

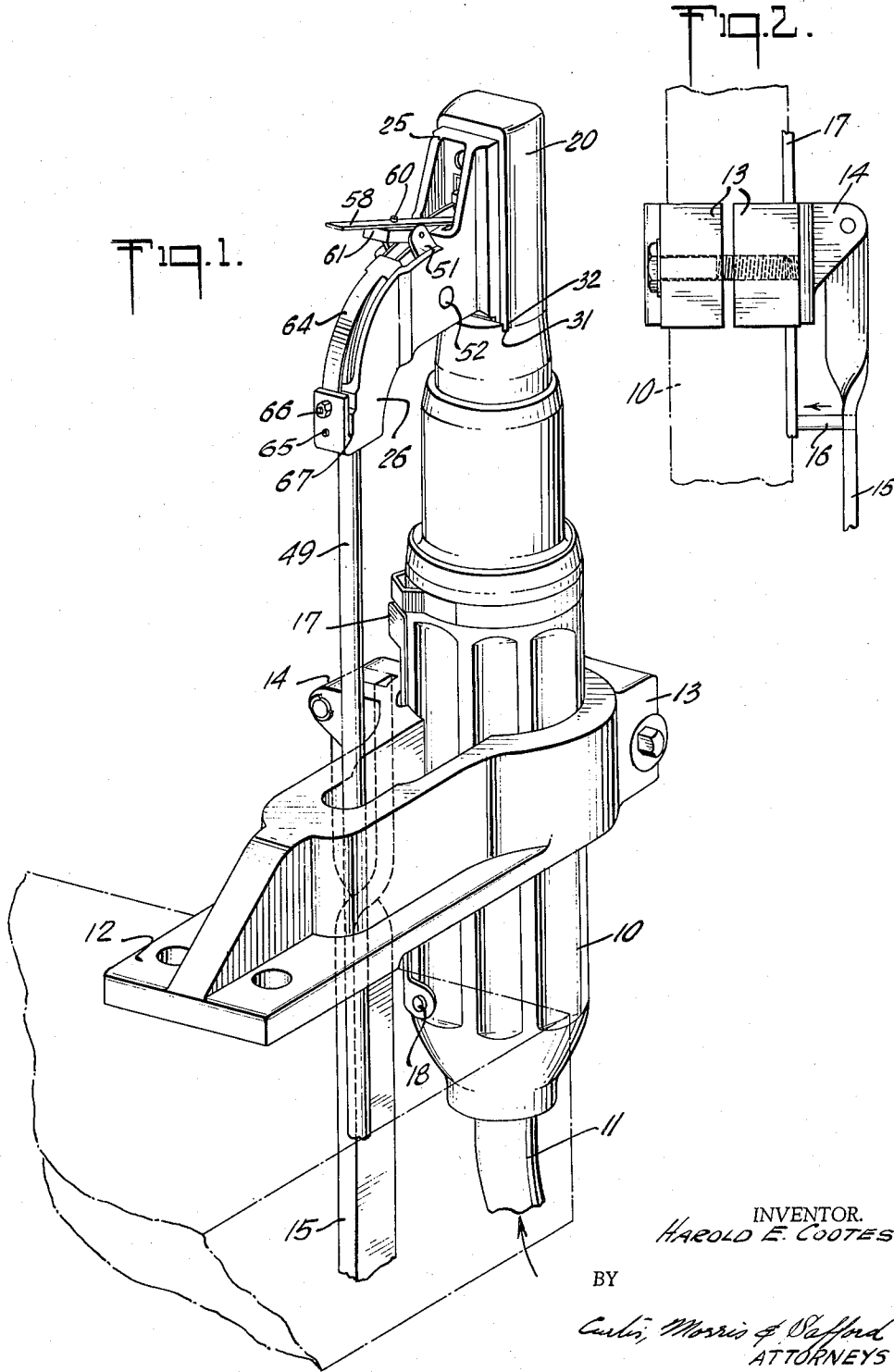
Oct. 3, 1961

H. E. COOTES
TERMINAL APPLICATOR

3,002,547

Filed Aug. 18, 1958

3 Sheets-Sheet 1



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