

[54] **AUTOMATIC TERMINAL APPLICATOR FOR INSULATED NON-METALLIC IGNITION TYPE WIRES**

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[51] Int. Cl. **H01r 43/04, H01r 9/00**
[58] Field of Search **29/203 DT, 203, 630 A**

[56] **References Cited**

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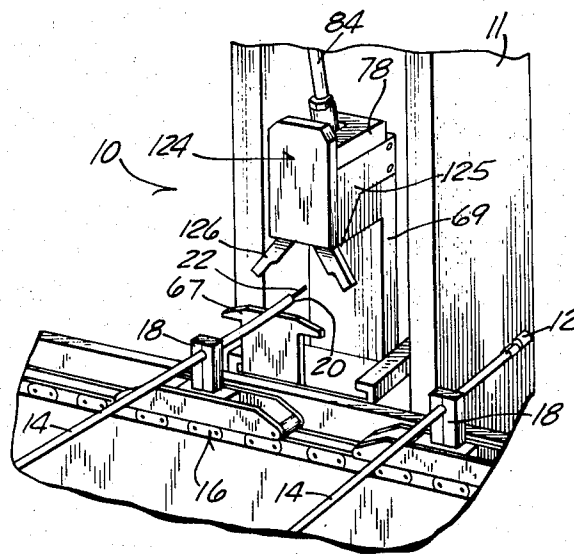
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[57] **ABSTRACT**

A terminal applicator for attaching an electric terminal to the end of an insulated non-metallic ignition type wire having one or both ends of the wire insulation stripped to expose a short section of the non-metallic conductor. The wire is conveyed in a step by step manner to the terminal applicator. The applicator includes a die set having a movable die and a fixed die. The movable die includes a pusher plate which is moved downwardly with the movable die to partially bend the exposed conductor at the end of the wire downward into the path of motion of the movable die. The whole terminal applicator is moved toward the wire to seat the end of the wire in the terminal ears of an electric terminal. The motion of the applicator is used to bend the downwardly bent conductor back against the outside surface of the insulation so that on crimping of the terminal ears around the insulation, the exposed end of the conductor of the wire will be in electrical contact with the terminal.

