

- [54] **TERMINAL APPLICATOR APPARATUS**
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 [52] U.S. Cl. **72/331; 29/203 DS; 29/630 A**
 [51] Int. Cl.² **B21D 31/02**
 [58] Field of Search **72/331, 404; 29/203 DT, 29/203 DS, 203 D, 629, 630 A; 113/119; 226/71, 70, 167, 72**

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ABSTRACT
 A terminal applicator comprises a frame including a side plate to which a ram guide is secured. A reciprocating ram assembly is movably mounted in the ram guide. A pair of crimping dies are slidably mounted to the ram assembly. A lower die or anvil supports the leading terminal of a terminal strip and cooperates with the pair of crimping dies for attaching the leading terminal to an electrical conductor. The crimp height of each crimping die is respectively adjusted by first and second adjustment dials on the ram assembly. A spring-loaded feed finger engages and feeds the leading terminal of the terminal strip into crimping position, and a finger guide guides the terminal strip along the surface of a terminal floor. The ram assembly includes a projection which is pivotally connected to a linkage member. A feed plate is pivotally connected by way of removable pins respectively to the frame, the linkage member and the feed finger. The feed plate includes a plurality of pivot holes which facilitate rapid adjustment of the feed stroke amplitude by changing the relative location of the removable pins, thereby to accomodate terminals of varying lengths.

