

March 31, 1964

P. A. HAUCKE

3,126,772

OPEN END CONNECTOR DEFORMING TOOL

Original Filed April 11, 1960

2 Sheets-Sheet 1

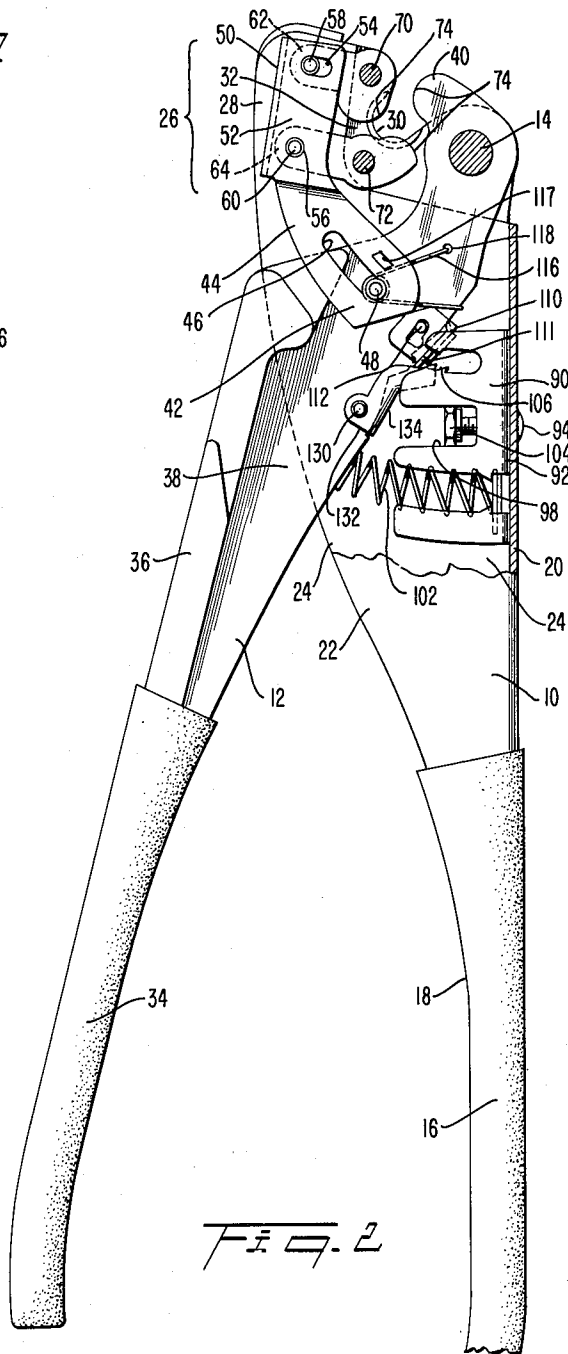
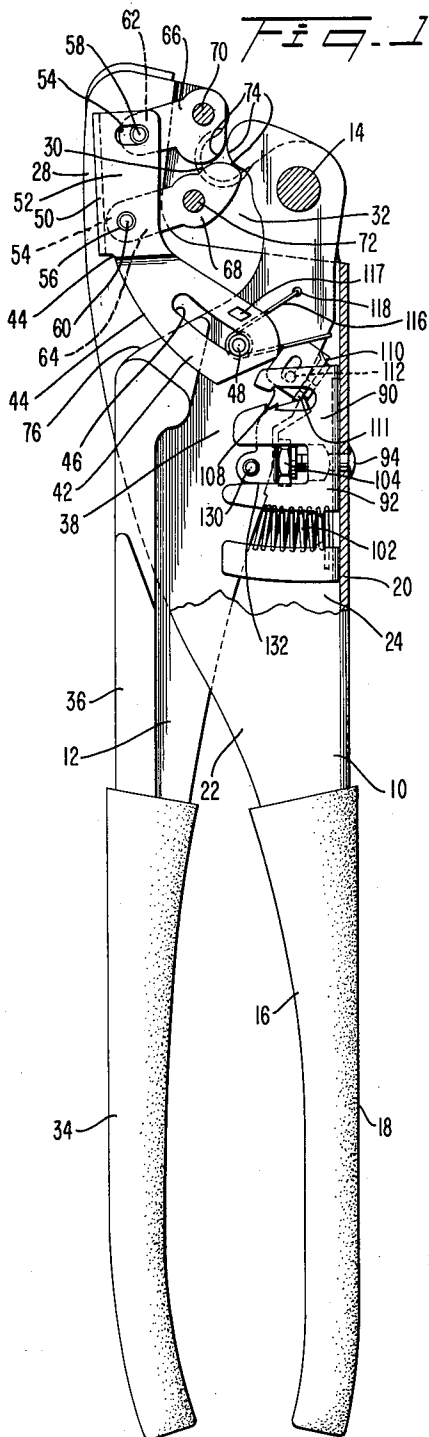


FIG. 2

INVENTOR.

