

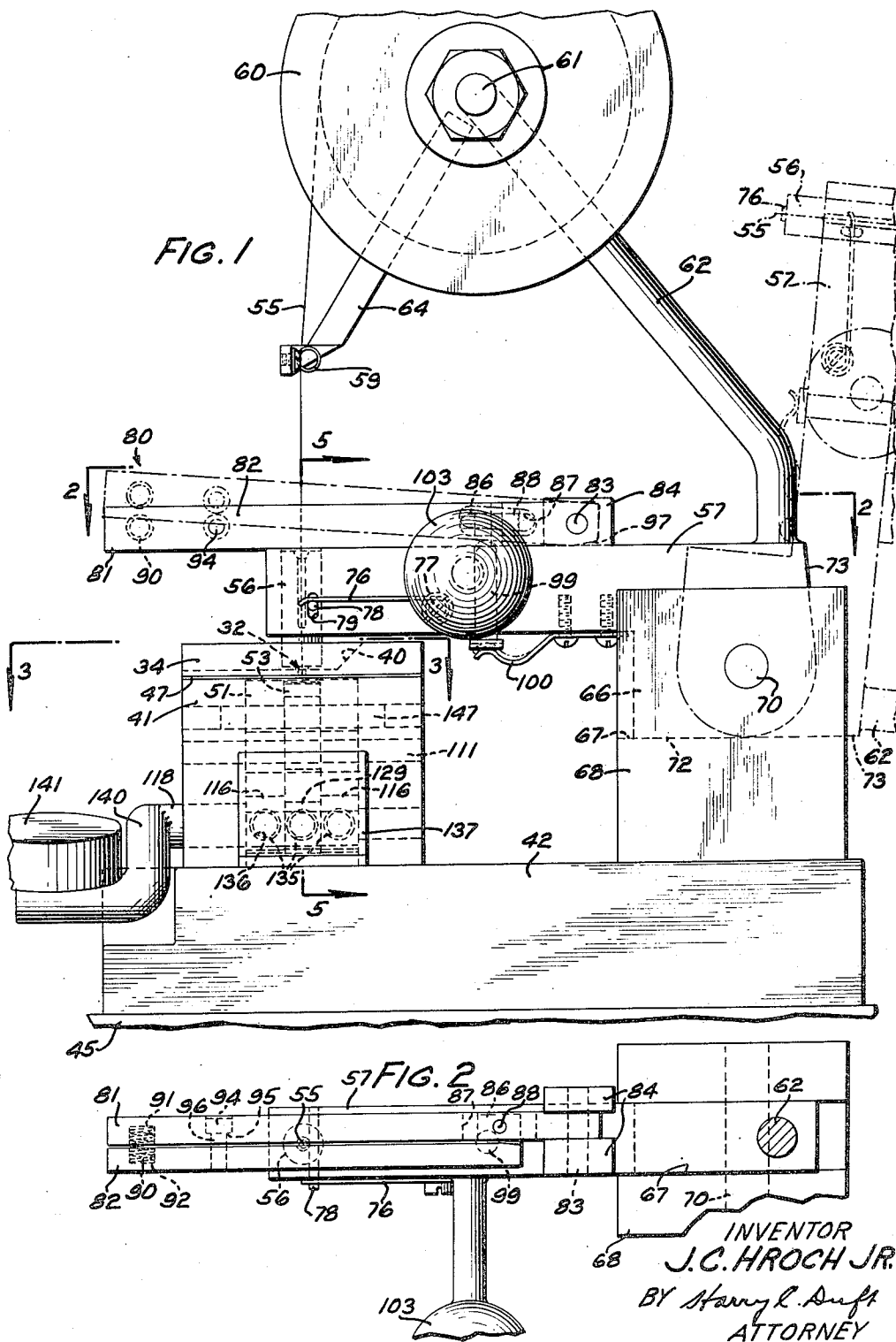
May 1, 1951

J. C. HROCH, JR
METHOD OF AND APPARATUS FOR FORMING AND
AFFIXING ELECTRICAL TERMINALS

2,551,376

Filed June 13, 1945

3 Sheets-Sheet 1



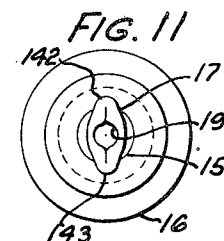