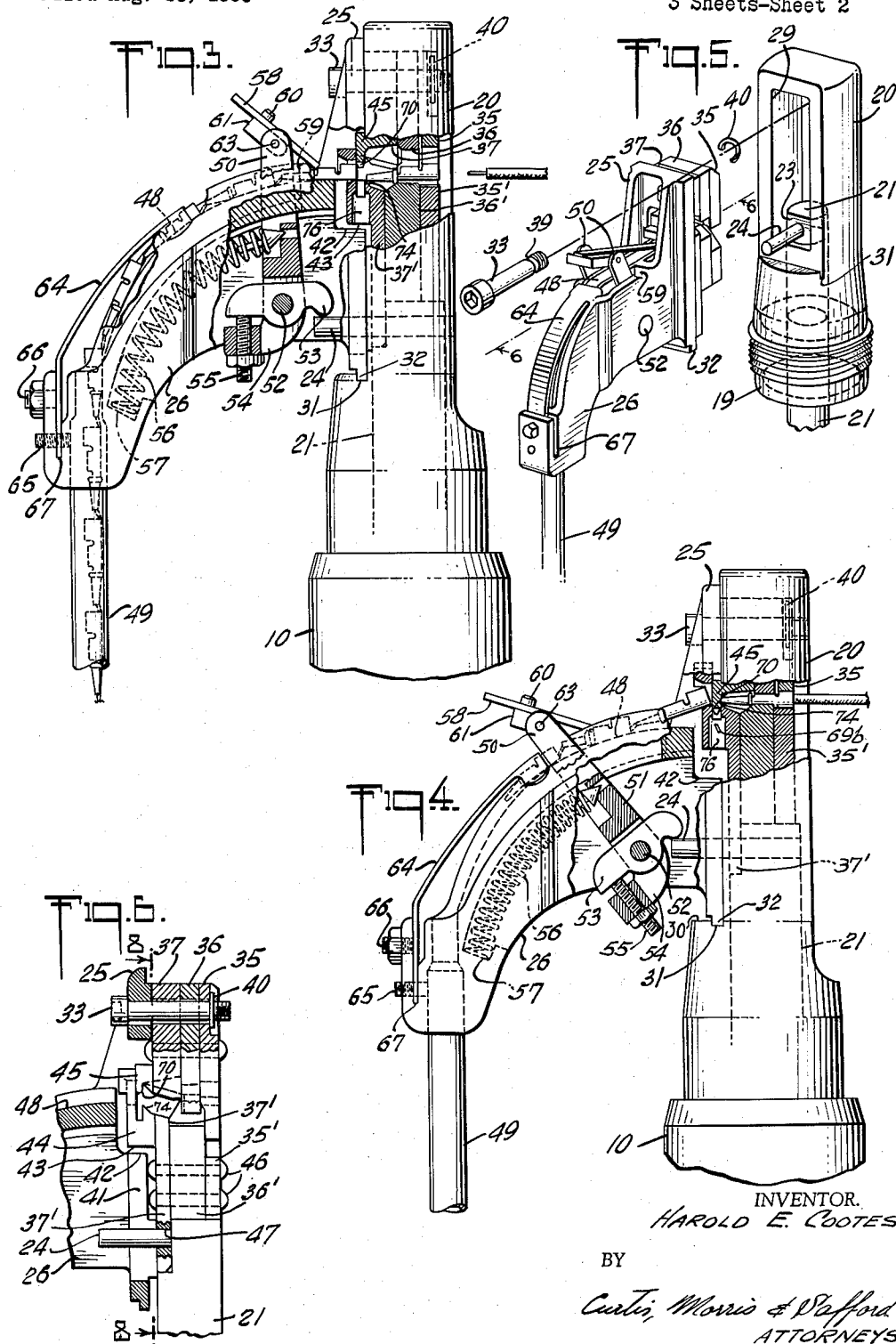
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

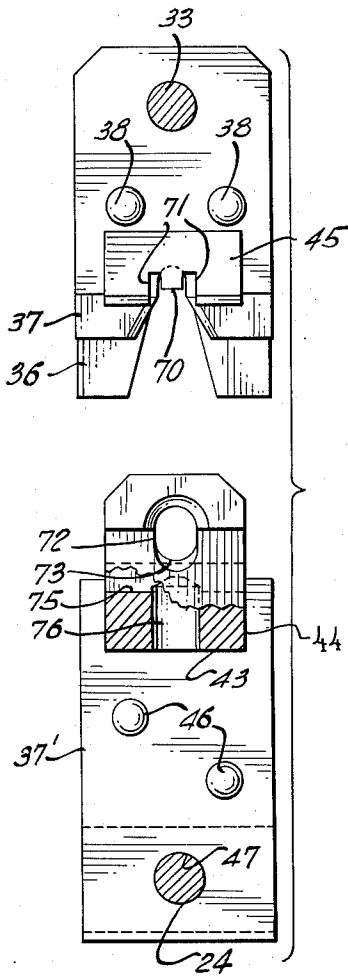


Fig. 8.