PAUL A. HAUCKE

BY

Robert E. Smith

ATTORNEY

March 31, 1964

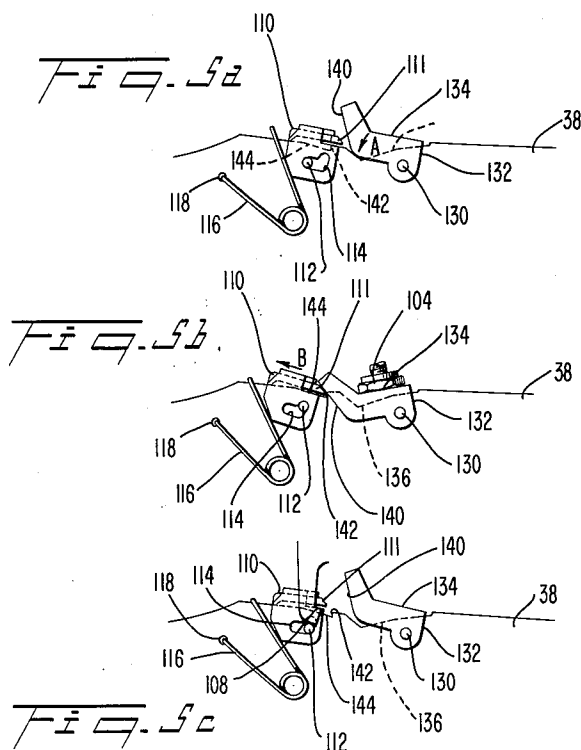
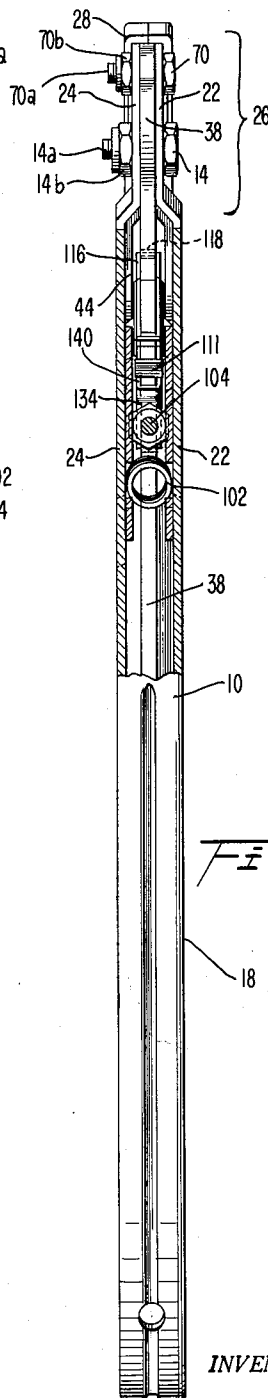
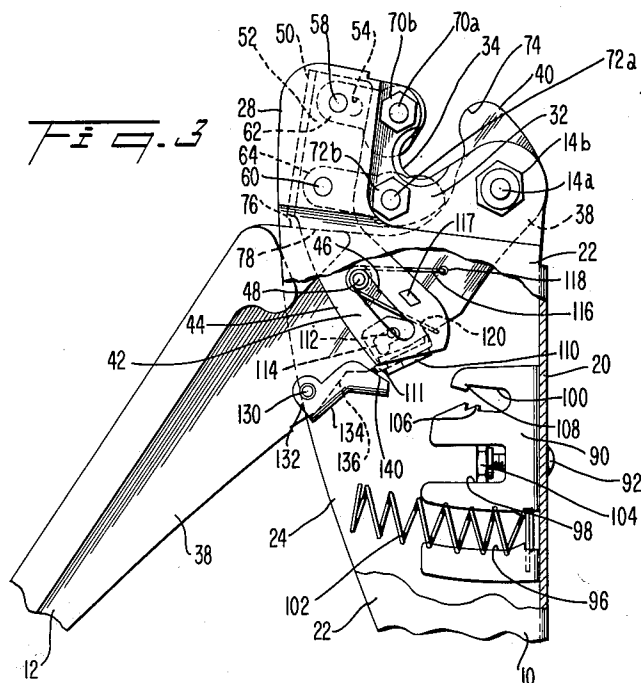
P. A. HAUCKE

3,126,772

OPEN END CONNECTOR DEFORMING TOOL

Original Filed April 11, 1960

2 Sheets-Sheet 2



INVENTOR.
BY PAUL A. HAUCKE
Robert E. Jones
ATTORNEY

1

3,126,772

OPEN END CONNECTOR DEFORMING TOOL

Paul A. Haucke, Rahway, N.J., assignor to Buchanan Electrical Products Corporation, Hillside, N.J., a corporation of New Jersey

Continuation of application Ser. No. 21,385, Apr. 11, 1960. This application July 27, 1961, Ser. No. 127,400
16 Claims. (Cl. 81-15)

This invention relates to the formation of electrical connections and particularly to an improved tool for effecting permanent insulated electrical connections at locations other than at wire ends.

This application is a continuation of my application Serial No. 21,385 filed April 11, 1960, now abandoned.

Although the desirability of effecting insulated electrical connections of the "through splice" or "in line splice" type by deformation of a pre-insulated fitting has long been recognized by the art, extensive commercial utilization thereof has been retarded by the lack of suitable tools to effect the same. Apart from the undesired destructive perforation of the insulator portion of the pre-insulated fitting member that is often effected by the converging advance of a plurality of crimping die members in conventionally constructed crimping tools of the split die or radially advancing die types, the need in conventional tools of the radially advancing die type for a plurality of spaced die members to effect the desired deformation of the fitting and required associated mechanism for effecting die advance has effectively precluded the reservation of sufficient space to permit workpiece entry and removal from the tool in a direction essentially perpendicular to the axis of the workpiece receiving bore thereof.

The copending application of George Ustin, Ser. No. 1,084, filed January 7, 1960, now abandoned, discloses a novel tool construction for effecting the necessary deformation of preinsulated fittings in the formation of insulated electrical connection that minimizes, if not actually eliminates, the undesired and destructive insulator perforation that is too frequently the characteristic of conventionally constructed tools employing radially displaceable crimping die members.