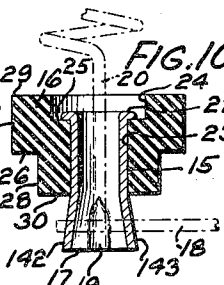
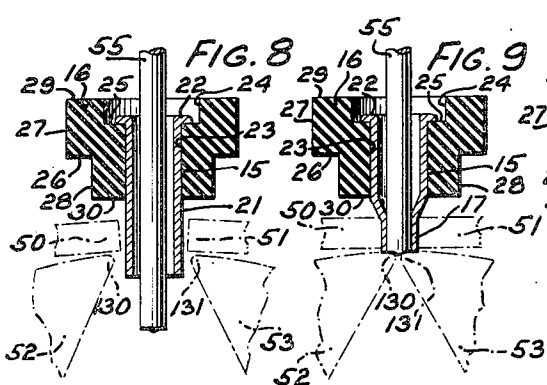
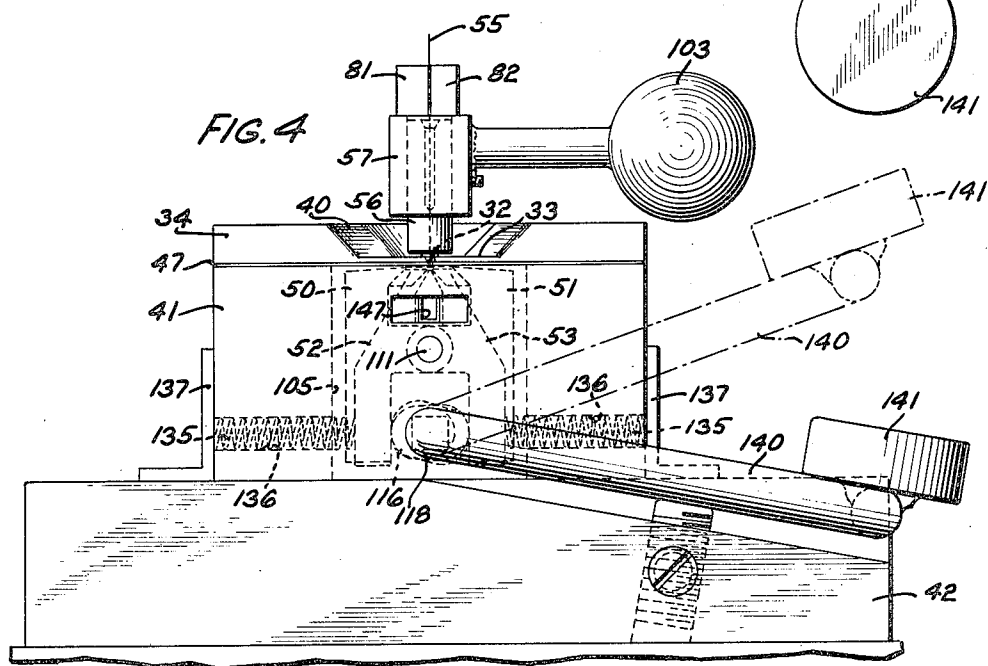
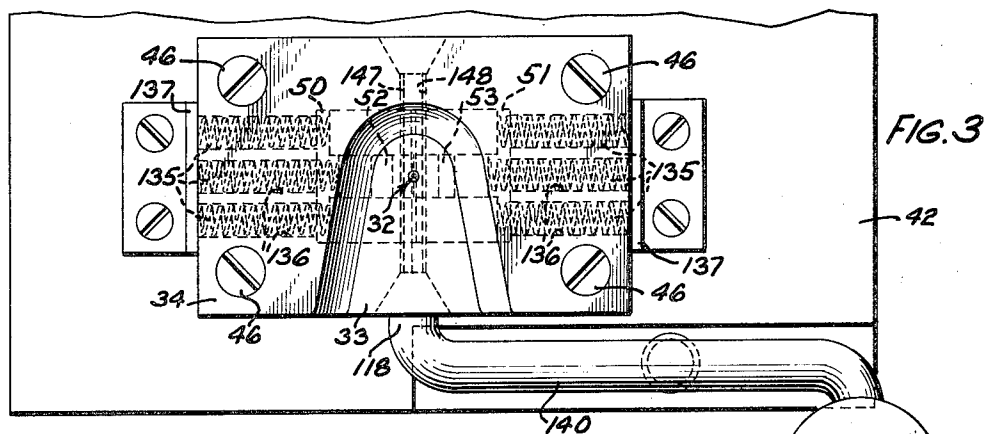
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3 Sheets-Sheet 2