24 Claims, 13 Drawing Figures

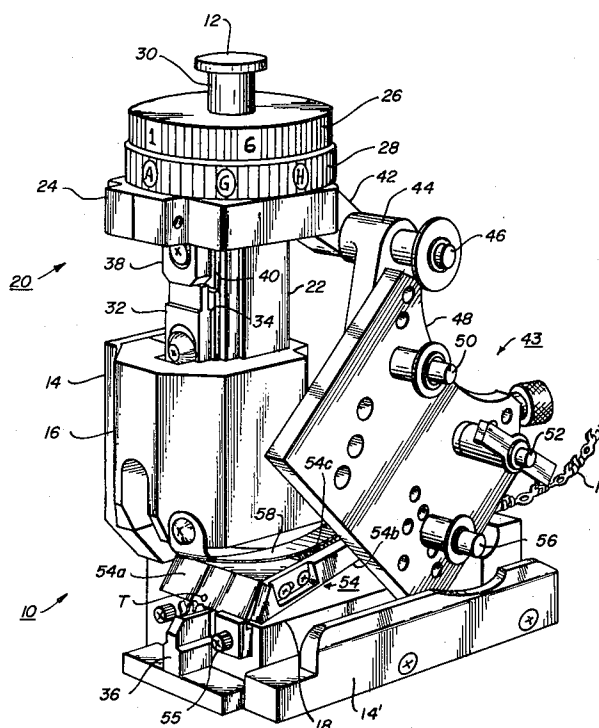


FIG. 1

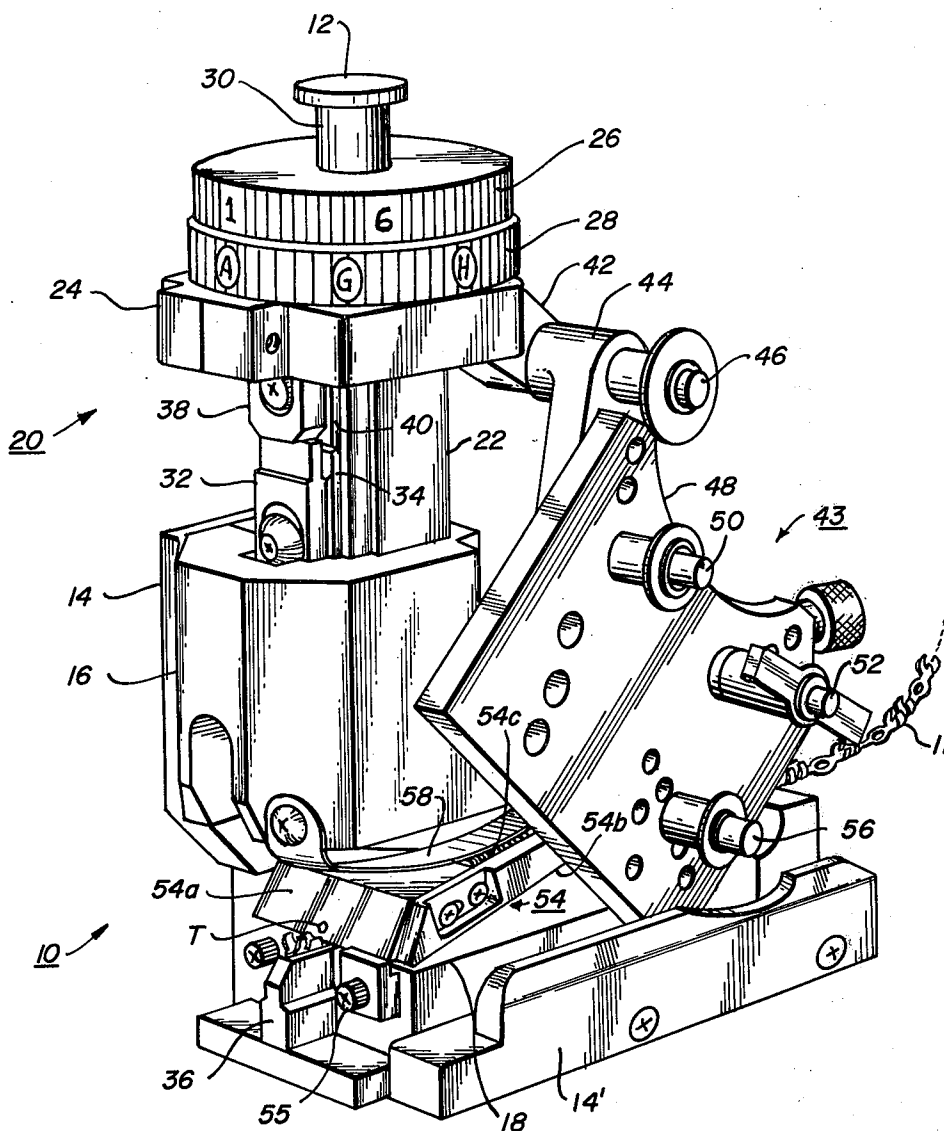


FIG. 2

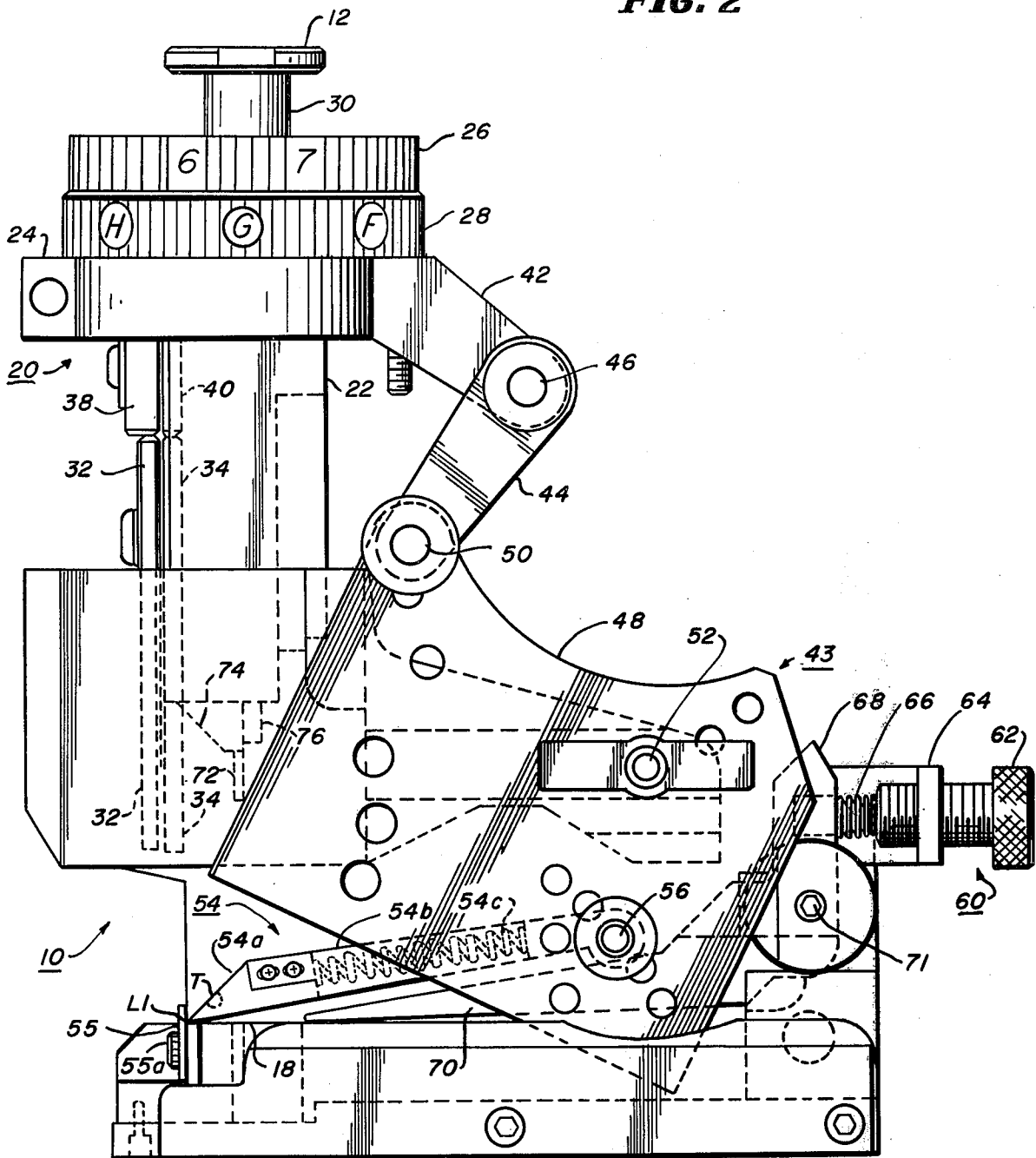


FIG. 3

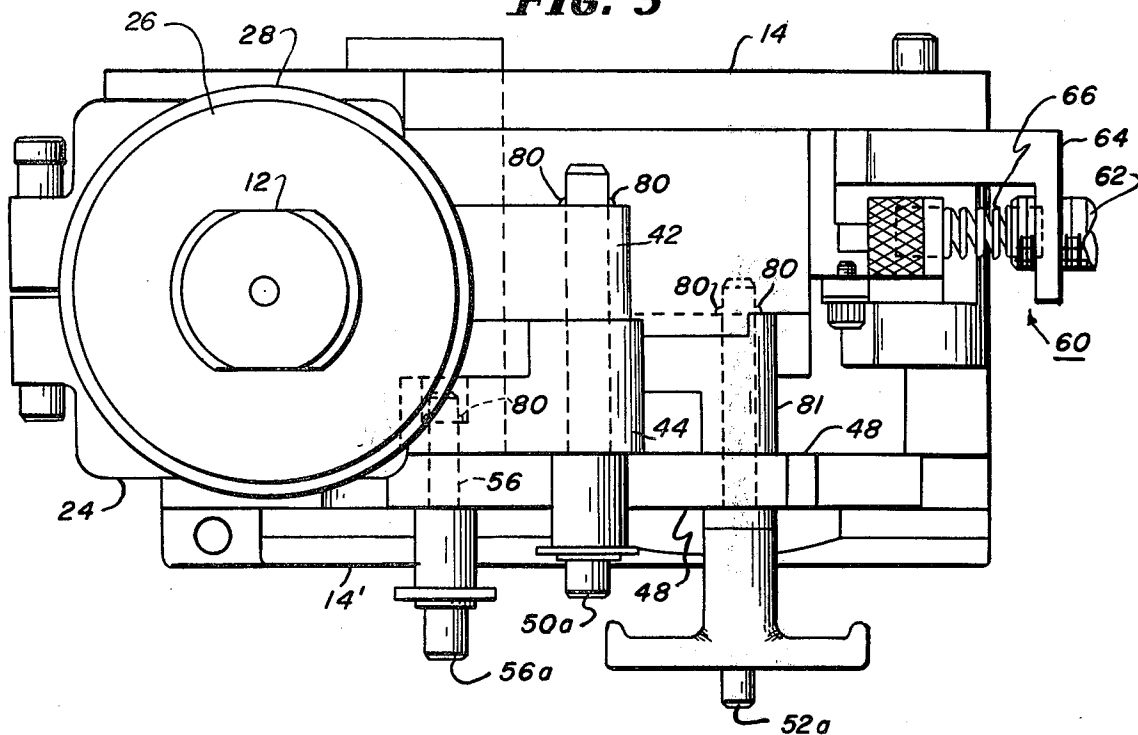
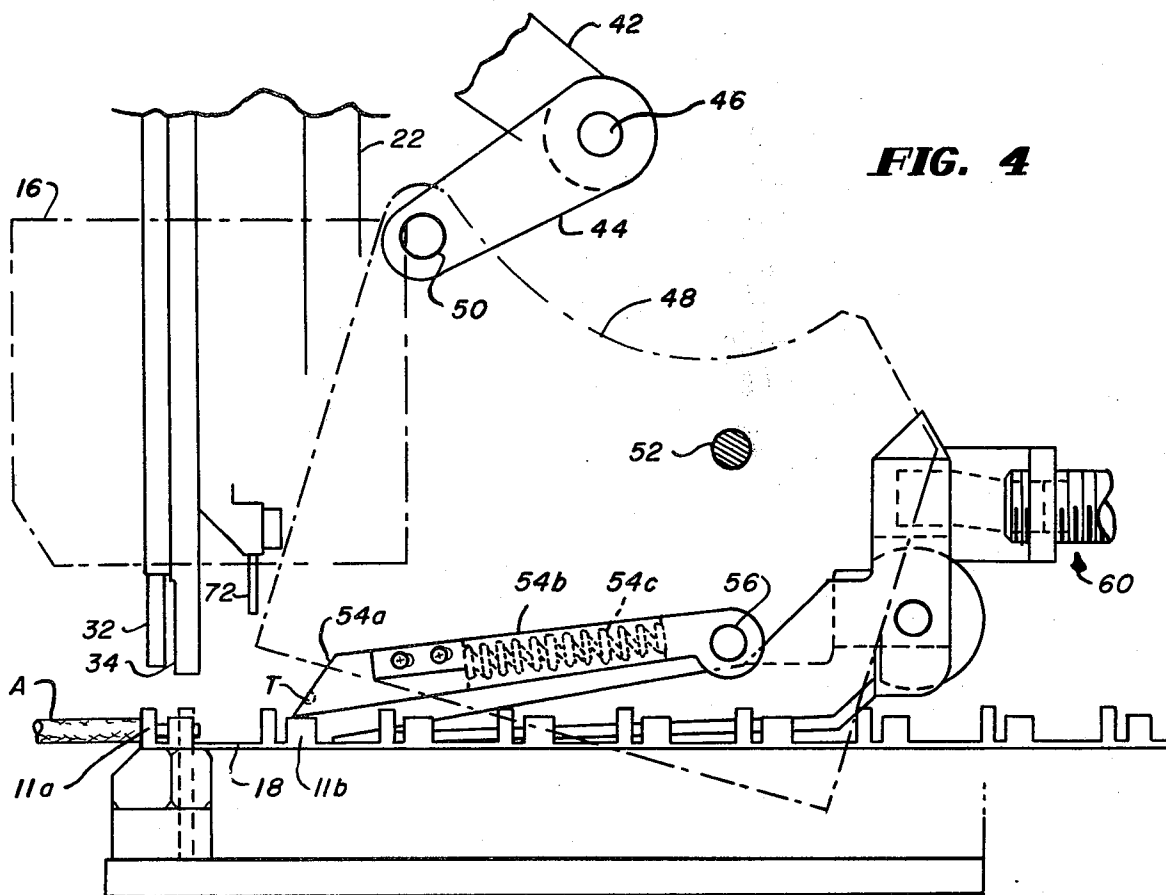
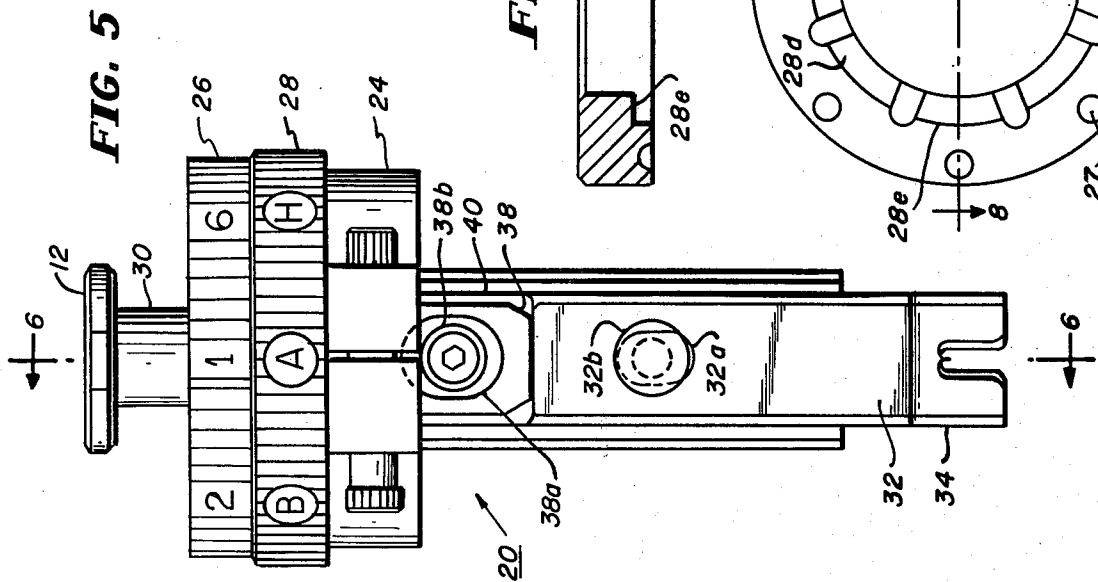