This invention may be briefly described as a novel tool construction incorporating a plurality of pivotally mounted workpiece deforming elements as broadly taught and disclosed in the aforesaid Ustin application, arranged to permit workpiece insertion in a direction essentially perpendicular to the longitudinal axis of a workpiece receiving bore so as to readily effect the formation of insulated electrical connections of the "through splice" type at locations remote from wire ends. As hereinafter explained the disclosed tool is such as to also permit, with equal facility, the formation of insulated electrical connections of the "pigtail splice" type and the formation of pre-insulated terminal assemblies by deformation of suitable workpiece elements. Also included in the novel tool construction is an improved full cycling mechanism to insure that once a deforming operation has been initiated upon a workpiece, a full operating cycle must be completed before initiation of a succeeding operation.

Among the advantages attendant the invention described herein is the provision of a simple and inexpensive tool for effecting the desired deformation of pre-insulated fittings in "through splice" type operations as well as for effecting, with equal facility, the desired deformation of pre-insulated terminals and "pigtail splice" operations, a permitted realization of the manufacturing economies inherent in "through splice" type insulated electrical connections and the minimization, if not actual elimination, of the hazards of insulator perforation in the formation

2

of insulated electrical connections of the "through splice" and "pigtail splice" types.

The object of this invention is the provision of an improved tool construction for effecting the deformation of pre-insulated fittings in the formation of insulated electrical connections of the "through splice" type.

Another object of this invention is the provision of an improved tool construction for effecting, with equal facility, deformation of pre-insulated fittings in the formation of insulated electrical connections of both the "through splice" and "pigtail splice" types.

The above and other objects of the invention will appear from the following specification and claims and from the appended drawings which illustrate the principles of the invention and the essentials of a presently preferred embodiment of a manually operable tool incorporating those principles.

Referring to the drawings:

FIGURE 1 is a side elevational view, partly in section, illustrating the positional disposition of the component elements of a tool at, or near the limit of workpiece deforming element displacement.

FIGURE 2 is a side elevational view, partly in section, illustrating the positional disposition of the component elements at, or near, an intermediate point in the cycle of operation.

FIGURE 3 is an enlarged side elevational view, partly in section, illustrating the positioning of the component elements at, or near, the initiation of a cycle of operation.

FIGURE 4 is a plan view, partly in section, of the tool illustrated in FIGURES 1-3.

FIGURES 5a, 5b and 5c are schematic views showing the positioning of the essential components of the full cycling mechanism during different portions of the cycle of operations.

Referring to the drawings, where there is shown by way of illustrative example the essentials of a manually operable tool incorporating the principles of this invention, there is provided a top handle member, generally designated 10, and a cam handle member, generally designated 12, pivotally connected thereto as at 14. The top handle member 10 is shaped to provide a manually engageable extending handle portion 16, suitably encased in a resilient insulating grip 18, a generally U-shaped elongate body portion formed of a transversely disposed base portion 20 and a pair of dependent integral spaced side wall portions 22, 24 of gradually increasing width and a terminal portion, generally designated 26 (FIGURE 2). The terminal portion 26, which is preferably formed by an extension of the side wall portions 22, 24 is shaped to provide a generally rectangularly shaped wiper arm housing 28 of somewhat reduced transverse extent and an adjacent workpiece receiving area of further reduced transverse dimension which includes an open sided and essentially semi-circularly shaped workpiece receiving bore 30 bounded by a recessed planar area 32 which, as will be explained later, serves as a support and guide structure for the pivotal mountings of the contained workpiece deforming elements and for the pivotal mounting 14 for the cam handle member 12 relative to the top handle member 10.

The cam handle member 12 is shaped to provide a manually engageable extending handle portion adapted to be suitably encased in an insulating grip 34, a transversely disposed base member 36 of limited extent and an elongate and extending body portion 38 in the form of an upstanding rib of reduced transverse dimension that is sized to be received within the spaced side wall portions 22 and 24 of the top handle member 10 upon converging pivotal displacement of the cam handle member 12 relative to the top handle member 10. As mentioned earlier,

3

the cam handle member 12 is pivotally connected to the top handle member 10 at 14 and the terminal portion thereof which is transversely dimensioned so as to be contained within the recessed planar area 32 of the terminal portion 26 of the side wall portions 22 and 24 is selectively shaped to provide an extending workpiece deforming element 40 arranged to be arcuately displaced into and out of the workpiece receiving bore 30 by converging and diverging manual displacement of the extending handle portions of the cam handle member 12 and top handle member 10.

Mounted in surrounding relation to the riblike body portion 38 of the cam handle member 12 and adapted to be disposed within the dependent side wall portions 22 and 24 of the top handle member 10 is the bifurcated end portion 42 of a wiper arm member, generally designated 44. As illustrated, the bifurcated end portion 42 of the wiper arm member 44 is provided with an arcuately disposed elongate slot 46 sized to slideably contain the extending ends of wiper arm drive pin 48 mounted on the cam handle body portion 38 whereby displacement of the wiper arm 44 will be selectively effected by engagement of the drive pin 48 at the slot ends in response to displacement of the cam handle member 12 relative to the top handle member 10. The other end of the wiper arm member 44 is sized to be disposed within the wiper arm housing 28 of the terminal portion 26 of the top handle member 10 and is shaped to provide a transversely disposed base portion 50 and a pair of dependent spaced wall portions 52 forming a generally U-shaped assembly. The terminal end of the side walls 52 is provided with an elongate slot 54 and adjacent thereto and in spaced relation therewith is a circularly shaped pin receiving aperture 56. Disposed intermediate the wall portions 52 and secured thereto by the extending ends of pins 58 and 60 disposed within the slot 54 and aperture 56 are the outwardly extending actuating arm portions 62 and 64 of a pair of workpiece deforming elements 66 and 68, respectively. The workpiece deforming elements 66 and 68 are pivotally mounted as at 70 and 72 in the planar recessed area 32 and are disposed intermediate the sidewall portions 22 and 24 of the top handle member 10 forming said terminal portion 26 thereof.

