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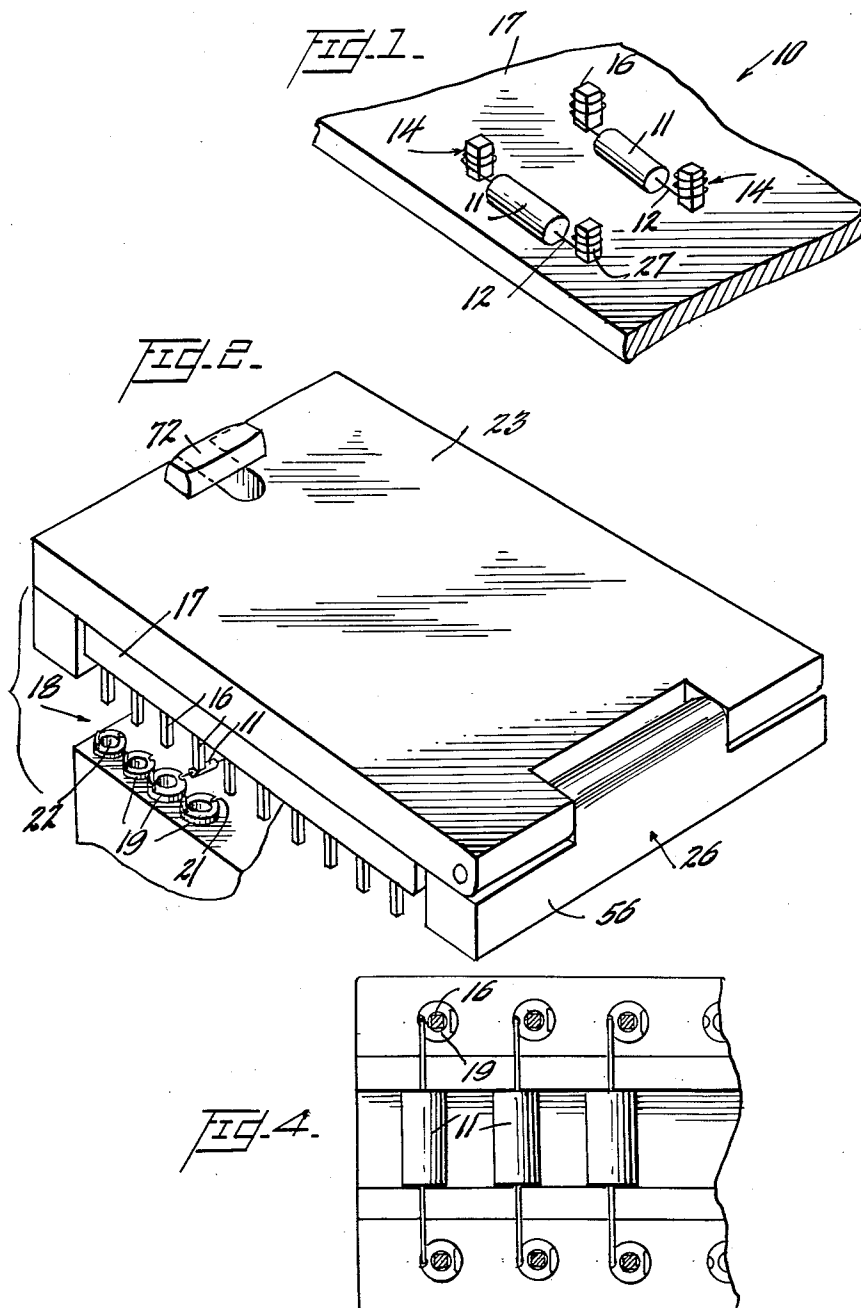
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APPARATUS FOR CONNECTING WIRE CONDUCTORS TO TERMINALS

