an unworked casting of said malleable metal and softer than the first-named half section.

6. In the art of securing a split tube constituting a channel-shaped casting of aluminum, U-shaped in cross section, to a cable horizontally disposed and wherein the crotch portion of the tube is provided on its inner side with a semi-cylindrical seat for snugly receiving the cable, and said crotch portion outlined on its outer side by a preformed half-hexagon including two flat outside faces disposed at about sixty degrees to the third flat face therebetween, and two legs extending integrally from the crotch portion, the method which consists in hanging the cast tube on the cable with its open side facing downwardly and with its legs depending below the cable, thereby to cause the tube rockably to assume a position with said third face at least substantially horizontal and with the legs depending vertically therefrom, and subjecting the tube to the squeeze action of a pair of superposed dies having opposing recesses each of half-hexagon form and wherein the dies have relative movement along a vertical line of thrust, the upper die being a holding die with downwardly-facing recesses of semi-hexagonal form and dimensioned to receive and hold the crotch portion without materially modifying it from its precast form, and the lower die being a forming die with its recess of semi-hexagonal form facing upwardly and dimensioned to receive the legs of the tube, causing the dies as they approach each other along said line of thrust to effect first an inward curling of the free ends of the legs about the cable until their free ends contact to form an annular ring with a downwardly-facing closed joint and finally as the jaws reach their point of nearest

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approach to cause the lower die to modify the lower portion of the ring so formed to cause it to assume a half-hexagon form coacting with the initial upper crotch-forming half-hexagon to provide a complete hexagon externally and internally to form a cylindrical form of bore crimped onto the conductor and to work the free end portions of the legs to form the lower portion of the ring containing the closed joint to make the same more rigid than the precast upper hexagon.

7. The method defined in claim 6 and wherein a continued approach of the dies after the complete hexagon is formed operates to squeeze the sleeve onto the conductor to increase the rigidity of the die-formed lower hexagon and thus tend to defeat subsequent opening of the closed joint without material affecting the initial cast condition of the upper crotch-forming hexagon.

8. In the art of deforming a stock sleeve being a casting of malleable metal U-shaped in cross section, wherein its crotch is half-hexagon in exterior cross section and wherein a pair of parallel legs project integrally from the crotch, into a finished sleeve whose outer perimeter is completely hexagonal in cross section, by the use of a two-die press wherein each die is provided with a recess facing the other and each recess being half-hexagonal in cross section and wherein the dies when in abutting relation form a recess hexagonal in cross-section, the method which consists in fitting the half-hex-

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agonal crotch of the stock sleeve snugly into the die recesses of one of the dies functioning as a holding die and with the legs projecting therefrom towards the other die, and then causing said other dies to approach the projecting legs, to receive the legs in the recess of said other die and as the dies approach their abutting position to cause the legs to curve inwardly towards each other and eventually to deform the legs into a form hexagonal in cross section, and thus to complete the formation of the sleeve hexagonal in cross-section.

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