INVENTOR
J. C. HROCH, JR.
BY *Harry L. Aufst*
ATTORNEY

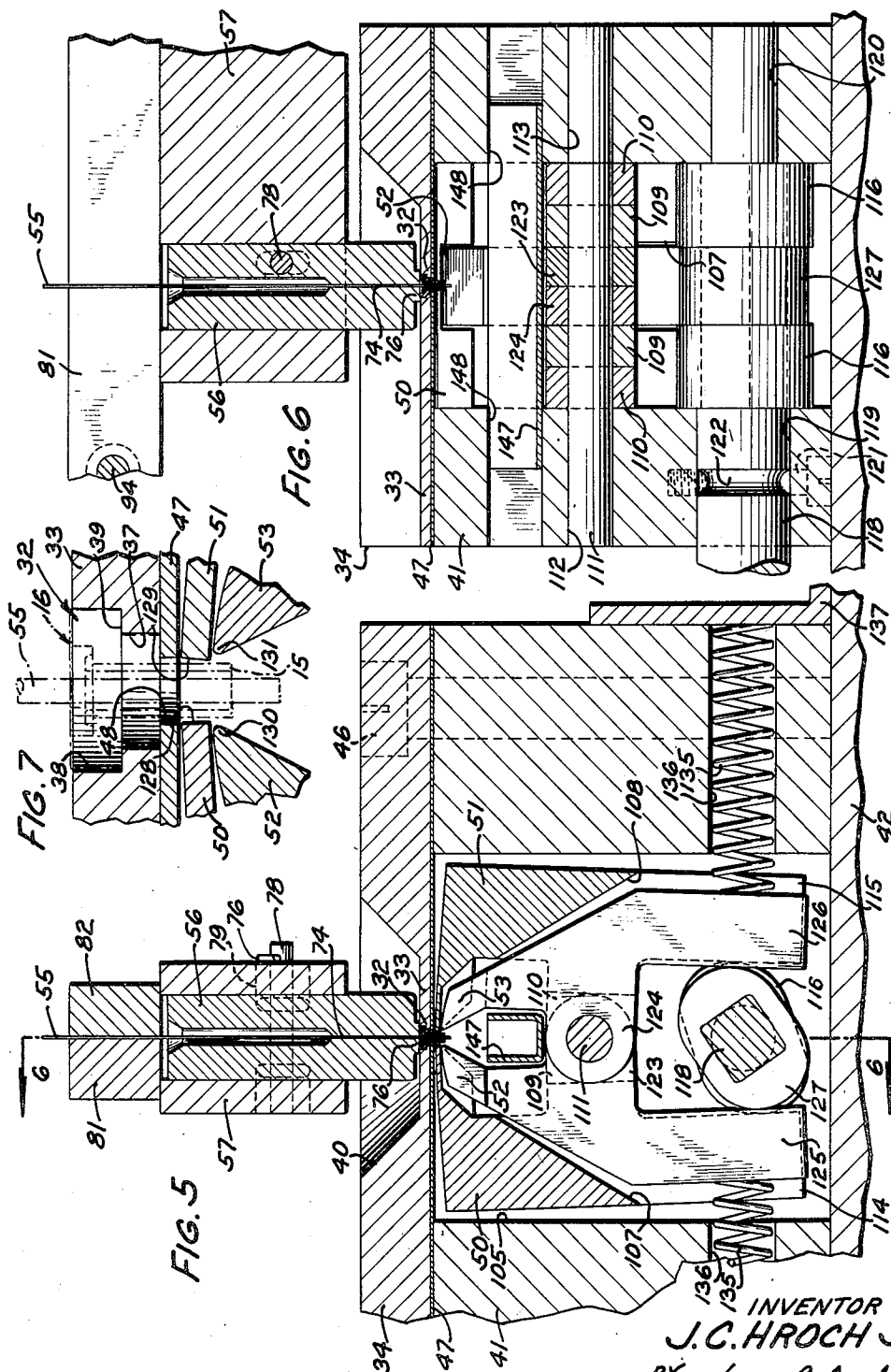
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3 Sheets-Sheet 3



