

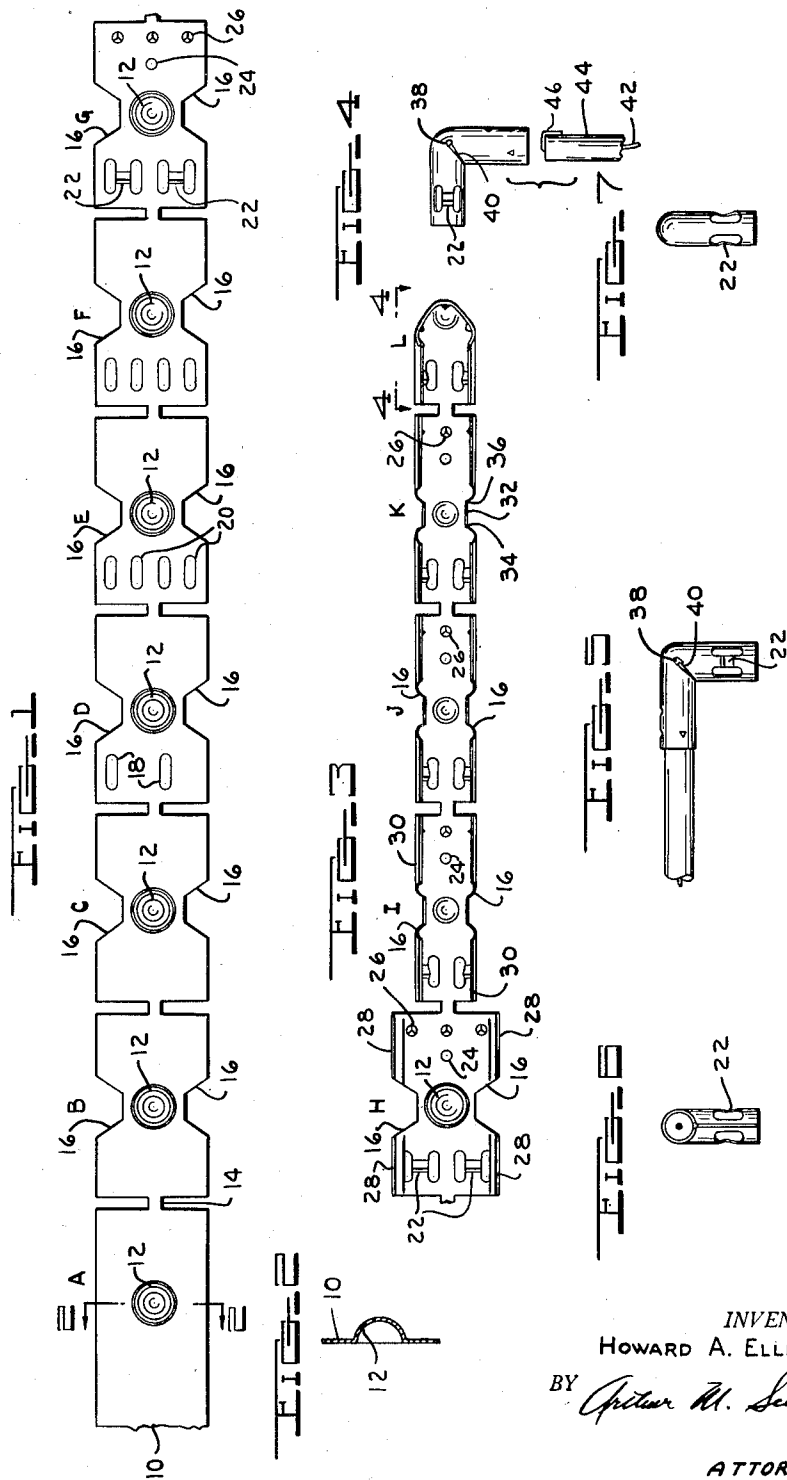
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METHOD OF MAKING SLEEVE-TYPE ELBOW TERMINALS

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METHOD OF MAKING SLEEVE-TYPE
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The present invention relates to improvements in electrical terminals and a method for their manufacture, and in particular to improvements in the formation of a sleeve type elbow terminal used with ignition systems and the like. The present application is related to application Serial No. 24,552, filed May 1, 1948, now Patent 2,553,083, granted May 15, 1951, which discloses and claims the article which results from carrying out the method disclosed and claimed herein.

