APPARATUS FOR FORMING AND APPLYING A STRAIN RELIEF SPLICE FROM A CONTINUOUS SUPPLY STRIP

Inventors: Irwin Zahn, New York, N.Y.; Wilhelm R. Meisinger, Verona, N.J.; George Magnifico, New York, N.Y.

Assignee: General Staple Company, Inc., New York, N.Y.

Filed: Mar. 5, 1973

Appl. No.: 338,266

Primary Examiner—Thomas H. Eager
Attorney, Agent, or Firm—Lerner, David, Littenberg & Samuel

ABSTRACT

Apparatus is disclosed for forming and applying a strain relief splice from a continuous supply strip with the apparatus comprising first means for forming a predetermined length of the supply strip into a predetermined shape having a first portion which will be crimped about at least one wire and an integrally connected second portion which will be crimped about the insulated portion of said wire; second means for bending the length into a generally U-shaped configuration; a die having a generally U-shaped receptacle provided therein for the reception of said wire; and third means for driving the length into the U-shaped receptacle whereby the first portion of the length will be crimped about said wire and the second portion of the length will be crimped about the insulated portion of said wire.

22 Claims, 9 Drawing Figures
APPROPRIATE FOR FORMING AND APPLYING A STRAIN RELIEF SPlice FROM A CONTINUOUS SUPPLY STRIP

BACKGROUND OF THE INVENTION
In U.S. Pat. No. 3,636,611 issued Jan. 25, 1972 to Irving W. Rosenbaum entitled APPARATUS FOR SPLICING WIRES, and assigned to the assignee of the instant invention, there is disclosed apparatus for automatically forming, driving and crimping an electrically conductive splice about a pair of wires which are to be mechanically and electrically connected thereby. As mentioned in the Rosenbaum patent, a significant advantage of the apparatus described therein is the fact that the apparatus employs a continuous supply strip and automatically forms, drives and crimps the splice formed therefrom in one continuous operation. This is in contrast to the prior art techniques which proceeded to the Rosenbaum patent in which a first manufacturing step was employed to produce a string of preformed splices (much like a string of conventional U-shaped staples employed in a desk top stapler), and a separate apparatus had to be employed to drive such preformed splices about the pair of wires to be joined thereby.

Similarly in U.S. Pat. No. 3,605,261 issued Sept. 20, 1971 to I. Zahn et al. assigned to the assignee of the instant invention, there is disclosed apparatus for automatically forming, driving and crimping a terminal about the end of a wire in one continuous operation and with the employment of a continuous supply strip.

SUMMARY OF THE INVENTION
The instant invention represents an improvement over the apparatus of the aforementioned patents and provides an apparatus for forming and applying a strain relief splice about one or more wires wherein, like the apparatus of the Rosenbaum patent, the splice is formed, driven and clinched in one continuous operation and with the use of a continuous supply strip which totally eliminates the need to previously manufacture preformed splices.

To understand the meaning of the expression "strain relief splice" it will be appreciated that typically, when it is desired to join two conductors, the insulation from both wires is first stripped away at the end thereof so as to expose their conductive portions. Thereafter, and in accordance with the teaching of the aforementioned Rosenbaum patent, the splice is crimped about the two juxtaposed bare portions to mechanically and electrically join the pair of wires.

In some applications, especially where the two wires so joined will experience opposing tensile forces, there is the possibility that the resultant stress will cause mechanical failure of one or both of the wires which have been joined.

Similarly where a terminal has been applied to the end of a wire (for example in the manner taught in the aforementioned Zahn et al. U.S. Pat. No. 3,605,261) there is the possibility, that mechanical stress on the wire could cause failure thereof.

Thus, and in accordance with the instant invention, the apparatus hereof not only forms, drives and clinches a splice (or terminal) about one or more wires but automatically provides such splice with at least one integrally extending portion which will be crimped about the insulated portion of the wire. In this manner, the splice itself is available to resist opposing tensile forces and provides "strain relief." Furthermore, and in accordance with the invention, the novel strain relief splice hereof is formed, driven and clinched in one continuous, automatic operation and with the use of a continuous supply strip which totally eliminates the need for preforming the splice hereof.