As shown in FIGURES 3 and 4, the pivotal mounting 14 of the cam handle member 12 relative to the top handle member 10 may be readily effected by means of an assembly shoulder bolt 14a passing through the sidewall portions 22 and 24 in the recessed planar area 32 surrounding the workpiece receiving bore 30 and passing through a suitable aperture in the body portion 38 of the cam handle member 12 and secured in position by externally disposed nut 14b. Similarly, the pivotal mountings 70 and 72 of the workpiece deforming elements 66 and 68 may be readily effected by means of assembly shoulder bolts 70a and 72a passing through the sidewall portions 22 and 24 in the recessed planar area 32 surrounding the workpiece receiving bore 30 and secured in position by externally disposed nuts 70b and 72b, respectively.

In accordance with the disclosure of the aforementioned Ustin application, each of the workpiece deforming elements 66, 68 and 40 are provided with an offset workpiece engaging arm portion having a selectively shaped workpiece engaging surface 74, disposed in facing relationship with the open sided workpiece receiving bore 30. More specifically, the illustrated workpiece engaging surfaces 74 are suitably arcuate in configuration, preferably in the shape of a sector positioned to sweep in an arcuate path and to arcuately traverse a portion of the area of the workpiece receiving bore 30 in response to pivotal displacement of the workpiece deforming elements 66, 68 and 40 about their respective pivotal mountings 70, 72 and 14, respectively.

In the illustrated tool the necessary pivotal displacement of the workpiece deforming elements 66, 68 and 40 is effected by pivotal displacement of the cam handle

4

member 12 relative to the top handle member 10 as by manual manipulation of the extending handle portion thereof. The selective positioning of the heretofore described component elements at the limit of divergent displacement of the cam and top handle members is shown in FIGURE 3. As there illustrated, the extent of the divergent displacement is limited by the engagement of a stop surface 76 on the cam handle member 12 with the shoulder 78 formed by the necessary deformation of the sidewall portions 22, 24 of the top handle member to form the reduced transverse extent terminal portion 26 thereof. With the parts so positioned, the workpiece deforming element 40 disposed at the terminal end of the body portion 38 of the cam handle member 12 is located at its limit of clockwise displacement (as viewed in the drawings) and remote from the workpiece receiving bore 30 as to readily permit workpiece entry therewithin through the now open sided bore. The wiper arm drive pin 48 is disposed at one end of the wiper arm slot 46 and the wiper arm member 44 is disposed in its retracted position with the consequent disposition of the workpiece deforming elements 66 and 68 at their limit of clockwise displacement. When so positioned, the workpiece deforming arm portions of the workpiece deforming elements 66 and 68 are disposed out of intersecting engagement with the workpiece receiving bore 30 leaving the same unobstructed to permit workpiece insertion therein.

FIGURE 1 illustrates the positioning of the various component elements when the cam handle member 12 and the top handle member 10 are disposed at or near their limit of convergence. When so positioned the wiper arm drive pin 48 is disposed in engagement with the end of the wiper arm slot 46 and the wiper arm 44 will be disposed in its advanced position. With the wiper arm 44 and cam handle member so disposed, the workpiece deforming elements 66 and 68 will be in their pivotally displaced or advanced position occupying a portion of the workpiece receiving bore 30 together with the now fully advanced workpiece deforming element 40.

FIGURE 2 illustrates the relative positioning of the various heretofore described component elements when the cam handle member 12 is disposed intermediate its limiting positions of convergent and divergent displacement relative to the top handle member 10 and as the same would be located upon a predetermined degree of divergent displacement from the heretofore described limit of convergent displacement as illustrated in FIGURE 1. As there illustrated, the cam handle member 12 has been pivotally displaced a sufficient distance from the position illustrated in FIGURE 1 to cause the workpiece deforming element 40 to be moved out of the workpiece receiving bore 30 but not out of the entry aperture thereto. The requisite pivotal displacement of the cam handle member 12 to the position illustrated effects a concomitant displacement of the wiper arm 44 through engagement of the inwardly directed detent 117 with the arm of the torsion spring 116 mounted on the body portion 38. The mentioned displacement of the wiper arm 44 effects a pivotal displacement of the workpiece deforming elements 66 and 68 sufficient to remove the same from occupation of the bore 30. As will be apparent to those skilled in this art the provision of the detent 117 and spring 116 serves to releasably limit divergent displacement at the illustrated intermediate position, which may be readily and effectively utilized as the starting position for effecting deformation operations upon pre-insulated fittings for "pig-tail splice" or terminal assembly units. With the parts so positioned the workpiece may be inserted along the longitudinal axis of the workpiece receiving bore 30 and the disclosed tool operated to effect deformation thereof by only utilizing the intermediate position as the limit of divergence.