FIG. 4





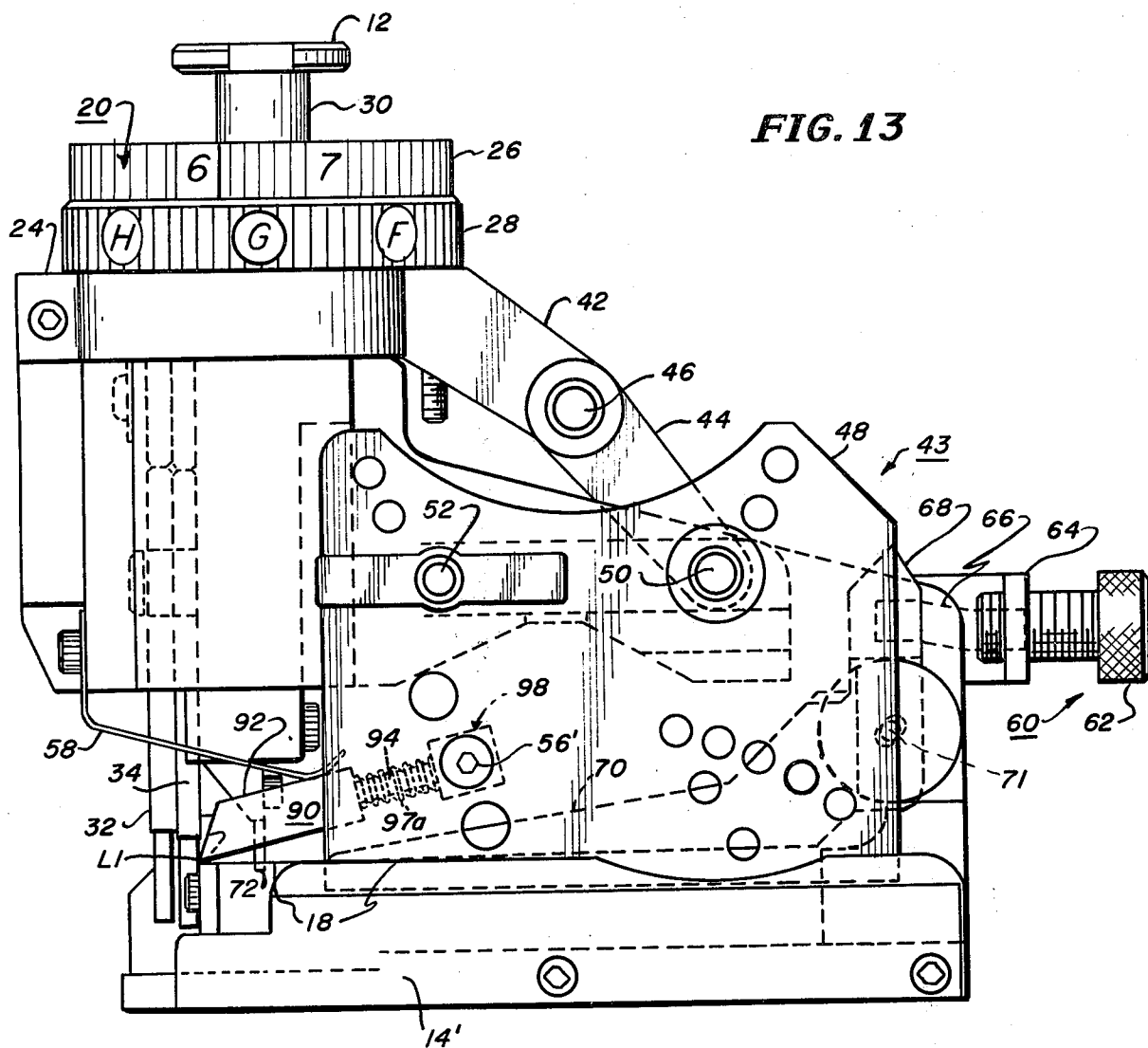


FIG. 13

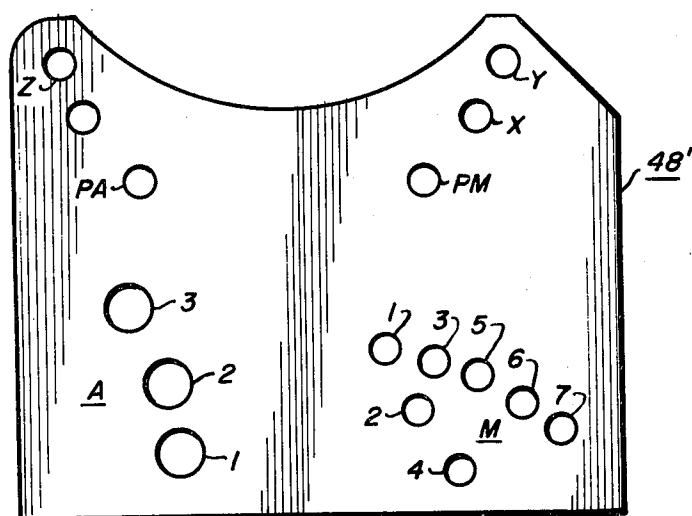
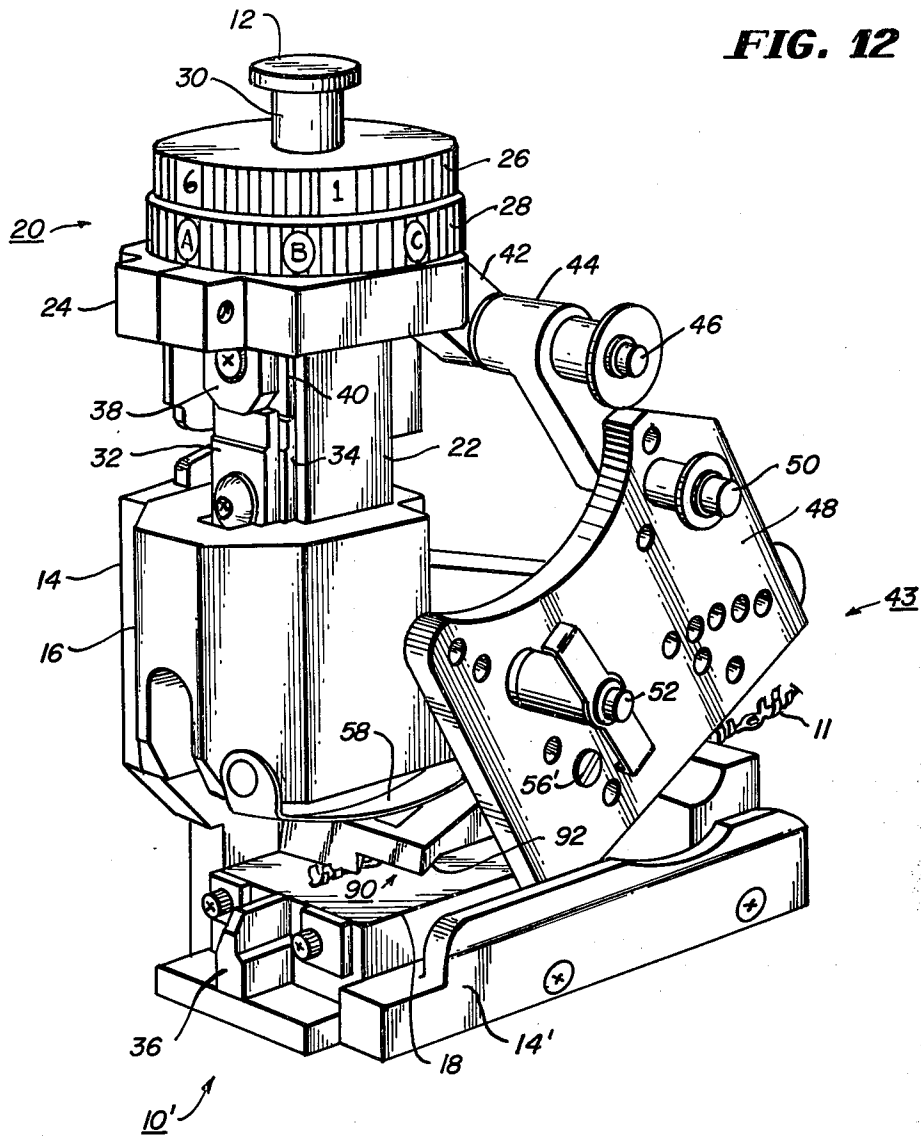