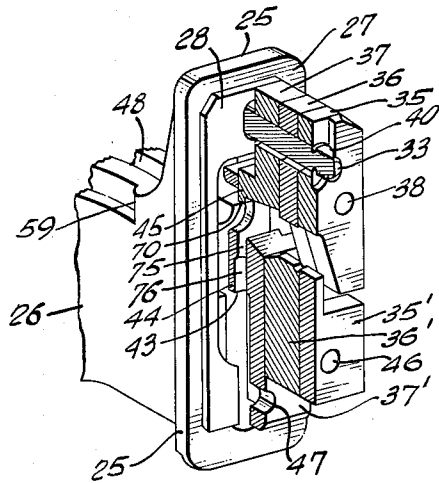


Fig. 7.

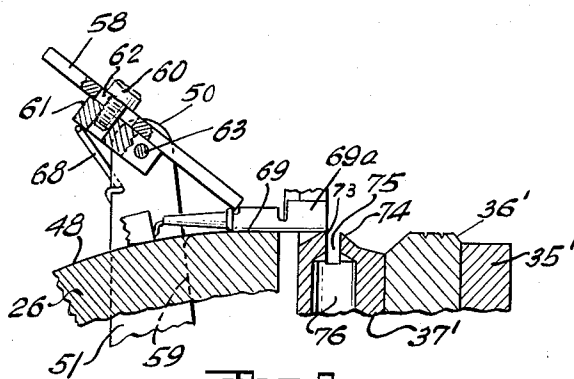


Fig. 9.

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1

3,002,547

TERMINAL APPLICATOR

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8 Claims. (Cl. 153-1)

The present invention relates to tools for crimping electrical connectors onto conductors and more particularly to terminal applicators actuated by fluid pressure.

Known types of terminal applicators include those wherein a set of crimping dies is assembled with die actuating means and means for holding terminal in position to be crimped onto a conductor by said dies. It has been found that the rapidly expanding use of pressure-forged "crimped-on" connectors has included a vast number of kinds and sizes of connectors. The present invention makes possible more economical and convenient use of a variety of sizes and/or types of connectors with a single applicator, and gives substantial advantages in both equipment costs and operating costs.

One object of this invention is to provide a terminal applicator wherein a connector-feeder and magazine are integrated with a set of dies arranged and adapted to most effectively crimp the size and style of terminal supplied by the magazine, and wherein such integrated magazine-die assemblies, respectively, each with a peculiar size and style of connectors and appropriate dies for forging them onto conductors may be easily mounted on and removed from a single applicator machine in such relation that both its die set, for crimping the connection and a feeder for feeding terminals from the magazine are engaged by the machine, to feed and crimp said terminals, respectively, at successive operations.

It is a further object of the invention to provide apparatus of the kind above noted which can readily be applied to and removed from a conventional pneumatic type of actuator, thus permitting a number of varied sizes and types of terminal feeding and crimping assemblies to be employed interchangeably with one actuating unit.

An object of the present invention has also been to provide a crimping tool which has mobility and portability, as compared to full automatic crimping-type connector applicators for permanent installation but like such fully automatic installations applies connectors successively to wires or other conductors without need for separately handling or manually positioning the connectors.

According to this invention, I provide a tool for applying electrical connectors to conductors wherein connectors are stored in and advanced through a magazine, advantageously in a continuous strip of interconnected terminals, to crimping and strip severing position between opposed dies. Strips of terminals of a desired length may be easily and quickly loaded into the magazine; and when thus loaded, the entire strip can be used up without replacement in the magazine, even though several other types of connectors are applied by the machine in the meantime. Each such type has its own unit with magazine, die set and feeder, and such units are interchangeable in the machine without disturbing the connectors in the magazine.