Application of additional diverging pressure upon the cam and top handle members will cause the spring member 116 to pass under the detent 117 and effect the ad-

5

vance of the wiper arm drive pin 48 to the other end of the wiper arm slot 46, with the parts assuming the positioning illustrated in FIGURE 3 wherein the workpiece deforming element 40 is positioned remote from the entry aperture of the workpiece receiving bore 30 so as to permit entry of a fitting adapted for "through splice" connection therein. Upon the return from the limit of divergence as illustrated in FIGURE 3, pivotal displacement of the cam handle member 12 will effect displacement of the wiper arm 44, due to frictional engagement or to engagement of the detent 117 and spring 116, and consequent pivotal displacement of the workpiece deforming elements 66 and 68 until the workpiece deforming element 40 engages a workpiece disposed within the bore 30, which will have now been slightly displaced out of axial co-alignment therewith by the unimpeded pivotal displacement of the elements 66 and 68. When the deforming element 40 engages the workpiece it will reposition the same and in so doing will halt or even reverse the direction of displacement of the wiper arm 42, as described above. Further converging displacement of the cam handle member will cause the wiper arm drive pin 48 to move to the other end of the slot 46, with the spring 116 passing under the detent 117, and to be thus positioned for effecting simultaneous converging advance of the workpiece deforming elements 66, 68 and 40 in response to further converging advance of the cam handle member 12 relative to the top handle member 10 and in consequent workpiece deformation.

As explained in more detail in the aforesaid Ustin application, the simultaneous arcuate displacement of the arcuately shaped workpiece engaging surfaces 74 of the workpiece deforming elements 66, 68 and 40 results in progressive occupation of predetermined portions of the workpiece receiving bore 30 thereby and consequent deformation of a generally cylindrically shaped workpiece positionable therein. Although the mechanics of the workpiece deformation are not fully understood at the present time, apparently the described inverted arcuate displacement of the arcuately shaped engaging surfaces 74 relative to the longitudinal axis of the workpiece receiving bore 30 and the abutting engagement of the normally convexly disposed arcuate surfaces of a workpiece and the arcuately shaped workpiece engaging surfaces 74 result in workpiece deformation by a wiping action in contradistinction to the radially applied direct pressure utilized and employed in conventionally constructed crimping tools.

The illustrated tool includes an associated full cycling mechanism to insure that once a workpiece deforming operation is initiated, a full operational cycle must be completed before the initiation of a subsequent cycle of operation. To this end, there is included within the top handle member 10 a particularly contoured U-shaped rack assembly, generally designated 90, having its base 92 secured, as by a threaded rivet 94, to the base 20 of the top handle member 10.

The rack assembly 90 is contoured so that the sidewall portions thereof are disposed adjacent to the sidewall portions 22 and 24 of the top handle member 10 and are spaced apart a sufficient distance to permit the entry therebetween of the body portion 38 of the cam handle member 12 and the hereinafter described operating elements of the full cycling mechanism that are mounted thereon. The sidewall portions of the rack assembly 90 are contoured to provide an arcuately shaped compression spring receiving and positioning recess 96, a stop assembly recess 98 and a latching and delatching assembly recess 100. Mounted in the spring receiving recess 96 is the base of an elongate compression spring 102 having the free end thereof adapted to engage the defining edge of the body portion 38 of the cam handle member 12 and normally bias said cam handle member 12 in diverging relation relative to the top handle member 10. Included within the stop assembly, recess 98 is an adjustable stop mechanism which may suitably be in the form of an adjustably positionable nut 104 mounted on the inwardly extending threaded end

6

of the rivet 94. The latching and delatching assembly recess 100 is shaped to provide pawl engaging ratchet surfaces 106 on one of the defining edge portions thereof and pawl release or delatching shoulders 108 on the other defining edge portion thereof.

Slidably mounted on the peripheral edge of the body portion 38 is a generally U-shaped pawl member 110 having the sidewall portions thereof disposed closely adjacent the sides of the cam handle slot body portion 38. Also included in the pawl member 110 is a ratchet engaging tooth 111 which is sized to extend beyond the side wall portions thereof and terminally engage the ratchet surfaces 106 and pawl release shoulders 108 on the sidewall portions of the U-shaped rack assembly 90. The pawl member 110 is positioned by the extending ends of a pin member 112 mounted on the body portion 38 which are disposed within an L-shaped guide slot 114 in the sidewall portions of the U-shaped pawl member. As illustrated, the guide slot 114 is generally L-shaped to permit a predetermined degree of pawl displacement in a longitudinal direction, i.e., parallel to that of the defining edge of the cam handle body portion 38, and a limited degree of vertical displacement, i.e., in a direction essentially perpendicular thereto at one of the limiting points of longitudinal displacement. The pawl member 110 is normally biased in an advanced or ratchet engaging position, i.e., in a direction remote from the pivot point 14 by the torsion spring 116, which is mounted on the cam handle body portion 38 as by having one end secured thereto as at 118, an intermediate section disposed in encircling engagement with the wiper arm drive pin 48 intermediate the wiper arm member 44 and the surface of the cam handle body portion 38 and its free end 120 disposed in abutting biasing engagement with the bevel shaped rear edge of the sidewall portions of the pawl member 110. When so positioned, the pawl member 110 will be biased so as to have the terminal ends of the tooth 111 engage the ratchet surfaces 106 upon converging displacement of the cam handle member 12 and thereby prevent retrograde movement of the cam handle member 12 once said pawl tooth and rack engagement has been effected while permitting further converging advance of the cam handle member 12. In order to effect retraction of the pawl member 110 and thereby prevent engagement of the tooth 111 with the rack 106 during divergent displacement of the cam handle member 12 a pawl release member 132 is provided. The pawl release member 132 is generally U-shaped in configuration and is pivotally mounted on the peripheral edge of the body portion 38 of the cam handle member 12 as at 130. This pawl release member 132 is provided with a trigger surface 134 positioned to engage and be pivotally displaced by the stop nut 104. As best illustrated in FIGURES 5a, 5b and 5c, the peripheral edge of the body portion 38 adjacent the pivotal mounting 130 is recessed as at 136 so as to permit a limited counterclockwise rotative displacement of the pawl release member 132 upon engagement of the trigger surface 134 with the stop nut 104 immediately prior to the cessation of convergent advance of the cam handle member 12. Said counterclockwise displacement of the pawl release member 132 results in an effective lineal advance of the arcuately shaped pawl tooth engaging surface 140 thereof and in engagement of the pawl tooth 111 thereby at a location inwardly adjacent the terminal end portions thereof and in a lineal retraction of the pawl assembly 110 against the action of the biasing spring 116. As best shown in FIGURES 5a and 5b, the rotative displacement of the pawl release member 132 in the direction indicated by the arrow A will result in a displacement of the pawl member 110 in the direction indicated by the arrow B. As also there shown, the peripheral edge of the cam handle body portion 38 is notched or recessed as at 144 beneath the pawl mechanism to form a retaining shoulder 142. As shown in FIGURE 5b, the parts are proportioned so that the lineal displacement of the pawl member 110 in the direction indicated by the