FIG. 11



TERMINAL APPLICATOR APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to terminal applicators for crimping terminals onto the ends of electrical conductors and, more particularly, to a terminal applicator which is readily adjustable to accommodate terminals of different types.

Terminal applicators have been developed for crimping terminal connectors to wire ends as exemplified in U.S. Pat. No. 3,184,950 and U.S. Pat. No. 3,002,669. A major problem encountered in prior art crimping operations is that it is often necessary to crimp various types and sizes of terminal connectors as well as different sizes of wires with and without insulation. While prior art crimping machines of this type have been successful, they nevertheless require rather complex adjustments of the machine each time a different terminal type or wire size is to be utilized with the machine. While these prior art crimping machines do permit such adjustments, the adjustments nevertheless require a skilled operator and at the same time result in substantial down time for the crimping machine and consequently cause a considerable lowering of production output. Moreover, changing terminal types often necessitates changing of the entire terminal applicator in order to accommodate the different terminal types.

Another problem common to prior art terminal applicators is that the feeding mechanism which feeds the chain or strip of terminals into the applicator operates on the terminal which is located several terminal positions behind the leading terminal or work piece. Consequently if one of the forward terminals is not within production tolerance, any dimensional error can be reflected in the crimped product of each preceding terminal. Further, bowing of the preceding terminals may result if tension is not provided on the terminals. Consequently, the work piece terminal will not be properly aligned within the crimping dies. Still another disadvantage of prior art feeding mechanisms in terminal applicator applications is that the feed mechanism utilizes a recessed channel or slot on the terminal platform to act as a guiding means. Consequently, terminals of widely varying widths cannot be readily accommodated without varying the width of the recessed channel or slot.

These and other disadvantages are overcome by the present invention wherein there is provided a terminal applicator which is readily adjustable with regard to the amplitude of the feed stroke thereby to accommodate connectors of varying lengths. Further, the applicator of the present invention permits alterations in the crimp height occasioned by the change between various types and sizes of terminal connectors and wire conductors.

SUMMARY OF THE INVENTION

Briefly, a terminal applicator for crimping terminals on wire conductors is provided. The applicator includes a frame having a ram guide and a terminal platform therein. A reciprocating ram assembly is movably mounted in the ram guide. The ram assembly includes an upper die mounted thereon. A feed member is pivotally mounted to the frame for translation in the direction of ram assembly movement. Guide means are provided for guiding terminals in strip form along the terminal platform. A linkage member is pivotally mounted at its other end to the feed member. A feed finger is

pivotally mounted to the feed member about a point which is spaced apart from the pivotal mounting of the linkage member. In one embodiment, the frame member includes a plurality of holes which accommodate removable pivot pins whereby a plurality of pivot mountings are provided in the feed member. Accordingly, rapid adjustment of feed stroke amplitude of the feed finger is accomplished by varying the pin positions.

BRIEF DESCRIPTION OF THE DRAWING

The advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description when taken in conjunction with the accompanying drawing wherein:

FIG. 1 is a perspective view of the terminal applicator of the present invention;

FIG. 2 is a side view of the terminal applicator shown in FIG. 1, particularly illustrating the feeding mechanism of the terminal applicator;

FIG. 3 is a top view of the terminal applicator illustrated in FIG. 1;

FIG. 4 is a partial side view showing the intermediate operation of the terminal applicator of FIG. 1;

FIG. 5 is a front view of the ram assembly of the terminal applicator in accordance with the present invention;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5;

FIG. 7 is a bottom view of the insulation crimp adjustment dial of the ram assembly of FIGS. 5 and 6;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 7;

FIG. 9 is a bottom view of the wire crimp adjustment dial of the ram assembly of FIGS. 5 and 6;

FIG. 10 is a sectional view taken along the line 10—10 of FIG. 9;

FIG. 11 is a plan view of the feed member of a feed mechanism in accordance with the present invention;

FIG. 12 is a perspective view similar to FIG. 1 which additionally illustrates another embodiment of the present invention; and

FIG. 13 is a side view of the terminal applicator illustrated in FIG. 12.

DETAILED DESCRIPTION

Referring now to FIG. 1, there is shown generally at 10 a terminal applicator machine in accordance with the present invention. Applicator 10 of FIG. 1 is adapted to be used in a manual mode of operation as described more fully hereinafter. Terminal applicator 10 is also adapted to receive a chain or strip of terminal connectors such as terminal strip 11 from a suitable source as a wheel or storage drum positioned at a remote location. Applicator 10 crimps the individual terminals of terminal strip 11 onto wire conductors fed into the front side of the applicator. Terminal strip 11 of FIG. 1 is shown in the form of tandem strip or "TS" type terminal connectors; however, it will be appreciated by those skilled in the art that the subject invention is also applicable to terminal applicators in which the terminal strips are fed from the side of the applicator. This alternate side feed configuration readily accommodates tandem carrier or TC terminal connectors. Terminal applicator 10 is adapted to be mounted in a bench or punch press (not shown) wherein head 12

or applicator 10 is secured to the ram of the press by any suitable means. Applicator 10 includes a frame comprising a side plate 14, a ram guide 16 and a terminal base or platform 18. A reciprocating ram assembly shown generally at 20 is movably mounted in ram guide 16. Ram assembly 20 includes a ram portion 22; and an adjustment support 24 with adjustment dials 26 and 28 mounted thereon about a rod 30.

Slidably mounted on ram assembly 20 are crimping dies 32 and 34. Crimping dies 32 and 34 cooperate with an anvil or lower die 36 to crimp the individual terminals of terminal strip 11 to the wire conductors. Lower die 36 is secured to the frame of applicator 10 by any suitable means such as a fastener extending from the under side of a base mounting plate. As discussed more fully hereinafter, crimping dies 32 and 34 communicate with individual pads in dials 26 and 28 by way of intermediate pads 38 and 40.

Adjustment support 24 of ram assembly 20 includes a fixed projection or feed arm 42. Feed arm 42 transmits the movement of ram assembly 20 to a feed mechanism which is shown generally at 43. Arm 42 is pivotally connected to a linkage member 44 by way of a ball-lock pin 46. The other end of linkage member 44 is pivotally connected to a feed member 48 by way of ball-lock pin 50. Feed member 48 is itself pivotally mounted to the frame of applicator 10 by way of a ball-lock pin 52. Feed mechanism 43 of terminal applicator 10 further includes a feed finger 54 which is also pivotally connected to feed member 48 by way of a ball-lock pin 56. Spring means 58 urges feed finger 54 downwardly toward platform 18.