It is contemplated that the above-mentioned and other objects and beneficial results are attained in the use of a terminal applicator comprising, in general, a frame secured thereto which carries in permanently assembled relation a set of crimping dies and a connector-storage magazine having a discharge opening arranged adjacent the mouth of the die set and a feeding device to deliver terminals, one by one, into position between the opposed crimping dies. Said frame and said magazine and die set are, as a unit, readily attachable to and detachable from an actuator, advantageously one having a fluid-

2

pressure operated ram, manual control for the fluid pressure on the ram, and a yoke with means to secure said interchangeable unit in operative relation to said ram, so that the ram moves one of said dies toward the other and also engages said terminal feeding means so that it is operated each time the ram thus operates the die set.

When an operator has inserted a conductor into a terminal, or other connector, positioned between the dies, and has activated the control valve to admit fluid pressure for actuating the ram, the resulting movement of the ram effects like movement of the movable die of the die set to crimp a connector fed between the dies by actuation of the feeding mechanism during the previous stroke of the ram. The movement of the die set also severs such terminal from the strip, and loads a driving spring whereby another terminal is advanced from the magazine into crimping and severing position when said opposed die assemblies are opened for discharge of the crimped connection.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon reading of the following detailed description when taken in conjunction with the drawings, in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention, but is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it and utilize it in various forms, each as may be best suited to the conditions of a particular use.

FIGURE 1 is a view in perspective of a terminal applicator or crimping tool incorporating the principles of this invention in a form adapted for use with a commercially available pneumatic ram-type hand tool;

FIGURE 2 is a view in elevation, on enlarged scale, showing an end of an operating lever on said tool by which the fluid pressure employed therein is manually controlled to operate the ram.

FIGURE 3 is a view in elevation of the die set and magazine unit, apart from the pneumatic ram tool shown in FIGURE 1, with portions broken away and portions shown in vertical section as assembled with an end fitting or yoke of the ram tool, and with the opposed die assemblies in open or extended relation and the end terminal of a strip of terminals in position to be crimped onto the end of a conductor wire and to be severed from the strip.

FIGURE 4 is a fragmentary view similar to FIGURE 3, but showing the relative positions of parts thereof on completion of a crimping and severing operation, before the crimping die assemblies are separated to permit removal of the severed and crimped-on terminal from between them;

FIGURE 5 is an exploded view in perspective showing the die and magazine unit and the end fitting of the pneumatic actuator to which it is releasably attached, as in FIGURE 1;

FIGURE 6 is a view partly in vertical section on the line 6-6 of FIGURE 5;

FIGURE 7 is an enlarged view in perspective and partly in vertical section, showing in detail the opposed dies mounted on the frame, and also the connector-strip-feeding magazine and mechanism;

FIGURE 8 is an enlarged view in elevation and partly in transverse vertical section on the line 8-8 of FIGURE 6; and

FIGURE 9 is a fragmentary view partly in section showing details of construction of portions of the strip advancing mechanism.

These drawings illustrate an embodiment of the in-

vention incorporated in an air-pressure operated portable crimping tool adapted for bench mounting. Air under suitable actuating pressure is supplied through hose 11 to the casing 10 of an air tool of conventional design and well-known operating characteristics. The casing 10 is conveniently supported, for example, at the edge of a bench or the like, by a bracket 12, which can be secured to the bench top by bolts (not shown). Said bracket 12 includes at its outer end a clamp portion 13 (FIGURE 2) which embraces and securely holds the tool in operative position.

As seen in FIGURE 2, bracket 12 has laterally extending spaced lugs 14 between which the upper end of operating lever 15 is pivotally suspended. Said lever carries a pin 16 which bears against lever plate 17 pivoted at 18, so that when the lower end of lever 15 is deflected to move pin 16 in the direction of the arrow (FIGURE 2) against lever plate 17, e.g., by pressure of the operator's knee, said lever plate causes the control valve of the tool to function in its usual manner. Under some circumstances, as where the air pressure supply permits and where terminals are to be applied to wiring in a fixed or cumbersome installation which cannot conveniently be brought to the bench tool, it will be apparent that the casing of the tool can be held manually as in its previously common use; and the air pressure control valve thereof may be worked by manual grip pressure applied directly to the lever plate 17 instead of by knee pressure, as in the bench mounted tool.

As seen in FIGURES 3 and 5, causing 10 carries at its upper end a head 19 which is threaded into the upper end of said casing. The outer end of head 19 provides a yoke 20, open at its opposite sides. A ram 21 is mounted with its outer end extending into said opening and with its inner end (not shown) extending into casing 10 as a piston. The air pressure supply and controls for operating the ram may be of conventional and well-known structure, so that when pressure is applied against the far end of said ram, the latter is thrust upward into said yoke 20 and, when the pressure is released or reversed, said ram returns to retracted position.

The outer end portion of ram 21, as seen in FIGURES 5 and 6, is cut away to form a shoulder 22 at the end of a flat laterally exposed face 23, from which a pin 24 extends laterally beyond the opening at the rear side of yoke 20.

As previously noted, a tool according to the present invention includes interchangeable terminal supplying and crimping units which can readily be mounted in and removed from said yoke 20 in such manner that the connectors of different sizes and shapes can be applied by the tool with only the simple exchange of these units.

In operation, the terminals are advanced from a supply in strip form, emerging one by one, from a magazine into crimping and severing position between opposed crimping and severing dies which are assembled on the end of each interchangeable unit, as shown in FIGURES 3-8. When one of the die assemblies is moved into crimping position by outward endwise thrust of said ram 21, the corresponding movement of pin 24 cams the feed lever to load the driving spring (compare FIGURES 3 and 4). Such an interchangeable unit is represented in FIGURE 5 by the housing 26 and related parts in assembled condition to be connected to yoke 20.

As shown in FIGURE 3, the terminal magazine to be more fully described later, is loaded or charged with a strip of taper pin terminals each having an end part adapted to be crimped around an insulated portion of a conductor, a middle part adapted to be crimped together with an end of the metal conductor, and a tapered tongue part attached to the end part of the next terminal by a "knock-out" connecting member (in this case, a narrow integral strip which is easily sheared out by suitable parts on the crimping die set).

The entire unit above referred to, and shown in the

drawings, includes a frame 25, which provides a housing for the feed mechanism, with a chamber 26 extending rearwardly thereon. Said frame 25 includes a depressed flange portion 27 to be fitted against the rear face of yoke 20 and form a boss 28 adapted to fit snugly in the rear opening 29 in the yoke.

As seen in said FIGURE 3, a shelf 30 at the bottom of the yoke member 20 has a groove 31, one side of which is flush with the flange 27. The lower edge portion 32 of frame 25 fits into this groove to secure it in position on the yoke.

A bolt 33 is held positioned in aligned holes in frame 25 and the upper die plates 35, 36 and 37, by a snap ring 40. This bolt is screwed into a threaded hole in the wall portion of yoke 20 when the unit has been inserted into opening 29. With the bottom edge of frame 25 in groove 31 and the bolt 33 screwed into the upper end of the yoke, the unit and the parts carried thereon are operatively connected to said yoke and positioned for actuation by said ram 21.

As seen in FIGURES 6 and 7, a set of dies designed more particularly to perform crimping and severing of plug terminals of the type above referred to and as shown in FIGURE 3, includes a fixed die assembly and a movable die assembly. The fixed die assembly comprises two crimping die pieces 35 and 36 and the severing die piece 37. The movable or lower die assembly includes the crimping die piece 35' which cooperates with fixed die piece 35; crimping die piece 36' which cooperates with fixed die piece 36, and severing die piece 37' which cooperates with die piece 37. Said fixed or upper die pieces are held together as a unit in precisely determined relation by dowel rivets 38; and this unit is releasably secured to frame 25 by bolt 33 which, as seen in FIGURES 5 and 7, is provided with a peripheral groove 39 into which is fitted a split retaining ring 40. This retaining ring engages the outer face of die piece 35 which, advantageously, is recessed to receive ring 40, as shown in FIGURE 7. Thus, bolt 33 not only serves to secure frame 25 and its related parts to yoke 20, but also to retain the upper die assembly on frame 25 when the latter is not secured to yoke 20.

It will be seen from FIGURES 6, 7 and 8 that the lower die assembly is retained on frame 25 in part by a portion of said frame and in part by portions of the upper die pieces which laterally overlap portions of lower die pieces. Thus, portions of frame 25 at the opposite sides of a longitudinally extending central opening 41 in said frame provide spaced shoulders 42. These are arranged with their upper faces opposite to the end portions of the downwardly exposed faces 43 of a rearward extension 44 of lower severing die piece 37' which also projects upwardly to overlap portions of the rearwardly exposed face of a rearward extension 45 on upper severing die piece 37. It also appears from FIGURE 6 that an upper portion of the outer (right) face of lower crimping die piece 36' is overlapped by a lower portion of the inner (left) face of upper crimping die piece 35. Said lower die pieces 35', 36' and 37' are secured together to operate as a unit by dowel rivets 46.