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2 Sheets-Sheet 1



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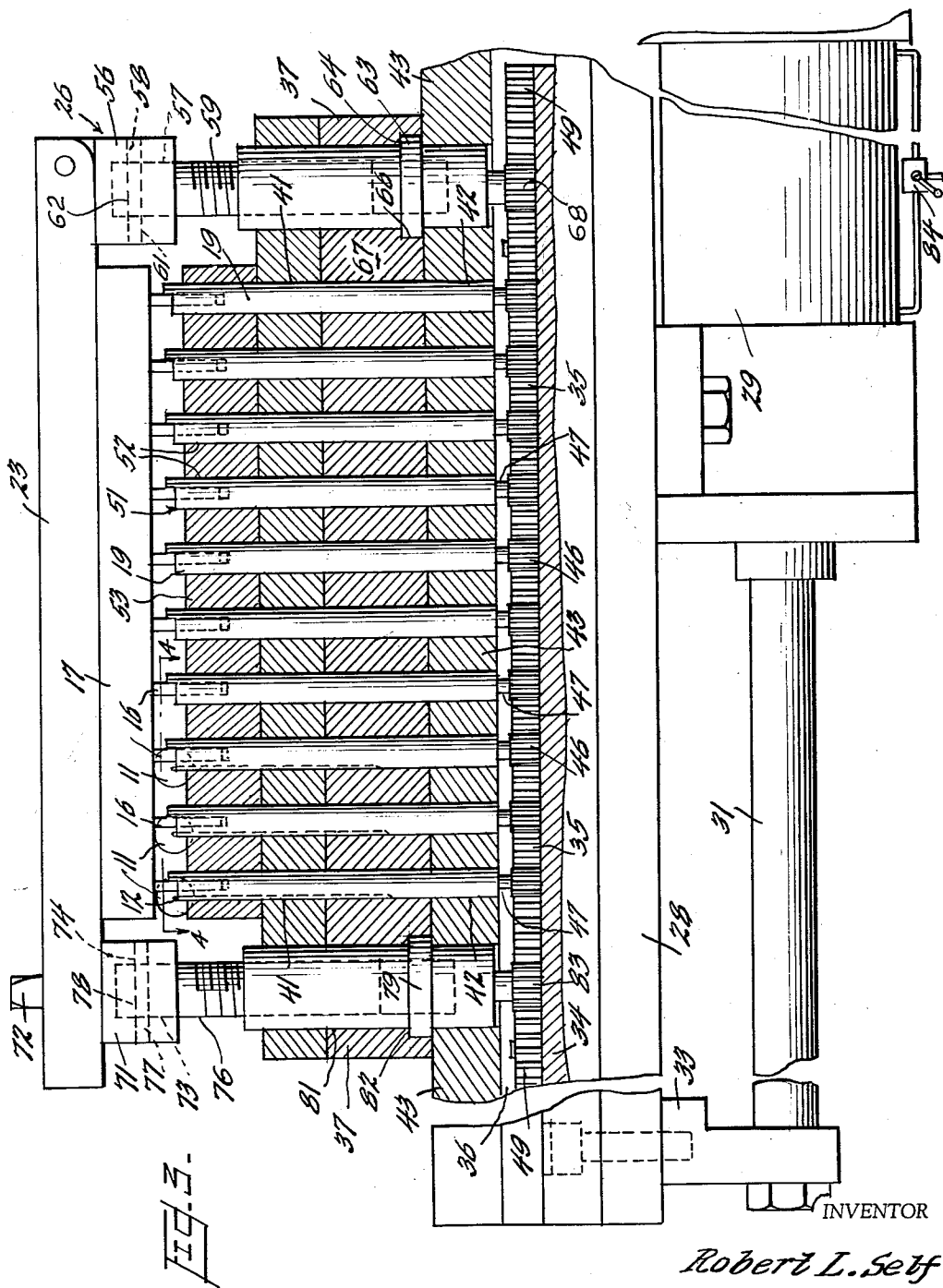
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APPARATUS FOR CONNECTING WIRE CONDUCTORS TO TERMINALS

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8 Claims. (Cl. 29—203)

This invention relates to an apparatus for connecting wire conductors to terminals and more particularly to an apparatus for wrapping onto a group of terminals secured to a circuit panel a plurality of lead wires secured to a group of components wherein the panel is selectively moved during wrapping to permit single layers of wires to be wrapped onto the terminals.

In the manufacture of circuit assemblies, it is necessary to connect circuit components, such as transistors, resistors, etc., to terminals projecting from circuit panels. More particularly, it is sometimes necessary to electrically and mechanically connect large numbers of circuit components to groups of terminals by wrapping lead wires extending from the components onto the terminals.

Known apparatus developed for wrapping lead wires onto terminals may include a housing and a wrapping bit mounted for rotation in the housing. A concentric recess may be provided on one end of the bit for receiving the terminal. The bit also may be provided with a peripheral groove extending longitudinally from the end for guiding a lead wire to be wrapped. A sleeve mounted over the bit maintains the wire in the groove. In operation, the bit is rotated relative to the terminal, whereupon the wire advances through the groove and is wrapped in a helical configuration on the terminal.

As the wire is wrapped, the operator must carefully regulate the back feed, or back off of the wrapping bit relative to the terminal by maintaining the pitch of the helices uniform to effect a tight and satisfactory wrapped connection.