Moreover, and as will be further explained, although the invention will be illustrated with respect to a novel strain relief splice (or terminal) apparatus for forming, driving and crimping same) which includes only one integrally extending portion which will be crimped about the insulated portion of only one of a pair of wires to be joined, it is within the contemplation of the present invention that a splice formed thereby may include an oppositely disposed second integrally connected portion which will be crimped about the insulated portion of the second one of the set of wires to be joined thereby. Similarly, although the invention will be primarily illustrated with respect to a splice being employed to join a pair of wires; as will be described, the invention may also be used in connection with a single wire, for example to provide strain relief for a wire to which a terminal has been applied in the manner taught in U.S. Pat. No. 3,605,261.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS
FIG. 1 is a perspective view, partly in section of the novel apparatus of the instant invention.
FIG. 2 is a partial perspective view of a portion of the apparatus of FIG. 1.
FIG. 3 is a perspective view, partly in section, of a portion of the apparatus of FIG. 1. FIG. 3A is a perspective view, partially in section, of a portion of the apparatus shown in FIG. 1.
FIG. 4 is a plan view of a portion of the continuous supply strip employed with the instant invention, illustrating the manner in which it is processed within the apparatus hereof.
FIG. 4A is a plan view of an alternative embodiment of a splice blank of the invention.
FIG. 4B is a plan view of yet another alternative embodiment of a splice blank of the invention, said blank including a terminal portion, said FIG. 4B further depicting a single wire which is to receive the terminal bearing splice.
FIG. 5 is a perspective view illustrating one of the strain relief splices of the instant invention, after it has been formed but before it has been driven and crimped about the pair of wires to be joined thereby.
FIG. 6 is a perspective view of the novel strain relief splice hereof after it has been applied to a pair of wires to be joined thereby.

DETAILED DESCRIPTION OF THE INVENTION
Turning to the figures, there is shown in FIG. 1 the apparatus 10 of the instant invention, which, as noted previously is in many aspects similar to the apparatus of U.S. Pat. No. 3,636,611 the disclosure of which is incorporated herein by specific reference thereto. The apparatus includes a base 12 upon which is reciprocally slidable, a generally U-shaped plate 18 having a bight portion 20 and upstanding side walls 22. Secured in the channelway of plate 18 by appropriate fastening means such as screws 30, are a pair of spaced apart forming...
members (also known as forming tools) 24 and 25 which as seen in FIGS. 1 and 2 are generally L-shaped in cross-section so as to include a base portion 26 and 27 respectively and upstanding portions 28 and 29 respectively, the front surfaces of which, as will be explained in greater detail, are employed to sever and bend a length of the supply strip 68 about the nose portion 66 of an anvil as is illustrated in FIGS. 2 and 5. A somewhat thicker plate 30 is notched as at 32 so as to be channeled for sliding reciprocal motion with respect to the first mentioned plate 18. A driver 34 slideable between the forming members 24 and 25 is connected to the second plate 30 as by a fastening member 35. The driver 34 includes a front driving surface 36 which, as will be explained in greater detail, drives the splice formed herein into the generally U-shaped receptacle 52 provided in a die broadly designated in 44 and about the pair of wires which are to be joined by the instant invention.

A cover (removed for drawing clarity) encloses the assemblage and constrains the moving parts to the desired paths of reciprocating motion.

Like the apparatus of the aforementioned Rosenbaum patent, the apparatus hereof includes a guide block 37 provided with a slot 39 through which the supply strip 68 is fed into appropriate position with respect to the forming and driving tools. The specifics of the novel guide block 37 employed herein will be further described. Like the apparatus of the Rosenbaum patent, the advancing mechanism for the supply strip 68 includes a pair of feed cams 104 and 105 mounted for rotation about fixed pins 106 and 108 and which are provided with flats 110 and 112. It will be appreciated that the supply strip 68 will be advanced when the circular portion of the cams 104 and 105 sandwich the supply strip 68 therebetween but that the supply strip will not be advanced when the flats 110 and 112 confront each other.