13 Claims, 11 Drawing Figures



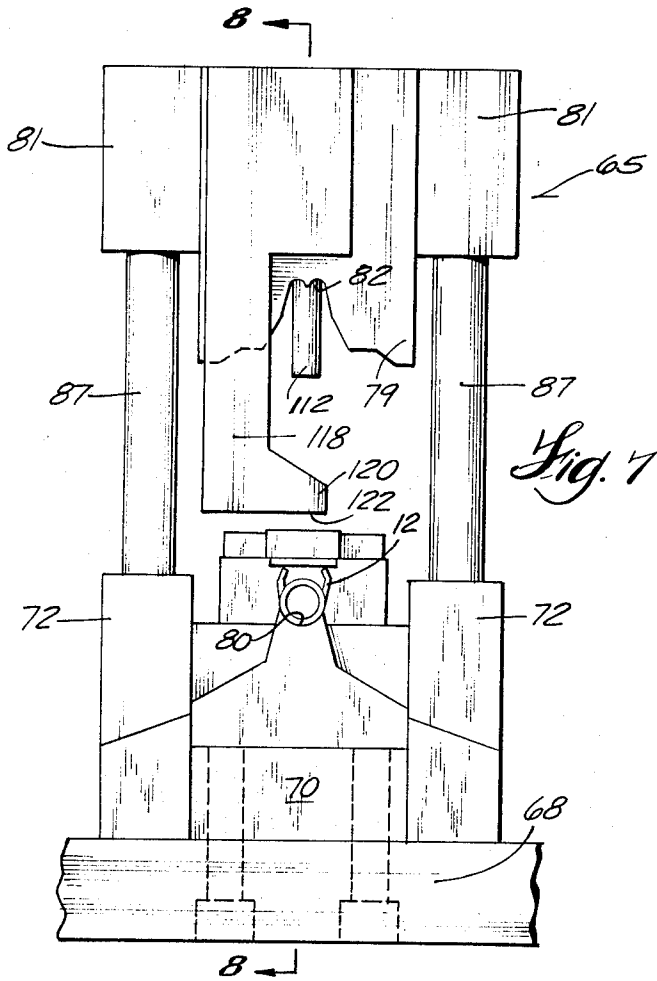


Fig. 7

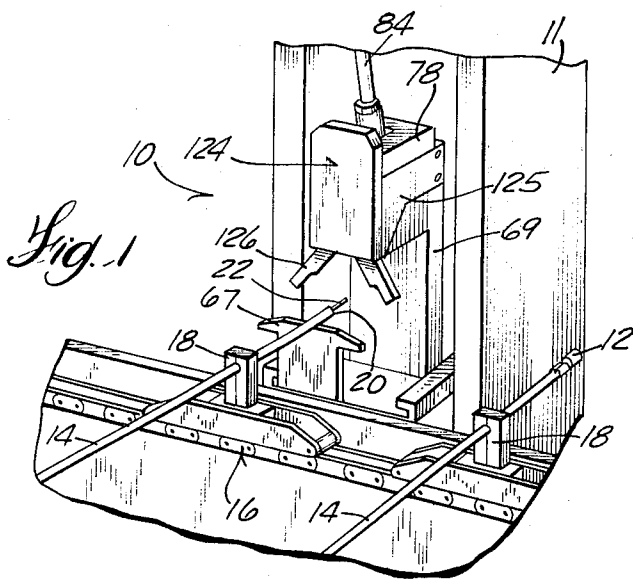


Fig. 1

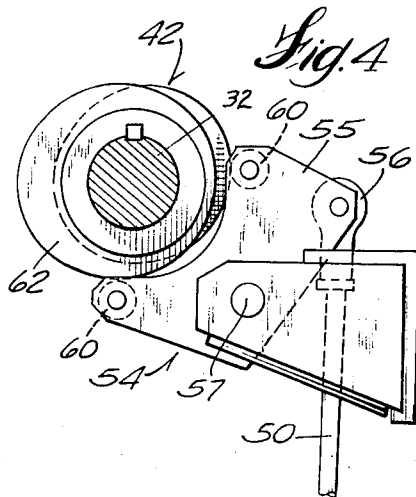


Fig. 4

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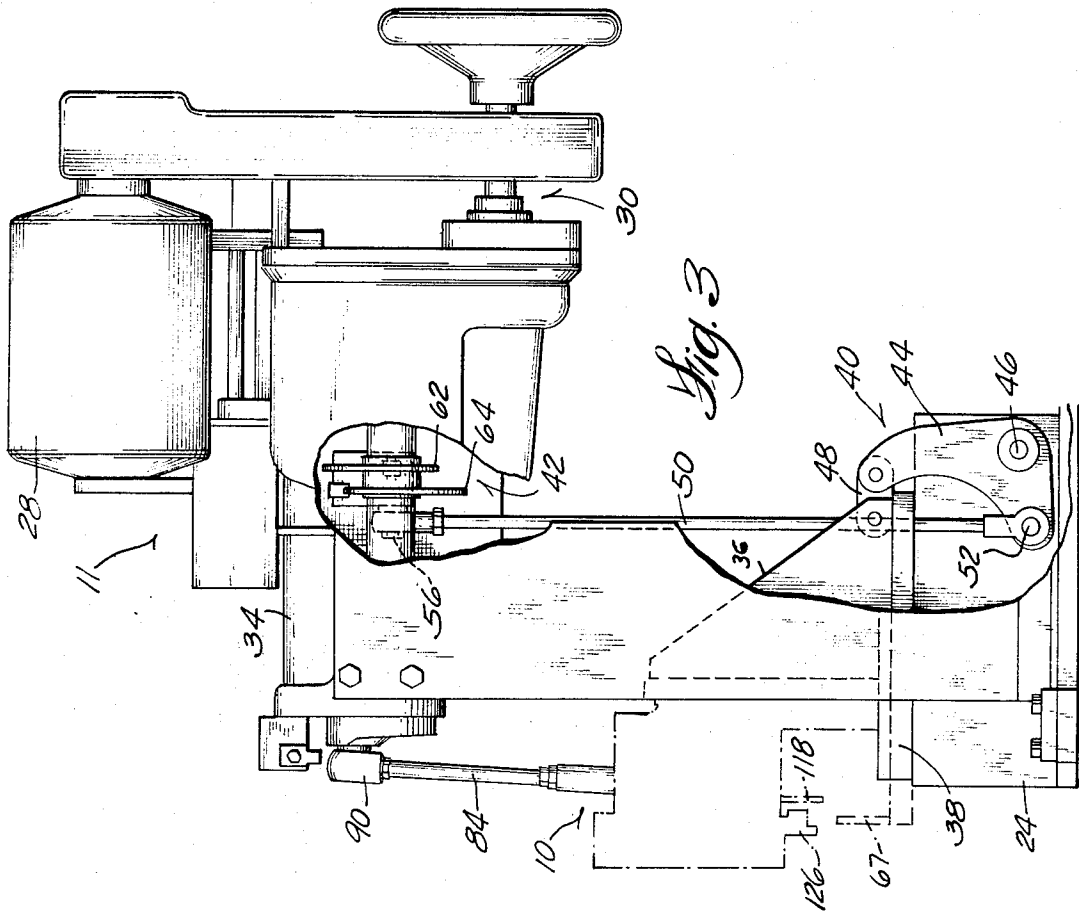


