METHODS FOR WIRE TERMINAL FORMING

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This application is directed to a novel method of forming a wire terminal such as disclosed in my copending application Serial No. 666,621, filed June 19, 1957, now issued as U.S. Letters Patent No. 2,946,368, dated July 26, 1960, and of which this application is a division.

This invention relates to the art of applying eyelift-type connectors to the ends of electrical wire conductors, and more particularly to the secure attachment of such a connector to form an electric conductor terminal on the end of a multiple strand wire conductor.

Examples, illustrating the present manner of applying eyelift-type terminal connectors, are disclosed in several United States patents, including the following: Patent No. 1,677,969, W. Hughes; Patent No. 2,296,983, Cooper et al.; and Patent No. 2,530,575, S. L. Goochin. As disclosed in the above patents, heretofore has been customary first to form an eye or loop on the end portion of the wire connector, then to insert an eyelift barrel within the preformed loop and finally to upset the eyelift barrel so that it is progressively split longitudinally, each split portion being deflected by an eyelift setting anvils member outward and upward to embrace the wire strands of the loop and to clench the wire between the eyelift flange and the upset barrel portions. Another manner of forming such a connector is disclosed in U.S. Patent No. 2,756,802, S. L. Goochin, whereby the wire loop is formed by first splitting a single section of the barrel and clenching it around an end portion of the conductor wire, then rotating the eyelift sufficient amount to cause the wire to form a wrapped loop about the barrel, whereupon the rest of the barrel is upset to embrace the wire of the loop. Although the above semiautomatic machines have been provided with means for forming the end or loop to be embraced by the upset portions of an eyelift barrel, in each instance special machinery was required to form the end of the wire into a loop, and special attention was necessary on the part of the operator in order to present the proper portion of the wire end to the loop forming machinery. Therefore these prior machines were not only costly but required expert handling on the part of the machine operator.

Another difficulty heretofore encountered was that the eyelift connector terminal thus attached, if not subsequently subjected to a dip soldering operation, had a tendency to pull out readily from the conductor wire if the latter were tensioned after the terminal had been secured to a fixed electrical mounting, such as a binding post. This disadvantageous tendency is due to the fact that the wire is wrapped to form the loop in only one direction and, therefore, as a tensile pull is exerted on the conductor, there is a unidirectional force tending to unwrap the wire or to rotate the eyelift. Substantially all of this force is concentrated upon the first split portion of the eyelift barrel that embraces the wire. This portion which is nearest in the direction of the tensile tensioning pull, will become unclenched and then the next adjacent split barrel portion will be subjected to the same concentration of force tending to unwind the wrapped loop of wire; thus the holding power of the terminal is progressively weakened until the wire is completely pulled out from the eyelift.

One of the objects of the present invention is to provide a method, and means to be applied to any eyelifting machine, for forming a wire conductor end into a curved or divided loop through which an eyelift barrel may be inserted and then clench upon the strands of the wire.

Another object is to provide a novel method and means for applying an eyelift-type connector to form a wire terminal of greatly increased holding power, and of such a formation that the above-described rotative force tending to unwrap the wire from around the eyelift is eliminated, by so dividing any tensioning pull upon the wire conductor that the forces are evenly distributed in both directions around the split portion of the upset barrel.

Another object of the invention is to provide a method and means whereby relatively heavy stranded conductor wires having increased wire diameters may be clamped satisfactorily by using much smaller eyelifts than could be clenched around the same wire if the wire end or loop were formed by heretofore known means.

A further object of the invention is to provide a novel method and means that require no expert handling of the wire on the part of the operator when presenting the end of the wire to the operation of a machine.

One feature of the invention is that the wire strands that are curved around the pilot spindle are adequately confined within the radial limits of the eyelift flange so that in the upsetting of the barrel portion and the clenching operation every strand of wire is gathered inward by the split portions of the barrel as they are curved outward and upward around the strand.

Another advantageous feature which is attained by my novel method and means of forming the connector terminal is that the finished terminal is substantially thinner or flatter in heightwise cross section than would be the case if the same eyelift and wire had been clenched by previously known means. This is a particular advantage when it is desired to mount a number of terminals in superimposed relation upon a single binding post.

The above and other advantageous features of this invention will be more fully understood and appreciated when considered with the following detailed description in connection with the drawings, and will be pointed out further in the description.

In the drawings:

FIG. 1 is a perspective view of a portion of an eyelift inserting machine adapted to perform my novel wire terminal attaching method;

FIG. 2 is an enlarged view showing the details of mechanical means for forming a divided loop on the end of a wire;

FIGS. 3 and 4 are top plan views showing progressive stages by which a divided loop may be manually formed on the end of the wire;

FIGS. 5 and 6 are side elevational views, partly in section, showing the progressive stages by which an eyelift is automatically inserted through the loop and finally clenched to form a terminal connector in accordance with the invention;

FIG. 7 is a top plan view partially in section, showing a clenched terminal when viewed along the section line VII—VII of FIG. 6; and

FIG. 8 is a view of a completed terminal as viewed from the bottom or opposite side from that illustrated in FIG. 7.