Like the apparatus of the aforementioned Rosenbaum patent, the instant apparatus also includes the aforementioned anvil 58 which is pivotally mounted about a pivot point 62 and normally biased toward its illustrated position by a spring 64. The anvil 58 includes a base portion 60 from which extends the wire stock supporting nose portion 66.

As thus far broadly described, the apparatus hereof is functionally the same as the apparatus of the aforementioned Rosenbaum patent and the operation thereof is applicable hereto. Thus, feed cams 104 and 105 position a predetermined length of the wire stock 68 beneath the forming tools 24 and 25. At this time, the end of the wire stock is supported on the nose portion 66 of anvil 58 which as noted previously is maintained in its supporting position by the bias of spring 64. With the help of an electric motor and through a clutch and appropriate linking mechanism (see for example the link 22 in the aforementioned Rosenbaum patent), the plate 18 with the forming tools 24 and 25 thereon is moved downwardly to bend the severed splice blank (severed by the cooperation of the moving forming member 25 and a shearing edge of a guide block 37) about the nose portion 66 of the anvil 58 into a generally U-shaped configuration. Thereafter, by appropriate driving linkage (see for example the drive link 23 in the Rosenbaum patent) the driving member 34 drives the U-shaped splice into the clinching receptacle 52 of the die 44 and about the pair of wires which have been inserted therein from mechanical and electrical connection by the splice. Of course, when the driving member 34 experiences its downward motion, its force drives the anvil counterclockwise about its pivot point 62 against the predetermined bias established by the spring 64.

As noted previously, the improvement of the instant invention relates to providing a strain relief splice; that is, not only a splice which mechanically and electrically joins a pair of wires (or which applies a terminal to the end of a wire) but which splice will include at least one integrally extending portion which will crimp itself about the insulation of a wire in such a manner as to allow the mechanical integrity of the splice to relieve the stresses on the rather weak wire. To that end, a number of specific structural distinctions between the apparatus hereof and the Rosenbaum apparatus will now become apparent.

To begin with, the guide block 37 hereof includes a generally T-shaped passageway or guideway 38 provided therethrough. Reciprocally slideable in the T-shaped passageway 38 is a T-shaped punching ram 40 which is connected to the plate 30 for simultaneous movement therewith by means of a connecting member 42. The ram 40 has a stem portion 41 and a transversely oriented top portion 43 which will produce the generally T-shaped cut out region 45 in the supply strip 68 (see FIG. 4). Of course, it will be appreciated that after the first two successive punches by the T-shaped ram 40, that the blank 75 shown in FIG. 4 will present itself beneath the forming members 24 and 25 and be supported by the nose portion 66 of the anvil 58.

As the forming members 24 and 25 descend (carried by the plate 18) the angled edge of the forming member 25 together with The angled edge 74 of the guide block 37 will shear the blank 75 of FIG. 4 from the remaining supply strip to form the new blank 76 illustrated at the right most end of FIG. 4. As will become further apparent, the new blank 76 includes a first portion 78 which eventually will mechanically and electrically join the pair of wires to be joined and an integrally connected second portion 82 which will eventually be crimped about the insulated portion of one of the pair of the wires which are being joined. In the illustrated embodiment, a neck portion 80 integrally connects the first and second portions 78 and 82 respectively, although such neck portion is not necessarily required.

Upon continued downward motion of the forming members 24 and 25, the blank 76 is bent about the nose portion 66 of the anvil 58 so as to assume U-shaped configuration shown in FIGS. 2 and 5. In such U-shaped configuration, the first portion 78 of the blank will include depending side legs 86 and 88 while the second portion 82 of the blank will include depending side legs 90 and 92.

At this point, it will be appreciated that depending side legs 86 and 88 are serrated. In accordance with this aspect of the instant invention, this has been effected by providing cooperating ridged surfaces along the sides of the stem 41 of the punching ram 40. In like fashion, the dependent legs 90 and 92 of the second portion 82 of the U-shaped splice are oppositely angled to terminate in respective points. In accordance with this aspect of the invention, this has been effected by providing the oblique shearing action between the
forming member 25 and the shearing surface 74 of the guide block 37.

