

PATENT SPECIFICATION

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(54) ELECTRICAL TERMINAL INSERTION APPARATUS

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to apparatus for inserting an electrical terminal into a cavity in a terminal support.

According to the invention, apparatus for inserting an electrical terminal into a cavity in a terminal support, comprises a terminal insertion ram, means for positioning the terminal support with the cavity in alignment with the ram, means for moving the ram through a working stroke towards the terminal support from a retracted position, means for locating the terminal between the ram and the cavity when the ram is in its retracted position, so that the terminal is entrained by the ram during its working stroke and is thereby inserted into the cavity and means for controlling the depth to which the terminal is inserted into the cavity, such insertion depth control means comprising a control member movable ahead of the ram so as to engage the terminal support during an initial portion of the working stroke of the ram, stop means acting to terminate the working stroke of the ram when the ram has moved a predetermined distance towards the terminal support after the control member has engaged the terminal support.

For a better understanding of the invention reference will now be made by way of example to the accompanying drawings in which:—

Figure 1 is a perspective view of apparatus for inserting electrical terminals into cavities in an insulating housing carried by a stator

for an electric induction motor;

Figure 2 is a perspective view of the stator in association with a strip of electrical terminals and parts of the apparatus, which are shown in fragmentary form, one of the terminals being shown in isolation from the strip;

Figure 3 is a sectional view showing a terminal insertion mechanism of the apparatus prior to the beginning of a cycle of operation of the apparatus;

Figure 4 is a fragmentary sectional side view showing the insertion mechanism at a first stage during a cycle of operation of the apparatus;

Figures 5 and 6 are similar views to that of Figure 3 but showing the insertion mechanism at a second and third stage during the cycle of operation, respectively;

Figures 7a to 7c are enlarged diagrammatic, fragmentary sectional views illustrating successive stages during the insertion of a terminal into a cavity of the housing carried by the stator;

Figure 8 is a front view of the apparatus, shown partly in section;

Figure 9 is a side view of part of the apparatus illustrating a stator supporting arbor in a horizontal operative position;

Figure 10 shows a fragment of Figure 9 but illustrating the arbor in a vertical loading position; and

Figure 11 is a view taken on the lines XI-XI of Figure 9.

As shown in Figure 1, the apparatus comprises a C-shaped frame 2 supporting on its lower (as seen in Figure 1) arm 3, terminal feeding, stator supporting and insertion mechanisms of the apparatus and on its upper (as seen in Figure 1) arm 5, a terminal punch drive unit housing 4.

As shown in Figure 8, the housing 4 contains a piston-and-cylinder drive unit 58 to the piston rod of which is connected to a punch assembly 42 carrying a terminal sever-

ing punch 60 arranged to be driven in a vertical reciprocating motion by the unit 58. The assembly 42 also carries a terminal feed cam 10 arranged to drive rightwardly (as seen in Figure 8) a horizontally slidable shaft 56, through a cam follower 68 thereon against the action of a return spring 64, at the end of the upward, or return stroke of the punch 60. The shaft 56 is connected through a lost motion connection, to a terminal feed lever 62 swingable about a pivot pin 63 which, as shown in Figure 1, is shiftable lengthwise of a slot in a bracket supporting the pivot pin 63, by means of an adjusting screw 7. A terminal feed arm 46 pivotally connected to the end of the lever 62 remote from the shaft 56 carries at its free end, a terminal feed finger 66, the throw of the lever 62 and thus the travel of the finger 66 being adjustable by means of the screw 7. The feed finger 66 projects into a terminal feed track 44 on the arm 3 and is engageable in holes 66 (Figure 2) in a terminal strip 23 to advance the strip leftwardly by one step, each time the cam 70 engages the cam follower 68. The strip 23 is held down in the feed track 44 by a spring loaded pressure pad 45.

A stator support arbor 50 is rotatable in a support block 51, the latter being mounted in a clevis 52 on the arm 3 for angular movement about a pivot pin 53 between the position shown in Figures 1 and 9 in which the arbor 50 extends horizontally, and that shown in Figure 10 in which the arbor extends vertically. At its lefthand (as seen in Figures 1 and 9) end, the arbor 50 has keyed thereto a hand wheel 54, the other end of the arbor, being provided with a collar 116 carrying a stud 102 extending axially of the arbor, a stator receiving portion 106 of the arbor extending axially from the collar 116. In the horizontal position of the arbor 50, the support block 51 actuates a limit switch 104 (Figures 9 and 10). The collar 116 has, as shown in Figure 11, a series of recesses 108 for receiving the conical tip of a spring loaded indexing plunger 110. Each recess 108 contains a set screw 118 which is withdrawable to close the recess so that it is not engaged in by the stop 110. The engagement of the stop 110 in any recess 108 causes a limit switch 114 to be actuated.