Referring to the drawings, and particularly to FIGS. 1 and 2, the invention is herein illustrated as performed in an eyelift setting machine of a well-known type whereby the eyelifts are set by pressure applied axially upon each eyelift while positioned between two relatively movable anvils in the form of set dies. Due to the well-known construction of such machines, whether manual or power...
operated, only so much of the machine has been illustrated, and will be described hereinafter, as is necessary for an understanding of the present invention. A reciprocating plunger rod \(10\), journaled through a forward portion of the machine frame \(12\), is driven in a vertical path by any suitable power means or by a foot treadle. The rod \(10\) has secured to its lower end an upper set cap assembly \(14\) provided with a coaxially disposed spindles \(16\) which is retractably mounted in the assembly. The eyelets to be set or clenched to the end of the constrictor wire \(24\) supplied through the guiding path of a raceway, the lower end of which is illustrated as \(18\). When in the at rest portion of the machine the upper set cap assembly is elevated so that the lower end of the spindle \(16\), which is spring biased to protrude downward beyond the annular surface of the upper set cap assembly \(14\), is above the level of the raceway end, and the spindle is in axial alignment with the barrel of the endmost eyelet \(E\) in the bottom of the raceway. Upon actuation of the machine, the spindle \(16\) descends and enters the barrel of the eyelet \(E\). While the eyelet is thus impaled by the spindle, the raceway thereby retracted to one side to strip the end most eyelet from the raceway and to clear the path for the further descent of the spindles which then carries the eyelet downward to place the lower end of the eylet barrel in contact with a lower set die having an annular upsetting anvil \(20\) above which protrudes a pilot pin \(22\) for centering the eyelet during the operation. The anvil \(20\) is rigidly affixed to a frame portion of the machine, and the front of the pilot pin \(22\) is formed with tapered surfaces \(24, 24\), which at their common junction provide a sharp vertical knife-like edge \(26\) facing the operator's position. The lower anvil member \(20\) is closely confined within a coaxial sleeve \(28\) that is spring biased, by a spring \(30\), so that it normally extends a substantial distance above the clenching surface of the anvil, as illustrated in FIG. 2. This sleeve \(28\) is relieved at its upper forward face providing an opening \(32\) through which the barrel end of a stranded wire \(W\) may be manually inserted to impinge endwise against the sharp edge \(26\). The downwardly yieldable sleeve \(28\) is attached to the anvil member \(20\) by a screw headed pin \(34\) passing through a longitudinal guide slot \(36\) in the wall of the sleeve, thus permitting the sleeve normally to be projected upward by the spring \(30\) so as to provide a confining wall around the anvil \(20\) and its associated pilot pin \(22\). However, the as the upper set die \(14\) approaches the lower anvil \(20\) during the operative stroke of the plunger rod \(10\), the die \(14\) abuttingly engages the upper rim \(32\) of the sleeve \(28\) and the force of the spring \(30\), FIGS. 5 and 6. Also, during the approach of the dies \(14, 20\), the pilot pin \(22\) engages the lower end of the yieldable spindle \(16\) causing the latter to become progressively retracted to within the die assembly \(14\) so that the eyelet barrel is transferred from its impelled relation upon the spindle \(16\) to a similar relation upon the pilot pin \(22\) which then acts to center the eyelet and, in conjunction with the anvil surface \(20\), to cause the barrel portions to be split and deflected outward and upward against the inner wall of the confining sleeve \(28\).

To form a connector terminal in accordance with the present method, the bare end of a multistranded electrical conductor wire which comprises the steps of: placing a bare end of the wire substantially perpendicular to and against a sharply defined spindles edge, formed by the junction of two tapering surfaces, so that the ends of substantially half the strands are disposed to be divided by the edge \(26\) endwise against the sharp edge \(26\) of the pilot pin, FIGS. 2 and 3, so that substantially half of the wire strands are disposed at either side of the edge \(26\). The wire is then continuously advanced endwise against the pin causing the edge and the tapered surfaces \(24, 24\), to divide the strands into two groups which are progressively deflected in diverging paths, FIG. 4, until the respective ends of the strands engage the inner wall of the confining sleeve \(28\), whereupon the ends are de-
vided loop on the end of the wire; discontinuing the advancement of the wire inserting an eyelet barrel through the divided loop; and clenching the eyelet barrel around the wire strands of the loop.

2. The method of forming an electrical terminal connector on an end of multi-stranded wire, comprising the steps of: advancing the wire in a continuous movement lengthwise of its axis while dividing the strands at said end of the wire into two distinct groups each containing substantially half the strands; simultaneously deflecting both groups in substantially the same plane away from each other, with each group moving away from the axis of the wire at an acute angle; continuing the axial advancement of the wire to deflect successive portions of both groups away from each other and the axis of the wire; in said continuous movement, deflecting the then converging ends of both groups toward each other in a converging path; deflecting the ends of the groups into substantial abutment, thereby to form a divided loop; discontinuing the advancement of the wire and finally clenching an eyelet barrel through said loop and around the divided strands.

3. The method of forming an electrical terminal connector on an end of multi-stranded wire, comprising the steps of: placing the end of the wire substantially perpendicular to and against a sharply defined spindle edge, formed by the junction of two tapering surfaces, so that the ends of substantially half of the strands are disposed adjacent either side of said edge; advancing the wire in a continuous movement lengthwise of its axis while dividing the strands at said end of the wire into two distinct groups each containing substantially half the strands; simultaneously deflecting both groups in substantially the same plane away from each other, with each group moving away from the axis of the wire at an acute angle; continuing the axial advancement of the wire, thereby to cause the tapering surfaces to deflect each group of strands progressively during their continuous advance into diverging paths along and beyond said surfaces; in said continuous movement, deflecting the then converging ends of both groups toward each other in a converging path until the ends of the respective strands in each group are deflected into substantial abutment, thereby to form a divided loop; discontinuing the advancement of the wire; and finally clenching an eyelet barrel through said loop and around the divided strands.

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