Fig. 3

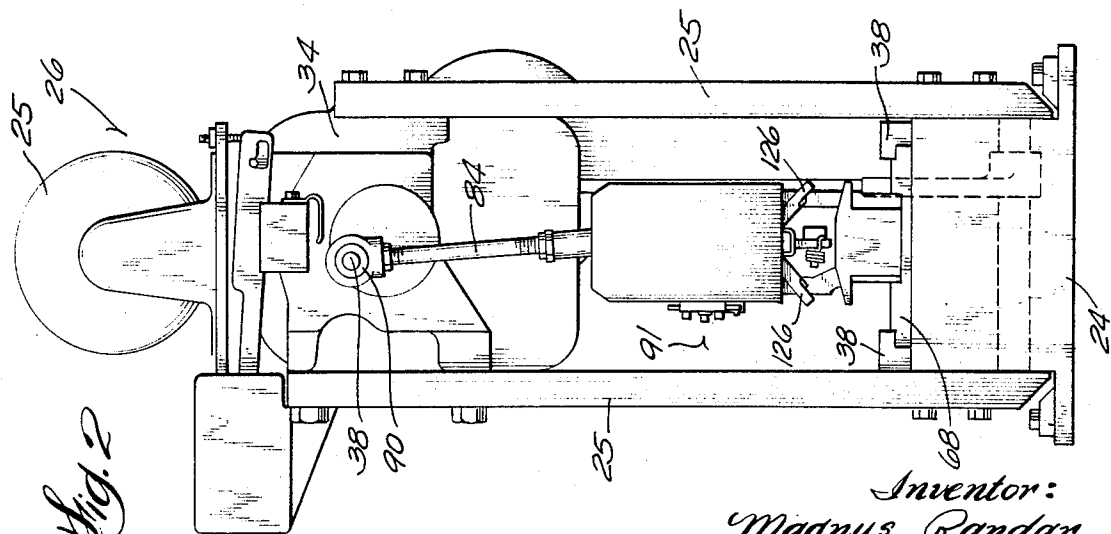


Fig. 2

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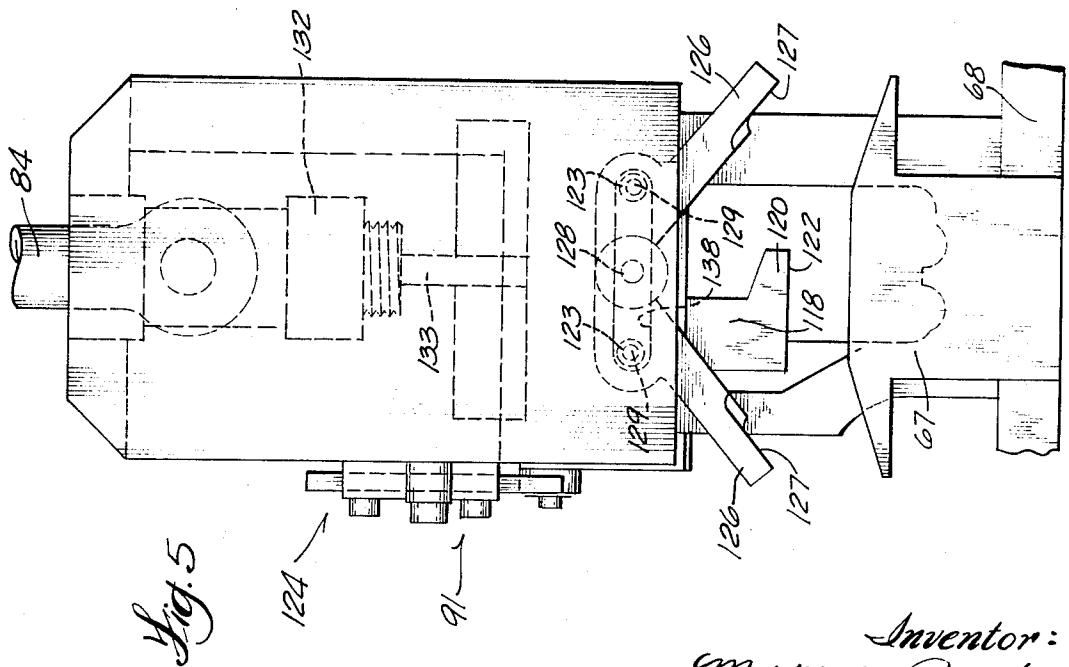
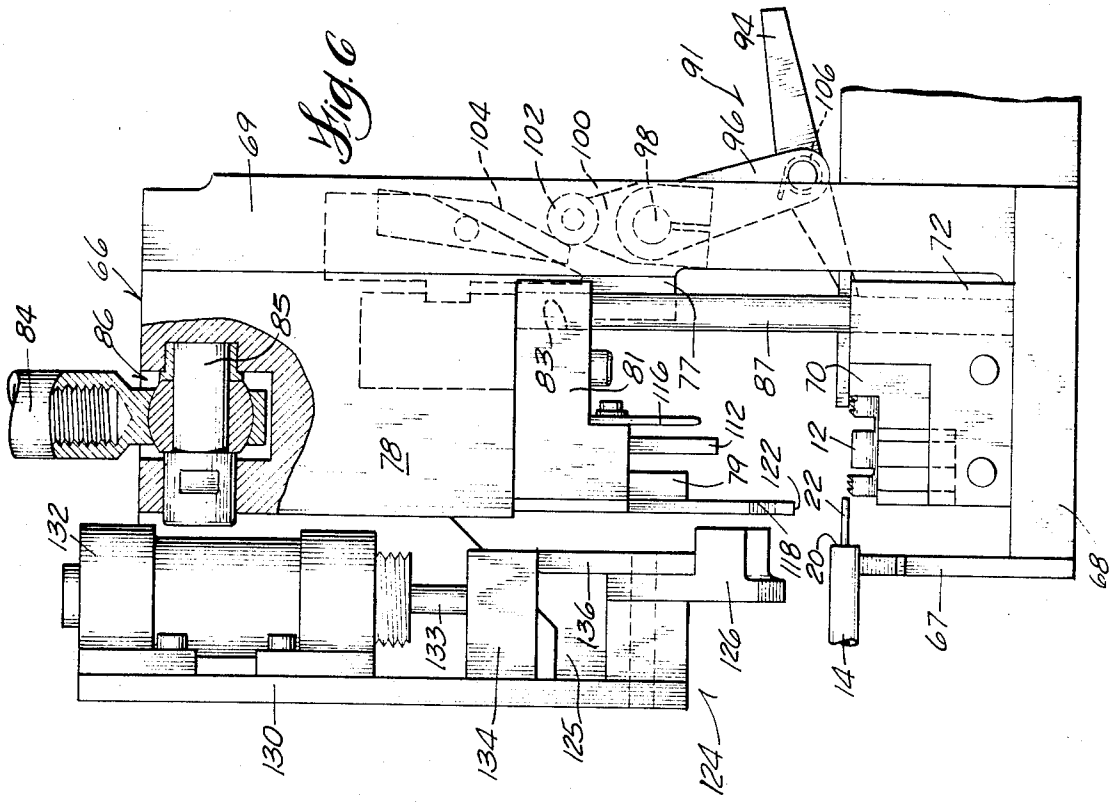