It has been common to form angular sleeve type electrical terminals from sheet metal stock, so as to provide an essentially tubular L-type sleeve or socket open at both ends. One open end of the terminal is provided for permanently receiving the end of an insulated wire conductor in electrical contact therewith. The other open end serves as a female-type sleeve terminal for detachably engaging a mating plug or male-type terminal of another conductor.

In the manufacture of such terminals, the tubular shaped is first formed in one die. Thereafter, the tubular member is placed in a second die and is bent to the angular or elbow shape. This double handling is obviously inefficient and materially increases the labor cost in the production of the terminal. Furthermore, prior to the present invention, the elbow or right angle bend of such sleeve terminals has been a source of weakness. The elbow is not uniformly stressed and is weakened so that it bends too readily, resulting in early breakage of the terminal at the elbow.

An object of the present invention is to provide an improved angular sleeve type terminal which is particularly resistant to bending or breakage at the elbow, and an improved method for manufacturing such a terminal.

Another object is to provide an angular sleeve type terminal of the character described and an improved method for its manufacture from a strip of sheet metal stock whereby the tubular shape and the angular elbow bend of the terminal are formed in a single series of progressive die operations without the requirement of double handling from one die to another as heretofore.

Another object is to provide an improved angular socket terminal and an improved method for making the same whereby the socket is economically manufactured by mass production methods from strips of sheet metal stock and is permanently secured to its conductor as a final step in its formation, without the use of solder or other bonding material.

Another object is to provide an improved sim-

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plified and efficient method for the mass production manufacture and attachment to a conductor of an improved angular sleeve terminal of the character described, the method comprising a series of related progressive stamping and forming operations.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

The above objects are accomplished in a preferred application of the present invention by means of a progressive die operation performed on a strip of electrically conductive sheet material such for example as bronze or other copper alloy, although other electrically conductive materials having the desired strength and bending and forming characteristics may be employed. In one of the early operations, an indenture having the shape of a spherical or spheroidal segment is embossed into the strip. This indenture later becomes the region of the bend of elbow and provides great strength and resistance to deformation of the terminal's final angular shape. In the succeeding operations, the strip is punched and indentured to provide gripping means and inturned tangs, the sides are rolled to provide a semi-closed sleeve form, being open sufficiently to receive an end of an insulated wire conductor, and the elbow shape is formed by bending the material at the spheroidal indenture. As a final operation, the conductor is inserted into an open conductor receiving leg of the elbow sleeve, with the conducting wire thereof in contact with the indentured side-wall of the sleeve. The sleeve is then closed tightly around the conductor with the indentured gripping means in positive electrical contact with the exposed portions of the conductor and with the inturned tangs embedded within the insulation to provide a permanent attachment therewith. The sidewalls of the other open end of the elbow sleeve are brought together to provide a conventional sleeve or socket type terminal.

The various steps in a preferred application of the method of the present invention are schematically indicated by way of example in the drawings wherein:

Fig. 1 is a plan view of a strip of the material from which a terminal embodying the present invention is made, illustrating various steps in the cutting and indenturing of the strip in the

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formation of a terminal according to the present invention.

Fig. 2 is a fragmentary section through the spheroidal indenture taken in the direction of the arrows along the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary plan view showing a continuation of the strip of Fig. 1, and illustrating the succeeding operations in the formation of the terminal.

Fig. 4 is a fragmentary elevation taken in the direction of the arrows along the line 4—4 of Fig. 3, schematically indicating the step of inserting the conductor into the conductor receiving sleeve of the terminal, and also showing the conductor prior to insertion into the sleeve.