arrow B will be sufficient to effect the introduction thereof into the recess 144. Once the pawl member 110 has been introduced into the recess 144, it will be there maintained due to the engagement of the tooth 111 against the shoulder 142 and the biasing action of the spring 116. As will be apparent to those skilled in this art, the timing of the introduction of the pawl assembly 110 into the recess 144 will be effected by the positioning of the stop nut 104 which also serves to limit the converging advance of the cam and top handle members 12 and 10 and the concomitant converging advance of the workpiece deforming elements 66, 68 and 40.

When the pawl member 110 is disposed in its retracted position within the recess 144 a release of manual converging pressure upon the cam and top handle members 12 and 10 will permit the now compressed biasing spring 102 to initiate diverging displacement of said handle members. Such divergent displacement will cause the retracted pawl mechanism 110 to be displaced outwardly of the latching recess 100 in conjunction with the divergent displacement of the cam handle body portion 38. In order to automatically re-set the pawl member 110 in its advanced position for latching engagement with the ratchet surface 106 during the next operational cycle, the latching and delatching assembly recess 100 is provided with pawl release shoulders 108. The shoulders 108 are positioned to engage the underside of the extending terminal portions of the pawl tooth 111 and effectively lift the same by momentarily impeding its displacement in the divergent direction while the cam handle body portion 38 continues its divergent displacement. As illustrated in FIGURE 5c, the dimension of the L-shaped slot is such to permit the lifting of the tooth 111 out of engagement with the recess shoulder 142 at which time the biasing spring 116 will advance the pawl member 110 into latching position as illustrated in FIGURE 5a. The pawl release shoulder is suitably positioned so as to effect delatching of the pawl member 110 only after sufficient divergent advance of the cam handle member 12 has occurred to permit the readvanced pawl tooth to clear the ratchet surface 106.

The hereinabove described tool is particularly adapted to be utilized in the formation of insulated electrical connections of the so-called "through splice" type. Although, as described earlier, it can be utilized with equal facility in the deformation of pre-insulated terminal assemblies and in the formation of "pigtail" type splices. In the formation of such "through" type splice connections, the necessary electrical leads are disposed within a pre-insulated fitting, conveniently in the form of a metallic sleeve surrounded by an insulating sleeve, suitably plastic. A workpiece, as so constituted, may be readily inserted into the workpiece receiving bore 30 when the entry aperture thereto is open as when the top and cam handle member 10 and 12, respectively, are at their divergent limiting position, as illustrated in FIGURE 3. With a workpiece so positioned, convergent displacement of the extending handle portions of cam handle member 12 relative to the top handle member 10 will cause the workpiece deforming element 40 terminally disposed on the cam handle body portion 38 to be selectively displaced in a counterclockwise direction and introduced into the entry aperture of said workpiece receiving bore 30. As described earlier, such initial displacement will effect a concomitant advance of the wiper arm 42 and workpiece deforming elements 66 and 68 with workpiece displacement until the workpiece deforming element 40 engages the workpiece. At such time the workpiece will be repositioned, the advance of the wiper arm 42 will be halted or reversed and the wiper arm drive pin 48 will be displaced into engagement with the terminal end of the wiper arm slot 46, as illustrated in FIGURE 2. With the component elements positioned as there illustrated, the pawl member 110 will be disposed in its advanced position ready to engage the rack surface 106 on the rack member 90 secured to the top handle member 10 upon