In assembling the frame and the parts thus far referred to, said fixed and movable die assemblies are first interengaged, with a portion of the lower severing die overlapping a portion of the upper severing die and with a portion of an upper outer crimping die overlapping a portion of a lower inner crimping die. Said interengaged assemblies are then mounted in the positions shown in FIGURES 5 and 7, and held by applying the retaining washer 40 on bolt 33, which retains the upper die assembly on frame 25 as described. The rearwardly extending portion 44 of lower severing die piece 37' extends through opening 41 to bring its lower surface 43 opposite (i.e., above) shoulders 42, FIGURE 7, where it normally rests while the magazine and die parts as a unit are not

mounted in the opening 41. Thus, said lower die assembly is prevented from falling away from the upper die assembly and is held positioned in an upward direction, by the overlapping dies of the upper or fixed die assembly.

As seen more clearly in FIGURE 8, the rearward extensions 45 on die piece 37, and 44 on die piece 37', are narrower than their respective die pieces. Accordingly, when assembled in the opening 41 of frame 25, as shown in FIGURE 4, the outer lateral edges of said extensions pass freely over inner lateral surfaces of said opening for easy assembly of said die assemblies with frame 25, and to afford lateral guiding and supporting surfaces for said rearward extensions.

As seen in FIGURE 6, lower die piece 37' has a hole 47 positioned and adapted to receive pin 24 on ram 21 so that said die part 37' is normally positioned with the under-surface 43 slightly spaced upwardly from shoulders 42; and, in operation, when ram 21 is thrust outwardly, pin 24 moves up with die 37' while the lower die assembly moves upwardly from said normal position into crimping position with respect to the upper die assembly.

A structure according to the present invention also includes a terminal feeding device operatively connected with frame 25. Thus, said frame 25 is shown in FIGURE 1 and others as part of housing 26 in which is mounted a curved track or feed tube for terminal strip. As shown, this track takes the form of a groove 48, FIGURES 3, 6 and 7. At its lower end, groove 48 communicates with a strip-guiding and protecting member such as a tube 49. Thus, where the strip of terminals to be applied is longer than the extent of groove 48, the trailing end portion of the strip is conveniently accommodated in or guided by said tube 49.

Housing 26 is open at its top side to give access to groove 48 and to accommodate the spaced ends 50 of a long arm 51 of a bifurcated feed lever pivotally mounted on a pin 52 extending transversely across the interior of said housing. A short arm 53 on said lever is also pivoted on said pin 52 and extends across a slot 54 in the lower end portion of long arm 51, wherein it is adjustable to vary its angular relation to long arm 51 by means of an adjustable set screw 55.

Said lever 51 is biased toward the position shown in FIGURE 3, i.e., terminal advancing position, by a compression spring 56 having one end seated at 57 in the housing and its opposite end bearing against a mid-portion of long arm 51. Said spring 56 is retained in operative position by the under surface of a portion of said track and is laterally confined between opposed portions of the side walls of said housing. A pawl 58 is pivotally secured on the end of lever arm 51.

To limit the extent of movement of long arm 51, and hence of pawl 58, portions of the side walls of said housing 26 are shaped to form stops 59 located in the path of clockwise movement of said outer ends of long arm 51.

To afford flexibility in adjustment of the feed plate or pawl 58 in relation to the terminal blanks being advanced through groove 48, and a degree of adaptability to minor variations in strip characteristics or operating conditions, said pawl 58 is mounted for endwise adjustment on a trunnion block 61.

To permit endwise adjustment of the pawl or feed plate 58 on block 61, the latter is provided with a set screw 60 extending through a slot in said plate 58—FIGURE 9. Also, as shown in said FIGURE 9, said block is biased in a clockwise direction by a spring 68, thus to retain the inner end of pawl 58 in yielding engagement with a portion of a terminal blank, as 69.