Feed finger 54 includes a frontal portion 54a and a frame member 54b. Frontal portion 54a is slidably mounted within a slot or slots provided in frame member 54b. The rearward portion of frame member 54b accommodates the pivotal mounting of feed finger 54 to feed member 48; and frame member 54b includes a suitable bracket for mounting a spring 54c between the bracket and frontal portion 54a. Spring 54c urges frontal portion 54a in the direction of crimping dies 32 and 34 and against the forward portion of the slot provided in frame member 54b. During the operation of applicator 10 of FIG. 1 the forward movement of frontal portion 54a of feed finger 54 is limited in the feed direction by a feed stop 55. However, since frontal portion 54a is spring-loaded within frame member 54b, and therefore yieldable, forward movement of frame member 54b is permitted even after frontal portion 54a engages feed stop 55. Finally, it would be noted that frontal portion 54a includes a shallow-drilled hole T which serves as a target area to facilitate manual insertion of a wire end into the uncrimped wire barrel of the leading terminal or work piece of terminal strip 11.

Ram assembly 20 of FIG. 1 is shown in its top-dead-center or retracted position. Feed member 48 is constrained to rotate about the pivot point defined by the location of pin 52, wherein feed member 48 translates in the direction of movement of ram assembly 20. When ram assembly 20 is forced downwardly, as by operation of the associated punch press (not shown), feed member 48 is translated in a counterclockwise direction. As feed member 48 is translated counterclockwise, feed finger 54 is caused to move away from the area of the crimping dies. The movement continues until crimping dies 32 and 34 contact and crimp the leading terminal of terminal strip 11 at which time feed

finger 54 is translated to its most rearward position. As will be discussed more fully hereinafter, the backward translation of feed finger 54 is limited to a distance substantially equal to the length of a single terminal as determined by the locations of ball-lock pins 50, 52 and 56.

Referring now to FIG. 2, there is shown a side view of the terminal applicator 10 of FIG. 1. FIG. 2 also illustrates a terminal connector guide mechanism 60 including an adjustable screw 62 which threadedly engages a screw mounting bracket 64 which, in turn, is coupled to the frame of applicator 10. The threaded end of screw 62 engages a spring 66 which, in turn, engages an upward arm 68 of a guide finger 70. Guide finger 70 is pivotally mounted as at 71 by way of a suitable fastener. Guide finger 70 preferably takes the form of a relatively thin blade adapted to engage the center or inner portion of the uncrimped barrel of each terminal of terminal connectors 11. Accordingly, guide finger 70 guides and feeds the terminals by way of their centers rather than their sides as in prior art feed mechanisms. Spring 66 of mechanism 60 urges guide finger 70 downwardly onto terminal platform 18 of applicator 10. In one constructed embodiment the spring constant of spring 66 was selected to provide approximately 20 pounds of downward pressure between the horizontal portion of guide finger 70 and platform 18. As will be described more fully hereinafter, this downward pressure facilitates holding of the terminal strip particularly during the manual mode of operation of applicator 10 of FIG. 1. Additionally, the downward pressure functions as anti-back up means wherein the terminal strip is prevented from moving in the reverse direction of the feed during the operating cycles of the terminal applicator. It will be appreciated that should it be necessary to remove the strip of terminals from the applicator, guide finger 70 can be conveniently raised, for example, by simply applying manual pressure at the upper surface of arm 68.

FIG. 2 also illustrates the cutting blade mounting of ram assembly 20. Cutting blade 72 is secured to a downward projection 74 of assembly 20 by way of a suitable fastener such as an allen head screw 76. Cutting blade 72 engages a mating lower die 78 which is suitably secured to the base of the frame of applicator 10. It should now be appreciated that in the manual mode of operation, when feed finger 54 is translated to its rearward position, crimping dies 32 and 34 perform the crimp operation while cutting blade 72 severs the leading terminal from terminal strip 11. Any excess terminal stock is allowed to fall through a suitable opening in lower die 78.

Referring now to FIG. 3, there is shown a top view of the terminal applicator 10 of FIGS. 1 and 2. The locking effect of ball-lock pins 50, 52 and 56, as provided by spring-loaded ball bearings 80, is more readily appreciated by reference to FIG. 3. It can be seen that spring-loaded ball bearings 80 secure their respective ball-lock pins to frame member 48 while permitting easy removal of the pins by simply depressing release buttons 50a, 52a, or 56a. FIG. 3 also illustrates a frame member 81 which is utilized to accommodate the pivotal mounting of feed member 48 to the frame of applicator 10. Frame member 81 is removably secured to the frame of applicator 10 as by way of a suitable removable fastener 81a. This removable feature permits feed member 48 to be pivotally mounted at an alternate

position on the frame of applicator 10 as discussed more fully hereinafter.

Turning now to FIG. 4, there is shown a partial side view of the terminal applicator of FIGS. 1-3 illustrating the intermediate operation of applicator 10. In FIG. 4, ram 22 of ram assembly 20 is shown in a position just prior to the crimping of leading terminal 11a. It can be seen that feed finger 54 is just about to drop behind the trailing edge of the next succeeding terminal, that is terminal 11b. Once crimping dies 32 and 34 make contact with the crimp leading terminal 11a, cutting blade 72 also cuts terminal 11a from terminal strip 11. At this time feed finger 54 is translated to its most rearward position and accordingly engages the rear edge of the wire barrel of terminal 11b. The cycle continues as the punch press (not shown) withdraws ram assembly 20 to its retracted or top-dead-center position. As ram assembly 20 is drawn upwardly, feed member 48 is caused to rotate about pin 52 in a clockwise direction in response to the movement of feed arm 42 and pivotally connected linkage member 44. As feed member 48 rotates clockwise, finger 54 advances terminal 11b—which terminal is now the leading terminal—toward the crimping dies.

It should be noted that during the downward portion of the operating cycle of applicator 10, terminal strip 11 remains in a stationary position by virtue of the pressure provided by spring-loaded guide finger 70. It should also be appreciated that applicator 10 of FIGS. 1-4 can be readily adjusted to accommodate terminals of different lengths by adjusting the amplitude of the feed stroke of feed finger 54. As will be discussed more fully hereinafter, particularly with reference to FIG. 11, the amplitude of the feed stroke of feed finger 54 is readily adjusted by arranging pins 50, 52 and 56 to predetermined alternate positions as provided by the plurality of holes in feed member 48.

It will be appreciated by those skilled in the art that applicator 10 of FIGS. 1-4, in accordance with the present invention, provides several features not heretofore provided in prior art terminal applicators. For example, feed finger 54 not only feeds on the leading terminal of terminal strip 11, but it also provides a back-stop for the end portion of wire conductor A, a means for holding the leading terminal during insertion of wire conductor A into the uncrimped wire barrel of the leading terminal. Further, since terminal strip 11 is guided down-the-middle by virtue of the operation of guide finger 70, a recessed slot or channel is not required as in prior art applicators. This has the advantage that guide finger 70 can accommodate terminal connectors of varying width without necessitating a change of the guide mechanism.

It should be noted that spring means 58 of FIGS. 1-4 provides means for urging feed finger 54 downwardly toward platform 18. This is done to keep feed finger 54 in contact with the terminal strip during the entire operating cycle, and particularly during the forward feed portion of the cycle. It should be appreciated, however, that this function can be provided by any suitable means such as, for example, a coil or spiral spring coupled to feed finger 54 at the pivotal mounting position of feed finger 54.