further advance of the cam handle body portion 38. Continued convergent advance of the extending handle portion of the cam handle member 12 relative to the top handle member 10 will result in displacement of the wiper arm 44 and in simultaneous arcuate advance of the workpiece engaging surfaces 74 of the workpiece deforming elements 66, 68 and 40 about their respective pivotal mountings 70, 72 and 14, respectively with a concomitant wiping type deformation of the workpiece disposed within the workpiece receiving bore 30. Concurrently with the simultaneous advance of the workpiece deforming elements 66, 68 and 40, the extending ends of the tooth 111 of the pawl member 110 will engage the latching surfaces 106 of the rack member 90 and when so engaged will prevent any divergent or retractive displacement of the cam handle member 12 relative to the top handle member 10 while permitting continued further convergent advance thereof. Convergent advance of the cam handle member 12 will continue until the trigger surface 134 of the pawl release member 132 is engaged by the stop nut 104 and the pawl release member 132 is rotatably displaced thereby. The convergent advance of the cam handle member 12 and rotative displacement of the pawl release member 132 will continue for a short distance until the underside of said pawl release member 132 abuts the surface of the recess 136 in the cam handle member body portion 38 at which time convergent advance of the cam handle member 12 is halted. The above described rotative displacement of the pawl release member 132 by engagement with the stop nut 104 effects a lineal retractive displacement of the pawl member 110 sufficient to introduce the same into the retaining recess 144 on the cam handle body portion 38. When so positioned within said recess, the action of the biasing spring 116 will urge the pawl tooth 111 against the shoulder 142 and will serve to retain the pawl member 110 in its retracted or non-latch engaging position. With the pawl member 110 so retracted, the now compressed spring 102 will displace the cam handle member 12 away from the top handle member 10 upon release of manual convergent pressure thereon. Such divergent displacement of the cam handle member 12 will cause the wiper arm 42 to be displaced in conjunction therewith due to the engagement of the detent 117 with the spring 116 and concurrently therewith will elevate the retracted pawl member 110 from the base of the latching and delatching recess 100. The elevation of the pawl member 110 will continue until the extending terminal portions of the pawl tooth 111 engage the delatching shoulders 104, at which time the pawl tooth 111 will be lifted out of engagement with the recess retaining shoulder 142. When so lifted, the biasing spring 116 will urge the pawl member 110 into its advanced position so as to be engageable with the latch 106 during the next cycle of operation. Of course, the point of pawl advance takes place after a degree of divergent displacement sufficient to permit the advanced pawl tooth 111 to clear the latching surface 106. Further divergent advance of the cam handle member 12 will result in retraction of the wiper arm 44 and in concurrent clockwise displacement of the workpiece deforming elements 66 and 68. The pivotal retraction of the workpiece deforming elements 66 and 68 coupled with the continued pivotal displacement of the workpiece deforming element 40, as continually occasioned by divergent displacement of the cam handle 12, will be releasably halted at the intermediate position illustrated in FIGURE 2 at which time the workpiece receiving bore 30 will be cleared sufficiently to permit removal of a now deformed workpiece of the "pigtail splice" type disposed therein. If a through splice type of connection is being utilized a further divergent advance of the cam and top handle members is required to clear the workpiece receiving bore 30 to permit workpiece removal therefrom. As explained earlier such is effected by causing the spring 116 to be advanced past the detent 117 with a concomitant

displacement of the wiper arm drive pin 48 to the other end of the slot 46 and displacement of the workpiece deforming element 40 to the position illustrated in FIGURE 3. The cam handle member 12 and top handle member 10, when disposed at their limit of convergence, permit the cycle of operation to be repeated upon a new through splice type workpiece insertable into the workpiece receiving bore 30.

As will be apparent to those skilled in this art, the above described structure provides a novel self-contained manually operable tool for readily effecting the deformation of insulated electrical connections of the "through splice" type and is such as to readily achieve the hereinbefore stated objects and advantages of this invention.

Having thus described my invention, I claim:

1. In a workpiece deforming tool, a terminal portion shaped to define an open sided workpiece receiving bore and a workpiece entry channel thereto, a first workpiece deforming element selectively displaceable between a first location remote from said entry channel, an intermediate location adjacent said workpiece receiving bore and closing said entry channel and a third location occupying a predetermined portion of said workpiece receiving bore, second and third workpiece deforming elements displaceable from a first location adjacent said workpiece receiving bore to a second location occupying predetermined portions of said workpiece receiving bore, and means for effecting the selective displacement of said first workpiece deforming element from its first location to its intermediate location substantially independent of displacement of said second and third workpiece deforming elements and subsequent simultaneous displacement of said first, second and third workpiece deforming elements from the intermediate and first locations to their third and second locations respectively wherein each occupies a predetermined portion of said workpiece receiving bore with consequent deformation of a workpiece insertable therein.

2. The workpiece deforming tool construction as set forth in claim 1 including means for precluding return displacement of said workpiece deforming elements after initiation of simultaneous advance thereof, and means for deactivating said return displacement precluding means after a predetermined degree of advance thereof.

3. The workpiece deforming tool construction as set forth in claim 1 wherein each of said workpiece deforming elements includes an offset selectively shaped workpiece engaging surface displaceable along an arcuate path intersecting said workpiece receiving bore to progressively occupy the same and effect a wiping deformation of a workpiece positionable therein.

4. In a workpiece deforming tool, an open sided workpiece receiving bore and an entry channel thereto, a first workpiece deforming element pivotally displaceable between a first location remote from said entry channel and a second location occupying a predetermined portion of said workpiece receiving bore, a plurality of auxiliary workpiece deforming elements pivotally displaceable from a retracted location adjacent said workpiece receiving bore to an advanced location occupying a predetermined portion of said workpiece receiving bore and means for effecting a selective predetermined degree of substantially independent pivotal displacement of said first workpiece deforming element to close said entry channel and a subsequent simultaneous pivotal displacement of all said workpiece deforming elements to effect progressive occupation of said workpiece receiving bore thereby.

5. In a workpiece deforming tool a first handle member having an extending handle portion and a terminal portion shaped to provide an open sided workpiece receiving bore and a workpiece entry channel thereto, a second handle member pivotally mounted on the terminal portion of said first handle member having an extending handle portion and a terminal portion shaped to provide a workpiece deforming element displaceable between a retracted location remote from said entry channel, an inter-

mediate location closing the same and an advanced location occupying a predetermined portion of said workpiece receiving bore, a plurality of auxiliary workpiece deforming elements mounted on said terminal portion of said first handle member displaceable from a first location adjacent said workpiece receiving bore to a second location occupying predetermined portions thereof, means responsive to converging advance of said extending handle portions of said handle members for selectively effecting selective initial substantially independent advance of said first workpiece deforming element from its retracted location to its intermediate location and subsequent selective simultaneous advance of all of said workpiece deforming elements into occupying relationship with said workpiece receiving bore with consequent deformation of a workpiece disposable therein.