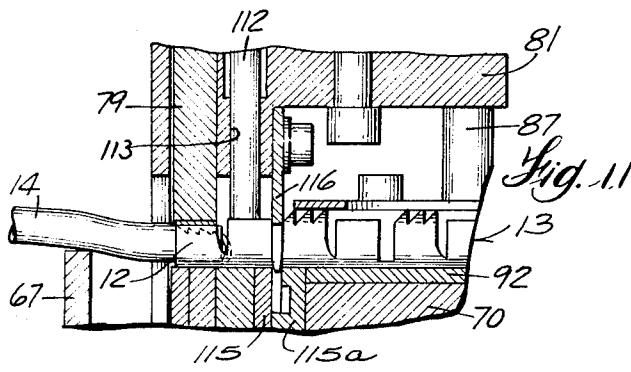
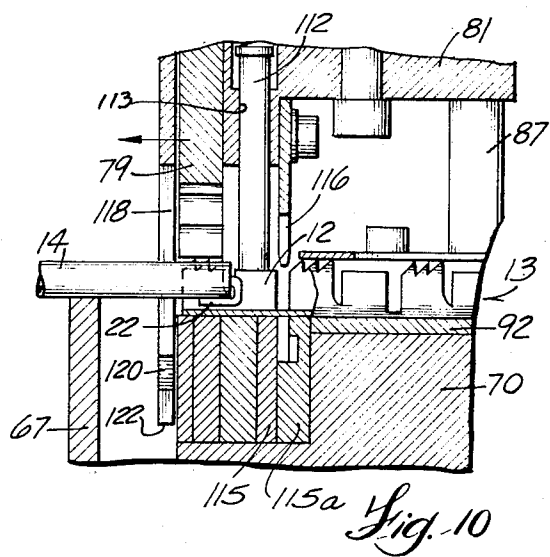
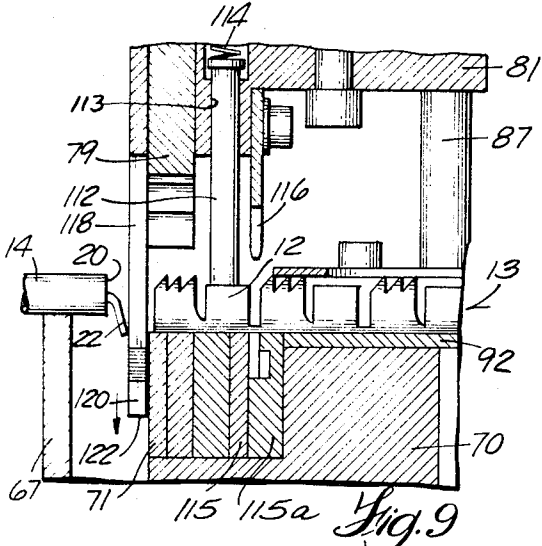
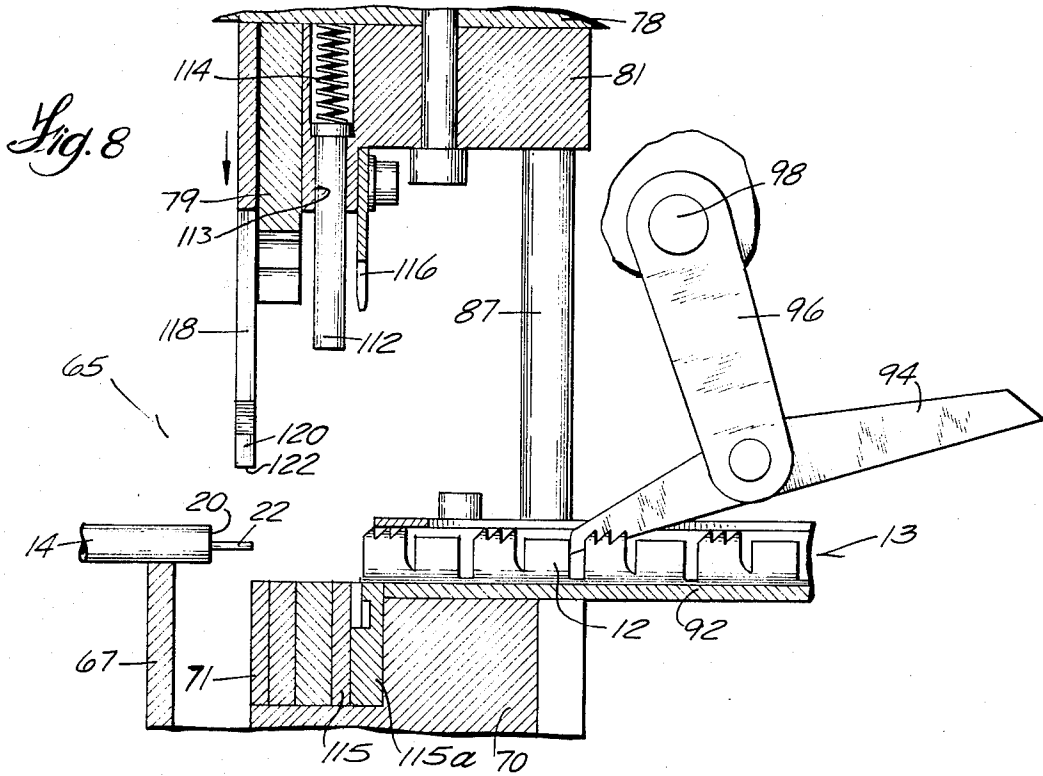