Close investigation of such known wrapping apparatus indicates that the limitations inherent in manually-controlled operations are eliminated by the provision of apparatus for mechanically controlling the back-feed of the terminals relative to the bits according to the speed of rotation of the wrapping bit.

An object of the invention resides in the provision of a new and improved apparatus for connecting wire conductors to terminals.

Another object of this invention is to provide in conjunction with an apparatus for wrapping wire on terminals, facilities for regulating the back-feed between the wrapping apparatus and the terminals according to the operation of the wrapping apparatus.

Still another object of this invention resides in the provision of facilities operated by a wire wrapping instrumentality for moving a clamping device to permit terminal posts secured to a clamped panel to advance through a predetermined distance for receiving a single layer of wrapped wire.

A further object of this invention is to provide an instrumentality for clamping a terminal panel with the terminals positioned to receive helical convolutions of wire from a wire wrapping facility in conjunction with a mechanism actuated by the wrapping facility for releasing the clamping instrumentality according to the desired pitch of the helical convolutions.

With these and other objects in view, the present invention contemplates an apparatus for uniformly wrapping component lead wires onto terminals secured to a circuit panel. A holder is provided for clamping the panel with the terminals extending into recesses formed in a group of wire wrapping bits. A group of components is mounted

on the bits so that component lead wires extend into peripheral grooves provided in the wire wrapping bits. The bits are rotated simultaneously for wrapping each lead wire on a terminal. A mechanism is actuated simultaneously with operation of the bits for backing off the holder. The holder permits the panel, and thus the terminals, to back-feed or backoff relative to the operating bits. The back-feed is regulated by the mechanism according to the desired pitch of the helical convolutions for simultaneously wrapping uniform wire connections on the terminals.

A complete understanding of this invention may be had by reference to the following detailed description when read in conjunction with the accompanying drawings illustrating a preferred embodiment thereof, wherein:

FIG. 1 is a perspective view of a group of components having lead wires uniformly wrapped onto terminals provided on a circuit panel by an apparatus constructed according to the principles of the invention;

FIG. 2 is an enlarged perspective view of a holder for clamping the circuit panel with the terminals extending into recesses provided in a group of wire wrapping bits;

FIG. 3 is a cross-sectional elevational view showing a drive mechanism for rotating the bits and for moving the holder during a wire wrapping operation; and

FIG. 4 is a view taken on line 4—4 of FIG. 3 showing a component having lead wires received in peripheral grooves provided in the wire winding bits.

Referring first to FIG. 1, a circuit assembly 10 which may be manufactured according to the principles of this invention is shown including components 11 having lead wires 12 wrapped onto and forming wrapped or solderless connections 14 with terminals 16 secured to and extending from a circuit mounting or panel 17.

Referring generally to FIG. 2, an apparatus 18 for forming the solderless connections 14 is shown including a pair of spaced wire wrap bits 19 for each component 11 to be assembled. To form the solderless connections 14, the components 11 are positioned with a lead wire 12 extending into an eccentric slot 21 provided in each of the bits 19. The circuit panel 17 is then positioned so that a terminal 16 extends into a central recess 22 provided in each of the bits 19, and an arm 23 of a clamp mechanism 26 is secured for holding the terminals in the recesses. The wire wrap bits 19 are rotated whereupon helical convolutions of each lead wire 12 are wrapped around the respective terminal 16 to form a solderless connection 14 between each lead wire 12 and each terminal 16. As successive convolutions 27 of each lead wire are wrapped onto the respective terminals 16, the terminals are urged upwardly and advance out of the recesses 22. At the same time, the clamp mechanism 26 is actuated for moving the arm 23 upwardly. Upward movement of the arm 23 permits the terminals 16 and the panel 17 to move upwardly for precluding wrapping of overlapping convolutions of lead wire 12 on the terminals 16.

Referring in detail to FIG. 3, a base 28 is shown supporting a fluid motor 29 provided with a piston (not shown) and a piston rod 31. A bracket 33 connects this piston rod 31 to a slide 34 which is mounted for movement in a slot 36 provided in the base 28. A rack gear 35 is secured to the slide 34.

A group of plates 37 secured to the base 28 are provided with a series of bearing recesses 41 which are aligned with similar recesses 42 provided in an upper wall 43 of the slot 36. One of the wire wrap bits 19 is received in each series of bearing recesses 41 and 42. A pinion 46 is provided at one end 47 of each of the wire wrap bits 19 for engaging the teeth 49 of the rack gear 35 and rotating the bits 19. At the other end 51 of each of the wire wrap bits 19, the recess 22 is provided for receiving a terminal 16 extending from the circuit panel 17.