It should also be noted that by means of spring 54c, frontal portion 54a of feed finger 54 is yieldable when feed finger 54 is stopped against feed stop 55. This fea-

ture ensures that the frontal portion 54a of feed finger 54 makes contact with feed stop 55 precisely at position L1 during each oscillatory cycle of finger 54 even if the physical locations of the various pivotal points provided by feed member 48 are not within their design tolerance. That is, since frontal portion 54a is spring-loaded and slidably mounted to frame member 54b of feed finger 54, frontal portion 54a is assured of making contact with feed stop 55 precisely at L1 notwithstanding a total accumulated dimensional error equivalent to the length of the slot in frame member 54b. Further, since frontal portion 54a feeds the leading terminal of the terminal strip, the leading terminal is therefore precisely positioned with respect to point L1. Hence, it should be appreciated that the terminal applicator in accordance with the present invention provides and maintains an accurate feed stroke amplitude notwithstanding such factors as nominal misalignment of the various pivot hole positions and any further misalignment due to mechanical wear as occasioned by prolonged use.

Referring now to FIG. 5, there is shown a front view of ram assembly 20 in accordance with the present invention. FIG. 5 shows more clearly the manner in which crimping die 32 is mounted to ram 22. It can be seen that crimping die 32 is provided with a slot 32a and is secured to ram 22 by way of a button screw 32b. Similarly, intermediate pad 38 is provided with a slot 38a and is also secured to ram 22 by way of a second button screw 38b. Crimping die 34 and intermediate pad 40 are similarly provided with slots which afford a slidable mounting to ram 22 by way of screws 32b and 38b.

Referring now to FIG. 6 there is shown a sectional view of ram assembly 20 taken along the line 6-6 of FIG. 5. It can be seen by reference to FIG. 6 that an inner rod portion 30a of head 12 is secured to ram 22 by way of a suitable fastener 30b. The punch press ram (not shown) applies force to the upper surface of wire crimp adjustment dial 26. This force is transmitted through insulation crimp adjustment dial 28 and adjustment support 24. Accordingly, since the fixed projection or feed arm 42 is an integral part of adjustment support 24, the punch press ram force is indirectly applied to feed mechanism 43 of FIGS. 1-4 by way of the initial force applied to the top surface of dial 26.

The punch press ram force is also applied to wire crimping die 34 through a lower surface 26a of wire crimp adjustment dial 26. The force at surface 26a is transmitted through intermediate pad 40 to crimping die 34. Similarly, the force applied to insulation crimp adjustment dial 28 is applied to insulation crimping die 32 by way of a lower surface 28a of insulation crimp adjustment dial 28 and intermediate pad 38. In accordance with the present invention, the crimp or shut height of both insulation crimping die 32 and wire crimping die 34 is adjusted by respectively rotating adjustment dials 28 and 26 to any one of a plurality of predetermined positions. Each predetermined position provides a different lower surface pad which, accordingly, provides a different crimp height. In the illustrated embodiment of the present invention as depicted in FIGS. 5-10, wire crimping adjustment dial 26 provides six (i.e. 1 to 6) crimp height adjustments while insulation crimping adjustment dial 28 provides eight (i.e. A to H) crimp height adjustments.

Referring now to FIGS. 7 and 8, there are shown views of insulation crimping dial 28. In FIG. 7 there is

shown a bottom view of adjustment dial 28. The various pads of dial 28 of FIG. 7 are illustrated at 28a, 28b, 28c, etc. FIG. 8 illustrates a sectional view taken along the lines 8—8 of FIG. 7. It can be seen that the vertical dimension between pad 28a and the upper surface of dial 28 is greater than the vertical dimension provided between 28c and the upper surface of dial 28. The spaces provided between the various pads, such as between pads 28a and 28b, provide means for separating the predetermined crimp height adjustment pad positions. Referring again to FIG. 7, it can be seen that dial 28 is further provided with a plurality of semi-hemispheric holes as at 27. Holes 27 provide detent holes which receive detent members as described more fully hereinafter.

Similarly, the construction of adjustment dial 26 is illustrated in FIGS. 9 and 10. The pads of dial 26 are illustrated at 26a, 26b, 26c, 26d, etc. Dial 26 also includes detent holes as shown at 29.

Referring again to FIG. 6, it can be seen that dials 26 and 28 can be adjusted and secured to their respective predetermined positions by virtue of a detent pin 82 and a detent ball 84. Detent pin 82 is urged against dial 26 by a spring 86 which is secured into ram 22 by way of a suitable fastener 88. Similarly, detent ball 84 is urged against dial 28 by way of a spring 86a which is secured to adjustment support 24 by way of fastener 88a. It will be understood by those skilled in the art that the arrangement of ram assembly 20, in accordance with the present invention, provides means for independently adjusting the crimp height of crimping dies 32 and 34 respectively. Further, since the punch press ram force is applied to ram assembly 20 by way of the continuous upper surface of dial 26, the force of the punch press ram can be brought to bear against the entire upper surface of dial 26 or any selected portion thereof. It will be appreciated by those skilled in the art that prior art ram assemblies necessitate the application of force to a limited or discrete area of the corresponding adjustment dial such as, for example, a specific pair of bosses on the upper surface of the dial.

Turning now to FIG. 11, there is shown a plan view of a feed member 48' adapted for use in terminal applicators in accordance with the present invention. Feed member 48' of FIG. 11 includes a plurality of pivot holes which, in turn, define a plurality of pivot points. In combination, selected pivot points of feed member 48' provide any desired feed-stroke amplitude for feed finger 54. The desired feed-stroke amplitude is determined by the length of the particular terminal to be crimped and, as illustrated in the applicable drawing figures, the resulting feed stroke amplitude is the distance between point L1 and the frontal portion of the associated feed finger when the feed finger is translated to its most rearward position.

In the manual mode of operation, pivot hole PM of FIG. 11 defines the pivot point for the pivotal mounting of feed member 48' to the frame of the applicator. Pivot holes M1-M7 define a plurality of pivot points for the pivotal mounting of feed finger 54; and pivot hole Z defines a pivot point for the pivotal mounting of linkage member 44. The locations of the various pivot points in feed member 48' are predetermined geometrically and/or trigonometrically to provide the desired feed-stroke amplitudes. For example, in one constructed embodiment the locations were selected so that the combination of pivot point PM, pivot point z

and pivot point M2(PM + Z + M2) provided a 0.590 inch feed-stroke amplitude.

The pivot points of feed member 48' of FIG. 11 which are defined by pivot holes PA, X, Y and A1-A3, are primarily used when the terminal applicator, in accordance with the present invention, is used in the automatic mode as discussed more fully hereinafter with reference to FIGS. 12 and 13. In the automatic mode of operation, pivot hole PA defines the pivot point of the pivotal mounting of feed member 48' to the frame of the applicator. Pivot holes A1-A3 define a plurality of pivot points for the pivotal mounting of an associated feed finger; and pivot holes X and Y define pivot points for the pivotal mounting of linkage member 44. However, it should be noted that in the manual mode of operation, pivot hole PA can be used to provide the pivotal mounting for linkage member 44. Similarly, in the automatic mode pivot hole PM can be used to provide the pivotal mounting for linkage member 44. Table 1 below illustrates various combinations of pivot points and the resulting feed stroke amplitude. It will be understood by those skilled in the art, however, that FIG. 11 and Table 1 are merely illustrative; and, that the size and shape of feed member 48' and the actual number of holes therein which provide the desired pivot points, and their respective locations, can be varied to accommodate any given application.

TABLE 1

COMBINATION OF PIVOT POINTS	FEED STROKE AMPLITUDE (Distance in Inches from L1)
PA+Y+A3	0.400
PA+X+A3	0.540
PA+Y+A2	0.620
PA+Y+A1	0.775
PA+X+A2	0.820
PA+PM+A3	0.870
PA+X+A1	1.020
PA+PM+A2	1.250
PA+PM+A1	1.500
PA+PM+M1	0.470
PM+Z+M2	0.590
PA+PM+M3	0.770
PM+Z+M4	0.820
PM+PA+M5	1.020
PM+PA+M6	1.270
PM+PA+M7	1.500

Referring now to FIGS. 12 and 13, there are shown perspective and side views respectively of an alternate embodiment of the terminal applicator of the present invention. Terminal applicator 10' of FIGS. 12 and 13 is adapted to be used in an automatic mode of operation. Applicator 10' of FIG. 12 and 13 is similar to applicator 10 of FIGS. 1-4 and, accordingly, like elements bear like reference numerals. The essential differences between applicator 10' and applicator 10 of FIGS. 1-4 are that applicator 10' includes a somewhat shorter feed finger which is pivotally mounted to feed member 48 at a correspondingly different position; and that the relative positions of the pivotal mountings of feed member 48 to the frame of applicator 10' and linkage member 44 to feed member 48 are interchanged with respect to the corresponding relative positions of applicator 10. As discussed with reference to FIG. 3, removable frame member 81 is preferably provided as a removable member so that the pivotal mounting position of feed member 48 can be readily changed to this alternate position. Further, feed stop 55 of FIGS. 1-4 is not required when the applicator of the

present invention is used in the automatic mode of operation as depicted by FIGS. 12. and 13. However, it should be noted that there are situations in the automatic mode of operation when such a feed stop is nevertheless desirable.