Fig. 5

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AUTOMATIC TERMINAL APPLICATOR FOR INSULATED NON-METALLIC IGNITION TYPE WIRES

BACKGROUND OF THE INVENTION

Automatic application of electric terminals to the exposed conductor of an insulated wire has previously been done by a stationary die unit as shown in U.S. Pat. No. 3,274,664 entitled "Terminal Attachment Device" and U.S. Pat. No. 3,231,961 entitled "Wire Cutting and Terminal Attaching Machine." In some instances, it is desirable to bend the exposed copper conductor back against the insulation to obtain electrical contact between the exposed conductor and the terminal. Automatic attachment of electric terminals directly to insulated non-metallic conductor wires has not been done due to the difficulty in holding the conductor in the bent back position. The conductor has a tendency to return to its straight position making it difficult to hold the conductor against the insulation while the terminal is being attached to the wire.

In the past, whenever terminals were attached to ignition wire by automatic machines, two methods were used. The most common method employed an intermediate step of inserting a formed metallic wire into the center of the conductor. The metallic wire was bent around the outside of the wire in the form of a U before attaching the terminal over the ignition wire and the metallic wire.

The second method employed a sharp barb in the terminal which would pierce the insulation and make contact with the conductor. The first method involved additional cost and was unreliable. The second method made poor electrical contact and was very unreliable.

Whenever electric terminals have been applied to non-metallic ignition type wires using the bent conductor method, the conductor has been bent by hand and held against the insulation while the electric terminal is attached to the wire. This is a costly and time consuming process.

SUMMARY OF THE INVENTION

The terminal applicator of the present invention makes it possible to automatically attach electric terminals to insulated non-metallic ignition type wires, without the intermediate step of inserting a metallic wire into the conductor portion of the wire before attaching the terminal. This is accomplished by initially stripping the insulation from the end of the wire to expose the conductor. The wire is then held in a fixed position and the applicator is moved toward the wire. A reciprocally movable pusher plate is provided on the movable die in the terminal applicator and is moved downward into engagement with the exposed portion of the conductor so that the bent conductor lies in the path of motion of the movable die. The motion of the applicator toward the insulated wire will bend the downwardly bent end of the conductor back against the insulation as the wire is seated in the electric terminal. The ears on the electric terminal are then crimped to the wire with the bent end of the exposed conductor squeezed between the insulation and the electric terminal. An intimate electric connection is then completed between the conductor and the terminal.

Other objects and advantages will be apparent from the following description of the invention when read in connection with the accompanying drawings:

THE DRAWINGS

FIG. 1 is a perspective view of a portion of a terminal applicator press with the movable terminal applicator of this invention shown positioned next to a wire conveyor.

FIG. 2 is a front view in elevation of the applicator.

FIG. 3 is a side view in elevation with the side of the applicator broken away to show the linkage assembly for the die set slide bracket.

FIG. 4 is a view taken on line 4—4 of FIG. 3 showing the drive cam for the slide bracket linkage assembly.

FIG. 5 is a front view of the wire guide assembly with a portion of the front plate broken away to show the guide fingers.

FIG. 6 is a side view of the moving die set.

FIG. 7 is a front elevation view of the moving die set with the wire guide finger assembly removed.