Fig. 5 is an elevation of the completed terminal with the insulated conductor secured within the conductor receiving sleeve thereof.

Figs. 6 and 7 are end elevations taken from the left and right ends respectively of Fig. 5.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to Fig. 1, the thin flat strip 10 from which the terminal embodying the present invention is made is run through a series of die cutting and forming operations. The principles involved in the making and arrangement of progressive dies adapted for carrying out the steps of the present invention are well known to those skilled in the art of tool and die making and are accordingly not discussed in detail herein. Briefly, as indicated in Figs. 1 and 3, the strip 10 is indexed intermittently from left to right through the progressive dies. At each indexed position of the strip, each die in the series performs its respective operation on the portion of the strip indexed thereat. Accordingly, in the strips shown, the first operation is indicated at the extreme left of Fig. 1, and the succeeding operations progress step by step to the right. The various indexed positions assumed by the material of the strip 10 in the formation of any one terminal are lettered A through L for future reference.

The first operation comprises the formation of the spheroidal indenture 12, Fig. 2, embossed within a flat portion of the strip 10 which later becomes the interior surface of the completed terminal. The indenture 12 serves as the fold point when the material is bent to the final elbow shape of the terminal, Figs. 4 and 5. The formation of the indenture 12 work hardens the material at the elbow to resist torsion and bending and also provides an essentially spheroidal elbow surface, noted particularly in Figs. 5 and 7, which permits an even distribution of forces over the area of the elbow and thereby achieves great strength and resistance to bending from its final angular shape.

The indenture 12 formed at position A is then indexed to position B whereat the end portion of the strip 10 is punched out to provide the blank required for completion of the terminal. In this operation, the excess material of the strip 10 is removed, leaving the blank at position B joined to the strip 10 merely by the connecting neck 14. The lateral portions of the blank at B are removed from opposite sides of the indenture 12

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to provide the truncated triangular recesses 16 which permit the subsequent folding operation in the formation of the elbow.

The succeeding operation at position D is conveniently spaced the length of two blanks from the operation B. Accordingly, two indexing movements are required to move the blank from position B to D. No work operation is performed on the blank indexed at position C. At position D, two longitudinal oval-like recesses 18 are stamped within the leg of the blank which subsequently becomes the detachable sleeve terminal.

On the next progressive movement of the strip 10, the blank is indexed from position D to E whereat the oval-like recesses 20, similarly to the recesses 18, are punched into the blank adjacent the recesses 18.

The next operation at G is spaced a distance equal to two blanks from position E, so that no operation is performed on the blank indexed at position F. At G, the two bars 22, one between each pair of recesses 18—20, are crimped upwardly to provide the inward bent resilient and opposed clamping bars or retainers in the completed sleeve terminal, as indicated at 22, Figs. 6 and 7. Simultaneously a conductor contacting nib 24 is raised along the center line of the blank in the leg thereof which finally becomes the conductor receiving sleeve, and the three jagged tangs 26 are also punched into the said conductor receiving leg. The nib 24 and tangs 26 are pressed in from the underside of the strip 10, Fig. 1, which becomes the external surface of the completed terminal, and thus project into the completed sleeve terminal. As will be noted later, the nib 24 provides positive means for electrically engaging an exposed portion of the conductor which is permanently secured to the terminal. The jagged inturned tangs 26 securely engage the insulation of the conductor and provide a permanent attachment therewith when the terminal is eventually formed around the conductor, Fig. 5. The plurality of small tangs 26 are spaced around the periphery of the completed sleeve terminal and are adapted in size so that the area of the surface of the insulation which is cut by any one tang is insufficient to break the insulation from the cable.

At the succeeding position H, the lateral edges 28 of the blank are rolled upwardly as indicated in Fig. 3. Upon the next advance of the blank from position H to I, the lateral portions 30 of the blank are further rolled inwardly to comprise the semi-closed sleeve structure shown at positions I, J and K.