INVENTOR
J.C. HROCH JR.
BY Harry L. Swift
ATTORNEY

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2,551,376

METHOD OF AND APPARATUS FOR
FORMING AND AFFIXING ELECTRICAL
TERMINALS

James C. Hroch, Jr., Cicero, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

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1

This invention relates to a method of and apparatus for forming and affixing electrical terminals and more particularly to a method of and apparatus for fastening an eyelet to an article and between the ends of a pair of forming jaws and a pair of cutting jaws. A wire of harder material than that of the eyelet is inserted into the eyelet after which the forming jaws are actuated to deform the walls of the end of the eyelet about the wire to form an enlarged flattened end portion having an aperture of reduced size therein and having offset portions to engage the article to secure the eyelet in the article and the cutting jaws are actuated to cut off a portion of the eyelet and the wire to trim the terminal to a predetermined length.

Objects of this invention are to provide a method of and apparatus for effectively and efficiently forming and affixing electrical terminals.

In one embodiment of the present invention, an eyelet and an article are supported in assembled relation in a gage of the apparatus with the end of the eyelet projecting beyond the article and between the ends of a pair of forming jaws and a pair of cutting jaws. A wire of harder material than that of the eyelet is inserted into the eyelet after which the forming jaws are actuated to deform the walls of the end of the eyelet about the wire to form an enlarged flattened end portion having an aperture of reduced size therein and having offset portions to engage the article to secure the eyelet in the article and the cutting jaws are actuated to cut off a portion of the eyelet and the wire to trim the terminal to a predetermined length.

The invention will be more fully understood from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a side elevational view of the apparatus;

Fig. 2 is a detailed plan section of a portion of the apparatus taken on the line 2—2 of Fig. 1;

Fig. 3 is a plan view of a portion of the apparatus and is indicated by the line 3—3 of Fig. 1;

Fig. 4 is a front elevational view of a portion of the apparatus;

Fig. 5 is an enlarged fragmentary vertical sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is an enlarged fragmentary sectional view of the apparatus showing the article holder and a portion of the forming and cutting jaws;

Fig. 8 is an enlarged sectional view of the insulator with an eyelet assembled therein and showing a mandrel inserted therethrough and in dotted lines the forming and cutting jaws;

Fig. 9 is a vertical sectional view similar to Fig. 7 showing the eyelet crimped against the mandrel and trimmed off to the proper size and in dotted lines the forming and cutting jaws moved to their final position;

Fig. 10 is a vertical sectional view through the insulator and the terminal taken in a plane perpendicular to that of Fig. 8, with the mandrel removed and showing in dotted lines a pair of conductors secured thereto; and

Fig. 11 is a bottom view of the insulator and the terminal affixed thereto.

In one embodiment of the invention the method

2

and apparatus are employed to affix an eyelet 15 to an annular insulator 16 to serve as an electrical connector terminal and shape it so as to provide a flattened end portion 17 extending perpendicularly outwardly from the insulator and to the outside of which may be secured as by soldering or brazing an electrical conductor 18, as illustrated particularly in Fig. 10, and which is formed with a reduced aperture 19 therein into which may be inserted and secured, as by crimping and brazing, an electrical conductor 20. The eyelet 15, comprising a tubular portion 21 and an integral flange 22 is inserted in an aperture 23 of the insulator 16, the aperture 23 being enlarged at 24 to form an annular shoulder 25 for engaging the flange 22 of the eyelet. The insulator 16 is provided with an annular exterior shoulder 26 and cylindrical surfaces 27 and 28 and flat top and bottom surfaces 29 and 30, respectively.

The insulator 16 with the eyelet 15 assembled therein is adapted to be placed in a positioning gage 32 formed in a portion 33 of reduced thickness of a gage plate 34. The gage 32 is in the form of a cylindrical aperture 37 enlarged at 38 to form an annular seat 39 adapted to engage the annular shoulder 26 of the insulator 16 when the insulator is inserted therein. The plate 34 is recessed at 40 to form the thin reduced portion 33 therein and is mounted on a block 41. The block 41 is secured to a base 42 which may be supported on a suitable table or bench 45, the plate 34 and the block 44 being secured to the base 42 by a plurality of screws 46 (see Figs. 3 and 5). Interposed between the plate 34 and block 41 is an auxiliary gage plate 47 which is apertured at 48 in alignment with the gage 32 and which acts as a spacer to space the eyelet 15 relative to the pair of forming jaws 50 and 51 and a pair of cutting jaws 52 and 53. The insulator 16 and the eyelet 15, when assembled together and inserted in the gage 32 occupy the position shown in Fig. 5 and in dotted lines in Fig. 7 with the lower end of the eyelet 15 passing through the aperture 48 in the plate 47 and fitting between the forming jaws 50 and 51 and the cutting jaws 52 and 53.