FIG. 8 is a section view taken on line 8—8 of FIG. 7 showing the upper die shoe in the upper position and the position of the exposed conductor prior to bending.

FIG. 9 is a section view similar to FIG. 8 showing the conductor pusher plate at an intermediate position with the exposed conductor bent downward.

FIG. 10 is a section view similar to FIG. 8 showing the die set of the applicator moved to the left and the exposed conductor bent under the terminal strip.

FIG. 11 is a section view similar to FIG. 10 showing the electric terminal crimped to the insulation at the end of the wire with the conductor in intimate contact with the terminal.

DETAILED DESCRIPTION OF THE INVENTION

The terminal applicator 10 of this invention as seen in FIG. 1 is used to automatically secure an electric terminal 12 to the end of an insulated non-metallic ignition type wire 14. The non-metallic conductor 22 in this type of wire generally includes carbon as the conductive material. Terminal applicators 10 are installed in terminal applicator presses 11 which are generally located on each side of a step by step type wire conveyor 16 in a position to engage the ends of the wire 14. It should be noted that the wire 14 is held in a fixed position by wire carrying fingers 18 (only one pair is shown) provided on each side of the conveyor 16. The wires 14 are initially cut in a cutting and stripping machine where the insulation 20 is stripped from each end of the wire 14, leaving a section of the conductor 22 exposed. The wires 14 are picked up by the conveyor 16 and advanced in a step by step manner past the front of the terminal applicators 10. The terminals 12 can be applied simultaneously to both ends of the wire 14 or to each at different positions of the wire 14.

An electric terminal 12 is generally secured to both ends of the wire 14. In accordance with the invention, the terminal applicators 10 bend the exposed conductor 22 of the wire 14 back against the outer surface of the insulation 16 to make electrical contact between the conductor 22 and the terminal 12.

THE TERMINAL APPLICATOR

The terminal press unit 11 (FIGS. 2 and 3) includes a base plate 24 having side plates 25 secured thereto for supporting a power unit 26. The power unit is a conventional unit and includes a motor 28 which is operatively connected through a reduction gear 30 to drive a shaft 32 which is mounted for rotary motion in a housing 34 secured to the plates 25. An applicator slide bracket 36 is mounted for reciprocal motion on the base plate 24 and is retained therein by guides 38. The applicator slide bracket 36 is reciprocated on the base 24 by means of a linkage assembly 40 which is actuated by a cam assembly 42 mounted on the shaft 32.

In this regard, the linkage assembly 40 (FIG. 3) includes a bell crank 44 pivotally mounted on a fixed pin 46. The bell crank 44 is connected to the slide bracket 36 by a link 48 and is pivoted about the pin 46 by means of a connecting rod 50 connected to the bell crank 44 by pin 52 and to a cam lever assembly 54 by a pin 56. The cam lever assembly 54 (FIG. 4) includes a bell crank 55 mounted on a pin 57 and having a pair of cam rollers 60 which are positioned to engage the cam assembly 42. The cam assembly 42 includes a primary cam 62 and a conjugate cam 64 to provide positive mechanical movement of the slide bracket 36 in both directions. The contour of the cams 62 and 64 are arranged to move the slide bracket 36 forward in synchronism with the operation of the terminal applicator as more fully described below.

The electric terminals 12 are crimped to the end of the wire 14 by means of a die set 65 (FIGS. 5, 6 and 7) which is mounted in a frame assembly 66 on the front of the slide bracket 36. The die set 65 and frame assembly 66 make up the applicator 10. In this regard, the frame assembly 66 includes a bottom plate 68 and a back plate 69. Two guide blocks 72

having openings 74 are secured to a fixed die shoe 70 which is secured to the bottom plate 68. A ramp 67 is secured to the front of the bottom plate 68. A slide block 78 is mounted for reciprocal movement in jib guides 77 provided on the back plate 69. A moving die shoe 81 having opening 83 is secured to the slide block 78 for movement with the slide block 78. A crimping die 79 is secured to the moving die shoe 81 in a position to operatively engage an anvil 71 which is secured to the fixed shoe 70. Accuracy in alignment of the anvil 71 and crimping die 79 is provided by means of guide pins 87 positioned in the openings 74 in the guide blocks 72 and openings 83 in the moving shoe 81. The die set 65 includes the fixed die shoe 70 and the movable die shoe 81. The fixed die shoe 70 onto which is secured the guide blocks 72, includes the anvil 71 having an arcuate terminal support surface 80. The crimping die 79 is secured to the moving shoe 81 and includes a curved crimping surface 82 which is used to crimp the ears of the terminal 12 against the insulation 16 of the wire 14.

Means are provided for closing the crimping die 79 on the terminal 12 in timed sequence with the movement of the slide bracket 36. In this regard, a connecting rod 84 is connected to a pin 85 in the movable block 78 by means of a universal bearing 86 and a crank pin 88 provided on the drive shaft 32 also by means of a universal bearing 90. It should be noted that the continuous motion of shaft 32 is transferred to the slide block 78 by the connecting rod 84. The universal bearings 86 and 90 allow the die set to be moved horizontally simultaneously with the vertical movement of the slide block 78.