As explained previously, the next motion which takes place is the downward motion of the driving ram 34 to drive the new U-shaped splice into the receptacle 52 in the die 44 and about the pair of wires which have been appropriately positioned therein. As best seen in FIGS. 1, 3, and 3A (FIG. 3A being reversed with respect to FIG. 3 for the sake of clarity), the die 44 actually comprises two die plates 46 and 48 appropriately secured together by fastening means 50. Die plate 46 includes the ridged U-shaped receptacle 54 while die plate 48 includes the smooth U-shaped receptacle 56 of slightly larger diameter as emphasized by the step 55 therebetween (see FIG. 3A). Together, the receptacles 54 and 56 constitute the receptacle which has been broadly designated 52 in the previous description.

The two wires to be joined are designated 120 and 122. Wire 122 includes a stripped away bare portion 124 and the insulated portion 126. In like fashion, wire 122 includes stripped away bare portion 128 and insulated portion 130. In positioning the wires, the bare portion 128 of wire 122 is positioned in one lobe of the ridged receptacle 54. The wire 120, as mentioned such that its bare portion 124 lies in the adjacent lobe of the ridged U-shaped receptacle 54 while the insulated portion thereof 126 resides in the smooth, larger diameter U-shaped receptacle 56 provided in the plate 48. In this manner, when the driving ram 34 drives the splice into the die block 44, the first portion 78 of the blank 76 will be crimped about the two bare portions 124 and 128 of the pair of wires 120 and 122 while the second integral portion 82 of the splice will crimp itself about the insulated portion 126 of the wire 120. The completed splice is illustrated in FIG. 5 whereby it will be seen that the mechanical integrity of the splice itself will take the mechanical stresses off the metallic conductive portions of the wire 120. Hence, and in accordance with the invention, the novel strain relief splice has been automatically formed, driven and crimped about the pair of wires to be joined in a manner which makes use of a continuous supply strip.

As noted previously, the instant invention has been described with respect to applying a strain relief splice which includes only one integrally connected second portion which will eventually be crimped about the insulated portion of one of the pair of wires to be joined. However, and in accordance with the invention, the invention hereof may be easily modified to produce a strain relief splice which will include oppositely directed integrally connected portions which will be crimped about both insulated portions of the pair of wires being joined to thereby relieve all of the mechanical strain on the conductor portions of the wires being joined.

Thus with respect to FIG. 4A, with appropriate tooling (i.e., appropriately modified guide block 37 and punching ram 40) a blank 76' will be presented including not only the first portion 78 (which crimps itself about the conductive portions of the wires being joined) and an integrally connected second portion 82 (which will crimp itself about the insulation of one of the wires being joined); but also an oppositely disposed integrally connected third portion 82' which will crimp itself about the insulation of the other of the pair of wires being joined. Of course, in this connection, another die plate such as die plate 48 of FIG. 3A would be disposed on the opposite side of the die plate 46 so as to receive the insulated portion 130 of the second wire 122. In this manner, the finished strain relief splice would extend from the insulated portion 126 of the wire 120 all the way to the insulated portion 130 of the second wire 122 thereby totally relieving all possible tensile strain on the conductive portions 124 and 128.

As also noted previously, the invention hereof may be easily modified to produce a terminal bearing strain relief splice which may be applied to a single wire. Thus with respect to FIG. 4B, with appropriate tooling, a blank 76'' will be presented wherein the first portion 78' which will be crimped about the bare portion 124' of wire 120 includes an integrally connected second portion (which will be crimped about insulation 130' to provide strain relief) and an oppositely disposed, integrally connected terminal portion 140. In the illustrated embodiment terminal portion 140 includes a post aperture 142, although clearly the dies may be configured to produce any desired terminal configuration such as a U-shaped, S-shaped, C-shaped, etc. Of course, and in this connection where only a single wire is being handled; the receptacle 52 would be correspondingly configured.

Finally, having now explained the invention it will be apparent that further modifications are possible. For example, in the manner taught in copending application 335,417 filed Feb. 23, 1973 in the name of Irwin Zahn, Wilhelm R. Meisinger and Edward Fischer (and assigned to the assignee of the present invention) the splices hereof can be formed with insulation thereon. Also employing the principles of U.S. Pat. No. 3,685,148, the splices formed herein may be of the insulation piercing type such that the insulation need not be stripped from the end of the wire before the splices are applied thereto.

Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art. It is preferred, therefore, that the scope of the invention be limited, not by the specific disclosure herein, only by the appended claims.

We claim:

1. Apparatus for forming a strain relief splice from a continuous supply strip; said apparatus comprising:
   first means for forming a predetermined length of said supply strip into a predetermined shape having a first portion which will be crimped about at least one wire and an integrally connected second portion which will be crimped about the insulated portion of said wire;
   second means for bending said length into a generally U-shaped configuration;
   a die having a generally U-shaped receptacle provided therein for the reception of said wire; and
   third means for driving said length into said U-shaped receptacle whereby said first portion of said length will be crimped about said wire and said second portion of said length will be crimped about the insulated portion of said wire.

2. The apparatus of claim 1 wherein said second means includes a pair of spaced apart vertically movable forming members.

3. The apparatus of claim 2 wherein said third means includes a driver member vertically movable in a path
of movement defined between said spaced apart forming members.
4. The apparatus of claim 1 wherein said first means includes
punching means for forming cut-out region in said supply strip; and shearing means for severing said length from said supply strip.
5. The apparatus of claim 4 wherein said punching means is connected to said third means for operation therewith.
6. The apparatus of claim 4 wherein said punching means comprises a punching ram reciprocally movable with respect to a complementary shaped guideway provided in a die block.
7. The apparatus of claim 6 wherein said ram includes a stem portion and a top portion transversely oriented with respect to said stem portion; said stem portion intersecting at least one longitudinal edge of said supply strip; said top portion of said ram intersecting said supply strip intermediate the longitudinal edges of said supply strip when said ram is moved through said supply strip so as to leave a non-interrupted portion of said supply strip joining successive ones of said predetermined lengths.
8. The apparatus of claim 7 wherein opposite edges of said stem portion of said T-shaped ram are ridged whereby the opposite edges of said first portion of said length will be serrated.
9. The apparatus of claim 7 wherein said shearing means severs said non-interrupted portion of said supply strip to finally sever said length from said supply strip.
10. The apparatus of claim 9 wherein said shearing means severs said non-interrupted portion of said supply strip at an angle whereby the opposite edges of said second portion of said length will be regularly disposed.
11. The apparatus of claim 10 wherein opposite edges of said stem portion of said ram are ridged whereby the opposite edges of said first portion of said length will be serrated.
12. The apparatus of claim 11 wherein said ram is connected to said third means for operation therewith.
13. The apparatus of claim 4 wherein said punching means comprises a punching ram reciprocally movable with respect to a complementary shaped guideway provided in a die block; and wherein said second means includes a pair of spaced apart vertically movable forming members; and wherein said shearing means comprises one edge of said die block and one edge of one of said forming members.
14. The apparatus of claim 1 wherein said receptacle comprises first and second regions, said first region receiving said first portion of said length, said second region receiving said second portion of said length.
15. The apparatus of claim 14 wherein said first region only of said receptacle includes an upstanding ridge along the center thereof.
16. The apparatus of claim 15 wherein the depth of said second region is greater than the depth of said first region.
17. The apparatus of claim 7 wherein said receptacle comprises first and second regions, said first region receiving said first portion of said length, said second region receiving said second portion of said length; and wherein said first region only of said receptacle includes an upstanding ridge along the center thereof.
18. The apparatus of claim 1 wherein said first means includes punching means for forming a generally T-shaped cut-out region in said supply strip; and shearing means for severing said length from said supply strip.
19. The apparatus of claim 18 wherein said punching means is connected to said third means for operation therewith.
20. The apparatus of claim 18 wherein said punching means comprises a generally T-shaped punching ram reciprocally movable in a complementary shaped guideway provided in a fixed die block.
21. The apparatus of claim 20 wherein said second means includes a pair of spaced apart vertically movable forming members; and wherein said shearing means comprises one edge of said fixed die block and one edge of one of said forming members.
22. The apparatus of claim 20 wherein said receptacle comprises first and second regions, said first region receiving said first portion of said length, said second region receiving said second portion of said length; and wherein said first region only of said receptacle includes an upstanding ridge along the center thereof.
* * * *