6. The workpiece deforming tool construction as set forth in claim 5 including means for precluding return displacement of said workpiece deforming elements after initiation of simultaneous advance thereof, and means for deactivating said return displacement precluding means after a predetermined degree of advance thereof.

7. The workpiece deforming tool construction as set forth in claim 5 wherein each of said workpiece deforming elements includes an offset selectively shaped workpiece engaging surface displaceable along an arcuate path intersecting said workpiece receiving bore to progressively occupy the same and effect a wiping deformation of a workpiece positionable therein.

8. The workpiece deforming tool construction as set forth in claim 5 wherein said auxiliary workpiece deforming elements are pivotally mounted on the terminal portion of said first handle member and are drivingly connected by lost motion means to said second handle member.

9. In a workpiece deforming tool, a first handle member having an extending handle portion and a terminal portion shaped to provide an open sided workpiece receiving bore and a workpiece entry channel thereto, a second handle member pivotally mounted on the terminal portion of said first handle member having an extending handle portion and a terminal portion, said terminal portion being shaped to provide a first workpiece deforming element pivotally displaceable between a retracted location remote from said workpiece entry channel and an intermediate location closing said workpiece entry channel and adjacent said workpiece receiving bore in response to a predetermined degree of initial converging displacement of the extending portions of said first and second handle members and to an advanced location occupying a predetermined portion of said workpiece receiving bore in response to further converging displacement of said extending handle portions of said first and second handle members, a plurality of auxiliary workpiece deforming elements pivotally mounted on the terminal portion of said first handle member displaceable from a retracted location adjacent said workpiece receiving bore to an advanced location occupying a predetermined portion of said workpiece receiving bore, each of said workpiece deforming elements including an offset selectively shaped workpiece engaging surface displaceable along an arcuate path to intersect said workpiece receiving bore and occupying said predetermined portions thereof and linkage means connecting said auxiliary workpiece deforming elements with the extending handle portion of said second handle member for selectively effecting concurrent displacement of said auxiliary workpiece deforming elements from their retracted to their advanced position with advance of said first workpiece deforming element from its intermediate to its advanced location in response to said further converging displacement of said extending handle portions of said first and second handle members with consequent wiping deformation of a workpiece disposable in said workpiece receiving bore.

10. The workpiece deforming tool construction as set

11

forth in claim 9 including means for precluding return displacement of said workpiece deforming elements after initiation of advancing displacement of said auxiliary workpiece deforming elements and means for deactivating said return displacement precluding means after a predetermined degree of advance of said workpiece deforming elements.

11. The workpiece deforming tool construction as set forth in claim 9 wherein said linkage means includes lost motion means to selectively permit independent advance of said first workpiece deforming element from its retracted location to its intermediate location during a predetermined portion of initial converging displacement of said extending portions of said first and second handle members and simultaneous advance of all said workpiece deforming elements during further convergent advance of the extending handle portions of said handle members.

12. The workpiece deforming tool construction as set forth in claim 9 wherein the workpiece engaging surfaces of said workpiece deforming elements are arcuate in shape.

13. The workpiece deforming tool as set forth in claim 9 including a spring biased pawl member mounted on the extending handle portion of said second handle member, latching means mounted on said extending handle portion of said first handle member and engageable by said pawl in response to converging advance of said extending handle portions of said handle members, and pawl release means for displacing said pawl member out of latching engagement with said latching means after a predetermined degree of convergent advance of said workpiece deforming elements.

14. The workpiece deforming tool as set forth in claim 9 including latching means mounted on the extending handle portion of said first handle member, a pawl member mounted on the extending handle portion of said second handle member normally biased for engagement with said latching means after initiation of converging advance of said auxiliary workpiece deforming elements, a pawl release member mounted on the extending handle portion of said second handle member, adjustably positionable

12

stop means mounted on said first handle member and engageable with said pawl release means to displace the same and bias said pawl member in retracted position out of engagement with said latching means after a predetermined degree of converging advance of said workpiece deforming elements and means for effecting displacement of said pawl member from its retracted position to its advanced position after a predetermined degree of divergent displacement of the extending handle portions of said handle members.

15. The workpiece deforming tool construction as set forth in claim 1 including means for releasably halting said first workpiece deforming element at its intermediate position and said auxiliary workpiece deforming elements at their first location upon retraction thereof from their third and second location respectively.

16. The workpiece deforming tool construction as set forth in claim 11 including releasable detent means for effecting simultaneous retraction of said first workpiece deforming element and said auxiliary workpiece deforming elements from their advanced location to their intermediate and retracted locations respectively upon a predetermined degree of initial divergent displacement of the extending handle portions of said first and second handle members and selective displacement of said first workpiece deforming element from its intermediate to its retracted location in response to further divergent displacement of said extending handle portion of said first and second handle members.

References Cited in the file of this patent

UNITED STATES PATENTS

2,829,547	Barnes	Apr. 8, 1958
2,861,490	Rozmus	Nov. 25, 1958
2,903,929	McVey	Sept. 15, 1959

FOREIGN PATENTS

1,173,617	France	Oct. 27, 1958
201,689	Austria	Jan. 10, 1959