TERMINAL FEED ASSEMBLY

Referring to FIGS. 6 and 8, means are shown for feeding a terminal strip 13 to the die set 65 in the form of a linkage assembly 91. The terminal strip 13 is fed through a tube or guide 92 provided on the fixed shoe 70. The terminal 13 is advanced in a step by step manner by a pawl 94 which is mounted on the end of a lever 96 pivotally mounted on a pivot pin 98 on the back plate 69. A second lever 100 is secured to the pivot pin 98 and includes a cam roller 102 which is positioned to engage a cam 104 provided on the slide block 78. The pawl 94 is biased into engagement with the terminal strip by a spring 106 and moves forward on the downward motion of the slide block 78 to push the terminal strip 13 forward in the guide 92. The pivot pin 98 is biased to return the pawl 94 to its initial position by a spring which is not shown in the drawing. This is a conventional terminal feed system. The terminal 12 is cut from the terminal strip 13 by the motion of the slide block 78 as more particularly described below.

The terminals 12 are held in position in the anvil 71 by means of a hold-down pin 112 which is positioned in a bore 113 in the shoe 81 and biased by a spring 114 downwardly toward the terminal 12. A cutter blade 116 is secured to the movable die shoe 81 and cooperates with a cut off block 115 and cut off die 115a to cut the terminal 12 from the terminal strip. The operation and construction of the applicator 10 is generally well known, the upper die shoe 81 being moved into engagement with the lower die shoe 70 to crimp the terminal 12 on the insulation and to cut the terminal 12 from the terminal strip.

CONDUCTOR BENDING APPARATUS

Means are provided for bending the exposed conductor 22 of the wire 14 downwardly into the path of motion of the fixed die shoe 70 in order to bend the exposed conductor 22 of the wire 14 against the insulation 20. Referring to FIGS. 6 and 7, such means is in the form of a pusher plate 118 mounted on the front of the crimping die 79. The plate 118 includes a flange 120 which projects across the front of the die set 65. The bottom edge 122 of the flange 120 is positioned to engage the exposed conductor 22 of the wire as the crimping die 79 is moved downward past the ramp 67. When the slide bracket 36 is moved horizontally toward the end of the wire 14, the anvil 71 will engage the downwardly bent conductor 22 pushing the

conductor 22 under the insulation 20 of the wire 14. As the terminal 12 is moved into alignment with the end of the wire 14 the crimping die 79 will be moved downward into operative engagement with the anvil 71, crimping the terminal 12 to the insulation on the wire 14. The sequence of movements is more completely described in the description of the operation of the applicator 10.

WIRE GUIDE ASSEMBLY

Means are provided on the front of the die set 65 for aligning and holding the wire 14 in a fixed position on the ramp 67 as the die set 65 is moved toward the end of the wire 14. Such means is in the form of a wire guide assembly 124 which is mounted on brackets 125 provided on each side of the back plate 69 and a pair of fingers 126 having recesses 127 which are closed on the wire 14 forming a guide opening between the recesses 127. The wire 14 slides through the guide opening as the die set 65 is moved toward the wire 14. In this regard, the fingers 126 are mounted for pivotal movement on a pin 128 provided in a mounting plate 130 which is secured to the side plates 125. Each finger 126 includes a roller 123 mounted on a pin 129. An air cylinder 132 is secured to the mounting plate 130 and includes a piston rod 133 which is connected to move a sliding cam block 134 and includes an elongate opening 138 operatively positioned to engage the rollers 123 on the fingers 126. When the air cylinder 132 is actuated the cam block 134 and plate 136 will move downward. The rollers 123 will be pushed downward rotating the fingers 126, closing them over the wire 14. The roller 123 will move inward in the slot 138 on downward movement of the cam block 134 and outward on upward movement of the cam block 134.

OPERATION

Referring to FIGS. 8 through 11, the sequence of operation is shown for the terminal applicator 10 of this invention. It should be noted that the slide block 78 which carries the movable die shoe 81 is moved continuously through each cycle of operation. As indicated above, the slide block 78 is connected to the crank pin 88 on the shaft 32 by connecting rod 84 and completes a cycle of operation in each revolution of the shaft 32.

In FIG. 8, the position of die set 65 is shown at the start of a cycle of operation. The wire 14 has been moved by the conveyor 16 to a position opposite the front of the terminal applicator 10 with the wire 14 resting on the ramp 67. The exposed conductor 22 is located above the anvil 71 and generally in line with it. As the slide block 78 is moved downward to the position shown in FIG. 9, the bottom edge 122 of the pusher plate 118 will engage the conductor 22 bending it downward in front of the anvil 71. Simultaneously with the movement of the pusher plate 118, the pawl 94 will move the terminal strip onto the anvil 71 until the electric terminal 12 on the front end of the strip is seated in the arcuate slot 80 in the anvil 71. As soon as the electric terminal 12 is seated on the anvil 71, the hold down pin 112 will engage and hold the terminal 12 in position.