In order to form the aperture 19 in the eyelet 15, a mandrel in the form of a wire 55 of harder material than that of the eyelet 15 and of less diameter than the aperture of the eyelet, is inserted therein against which the walls of the eyelet are deformed or crimped by the forming jaws 50 and 51 and against which a part of the cutting jaws 52 and 53 act to clip off the excess portion of the eyelet together with a part of the wire.

The wire 55 which is inserted in the eyelet 15 is one end of a supply which passes through a cylindrical guide member 56 reciprocally

mounted in a supporting member 57 and through a friction holding device 59 from a supply spool 60. The supply spool 60 is mounted on a shaft 61 carried by an arm 62 secured to the supporting member 57. The friction wire holding device 59 comprises a helical spring mounted in a horizontal position on the end portion of an arm 64 which is carried by the spool supporting arm 62, the wire 55 being inserted between two of the closely positioned convolutions of the coil 59. The supporting member 57 is provided with an enlarged end 66 which fits in a slot 67 of a block 68 secured to the base 42, and is apertured to receive a pin 70 carried by the block 68. The enlarged end 66 of the support 57 is provided with the surface 72 which engages the bottom of the slot 67 to position the supporting member 57 horizontally and is further provided with a surface 73 disposed at an angle to the surface 72 whereby the supporting member 57 may be turned about the pin 70 through an arc more than 90° until the surface 73 engages the bottom of the slot 67 as indicated in dotted lines in Fig. 1.

The cylindrical guide member 56 is centrally apertured at 74 and vertically aligned with the gage 32 to guide the wire 55 into the eyelet 15. The guide member 56 is provided with an end surface 75 for engaging the top surface 29 of the insulator 16 and is urged downwardly by a spring 76 fixed at one end to the supporting member 57 at 77 and at its other end engaging a horizontal pin 78 secured to and extending out from the cylindrical guide member 56 through a slot 79 in the member 57.

A feeding mechanism 80 is provided for advancing the wire 55 a predetermined distance and comprises a lever 81 pivotally mounted on the supporting member 57 and a lever 82 carried by and cooperating with the lever 81 to grip and feed the wire 55 when actuated. The lever 81 is in the form of a rectangular bar mounted adjacent the wire 55 and pivoted on a pin 83 carried by lugs 84 of the supporting member 57. The lever 82 is positioned on the opposite side of the wire 55 and is provided with a lug 86 which fits into a slot 87 in the lever 81 to which it is pivotally attached by a pin 88. A compression spring 90 fitting in recesses 91 and 92 of the levers 81 and 82, respectively, tends to move the lever 82 about the pivot 88 to separate the free ends of the levers, which movement is limited by a headed screw 94 carried by the lever 82 which engages a shoulder 95 in a recess 96 in the lever 81. The levers 81 and 82 are vertically movable about the pin 83 and the lever 81 is formed with an inclined stop surface 97 engageable with the supporting member 57 to limit the upward movement of the free ends of the levers 81 and 82. A pin 99, reciprocally mounted in an aperture in the supporting member 57 and urged upward by a leaf spring 100 carried by the member 57 engages the underneath side of the lever 81 to urge the free ends of the levers 81 and 82 upward to the position shown in dotted lines in Fig. 1. With the levers 81 and 82 in the upper position, the operator may move the levers toward each other to grip the wire therebetween and then move the levers down until they engage the supporting member 57 to feed the end of the wire 55 into the eyelet 15. A handle 103 is secured to the supporting member 57 by means of which the wire supporting and feeding mechanism may be tilted about the pin 70 to the position indicated in dotted lines in Fig. 1 to facilitate

the loading of an insulator 16 and eyelet 15 in the gage 32.