The arrangement of these parts is such that when arm 51 is rocked counterclockwise, as to the position shown in FIGURE 4, the inner end of pawl 58 drags across portions of a terminal blank and comes to rest behind the rear edge of a ferrule portion, for example, so that with the next forward swing of arm 51 under pressure of spring 56, the whole strip of terminal blanks will be

advanced to bring the leading blank into crimping position.

As an aid to accurate and effectively controlled feeding of the terminal blank strip, a keeper in the form of a spring clip 64 is mounted on housing 26 with its free end overlying and straddling a portion of groove 48 midway between its ends in such a manner as to press yieldingly downward on the terminal blanks as they reach that position in the advance of the strip of terminal blanks toward the crimping dies. Said clip 64 is pivoted on a set screw 65 which also secures the tube 49 in operative position; and a set screw 66 is mounted with its inner end positioned to bear against a portion of spring clip 64 in slot 67, and thus permit adjustment of the effective pressure of said spring clip 64 on the terminal blanks.

By lifting the upper end of clip 64 out of straddling engagement with the terminal guiding track and swinging the free end thereof laterally, said clip can be displaced from its strip guiding position thus giving access to groove 48, the open upper end of tube 49 and any terminal blanks carried therein. This enables an operator quickly to charge or reload the magazine with a desired strip. If the strip is longer than the length of the groove 48, the trailing end of the strip is first dropped or passed into the open upper end of tube 49 after which the leading end of the strip is conveniently advanced upwardly along groove 48 until a terminal blank comes into position to be engaged by pawl 58 for feeding operation as previously described. Clip 64 is then restored to its normal strip retaining condition, as seen in FIGURE 4.

It will be clear from the foregoing description, that when the housing 26 and the parts carried thereby are joined with the aforesaid upper and lower crimping and severing die assemblies, a feeding and crimping unit is produced which is capable of being effectively actuated by a suitable power applying device, as an air ram. It will also be clear that such units loaded with different types of terminal blanks and/or equipped with different crimping dies may be interchangeably employed with the same power source.

When such unit is operatively mounted on yoke 20, for example, the lower die assembly is controllably movable from its position as shown in FIGURE 3 toward its position as shown in FIGURE 4 by endwise outward movement of ram or plunger 21. The same outward stroke of ram 21 causes the outer end of pin 24 to engage cross arm 53, thus rocking arm 51 to load spring 56, counterclockwise to the position shown in FIGURE 4. On this stroke, the ferrule-forming portions of terminal blank 69 are crimped by the crimping dies; and the crimped terminal is separated from the next following terminal blank by operation of the severing die pieces 37 and 37'.

As seen in FIGURES 3 and 8, die piece 37 has an extension 45 which provides a shearing blade 70 between slots 71, these slots being provided to facilitate passage of the ferrule-forming portion 69a of blank 69, which is U-shaped in transverse section, when the leading blank 69 of a strip of blanks is being fed into position between the upper and lower die assemblies. Extension 44 of lower die piece 37' has a transverse groove 75 (FIGURE 6) arranged opposite said shearing blade 70.

Said extension 44 also has a hole 72 (FIGURE 8) through which said terminal blanks are moved and which is flared at its outer, connector receiving, end to facilitate passage of the connectors to crimping position. The lower inner edge 73 of the hole 72 provides a shearing edge at one side of groove 75 which cooperates with a shearing edge 74 at the opposite side of groove 75 and with said blade 70 to punch out the slugs 69b, by which the terminal blanks are tied together in a strip. As seen in FIGURE 4, slugs 69b are punched out by blade 70 whenever engaged by the shearing edges 73 and 74 pushing it upwardly against the blade and to the position shown in FIGURE 4. The punched out slug 69b is discharged by gravity through an opening 76 extending from

channel 75 downwardly through the extension 44 of die piece 37'.

It will be understood that normally, in using the bench type apparatus shown in FIGURE 1, for example, the operator will insert an end portion of an electrical conductor into the U-shaped ferrule portions of the leading terminal while it is positioned for crimping, as shown in FIGURE 3. He then actuates lever 15 to effect upward movement of the lower die assembly and counterclockwise swing of lever arm 51 against spring 56. This effects the desired crimping of the ferrule portions, punching out the connecting pieces 69b and cocking of the feed devices to the positions shown in FIGURE 4. When the operator releases pressure on operating lever 15, the lower die assembly returns to extended or open position, and spring 56 causes arm 51 and pawl 58 to advance the connector strip so that another connector is brought automatically to crimping position.