Also mounted on the arm 3 and extending at right angles to, and below, a terminal loading station 90 of the feed track 44 is a terminal insertion mechanism (Figures 3 to 6) comprising an actuating piston-and-cylinder unit 72 the piston rod of which is connected to a ram base 73 having a cavity 75 receiving a terminal insertion ram 74 attached to the ram base 73, at the rear or leftward (as seen in Figures 3, 5 and 6), end of the ram 74. The ram 74 has a shoulder 84 positioned about one third of the

length of the ram, back from its rear end, so that the ram has a reduced cross-section effective working portion 74a extending from the shoulder 84 towards the arbor 50. The portion 74a of the ram is received in a longitudinally slidable ram track tube 80, coupled to the ram base 73 by a spring 78, one end of which is attached to a shoulder 95 on the ram base 73 and the other end of which is connected to a block 94 on the tube 80. A stud 124 on the ram portion 74a projects into a slot 122 in the tube 80 (Figure 5). Positioned below the tube 80 and secured to the ram base 73, is a wire cutter blade 76 having a cutting edge 77. The upper (as seen in Figures 4 to 6), wall of the tube 80 has an opening 100, which in the position of the parts shown in Figures 3 and 4, registers with the guide track 44 which is defined by terminal guide plates 86 and 88, a shear plate 91 having a shearing edge 92 projecting into the track 44 at the station 90. The left hand (as seen in Figures 4 to 6) or rearward end of the tube 80 presents an abutment surface 82 towards the shoulder 84, the opposite end of the tube 80 presenting an abutment face 96 towards the arbor 50. A cam block 97 is secured to the right hand (as seen in Figures 4 to 6) or forward end of the base plate 111 of the terminal insertion mechanism, has a chamfered cam surface 97' for cooperation with the blade 76 and also defines an opening 98 for receiving the blade 76.

As shown in Figure 2, the terminal strip 23 comprises individual terminals 25 all extending from one side of a carrier strip 36 in which the holes 24, mentioned above, are formed. Each terminal has opposed side walls 28 and 28' each provided with a wire receiving slot 30, these slots being aligned with one another and opening into a forward wall 31 of the terminal. An obliquely inwardly directed tab 26 is connected to the side wall 28' by a bight 27. Each terminal has a series of lances 32 projecting from the lateral edges of each side wall 28 and 28'.

A stator 12 to be mounted on the arbor 50 and having a central through hole 35 has secured thereto, as shown in Figure 2, an insulating electrical terminal housing 18 which projects from the rear (as seen in Figure 2) end of the stator 12, the stator coils 14 and 14', extending through portions of the housing 18. The housing 18 has four terminal receiving cavities 20, 20' on each of two opposite sides of its periphery, these cavities each being bounded by an edge portion 34 of the housing 18. Each cavity 20, 20' has two slots 22a and 22b respectively, one formed in each of two opposite side walls 38 of the cavity, the slots 22a being formed in a side wall 38 which coincides with the outer periphery of the stator and the slots 22b, which are deeper than

the slots 22a, being formed in a side wall 38 which coincides with the inner periphery of the stator. In order to prepare the stator for use with the apparatus, a coil wire 16 of the stator has been laced through each pair of slots 22a and 22b.

To load the apparatus for use, the arbor 50 is tilted about the pin 53 to the vertical position of Figure 10 and a stator 12 is pushed over the portion 106, with the housing 18 trailing, the stud 102 on the collar entering a hole 35 (Figure 10) in the end of the stator remote from the housing 18 angularly to position the stator with respect to the arbor. The arbor is then returned to its horizontal, Figure 9, position whereby the switch 104 is actuated. The hand wheel 54 is then rotated so that the tip of the plunger 110 engages in a recess 108 of the collar 116 so that the switch 114 is actuated.

The actuation of the switches 104 and 114 causes the piston-and-cylinder device 58 to advance its piston rod so that the punch 60 (which is in the position of Figures 3 and 8) descends and severs the leading terminal 25' of the strip 23, which terminal is positioned at the terminal loading station 90, from the carrier strip 36 in cooperation with the shearing edge 92 of the shear plate 91. As shown in Figure 4, the terminal 25' is driven by the punch 60 through the opening 100 into the tube 80 with the wall 31 of the terminal 25' directed towards the cavity 20 fixedly positioned immediately in front of the tube 80 by the engagement of the plunger 110 in the recess 108.

Also by virtue of the actuation of the switches 104 and 114, the unit 72 now advances its piston rod so that the ram base 73 is advanced to advance the ram 74 from its Figures 3 and 4 position to engage the terminal 25' as shown in Figure 5. At this time, the punch 60 rises so that the cam 70 engages the cam follower 68 to feed another terminal to the loading station 90 as shown in Figure 5. The advancing ram base 73 drives the tube 80, by way of the spring 78, towards the housing 18 until the face 96 of the tube 80 engages the edge portion 34 of the cavity 20, the travel of the ram base 73 continuing so that the spring 78 is compressed as shown in Figure 6, this spring in effect providing a lost motion connection between the ram base 73 and the tube 80. The continued advance of the ram base 73 causes the ram 74 to push the terminal 25' down the tube 80 and into the cavity 20 as shown in Figure 6, the insertion stroke of the ram 74 ceasing when the shoulder 84 thereof engages the abutment surface 82 of the tube 80. It will therefore be apparent that the difference in length between the ram portion 74a, i.e. the effective length of the ram, and the length of the tube 80 determines the final position of the terminal 25'

with respect to the edge portion 34 of the cavity 20. This edge portion accordingly constitutes a datum or reference position for determining the insertion depth of the terminal into the cavity 20.