The block 41 is provided with a vertically disposed rectangular aperture 105 in which are mounted the forming jaws 50 and 51 and the cutting jaws 52 and 53. The forming jaws 50 and 51, as viewed from the side, are rectangular and are centrally slotted at 107 and 108 to receive the relatively narrow cutting jaws 52 and 53 and are each provided with a pair of lugs 109 and 110 apertured to receive a pin or shaft 111 on which the jaws are fulcrumed and which fit in apertures 112—113 in the block 41. Portions of the forming jaws extend downwardly on opposite sides of the cutting jaws to form arms 114 and 115, the inner surface of which engages the cams 116—116. The cams 116 are provided with square apertures to receive a squared portion of a cam shaft 118 journaled in apertures 119 and 120 in the block 41, the cam shaft being held against axial displacement by a pin 121 engaging an annular groove 122 in the cam shaft. The cutting jaws 52 and 53 are provided with lugs 123 and 124 which are apertured to receive the pin 111 on which the jaws 52 and 53 are fulcrumed. Extensions or arms 125 and 126 are provided on the jaws 52 and 53 which engage a cam member 127 carried by the cam shaft 118.

The upper ends of the forming jaws 50 and 51 are provided with inwardly directed portions which taper to form straight narrow edges 128 and 129 extending across the jaws. The central portions of the inwardly directed parts of the jaws 50 and 51 are undercut to provide clearance for the cutting jaws 52 and 53. The upper ends of the cutting jaws 52 and 53 are defined by inclined inner surfaces and curved upper surfaces which converge to form the cutting edges 130 and 131 which have a small radius of curvature, as viewed from the front and which extend across the jaws in a straight line, as viewed from above. The forming jaws 50 and 51 are normally spaced apart and are disposed on opposite sides of the eyelet 15 when the eyelet 15 and the insulator 16 are seated in the positioning gage 32, as indicated in Figs. 5 and 7. The cutting edges of the cutting jaws 52 and 53 are likewise disposed on opposite sides of the eyelet 15 and immediately below the edges 128 and 129 of the forming jaws.

Bearing against the arms 114 and 115 of the forming jaws 50 and 51 and the arms 125 and 126 on the cutting jaws are helical compression springs 135 positioned within horizontal recesses 136 in the block 41 and bearing against the vertical portion of angle members 137 secured to the base 42. The springs 135 function to move the jaws about the pin 111 to an open position when the cam shaft 118 and the cams thereon are rotated to permit this action. The cam shaft 118 extends outwardly beyond the block 41 is bent at right angles to form a lever 140 which is provided at its ends with a handle 141. The operating lever 140 may be moved from the upper or dotted line position shown in Fig. 4 downward to the lower or full line position to rotate the cam shaft 118 and the cams 116 and 129 thereon through a similar arc which movement will be transmitted to the arms 114, 115, 127 and 128 to actuate the forming and cutting jaws. The cams 116 and 127 are so shaped as to actuate the forming jaws slightly in advance of the cutting jaws.

The edges 128 and 129 of the forming jaws 50 and 51 upon being moved toward each other will engage opposite walls of the eyelet 15 and crimp the walls against the wire insert 55 therein and

deform the walls to the approximate shape illustrated in Figs. 9, 10 and 11. Portions of the walls of the eyelet will be deflected laterally to form wings or abutments 142 and 143 which diverge outwardly from the insulator 16 and serve to affix or secure the eyelet in the insulator. The edges 128 and 129 of the forming jaws move from the position shown in dotted lines in Fig. 8 to the position shown in Fig. 9 where they are spaced apart a distance slightly less than the diameter of the wire 55 plus the thickness of the walls of the eyelet. The cutting edges 130 and 131 of the cutting jaws 52 and 53 are moved toward each other from the position indicated in Fig. 8 to a position indicated in Fig. 9 where they are shown at the end of the cutting operation with the edges spaced slightly apart. In moving toward each other, the cutting edges 130 and 131 cut through the walls of the eyelet 15 and into the wire and apply a force on the lower portion of the eyelet 15 and the wire 55 to cause them to snap off and be severed at the cutting edges of the cutters.

To catch the waste material clipped from the eyelet, a U-shaped pan 147 is provided and is supported at its ends within rectangular apertures 148—148 in the block 41, in a position between the cutting and forming jaws and directly underneath the eyelet. The U-shaped pan 147 is open at its ends and together with the apertures 148 form a passageway through the block 41 into which a blast of air may be directed to blow away the waste material therein.