In the next three indexing movements, the blank is moved from the position I to the position L without being subjected to work operations at positions J and K. At position L, the semi-closed sleeve is folded to the elbow shape indicated in Fig. 4. It will be apparent that the elbow may be provided at other than a right angle, as for example 45°. The latter angle is particularly desirable for terminals used with certain types of automobile ignition systems and faces the terminal in use toward the operator in a convenient position. In the elbow bending operation, the axially extending base 32 of each truncated triangular recess 16 is deformed and swaged under relatively high pressure so that the axially spaced points 34 and 36 at the ends thereof are brought together at essentially a single point 38, Figs. 4 and 5. The thickening of the material resulting from compressing each base 32 on opposite sides of the elbow to essentially a single point

38 is swaged and flattened under pressure to provide a thickened and work hardened reinforcement at the base of the slot 40. The latter is a remnant of the recess 16 after the elbow forming operation.

The spacing of the semi-closed elbow sleeve at position L from the forming die at position I by the length of two blanks at J and K provides room for the final operations of inserting one end of the insulated conductor 42 into the conductor receiving sleeve of the elbow and of closing the sleeve securely around the insulation 44 of the conductor 42. As indicated in Fig. 4, an exposed tip 46 of the conductor 42 is bent backward on itself in a U-bend adjacent and externally to the insulation 44. The insulated conductor 42 is then inserted into the said semi-closed conductor receiving sleeve, with the exposed conductor tip 46 contacting the nib 24, assuring a positive electrical contact therebetween after the sleeve is firmly closed around the insulation 44.

The final step in the formation of the terminal and its attachment to the conductor 42 comprises closing the sleeve while still attached to the strip 10, and thereby securely and permanently gripping the insulation 44 by the jagged tangs 26. The final step of folding the sleeve around conductor 42 while the sleeve is still attached to the strip 10 is unusual in the industry. It simplifies and expedites production by avoiding double handling of the terminal and is believed to be a novel short-cut in the production of such angle type terminals. The completed structure of the terminal as attached with the conductor 42 is shown in Figs. 5, 6 and 7.

As thus formed, the open end of the leg of the sleeve terminal which is not secured to the conductor 42 comprises a conventional sleeve or socket connector for detachably coupling with a conventional mating male insert terminal, as for example of the type used in automotive ignition systems. The opposed inward bent bars 22 assure a positive electrical contact with the inserted terminal tip and a secure gripping thereof.

It will be observed from the operations described that various steps in the process may be readily interchanged by the skilled mechanic without deviating from the spirit of the present invention. For example, the advantages and strengthening afforded by the indenture 12 may be obtained by forming the latter farther along in the process provided the portion of the strip 10 which receives the indenture 12 remains essentially flat. The formation of the indenture 12 will be of less value the more the sides of the blank are rolled upward in the latter operations. Accordingly, the indenture 12 is preferably formed in the first operation and thereafter serves as a guide for centering the blank for succeeding operations. It is also to be observed that the reinforcement effected by the indenture 12 may also be achieved if the latter is upraised in Fig. 1, so as to provide a corresponding depressed spheroidal surface at the elbow. Likewise, the present invention is not limited to the spheroidal embossment 12, since embossed indentures having other surfaces, as for example a symmetric multi-facet indenture, will provide a work hardened, stress distributing, elbow reinforcement within the spirit of the present invention. It is also to be noted that in addition to the reinforcement achieved by means of the indenture 12, the latter also improves the appearance of the terminal which is folded and blended thereabout.

From the foregoing, it is apparent that I have

disclosed a superior sleeve type elbow terminal and a simple efficient method for its manufacture by conventional progressive automatic die cutting and forming processes. The completed terminal is formed securely on its cable to provide a permanent attachment therewith as a final stage in the forming operation. The elbow terminal itself is characterized by both an improved appearance and in greatly increased strength and resistance to bending at the elbow in comparison to similar terminals of conventional construction.