The slide bracket 36 will start to move forward to the position shown in FIG. 10 after the flange 120 on the pusher plate 118 clears the end of the wire 14. The wire guide fingers 126 on the wire guide assembly are closed on the wire 14 with the wire positioned in the slot formed by the recesses 127 at the end of the guide fingers 126. The movement of the slide bracket 36 to the position shown in FIG. 10 will bend the conductor 22 back against the insulation 20 at the end of the wire 14. Since the wire 14 is immediately seated in the electric terminal 12, the conductor 22 will be held against the insulation 20 at the end of the wire 14. The continued motion of the slide block 78 will move the crimping die 79 toward the anvil 71 crimping the ears on the electric terminal 12 onto the end of the wire 14 as seen in FIG. 11. The cutter blade 116 will simultaneously cut off the terminal 12 at the end of the terminal strip 13. As the slide block 78 starts to move upward, the conveyor 12 is actuated to move the wire 14 to the next position.

RESUME

The terminal applicator of this invention can be used to automatically attach an electric terminal to the end of an insulated non-metallic ignition type wire. The apparatus automatically bends the exposed conductor of the wire back against the insulation and will hold the conductor against the wire. The wire is held in a substantially fixed position by a wire guide assembly to assure accuracy in alignment of the wire with the terminal applicator. The movable terminal applicator of this invention is fully automatic thereby reducing the time and cost in securing electric terminals to insulated non-metallic wires.

I claim:

1. An apparatus for crimping an electric terminal to the end of a non-metallic insulated ignition type wire having a portion of the insulation removed to expose the conductor at the end of the wire and being conveyed in a step by step manner to an operative position with respect to the apparatus, said apparatus comprising,

a base,

a terminal applicator mounted on said base for movement toward the end of said wire, said applicator including a die set having a fixed anvil and a movable crimping die,

means for closing said crimping die on the end of the wire to crimp an electric terminal to the end of the wire,

means movable with said crimping die set for bending the exposed conductor at the end of the wire into the path of motion of said fixed anvil whereby said fixed anvil on movement of said terminal applicator toward the end of the wire will bend the downwardly bent conductor back against the insulation at the end of the wire.

2. The apparatus according to claim 1 wherein said die set unit includes a ramp positioned to support the end of the wire.

3. The apparatus according to claim 2 including means for holding the end of the wire on the ramp in alignment with said fixed anvil.

4. The apparatus according to claim 3 wherein said holding means includes a plate, a pair of fingers mounted for pivotal movement on said plate between operative and inoperative positions with respect to the wire, each of said fingers including a recess located in a position to form a guide slot between said fingers for said wire, and means for closing said fingers on said wire.

5. The apparatus according to claim 2 wherein said means for bending said conductor comprises a plate connected to said movable crimping die, said plate including a flange positioned to engage the exposed conductor on closing of said crimping die.

6. An apparatus for attaching an electric terminal to a non-metallic ignition type wire being conveyed in a step by step manner to an operative position with respect to said apparatus, a portion of the insulation being stripped from the end of the wire to expose the conductor, said apparatus comprising,

a base,

a slide bracket mounted on said base for movement between operative and inoperative positions with respect to the end of the wire,

a terminal applicator secured to said slide bracket and including a fixed anvil and a movable crimping die positioned to operatively engage the end of the wire,

means for moving said slide bracket to said operative position with respect to said wire,

means for closing said applicator to crimp an electric terminal onto the end of the wire,

a ramp secured to said applicator and positioned to support the end of the wire,

and a pusher plate connected to move with said movable crimping die and including a flange positioned to engage the exposed conductor of the wire to bend said conductor into the path of motion of said fixed anvil.

7. The apparatus according to claim 6 wherein said slide bracket moving means includes a cam assembly contoured to move the slide bracket to the operative position after the pusher plate has bent the conductor into the path of the anvil.

8. The apparatus according to claim 6 including means for holding the wire in a fixed position with respect to said fixed anvil.

9. The apparatus according to claim 8 wherein said holding means includes a mounting plate connected to said applicator, a pair of fingers mounted for pivotal movement about a common axis on said mounting plate, said fingers each including a recess positioned to form a guide slot for the wire on closing of said fingers, and means for closing said fingers on the wire prior to engagement of the exposed conductor by said flange on said pusher plate.

10. A die set for crimping an electric terminal on the end of an insulated non-metallic ignition type wire, said die set including a fixed anvil and a movable crimping die,

a ramp operatively connected to said fixed anvil to support the end of said wire,

a pusher plate operatively connected to said movable crimping die to engage and bend the exposed conductor of said wire on closing said die set,

and means for moving said die set toward the end of said wire whereby the motion of said anvil will bend said conductor back against the insulation on the end of the wire.

11. The die set according to claim 10 including means connected to said movable crimping die for holding the end of the wire in a fixed position with respect to said fixed anvil.

12. The method of attaching an electric terminal to an insulated non-metallic wire, said method including the steps of stripping a portion of the insulation from the end of the wire to expose the non-metallic conductor, bending the exposed conductor out of axial alignment with the wire,

pushing an electric terminal onto the end of the wire against the exposed conductor to force the exposed conductor back against the insulation,

and crimping the terminal against the insulation with the conductor squeezed between the terminal and the insulation.

13. The method according to claim 12 including the step of holding the wire in a fixed position prior to pushing the terminal onto the wire.

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