Also at the end 51, the slots 21 are machined longitudinally along the periphery of the bits 19 for receiving the lead wires 12 of the components 11. The walls 52 of the recesses 41 of an upper plate or common sleeve 53 surround each of the bits 19 for maintaining the lead wire 12 in each slot 21.

Upon insertion of the lead wires 12 into the slots 21 and positioning of the panel 17 over the bits 19 so that the terminals 16 extend into the recesses 22, the arm 23 of the clamping mechanism 26 is locked for holding the panel 17 against the components 11. One end of the arm 23 is pivotally secured to a bar 56 that is provided with a threaded recess 57 and a slot 58 machined transversely to the recess 57. A screw shaft 59 is threaded into the recess 57 and locked against relative rotation therein by a pin 61 which is inserted in the slot 58 and a lock notch 62 formed in the shaft 59. The shaft 59 is threaded into a nut 63 that is maintained in a fixed axial position by the shoulder 64 of a counterbored aperture 66 provided in a lower plate 67 of the group of plates 37. A pinion gear 68 secured to the nut 63 meshes with the rack 34 for rotating the nuts 63 within the aperture 66.

The other end of the arm 23 may be locked to an elongated block 71 by a latch 72. The block 71 is similarly provided with a threaded recess 73 and a slot 74 for receiving a second screw shaft 76. A second pin 77 is inserted into the slot 74 and an aperture 78 provided in the shaft 76 for precluding relative rotative movement between the block 71 and the second shaft 76. The other end of the shaft 76 is threaded into a second nut 79 that is rotatably mounted in a counterbored aperture 81 provided in the lower plate 67 and precluded from axial movement by a shoulder 82 of the aperture 81. A pinion gear 83 secured to the nut 79 meshes with the rack gear 34 for rotating the nut 79.

In the operation of the apparatus, the components 11 are mounted on the bits 19 with the lead wires 12 inserted in predetermined slots 21 whereafter the circuit panel 17 is placed over the wrapping bits and the terminals 16 inserted into preselected recesses 22 of the wrapping bits 19. The arm 23 of the clamp mechanism 26 is rotated toward the block 71 and is secured by the latch 72 for maintaining the panel 17 against the mounted components 11. A valve 84 is then operated for supplying pressurized fluid to the fluid motor 29. The motor 29 advances the piston rod 31 and the bracket 33 to the left for advancing the slide 34 and the gear 35 to the left within the slot 36. The rack gear 35 rotates the pinions 46, which rotate the wire wrap bits 19. The rotating bits 19 wrap convolutions of each lead wire 12 on the respective terminal 16.

As the convolutions 27 are wrapped, a back force is exerted between the bits 19 and the wrapped convolutions, tending to advance the wrapped convolutions relative to the bits. Because the bearing recesses 41 limit the axial movement of the bits 19, the bits are precluded from advancing relative to the terminals 16.

The clamp mechanism 26 is operated as the bits 19 rotate for releasing the panel 17 so that the force between the bits 19 and the wrapped convolutions is effective to advance the terminals 16 upwardly out of the recesses 22. The clamp mechanism 26 is operated upon advancement of the rack gear 35 to the left. The rack gear 35 rotates the pinions 68 and 83 which rotates the nuts 63 and 79. Inasmuch as the nuts 63 and 79 are maintained in a fixed axial position by the shoulders 64 and 82 and the pins 58 and 77 preclude rotation of the shafts 59 and 76, the shafts 59 and 76 are advanced upwardly upon rotation of the nuts. The bar 56 and the block 71 are thereby advanced upwardly by the shafts 59 and 76 so that the arm 23 releases the panel 17 to permit the panel 17, and thus the terminals 16, to advance upwardly under the action of the back force during the wrapping operation. The speed of rotation of the wrapping bits 19 and the nuts 63 and 79, along with the pitch of the threads provided on the screw shafts 59 and 76 and the nuts, are

correlated so that the vertical advancement of the clamp mechanism 26 for each revolution of the bits 19 is equal to the diameter of the particular lead wires 12 that are to be wrapped on the terminals 16.

When the lead wires 12 are fully wrapped on the terminals 16 to form the solderless connections 14, the operator opens the latch 72 and removes the circuit assembly 10 from the wrapping apparatus. The fluid motor 29 is then reversed to restore the bits 19 and the clamp mechanism 26 to their original position.