The insertion of the terminal into the cavity 20 is shown in detail in Figures 7A to 7C. As shown in Figure 7A a wire 16 laced through the slots 22a and 22b in the side walls of the cavity 20, as mentioned above, lies in the path of the terminal 25, this wire being positioned opposite to the slots 30 in the side walls 28 and 28' of the terminal. Since slot 22b is of greater depth than the slot 22a, the wire 16 extends obliquely across the cavity 20. Figure 7B shows the terminal 25' entering the cavity 20, with the edge 77 of the blade 76, which moves with the ram 74, lying just ahead of the terminal 25'. The edge 27 cooperates with the base of the slot 22a to trim the wire 16 prior to the wire 16 being received in the slots 30 of the terminal, by virtue of the obliquely extending position of the wire 16. As will be apparent from Figure 7B, the cam surface 97' of the block 97 deflects the blade 76 towards the housing 18 only after the edge 77 has passed the edge portion 34 of the housing so that the edge 77 does not foul the housing. Figure 7C shows the terminal 25' fully inserted into the cavity 20, there being a space between the wall 31 of the terminal and the base of the cavity 20. Since the insertion depth of the terminal into the cavity is not determined by the terminal bottoming in the cavity, but by the relative lengths of the portion 74a of the ram and the tube 80, any excess load is carried by the housing and does not therefore cause deformation of the terminal, which might impair its spring properties. The piston-and-cylinder unit 72 is pneumatic and thus has sufficient resilience to prevent damage to the housing 18 by abutment of the tube 80 against the edge portion 34. As will be apparent from Figure 7C, the severed free end of the wire 16 is drawn into the cavity 20 as a result of the movement of the terminal 25' towards the base of the cavity 20, so that no exposed portion of the wire lies outside the housing 18. The terminal is retained in its cavity by the engagement of the lances 32 on the terminal with the cavity wall.

After the completion of its insertion stroke, the ram 74 is returned to the position of Figure 3, the stud 124 on the ram portion 72b cooperating with the rear end of the slot 122 in the tube 80 to return the tube 80 to its initial position. The wire 16 can be connected to an external lead by connecting the lead to the tab 26 of the terminal 25'.

A further operating cycle of the apparatus can be initiated by rotating the hand wheel

13

54 to engage the tip of the plunger 110 in a further recess 108 of the sleeve 116.

Where no terminal is to be inserted into one of the cavities 20 or 20', the appropriate set screw 118 is set so as to ensure that the plunger 110 does not engage in the recess receiving that set screw.

WHAT WE CLAIM IS:

1. Apparatus for inserting an electrical terminal into a cavity in a terminal support, the apparatus comprising a terminal insertion ram, means for positioning the terminal support with the cavity in alignment with the ram, means for moving the ram through a working stroke towards the terminal support from a retracted position, means for locating the terminal between the ram and the cavity when the ram is in its retracted position, so that the terminal is entrained by the ram during its working stroke and is thereby inserted into the cavity and means for controlling the depth to which the terminal is inserted into the cavity, such insertion depth control means comprising a control member movable ahead of the ram so as to engage the terminal support during an initial portion of the working stroke of the ram, stop means acting to terminate the working stroke of the ram when the ram has moved a predetermined distance towards the terminal support after the control member has engaged the terminal support.

2. Apparatus according to Claim 1, in which the control member is in the form of a guide track through which the leading portion of the ram extends, the guide track having a first end surface facing a shoulder on the ram and a second end surface facing the terminal support, the guide track being connected to the ram through a resilient lost motion connection.

3. Apparatus according to Claim 2, in which the guide track has an opening

through which the terminal is introduced into the guide track by a punch, the guide track being retracted by the ram during its return stroke, to align the opening with the punch.

4. Apparatus according to Claim 3, in which, the means for positioning the terminal support is movable between a first position for loading a terminal support onto the positioning means and a second position in which the cavity is aligned with the ram, movement of the positioning means from its first to its second position serving to actuate switch means for initiating the working strokes of the punch and the ram.

5. Apparatus according to any one of the preceding claims, in which the ram carries a blade for trimming a wire extending through the cavity and across the insertion path of the terminal, a cam surface positioned adjacent the terminal support serving to cam the blade towards the terminal support to sever the wire during the working stroke of the ram.

6. Apparatus according to any one of the preceding claims, in which the positioning means is an arbor which is displaceable between a position in which it extends at right angles to the path of movement of the ram and a position in which the arbor extends axially of such path of movement, in which position the arbor is rotatable about its own axis to an angular position in which the cavity is in alignment with the ram, detent means being provided for locking the arbor in such angular position.

7. Apparatus for inserting an electrical terminal into a cavity in a terminal support, substantially as hereinbefore described with reference to the accompanying drawings.

For the Applicants:
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