Similar results are contemplated where a unit embodying the invention is used as part of portable equipment, not attached to, or mounted on, a bench or the like.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration whereas the following claims, when viewed in their proper perspective against the description and drawings and the prior art, are intended to point out and distinguish the invention.

I claim:

1. An applicator for serially applying connectors in strip form to wire conductors in response to the repetitive strokes of a power driven ram comprising a yoke attachable to the ram power unit so that the ram reciprocates in the slot thereof, a frame carrying a die set for detaching the lead connector from the strip and applying it to a wire and a feed mechanism for advancing the strip to said die set, means for releasably securing said frame to the yoke with the die set disposed in said slot, and means operatively connecting the die set and the feed mechanism to the ram for repetitive actuation thereby.

2. An applicator for serially applying connectors in strip form to wire conductors comprising a power unit having a reciprocable ram, a yoke detachably secured to the power unit so that the ram reciprocates in the yoke slot, a frame carrying a die set having relatively movable parts for detaching the lead connector from the strip and applying it to a wire and a feed mechanism for advancing the strip to said die set, means for releasably securing said frame to the yoke with the die set disposed and guided in movement in said slot, and means operatively connecting the die set and the feed mechanism to the ram for repetitive actuation thereby.

3. An applicator for serially applying connectors in strip form to wire conductors in response to the repetitive strokes of a power driven ram comprising a yoke attachable to the ram power unit so that the ram reciprocates in the slot thereof, a frame, a die set carried by said frame for detaching the lead connector from the strip and applying it to a wire, said die set including a movable die adapted for reciprocation relative to a fixed die, a feed mechanism carried by said frame for advancing the strip to said die set, means for releasably securing said frame to the yoke with the die set disposed in said slot, the sidewalls of said slot cooperable with said die set to guide the reciprocation of said movable die, and means operatively connecting the die set and the feed mechanism to the ram for repetitive actuation thereby.

4. An applicator for serially applying connectors in strip form to wire conductors in response to the repetitive strokes of a power driven ram comprising a yoke attach-

able to the ram power unit so that the ram reciprocates in the slot thereof, a frame carrying a die set having relatively movable parts for detaching the lead connector from the strip and applying it to a wire and a feed mechanism for advancing the strip to said die set, said frame having an end boss snugly received in said slot to orient said die set for guided movement within said slot and a flange projecting laterally from said boss, fastening means for releasably securing said flange in abutting relation with the side of said yoke, and means operatively connecting the die set and the feed mechanism to the ram for repetitive actuation thereby.

5. An applicator for serially applying connectors in strip to wire conductors in response to the repetitive strokes of a power driven ram comprising a head including a base detachably secured to the power unit and a yoke upstanding from the base, the yoke having a slot defined by parallel sidewalls, the head being arranged so that the ram reciprocates in said base and along said slot, a frame carrying a die set having relatively movable parts for operating on said strip and a feed mechanism for advancing the strip to the die set, said frame having an end boss snugly received in said slot to orient said die set for guided movement by said parallel sidewalls, means releasably fastening said frame in abutting relation with the side of said yoke, and means operatively connecting the die set and the feed mechanism to the ram for repetitive actuation thereby.

6. An applicator for serially applying connectors in strip form to wire conductors in response to the repetitive strokes of a power driven ram comprising a self-contained housing unit having a frame at one end provided with an opening which communicates with the interior of the housing unit, a strip-severing and connector crimping die set releasably clamped to the outer face of said frame, connector feeding means in said housing unit having a reciprocable operating element for successively feeding the connectors through the housing unit and said opening to said die set, and means for setting said housing unit in fixed position relative to said ram with the die set and said reciprocable element operatively connected to said ram.

7. An applicator according to claim 6 wherein said die set includes a fixed die assembly and a movable die assembly, said fixed die assembly being releasably clamped to one side of the frame, the movable die assembly being retained in assembled position between a portion of the frame and portions of said fixed assembly.

8. An applicator according to claim 6 wherein said die set includes a fixed die assembly and a movable die assembly, said fixed assembly being releasably clamped to one side of the frame with the movable assembly being arranged for reciprocable movement relative to the fixed assembly across said outer face of the frame, said reciprocable operating element and said movable assembly being arranged for operative engagement by a lateral pin carried by the ram and projecting through the opening in said frame.

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