It is also contemplated that the circuit panel 17 may be secured to the arm 23 or to the bar 56 and the block 71. In this manner, the back-feed of the clamp mechanism 26 positively back-feeds the circuit panel 17, so that the terminals 16 receive uniform convolutions of lead wire 19.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. In an apparatus for wrapping convolutions of wire onto terminals extending from a circuit mounting into concentric recesses provided in a plurality of rotary bits, wherein a back force tending to advance the terminals relative to the bits is applied to the wrapped convolutions by successively wrapped convolutions, a base, means for clamping the circuit mounting with the terminals extending into the concentric recesses against the action of said back force, means mounting the clamping means for movement relative to the bits, means supported on said base for rotating the bits to wrap convolutions of wire onto the terminals, and means driven by the rotating means for moving the clamping means relative to the bits to permit the circuit mounting to follow the clamping means under the action of said back force.
2. In an apparatus for connecting a component lead wire to a terminal extending from a circuit panel, a base, means mounted on said base for clamping the panel, means mounted on said base for wrapping convolutions of the lead wire on the terminal extending from the clamped panel, and means connected to the clamping means for imparting relative back-feed between the wrapping means and the terminal during a wrapping of the lead wire on the terminal, said imparting means including means mounted on said base for supporting the clamping means for movement relative to the wrapping means, and means actuated by the wrapping means for advancing the supporting means through a predetermined distance as each convolution is wrapped on the terminal to permit the terminal to advance through said predetermined distance under the action of the laying of the wrapped convolutions.
3. In an apparatus for securing components having lead wires to a circuit mounting having terminal posts, a base, a plurality of bits mounted for movement on said base, each provided with a lead wire receiving groove and a terminal post receiving recess for wrapping convolutions of the lead wire on each post, a plate mounted on said base and provided with apertures having walls surrounding each bit for maintaining each lead wire in a predetermined groove, means movably mounted on said base for holding the circuit mounting against the components with a post received in each recess, means for rotating the bits to wrap said convolutions on each of the terminal posts, and

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a threaded coupling interconnecting the rotating means and the holding means and driven by the rotating means for permitting the circuit mounting to move away from said bits to preclude wrapping of overlapping convolutions on the terminal posts. 5

4. In an apparatus for connecting lead wires of components to terminals secured to a panel, a base, a plurality of wire wrap bits movably mounted on said base for wrapping wires on said terminals, each bit having a recess to receive the terminal, 10

a pinion gear secured to each of said bits,

a holder movably mounted on said base for mounting the panel to position a terminal in each recess,

a rack gear engaged to the pinion gears for rotating the bits to wind convolutions of lead wire on each terminal, 15

a pair of internally threaded members rotated by the rack gear,

means for limiting axial movement of said members,

a pair of threaded shafts connected to said holder and threadably engaging said pair of internally threaded members for advancing the holder relative to the bits upon the advance of the rack gear and rotation of the bits to permit each terminal to receive a single layer of the convolutions, and 20

means for advancing the rack gear.

5. In an apparatus for wrapping wires onto terminals secured to a panel,

a plurality of bits each having a recess for receiving a terminal and a slot for receiving a wire to be wrapped on the terminal, each of said bits having a pinion gear section, 30

a plurality of annular members each having an internally-threaded section and a pinion gear section,

a base for rotatably mounting the bits and the members while limiting the axial movement thereof, 35

a clamp for the panel to position the terminals to extend into each recess,

a screw shaft threaded in each internally-threaded section and connected to the clamp for moving the clamp away from the bits, and 40

means for simultaneously rotating the pinion gear sections to wrap convolutions of wire on the terminals and move the panel during the wrapping of said convolutions. 45

6. In an apparatus for connecting a component lead wire to a terminal secured to a circuit panel,

a support, 50

means mounted on said support for wrapping the lead wire on the terminal,

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movably mounted means for clamping the panel to position the terminal within the wrapping means, and

means actuated by the wrapping means for moving the clamping means away from the wrapping means through a predetermined distance as the wire is wrapped on the terminal.

7. In an apparatus for connecting component lead wires to terminals secured to a circuit panel,

a base,

wrapping means supported on said base having an aperture for receiving a component lead wire and a recess for receiving a terminal,

means for clamping the panel in overlying relationship with the wrapping means to position a terminal in said recess,

means for driving the wrapping means to wrap convolutions of a lead wire received in said aperture on the terminal, and

means actuated by the driving means for retracting the clamping means from the wrapping means to permit the terminal to advance from said recess to receive a single layer of said convolutions.

8. In an apparatus for wrapping convolutions of wires about terminals extending from a piece of electrical equipment,

a supporting structure,

a plurality of parallel wire wrapping bits mounted on said supporting structure for rotation and having openings to receive said terminals,

a clamp spaced from and mounted to move toward and away from said bits for positioning said electrical equipment to locate said terminals within said openings in said bits,

means for selectively rotating said bits in opposite directions, and

means actuated by said bit rotating means for moving said clamp toward and away from said bits.

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