In practicing this method of forming and affixing a tubular terminal to an article with the apparatus disclosed, the wire supporting and feeding mechanism is tilted backward to the position indicated in dotted lines in Fig. 1 and an insulator 16 with an eyelet assembled therein is inserted in the gage 32 in the gage plate 34. The wire supporting and feeding mechanism is then moved to its operating position as shown in full lines in Fig. 1 and the levers 81 and 82 are moved toward each other to grip the wire and then move downward to feed the wire into the eyelet 15. The wire 55 is fed through the eyelet so that the end thereof extends beyond the end of the eyelet as indicated in Fig. 7. The insulator 16 is retained in the gage 32 by the engagement therewith of the end 76 of the spring pressed guide member 56. The operating lever 140 is moved from its upper position to its lower position as indicated in Fig. 4 to rotate the cam shaft 118 and the cams thereon to actuate the forming and cutting jaws which operate as described above to deform the side walls of the eyelet about the wire insert to form an enlarged flattened terminal portion having a reduced aperture 19 therein and laterally deflected portions 142 and 143 which engage the insulator and serve to affix the terminal thereto. Coincident with the forming operation is the action of the cutting jaws which cut off the excess portion of the eyelet 15 and the wire 55 thereby trimming the eyelet terminal to the desired length. The operating lever 140 may then be elevated to its upper position to permit the opening of the forming and cutting jaws after which the wire supporting and clamping mechanism may be tilted back to the position indicated in dotted lines in Fig. 1 which will carry with it the wire 55 and the insulator and terminal secured to the end of the wire. The insulator 16 with the completed terminal affixed thereto may be removed from the end of the mandrel-wire 55 which, as described above, forms the reduced aperture 19 in the flattened end of the terminal

and into which a conductor may be inserted from either end and secured (see Fig. 10).

What is claimed is:

1. An apparatus for forming an electrical terminal from an eyelet projecting from an aperture in an insulator comprising means for supporting said insulator and said eyelet with an end portion of said eyelet projecting beyond said insulator, a mandrel insertable in said eyelet, means for inserting said mandrel into said eyelet, a pair of forming jaws having forming surfaces normally arranged to receive the end portion of said eyelet therebetween, a shaft for pivotally supporting said jaws, said forming jaws having cam engaging portions and spaced apart bearing members providing intervening space, a pair of severing jaws pivotally mounted on said shaft in said intervening space and having cutting edges normally arranged to receive the ends of said eyelet therebetween, said severing jaws having cam engaging portions thereon, a rotatable cam engageable with the cam engaging portions of said forming jaws, a rotatable cam engageable with the cam engaging portions of said cutting jaws, a shaft for supporting said cams in a predetermined relation thereon, and means for rotating said shaft to cause the sequential actuation of said forming jaws and said severing jaws whereby said forming jaws act to press the opposite walls of the end of said eyelet against the mandrel and the severing jaws act to sever a part of the end portion of the eyelet and the mandrel therein.

2. An apparatus for forming an electrical terminal from an eyelet projecting from an aperture in an insulator comprising a base, means on said base for supporting said eyelet and said insulator in assembled relation with an end portion of said eyelet projecting from said insulator, a mandrel wire insertable in said eyelet, a supporting member for supporting a supply of said wire and having means thereon for guiding the end portion of said wire in a straight path, means mounting the supporting member on said base for movement to and from an operative position with the wire in alignment with said eyelet when the supporting member is in said operative position, feeding means on said supporting member movable through a predetermined distance to feed a predetermined length of said wire into said eyelet, a pair of forming jaws having forming surfaces thereon disposed to receive the end portion of said eyelet therebetween, a pair of cutting jaws having cutting edges arranged to receive the end portion of said eyelet therebetween, and means for actuating said forming jaws and said cutting jaws to deform the opposite walls of the end of said eyelet about said mandrel wire and to sever a portion of said deformed end of said eyelet and said wire.

3. A method of attaching a tubular member to an apertured insulator and forming the tubular member into a connector terminal having a relatively small axially directed aperture in the end thereof which comprises inserting the tubular member in the aperture in said insulator with the end of the tubular member projecting beyond the insulator, inserting in said tubular member a wire mandrel of less cross-sectional area than that of the aperture of said tubular member and of harder material than that of the tubular member, pressing a pair of diametrically opposite wall portions of the projecting portion of the tubular member toward each other and the mandrel to form an enlarged substantially flat portion extending axially and diametrically across said tu-

bular member and having offset portions engageable with the article, and removing the wire mandrel from said terminal to form an axially extending relatively small aperture in the flat end portion of said terminal.