Feed finger 90 of FIGS. 12 and 13 includes a frontal portion 92 which is slidably mounted to rods 94 and 96 of a frame member 98. Frame member 98 is pivotally mounted to feed member 48 as at 56'. Frontal portion 92 is biased towards crimping dies 32 and 34 by means of coil springs 97a and 97b which respectively surround rods 94 and 96. Thus, frontal portion 92 is spring-loaded and yieldably mounted within feed finger 90. As discussed with reference to feed finger 54 of FIGS. 1-4, this feature ensures that frontal portion 92 of feed finger 90 — and therefore the leading terminal of the terminal strip — will advance precisely to the positional point L1 during each oscillatory cycle of applicator 10'.

The operation of applicator 10' of FIGS. 12 and 13 is more readily described and appreciated with reference to FIG. 13. It can be seen that when ram assembly 20 is translated to its downward or crimping position, feed finger 90 is translated to its most forward position wherein frontal portion 92 engages crimping die 34 precisely at point L1. Since cutting blade 72 engages mating die 78 when ram assembly 20 is in its downward or crimping position, and therefore when feed finger 90 engages crimping die 34, a suitable opening is provided for the passage of blade 72 through the frontal portion 92 of feed finger 90. As ram assembly 20 is drawn upwardly in response to the operation of the associated punch press, feed member 48 is caused to rotate about pin 52 in a counterclockwise direction in response to the movement of feed arm 42 and pivotally connected linkage member 44. As feed member 48 is translated counterclockwise, feed finger 90 is caused to move away from the area of the crimping dies. The movement continues until ram assembly 20 is retracted to its top-dead-center position during which time feed finger 90 is translated to its most rearward position. At this time, frontal portion 92 of feed finger 90 engages the uncrimped wire barrel of the next succeeding terminal of the associated terminal strip (not shown).

When ram assembly 20 is forced downwardly, as by operation of the associated press (not shown), feed member 48 is translated in a clockwise direction. As feed member 48 is translated clockwise, feed finger 90 is caused to move toward the area of the crimping dies. As feed finger 90 approaches the crimping dies, the lowermost portion of crimping die 34 passes below the level of terminal base or platform 18. The movement continues until feed finger 90 moves the leading terminal precisely into position at L1 and feed finger 90 engages crimping die 34, which events occur just prior to the time when crimping dies 32 and 34 contact and crimp the leading terminal of the associated terminal strip. During this sequence of operation, the inward or back-side of crimping die 34 serves as a feed stop for feed finger 90. Thus, a separate feed stop, such as feed stop 55 of FIGS. 1-4, is not required. As previously alluded to, however, it may be desirable and advantageous to utilize a feed stop. For example, variations in design tolerance of the terminal strip may dictate that the feed finger be stopped in a vertical plane other than that of the vertical plane of the inward or backside of crimping die 34. It can also be seen that cutting blade

72 functions to sever the leading terminal from the terminal strip at the time of the actual crimping operation when feed finger 90 is in engagement with crimping die 34.

It should be noted that the operation cycle of the applicator of the present invention as depicted in FIGS. 12 and 13 is somewhat reversed from that depicted in FIGS. 1-4. The reason for this difference is that the operation of the applicator of FIGS. 1-4 relates to the manual mode of operation whereas the applicator 10' of FIGS. 12 and 13 is adapted for an automatic mode of operation. In the automatic mode, applicator 10' of the present invention is particularly suited for use in a fully automatic terminal machine (FATM). That is, the automatic mode of operation as depicted in FIGS. 12 and 13 is used advantageously in FATM applications because when ram assembly 20 is at top-dead-center, feed finger 90 is at its most rearward position. Accordingly, the associated automatic indexing of the wire leads, for example, can be accomplished without the interfering effects otherwise caused by the presence of a feed finger. Hence, by having the feed finger in its fully retracted position, sufficient clearance and operating time is provided to accomplish removal of the wire conductor with the newly crimped terminal connector thereon. Thus, in the automatic mode of operation, the applicator of the present invention feeds, crimps, and cuts the leading terminal from the terminal strip during the down-stroke of ram assembly 20. Whereas, in the manual mode of operation, the applicator feeds the terminal strip on the up-stroke of ram assembly 20, and crimps and cuts the leading terminal from the terminal strip on the down-stroke of ram assembly 20.

As previously discussed, it is desirable to have the feed finger in its fully advanced position during the crimping operation of the manual mode; the reason being that the feed finger, in accordance with the present invention, provides a hold-down means for the leading terminal, a back-stop for the wire conductor, and a target area to facilitate manual insertion of the wire conductor.

In the automatic mode of operation, when ram assembly 20 is at top-dead-center or its fully retracted position, feed member 48 is in its maximum counterclockwise position. At this point, linkage member 44 is nearly vertical. Hence, during the initial portion of the downward stroke of ram assembly 20, feed member 48 rotates clockwise with maximum velocity; whereas, however, when ram assembly 20 is approaching its downward position, the relative positions of linkage member 44 and feed member 48 are such that feed member 48 rotates with a substantially reduced velocity. It will be appreciated by those skilled in the art that this motion is generally referred to as a Geneva-type motion. The resulting Geneva motion thusly imparted to feed mechanism 43 in the automatic mode of operation, in accordance with the present invention, has the advantage that feed finger 90 slows down just prior to making contact with the inward or back side of crimping die 34, thus, the inertial forces and effects of a moving feed finger 90 are substantially reduced just prior to the crimping operation; and, more particularly, when it is desired to prevent inertia from causing over-travel of the feeding, thereby to maintain the associated terminal strip in a stationary position. Accordingly, this feature further ensures that the precise positioning of

the leading terminal, as achieved in accordance with the present invention, is maintained. It is also noted that feed member 48 is preferably constrained to rotate in a fixed plane by virtue of the channel provided between platform 18 and the side rail 14' as illustrated in FIGS. 1 and 12.

Additionally, it should be appreciated that the removable frame member 81, as illustrated in FIG. 3, facilitates rapid changeover of the operation of the applicator, in accordance with the present invention, from one mode to the other.

What has been taught, then, is a terminal applicator for crimping terminals in strip form onto the ends of electrical conductors. The terminal applicator, in accordance with the present invention, facilitates, notably, both manual and automatic modes of operation. In either mode, the terminal strip is fed so that the leading terminal of the strip is precisely positioned between the crimping and anvil dies. The terminal applicator is readily adjustable to accommodate terminals of different types particularly with respect to different lengths, and different crimping heights.

The form of the invention illustrated and described herein is the preferred embodiment of these teachings in the form currently preferred for manufacture. It is shown as an illustration of the inventive concept, however, rather than by way of limitation, and it is pointed out that various modifications and alterations may be indulged in within the scope of the appended claims.

I claim:

1. A terminal applicator for crimping terminal connectors on wire conductors, said applicator comprising, in combination:

a frame having a ram guide portion and a terminal platform therein;

a reciprocating ram assembly movably mounted in said ram guide, said ram assembly having an upper crimping die mounted thereon;

a lower crimping die mounted on said frame for cooperation with said upper crimping die;

means for guiding a strip of terminals along said platform and in a direction toward said dies;

a feed member pivotally mounted to said frame for translation in the direction of ram assembly movement;

a linkage member pivotally mounted at one of its ends to said ram assembly and pivotally mounted at its other end to said feed member wherein movement of said ram assembly provides translation of said feed member;

a feed finger pivotally mounted to said feed member, wherein said translation of said feed member provides oscillatory movement of said feed finger toward and away from said dies in accordance with a given feed stroke amplitude; and,

means including said feed member for unilaterally adjusting the amplitude of said feed stroke solely in the direction away from said dies thereby to accommodate terminal connectors of different size and wherein the maximum amplitude of said feed stroke in the direction toward said dies is substantially fixed and independent of said adjusting means.