Having thus described my invention, I claim:

1. In the method of fabricating a sleeve type elbow terminal from a flat metal strip and of securing a conductor receiving leg of said terminal to an insulated wire conductor, the steps of forming a spheroidal work-hardened indenture in said strip, of slotting said strip on each side of said indenture, of forming an inward projecting conductor contacting nib in the inner wall of said conductor receiving leg, of bending the lateral edges of said strip toward each other to form a semi-closed sleeve, of bending said semi-closed sleeve to the elbow shape with said spheroidal indenture comprising the elbow bend, of exposing a terminal tip of said insulated wire conductor and of bending said tip rearwardly in a U-bend against the external surface of the insulation of the conductor, of inserting said conductor into said semi-closed sleeve with said exposed rearwardly bent tip in contact with said conductor contracting nib, and of thereafter closing said sleeve with said conductor receiving leg thereof securely gripping said conductor.

2. In the method of manufacturing a sleeve type elbow terminal, the steps of forming a work-hardened spheroidal elbow reinforcing indenture in the plane surface of a thin flat blank, of cutting out a portion of the blank on each side of said indenture, of thereafter bending the lateral sides of said blank toward each other into a sleeve shape and thereafter forming the elbow shape with said spheroidal indenture comprising the bend of the elbow.

3. In the method of manufacturing a sleeve type elbow terminal, the steps of forming a work-hardened elbow reinforcing indenture in the plane surface of a thin flat blank, of removing a portion of the excess material of said blank by cutting a recess into opposite sides thereof at the region which is to comprise the bend of the elbow, and thereafter bending the lateral sides of said blank toward each other and forming the elbow shape with said indenture comprising the bend of the elbow.

4. In the method of manufacturing a sleeve type elbow terminal, the steps of forming an elbow reinforcing indenture in the plane surface of a thin flat blank, of removing a portion of the excess material of said blank by cutting a truncated triangular recess into opposite sides thereof at the region which is to comprise said elbow and converging inwardly toward the midline of the blank, of bending the lateral sides of said blank toward each other, of drawing the opposite ends of the base of each inwardly converging truncated triangular recess essentially together in the elbow bending operation, and of swaging and flattening the excess material along the said base to form a thickened reinforcement at the sides of the elbow.

5. In the method of manufacturing a sleeve type elbow terminal, the steps of forming an elbow reinforcing indenture in the plane surface of a thin flat blank, of cutting out a portion of

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the material from each side of said blank at the region which is to comprise the elbow, of bending the lateral sides of said blank toward each other, of drawing essentially together a pair of axially spaced points along the base of each cut-out portion in the operation of forming the elbow, the said indenture comprising the bend in the elbow, and of swaging and flattening the excess material of said base portions between said axially spaced points to form a thickened reinforcement at the sides of the elbow.

6. In the method of fabricating a sleeve type elbow terminal from a flat metal strip including an operation to cut out side portions of the strip adjacent the apex of the elbow, the novel steps of work-hardening a portion of said strip which is to be used at the apex of the elbow of the terminal by embossing a reinforcing indenture therein, and of thereafter forming the terminal with said indenture comprising the bend in the elbow.

7. In the method of fabricating a sleeve type elbow terminal from a flat metal strip and of securing a conductor receiving leg of said terminal to a conductor, the steps of work-hardening a portion of said strip which is to be used at the apex of the elbow of the terminal by embossing a spheroidal reinforcing indenture therein, of cutting out a portion of the strip along each edge on opposite sides of said indenture, of bending the lateral edges of said strip toward each other to form a semi-closed sleeve, of bending said semi-closed sleeve to the elbow shape with said spheroidal indenture comprising the bend of the elbow, of inserting said conductor into the conductor receiving leg of said semi-closed sleeve terminal, and of thereafter closing said sleeve with said conductor receiving leg thereof securely gripping said conductor.

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roidal indenture comprising the bend of the elbow, of inserting said conductor into the conductor receiving leg of said semi-closed sleeve terminal, and of thereafter closing said sleeve with said conductor receiving leg thereof securely gripping said conductor.

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