4. A method of attaching a tubular member to a recessed insulator and forming the tubular member into a connector terminal having a relatively small axially directed aperture in the end thereof which comprises inserting a tubular terminal member in the recess of said insulator with the end of the tubular member projecting beyond the insulator, inserting within said tubular member a wire mandrel of less cross-sectional area than that of the aperture of the tubular member and of a harder material than that of said tubular member, applying pressure with flat surfaces to oppositely disposed wall portions of the projecting portion of the tubular member in directions transverse to the axis of said tubular member to compress said walls against each other and the mandrel to form an enlarged flattened axially and diametrically extending end portion on said tubular member, cutting off a portion of the flattened end of the tubular member and the mandrel therein to trim the terminal to a predetermined length, and withdrawing the remaining portion of the mandrel from the terminal to form an axially extending aperture in the flattened end portion of the terminal.

5. An apparatus for attaching a tubular member to an apertured insulator and forming said tubular member into an electrical connector terminal comprising a base, a pair of forming members mounted on said base and having flat forming jaws movable toward and away from each other on opposite sides of a predetermined centerline, means on said base for supporting said insulator and said tubular member on said predetermined centerline adjacent said forming jaws and with the projecting end of said tubular member disposed between said forming jaws, a wire mandrel, means on said base guiding said mandrel for movement along said predetermined centerline into said eyelet, and means for actuating said forming members to move the forming jaws thereof toward each other to press the opposite walls of the projecting portion of the tubular member against each other and the wire mandrel to form an enlarged flattened axially extending end having shoulder portions engaging said article and an axially directed aperture in said flattened end formed by said wire mandrel.

6. An apparatus for attaching a tubular member to an apertured insulator and forming said tubular member into an electrical connector terminal comprising a base, a pair of forming members mounted on said base and having a pair of flat forming jaws movable toward and away from each other on opposite sides of a predetermined centerline, means mounted on said base for supporting said insulator and said tubular member in assembled relation on said centerline in a predetermined position adjacent said forming jaws and with a portion of said tubular member extending from said article positioned between said forming jaws, a wire mandrel, means mounted on said base for guiding said wire mandrel along said predetermined axis for movement into said tubular member, a pair of cutting jaws mounted on said base adjacent said forming jaws on opposite sides of said predetermined centerline, and means for sequentially actuating said forming members and said cutting jaws to

cause said forming jaws to move toward each other to press the opposite walls of the projecting portion of said tubular member into flattened condition about said mandrel and to subsequently cause the cutting jaws to cut off a portion of the flattened end of the eyelet and the mandrel wire inserted therein.

7. An apparatus for attaching a tubular member to an apertured insulator and forming said tubular member into an electrical connector terminal comprising a base, a pair of forming members pivoted about a common axis intermediate their ends and having a pair of flat forming jaws formed on one end thereof movable toward and away from each other on opposite sides of a predetermined centerline and having their opposite ends provided with cam-engaging surfaces, a seat for supporting said insulator and said tubular member in assembled relation on said predetermined centerline and in predetermined position adjacent said forming jaws and with a portion of said tubular member projecting from said insulator and disposed between said forming jaws, a wire mandrel, means mounted on said base for guiding said mandrel into said tubular member, a pair of cutting members mounted for pivotal movement intermediate their ends about said common axes and having a pair of cutting jaws formed at one end and cam-engaging surfaces at their opposite ends, said cutting jaws being disposed adjacent said forming jaws and movable toward and away from each other on opposite sides of said predetermined centerline and spaced a predetermined distance from said seat to trim the projecting end of said tubular member to a predetermined length, means mounting said forming members and said cutting members on said base for pivotal movement about said common axis, and cam means mounted on said base engageable with the cam surfaces of said forming members and said cutting members and operable for sequentially actuating said members to cause said forming jaws to engage opposite walls of the projecting portion of the tubular member and compress them into a flat condition about the wire mandrel and to cause the cutting jaws to sever a portion of the flattened end of said tubular member and the wire mandrel therein.

JAMES C. HROCH, JR.

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