2. The applicator according to claim 1, wherein: said frame includes means for limiting the movement of said feed finger in the feeding direction of said strip, and wherein said feed finger is yieldable towards its pivotal

axis when moving in the feeding direction of said strip and when limited by said means for limiting.

3. The applicator according to claim 2, wherein said means for limiting the movement of said feed finger incorporates said crimping die.

4. The applicator according to claim 1, wherein said means for guiding said strip of terminals comprises a guide finger having a blade-like projection in the feeding direction of said strip, said blade-like projection engaging said strip.

5. The applicator according to claim 4, wherein said guide finger is spring-loaded to urge said blade-like projection against said strip.

6. The applicator according to claim 1, wherein said feed member comprises a feed plate having at least first, second and third holes therein, said first hole receiving means for pivotally mounting said feed plate to said frame, said second hole receiving means for pivotally mounting said linkage member to said feed plate and said third hole receiving means for pivotally mounting said feed finger to said feed plate.

7. The applicator according to claim 6, wherein said feed plate includes a fourth hole, wherein said feed plate is pivotally mounted to said frame at one of said first and fourth holes for rotational translation thereabout and wherein the rotational direction of translation of said feed plate in response to said movement of said ram assembly is reversed by pivotally mounting said feed plate at the other one of said first and fourth holes.

8. The applicator according to claim 6, wherein each of said means for pivotally mounting said feed plate comprises a pin.

9. The applicator according to claim 8 wherein each pin includes releasable locking means for securing said pin to the respective element of said applicator.

10. The applicator according to claim 1, wherein said feed finger engages and feeds the leading terminal of said strip of terminals.

11. The applicator according to claim 1, wherein said ram assembly includes a fixed projection extending therefrom, and wherein said linkage member is pivotally mounted at said one of its ends to said fixed projection.

12. The applicator according to claim 1, wherein the pivotal mountings of said feed member, said linkage member and said feed finger are respectively spaced apart from one another.

13. The applicator according to claim 1, wherein said ram assembly comprises:

a ram member having an extended head portion; an adjustment support carried by said ram member, wherein said adjustment support includes means for providing said pivotal mounting of said linkage member to said ram assembly;

an adjustment dial concentrically mounted about said head portion and slidably engaging said adjustment support in force transmitting relation therewith, said dial having at least first and second spaced-apart pads on a lower surface thereof, and wherein said first pad has a dimension in said direction of ram assembly movement which is different from the corresponding dimension of said second pad; and

means for engaging one of said pads with said upper crimping die when said dial is in a corresponding

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position and said ram assembly is moved in the direction of said lower die.

14. The applicator according to claim 1, wherein said feed finger engages and feeds the leading terminal of said strip of terminals, and wherein said feed finger includes means for providing a target area on the portion of said feed finger which engages said leading terminal.

15. A ram assembly for use with a terminal applicator, said ram assembly comprising:

a ram member having an extended head portion;
an adjustment support carried by said ram member, wherein said adjustment support includes means for providing a pivotal mounting of a linkage member of said applicator to said ram assembly;
at least one adjustment dial concentrically mounted about said head portion and slidably engaging said adjustment support in force transmitting relation therewith, said dial having at least first and second spaced-apart pads on a lower surface thereof, and wherein said first pad has a dimension in said direction of ram assembly movement which is different from the corresponding dimension of said second pad; and

means for engaging one of said pads with an upper crimping die of said applicator when said dial is in a corresponding position and said ram assembly is moved in the direction of a cooperating die of said applicator.

16. A feed mechanism for use with a terminal applicator wherein terminal connectors are crimped onto wire conductors, said mechanism comprising, in combination:

a feed member having first, second and third spaced-apart pivotal mounting positions therein;
means for pivotally mounting said feed member to said applicator at said first position;
a linkage member pivotally mounted at one of its ends at said second position and said linkage member being adapted for fixed pivotal mounting to a ram assembly of said terminal applicator at its other end thereof;

17. A terminal connector guide mechanism in combination with a terminal applicator of the type wherein terminal connectors in strip form are crimped onto wire conductors, said mechanism comprising: a guide finger having a projection in the feeding direction of said terminal connectors, and means for mounting said finger to said applicator wherein said finger engages at least one terminal connector and projects through a plurality of successively adjacent terminal connectors between upwardly projecting portions of the respective terminal connectors.

18. The mechanism according to claim 17, wherein said applicator includes a platform upon which said terminal connectors are slidably disposed and wherein said mounting means includes means for resiliently biasing said guide finger toward said platform.

19. The mechanism according to claim 18, wherein said guide finger is pivotally mounted to said applicator at one end of said projection and said guide finger including an upwardly projecting member at said one

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end, and wherein the resiliently biasing means includes a spring disposed between said member and an adjacent portion of said applicator.

20. The mechanism according to claim 17 wherein said upwardly projecting portions of said terminal connectors comprise uncrimped wire barrel portions.

21. A ram assembly for use with a terminal applicator, said ram assembly comprising:

a ram member having an extended head portion;
an adjustment support carried by said ram member; first and second adjustment dials concentrically mounted about said head portion in force transmitting relation therewith, wherein one of said dials slidably engages said adjustment support, said dials each having at least first and second spaced-apart pads on a respective lower surface thereof, and wherein said first pad has a dimension in said direction of ram assembly movement which is different from the corresponding dimension of said second pad; and

means for engaging one of said pads of each of said dials with a respective one of a pair of crimping dies of said applicator when said dials are in a corresponding position and said ram assembly is moved in the direction of a cooperating die of said applicator.

22. The feed mechanism according to claim 16, wherein said feed member comprises a plate having at least four holes therein and wherein three of said holes are selected to provide said pivotal mounting positions and wherein each different selected combination of pivotal mounting positions provides a different feed stroke amplitude.

23. An adjustable terminal applicator for crimping terminal connectors to the end portions of a wire comprising:

a reciprocating terminal crimping ram;
a crimping station;
a feed finger for advancing said terminal connectors to said crimping station;
first means coupled between said ram and said feed finger for moving said feed finger in response to said ram toward and away from said crimping station; and

means cooperating with said first means for adjusting the stroke of said feed finger solely in the direction away from said crimping station to provide different predetermined stroke amplitudes thereby to accommodate terminals of different size, and wherein said feed finger advances toward said crimping station to a substantially fixed point, independently of said adjustment means and said different stroke amplitudes.

24. The adjustable applicator according to claim 23, wherein said feed finger engages and advances the leading terminal connector of a strip of terminal connectors, and including a positive feed stop for limiting the movement of said feed finger toward said crimping station to said fixed point.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,911,717

Dated Oct. 14, 1975

Inventor(s) Lawrence Frank Yuda

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 15 change "andd" to --and--.
Column 1, line 16 change "macchines" to --machines--.
Column 1, line 20 change "while" to --While--.
Column 1, line 37 change "ot" to --not--.
Column 1, line 48 change "readdily" to --readily--.
Column 2, line 10 change "DDESCRIPTION" to --DESCRIPTION--.
Column 2, line 52 change "mmode" to --mode--.
Column 3, line 1 change "or" to --of--.
Column 3, line 10 change "ddies" to --dies--.
Column 3, line 51 change "whould" to --should--.
Column 4, line 49 change "bladde" to --blade--.
Column 6, line 50 change "crimpinng" to --crimping--.
Column 9, line 54 change "andd" to --and--.
Column 10, line 61 change "thus" to --Thus--.
Column 11, line 11 change "moe" to --mode--.
Column 11, line 34 change "andd" to --and--.
Column 13, line 41 after "thereof;" insert:

a feed finger pivotally mounted at said third position, said finger being adapted to feed said terminal connectors into crimping position in response to movement of said feed member and in accordance with a feed stroke determined by the respective distances between said pivotal mounting positions; and

means including said feed member for unilaterally adjusting the amplitude of said feed stroke solely in the direction away from said dies thereby to accomodate terminal connectors of different size and wherein the maximum amplitude of said feed stroke in the direction toward said dies is substantially fixed and independent of said adjusting means.

Signed and Sealed this

sixth Day of January 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks