United States Patent [19]

McCaughey

[11] **3,710,610**

[45] **Jan. 16, 1973**

[54] WIRE TERMINAL CRIMPING TOOL

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[73] Assignee: **The Bunker-Ramo Corporation,** Oak Brook, Del.

[22] Filed: **June 5, 1970**

[21] Appl. No.: **43,688**

[52] **U.S. Cl.**.....**72/410,** 29/203 H, 29/212 D, 81/389, 81/421

[51] **Int. Cl.** **B21d 9/08**

[58] **Field of Search**.....72/410; 29/200 H, 20 3H, 203; 29/212 R, 212 D, 282, 513; 81/341, 389, 421, 424

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Primary Examiner—Charles W. Lanham
Assistant Examiner—Michael J. Keenan
Attorney—Frederick M. Arbuckle

[57] **ABSTRACT**

Tool for attachment of terminals to pre-stripped wires provides a combination crimping and shearing anvil, two crimp dies which are sequentially shiftable relative to the anvil, and a shear blade actuator movable into operative relation with the shearing member of the anvil. A group of terminals, joined by an integral carrier is manually advanced through a magazine, to position the leading terminal between the dies and anvil. The magazine confines only the end of the terminal which is to be attached to the wire, and thus permits any desired size or conformation of the other end. The pliers-handles of the tool are held in one hand while the wire, held by the other hand, is inserted between the die and anvil members and against a wire stop. Squeezing the handles moves the two dies in sequence, and the actuator, toward the anvil, crimping the terminal (1) onto the wire, (2) onto the insulation, and (3) shearing the terminal from the carrier. A lever on a screw interposed between the slide block and the dies permits selection of the degree of closure between the dies and anvil, to achieve proper crimp on predetermined wire size ranges.

4 Claims, 14 Drawing Figures

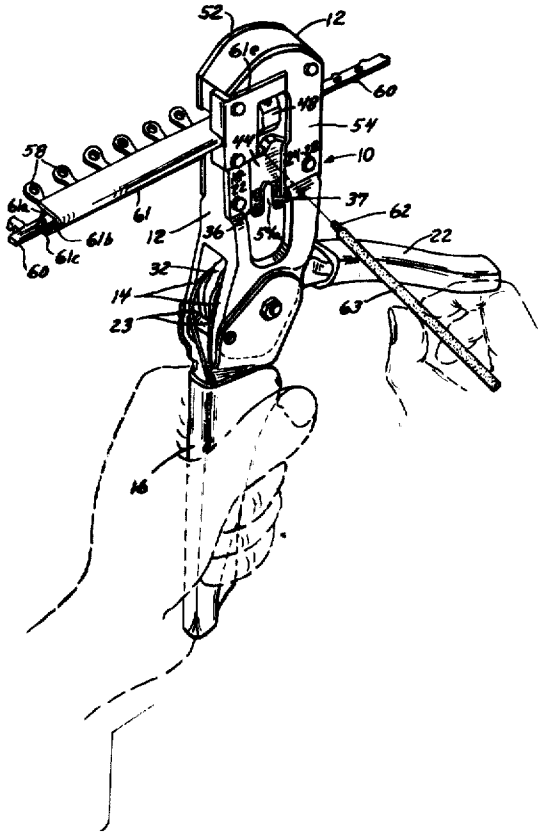


FIG. 1.

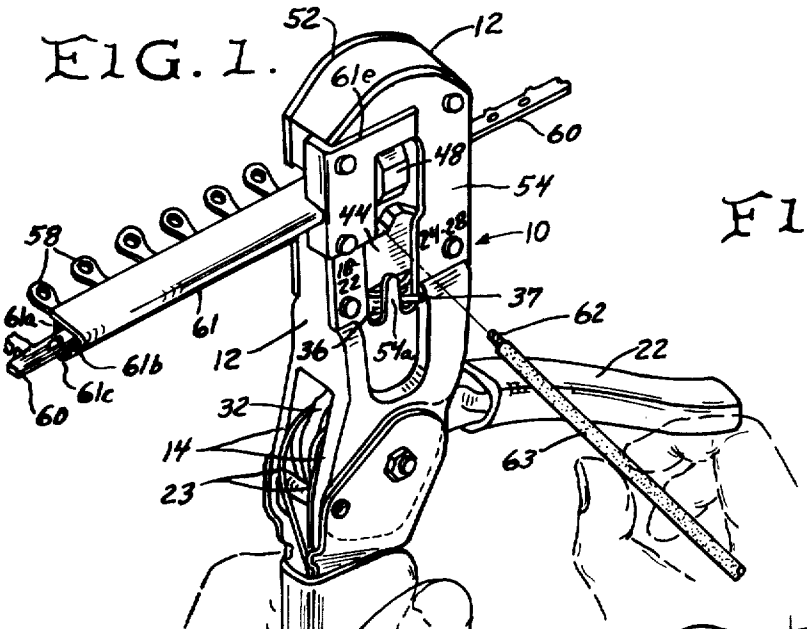
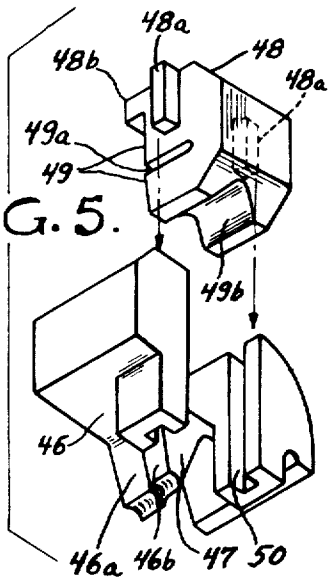


FIG. 5.



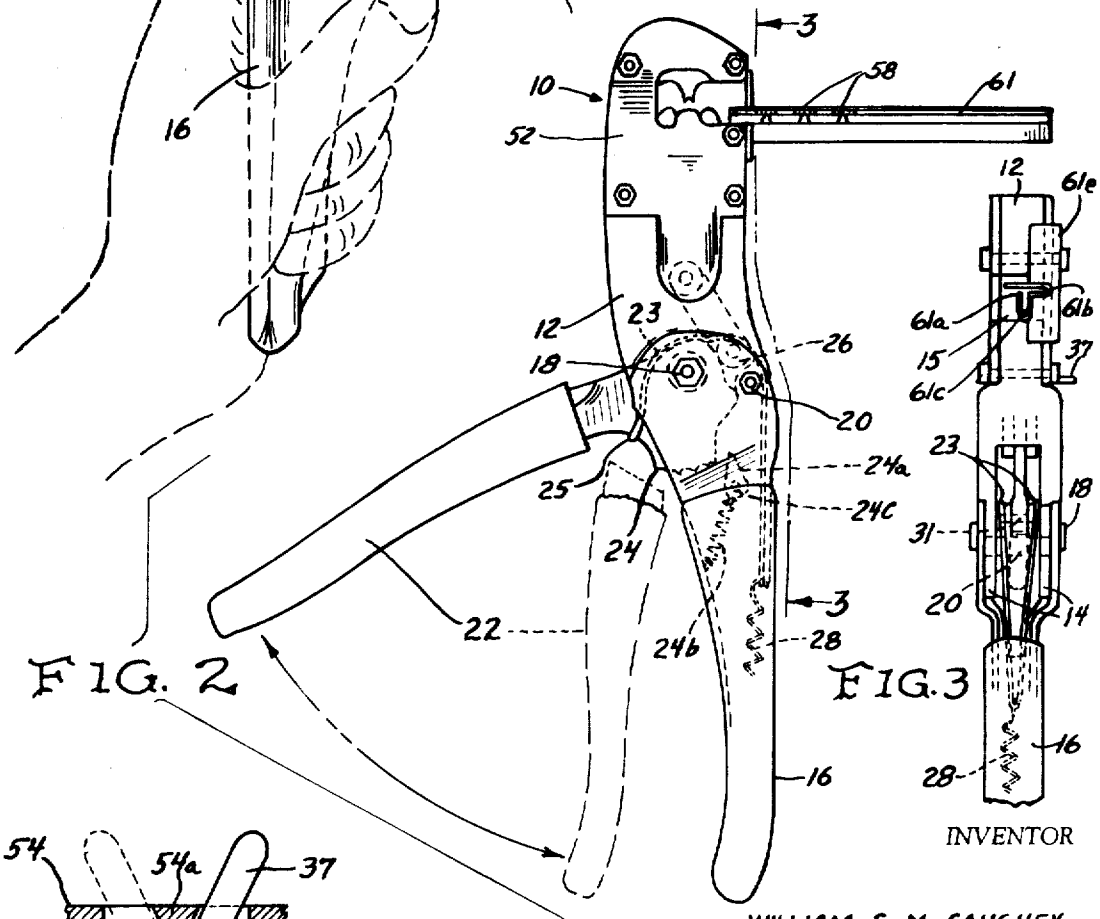


FIG. 2

FIG. 3

FIG. 12.

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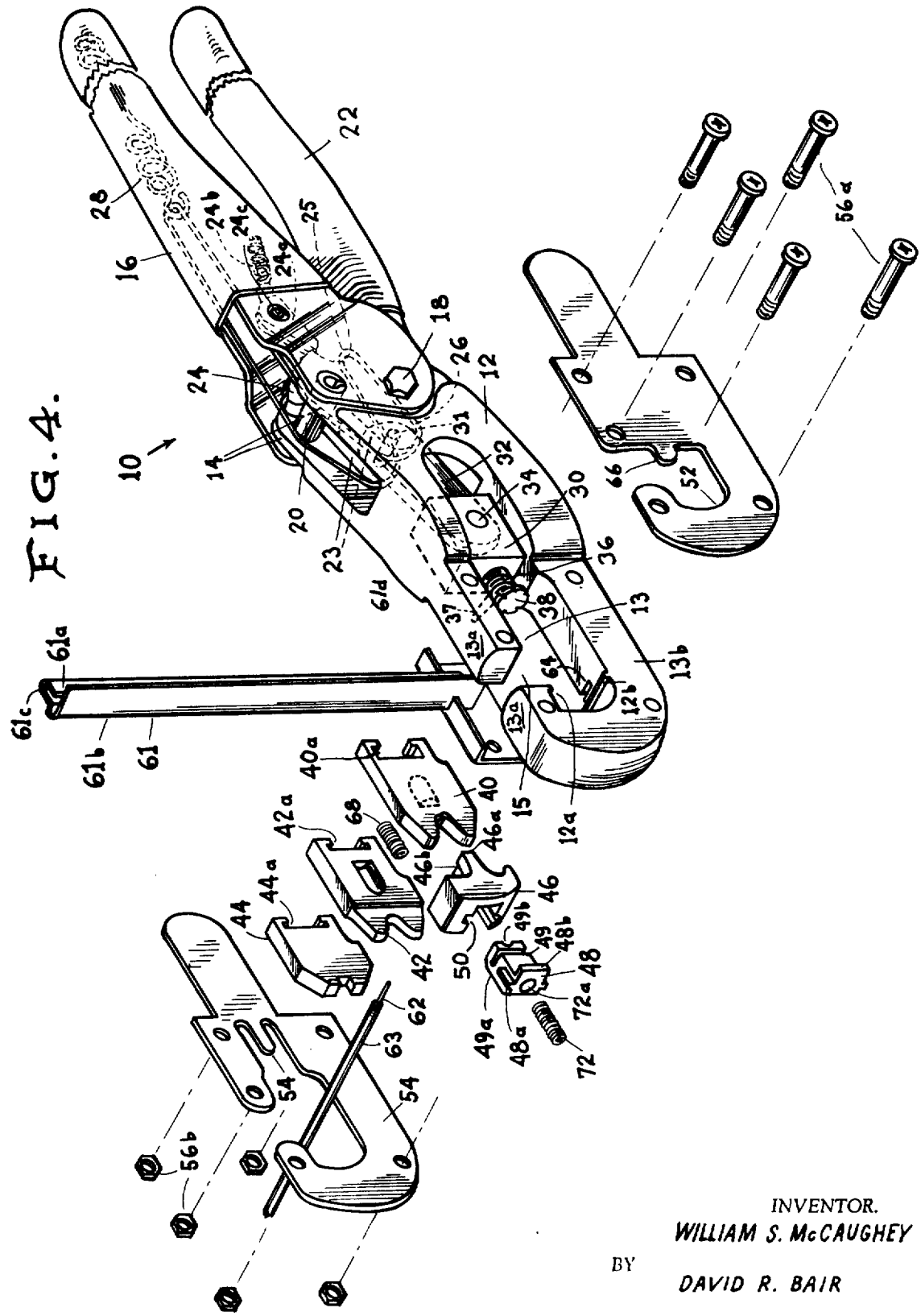
FIG. 4.



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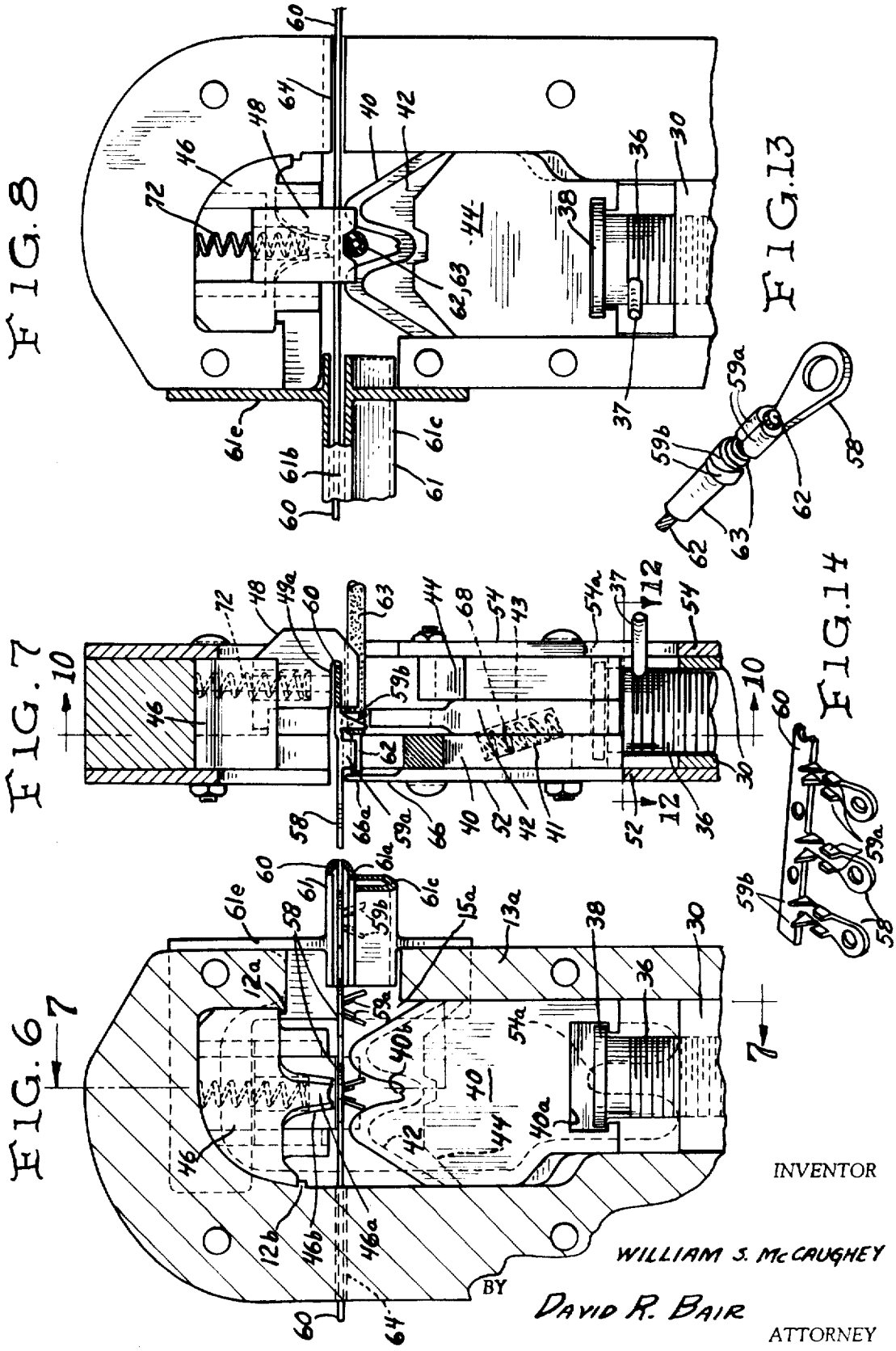
FIG.8
FIG.13
FIG.7
FIG.14
FIG.6
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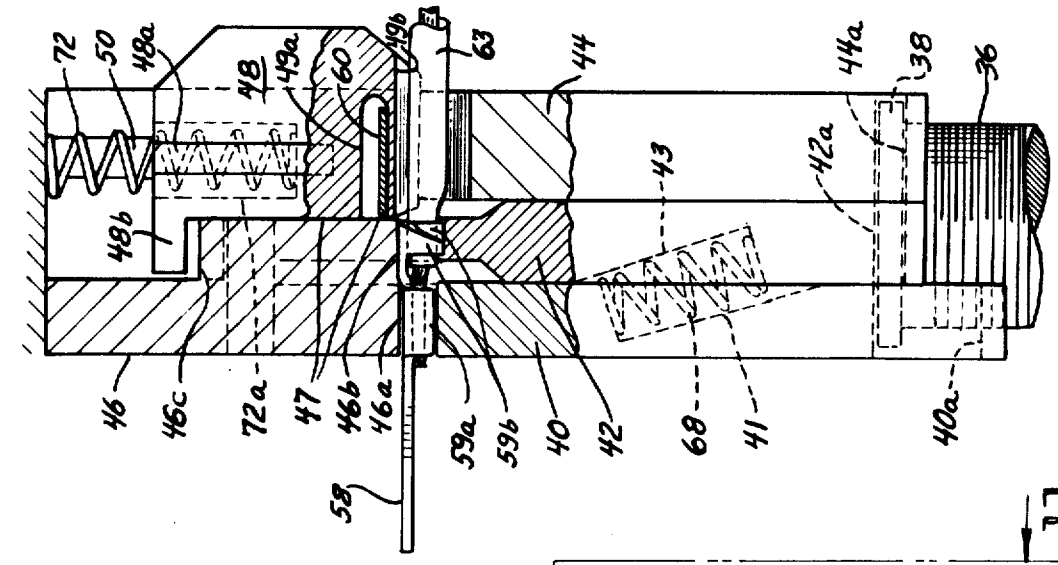

FIG. 11

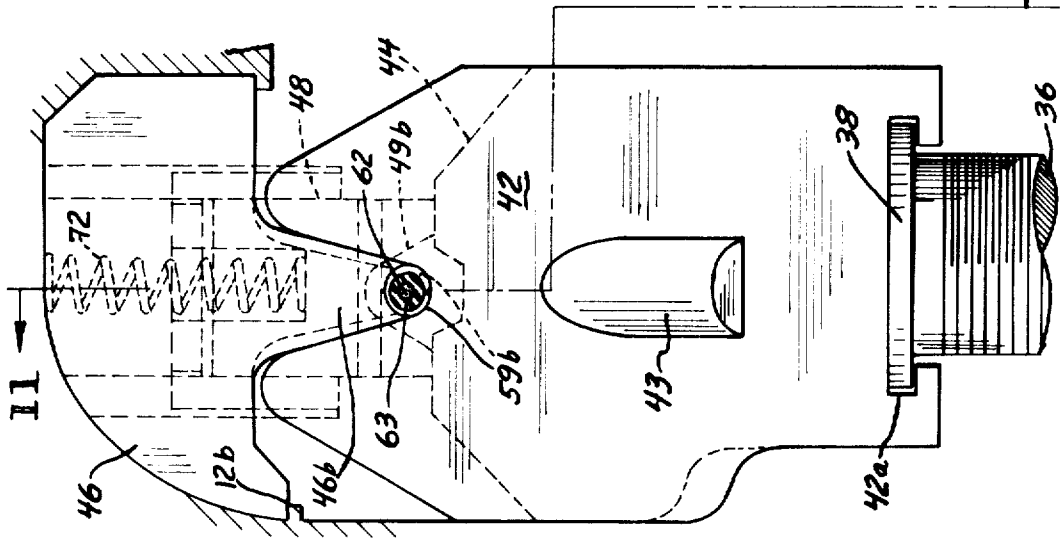

FIG. 10

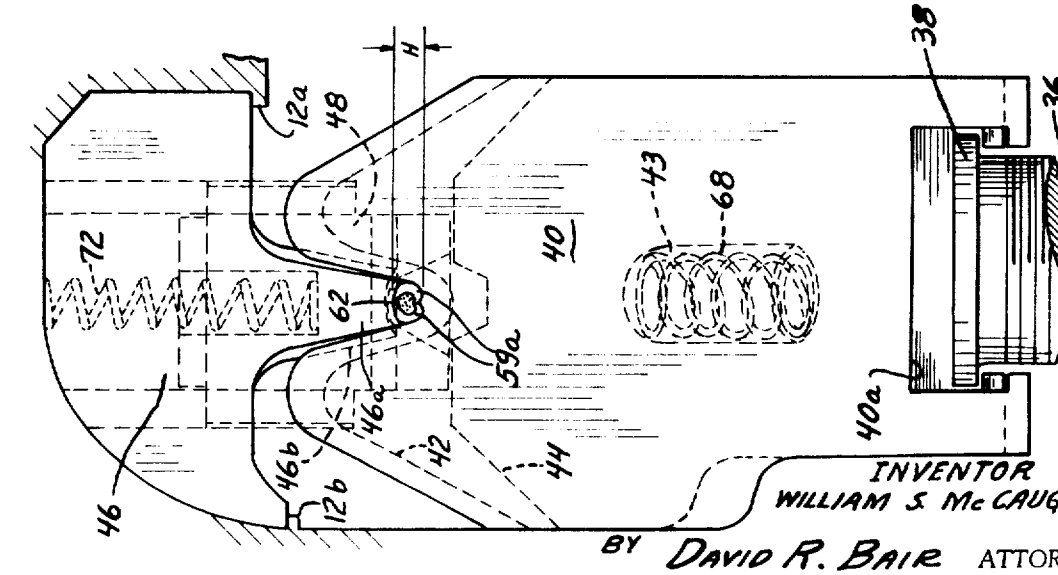

FIG. 9

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WIRE TERMINAL CRIMPING TOOL

BACKGROUND OF THE INVENTION

Many types of electrical connecting terminals are produced in continuous strips for convenience of use under conditions where large numbers of terminals are applied to wires used in manufacturing or assembly operations. Automated machinery is well known in the art for applying such terminals to the wire during repeat cycles of operation where relatively large quantities are involved. In general, the equipment used for such work is large, bulky and heavy, not well adapted for use in a remote location or in field repair work. There is a need for an effective tool of the hand-held, hand-operated type usable with convenience where only a few terminals need be applied at a time, and having a number of advantages described herein.

U.S. Pat. No. 3,842,018 relates to a hand tool for feeding and crimping magazine-fed electrical connectors, but it is primarily designed for the plastic sleeved type of terminal with a closed wire barrel. The apparatus disclosed in that patent is believed to have required undue or extreme amounts of force to cycle the tool, which would preclude easy, single hand operation.

U.S. Pat. No. 3,420,086 discloses a hand crimping tool using open barrel strip type terminals. In the use of that tool the strip must be hand-held and the tool is partially cycled to cut a terminal from the strip, whereupon the strip is set aside. The wire is then picked up and inserted and the tool is further cycled to complete the crimp. If more than one terminal is to be attached, the extra handling of the strip each time is an inconvenience.

There are a number of features needed in a tool for use in the field. It should be compact and reliable. It should be easy to operate, in the sense that only a moderate amount of manual force should be required to actuate it. The number of steps required in its use should be as few as possible. The sequence of those steps should be uncomplicated because, in many cases, the tool must be used by a technician who has little or no experience with the device. The same tool should be usable with various sizes and types of terminals without the necessity for changing removable parts which can easily get lost. In addition, it should be shiftable between a plurality of precisely predetermined settings for different ranges of wire sizes, again without the necessity for changing removable parts.

SUMMARY OF THE INVENTION

This invention provides a device for attachment of terminals to pre-stripped wires, utilizing terminals grouped in a strip by attachment to a suitable carrier. The invention may include two or more anvils and shear means mounted in opposed relation to a plurality of dies and a shear actuator, and means for sequentially moving the dies and shear actuator to and from working position. A setting device in the die moving means permits the degree of closure to be preselected. A suitable magazine guide is arranged to support a strip of terminals and to direct the foremost terminal into proper location between the anvil and the dies. The magazine permits the ends of the terminals opposite the crimp tabs to project beyond its confines, so that terminals of various shapes and sizes may be used.

When the tool is used, a stripped wire is inserted until it engages a stop member, and operation of the die moving means then causes the dies to crimp the terminal onto the wire, and also shears the terminal from its carrier in the same cycle.

This invention meets the objective of providing an improved tool which is relatively light in weight and which requires only one hand to hold and cycle the tool while the other hand is free to insert the wire end and to removed the terminated wire.

It is another object to provide a tool with the above features which can be conveniently used in restricted areas such as may be encountered in applying a terminal to the end of a wire already in place in an existing piece of equipment in the field.

Still another object is the provision of a tool with simple setting for proper crimping on wires of different size ranges.

These and other objects will become more apparent as shown in a preferred embodiment of the invention in a tool described in more detail in conjunction with the following drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of the tool as held by an operator.

FIG. 2 is a side elevational view of the tool as seen from the side opposite that shown in FIG. 1. In broken outline the closed handle position is shown, indicating the operating range of the handle.

FIG. 3 is an elevational view of the tool as viewed on the line 3—3 of FIG. 2.

FIG. 4 is an exploded perspective view of the parts of the tool involved in this invention.

FIG. 5 is a perspective detail view of the combination anvil and shear blade, shown in exploded relation.

FIG. 6 is an enlarged fragmentary side elevational view of the wire and insulation crimping dies and the shear blade actuator shown in superposed relative position, within a cross-sectional part of the crimp plier frame, with a strip terminal properly positioned, prior to crimping actuation by the dies.

FIG. 7 is a transverse cross-section of the parts shown in FIG. 6, as seen on line 7—7 of FIG. 6.

FIG. 8 is a view similar to FIG. 6 but as seen from the opposite side of FIG. 6, with the shear blade and shear blade actuator seen foremost.

FIG. 9 is an enlarged elevational view generally similar to FIG. 6 but only of the anvil and crimp dies, illustrating the first stage in the crimping operation.

FIG. 10 is an enlarged view somewhat similar to FIG. 9, but taken on the line 10—10 of FIG. 7. It illustrates a second stage in the crimping operation.

FIG. 11 is a transverse sectional view as seen substantially on line 11—11 of FIG. 10, showing the terminal as sheared from the continuous strip, with the terminal crimped onto the wire shown in elevation.

FIG. 12 is a fragmentary cross-sectional view taken on line 12—12 of FIG. 7, showing the setting slot detail.

FIG. 13 is a perspective detail of the completed crimped terminal attached to the wire.

FIG. 14 is a perspective view of a partial strip of one form of terminal for use with this tool, shown in an inverted position.

GENERAL DESCRIPTION

Referring to the drawings, and particularly FIG. 1 – 4, wherein like reference numerals designate like parts throughout the various figures, the tool designated generally at **10** comprises a crimp plier frame or housing **12** open in its middle area **13** and having a bifurcated handle attaching end **14**, from which a fixed, complementally bifurcated handle **16** extends. The fixed handle is attached by any suitable means such as a bolt-and-nut assembly **18** and a rivet **20**. A movable handle **22** with ratchet segment **24** is pivotally mounted within the handle **16** and bifurcated end **14** by means of said bolt assembly **18**. A spring **28** mounted inside the handle **16** exerts tension on a flexible cable **23** which passes around the pivot point and under the handle **22** at **25**. The effect of the spring is to move the handle normally to the open position shown in full lines in FIG. 2. Handle **22** has an upper nose end **26** which by engaging against rivet **20** acts as a stop, limiting movement of the handle in the opening direction. Closing and opening movement of the handle **22** effects reciprocating movement of slide block **30** (FIG. 4) via the connecting link **32** pivotally connected at **34** within a bifurcated lower portion of said slide block **30**. The block **30** has a screw **36** adjustably threaded in the upper end of said block **30**, and terminating in a headed or flanged portion **38**.

A conductor crimp die **40**, insulation crimp die **42**, and shear blade actuator **44** are disposed within the middle open cavity **13** of frame **12**, in side-by-side relation as illustrated in FIG. **4**. The three members are complementally notched at their respective lower ends **40***a*, **42***a* and **44***a*, for engagable mounting upon and movement by the flanged end **38** of adjusting screw **36**. An anvil **46** carrying a shear blade **48** with opposed lugs **48***a* slidably mounted in trackway **50**, is mounted within the upper end of open cavity **13** of said frame **12**, with the aid of retaining lugs **12***a* and **12***b* on the respective front and back walls **13***a* and **13***b*, seen in FIG. **4** and FIG. **6**. These major tooling parts are held within the open cavity **13** of the frame **12** by removable laterally opposed housing side wall plates **52** and **54** attached by a plurality of screw-and-nut assemblies **56***a* and **56***b*, the screws passing through suitable clearance holes formed in the frame **12** (see FIG. **4**).

The front wall .13a of frame **12** is interrupted at **15**, leaving a space which permits insertion of the terminals **58** into the crimping area.

In the usual way of manufacturing terminals of the kind for which this tool is intended, the individual terminal elements **58** are formed integrally with a carrier strip **60** which spaces them uniformly, and connects them in a group for convenience in handling, orientation and use. For use with this invention, the wire attachment ends of the terminal elements are preferably fabricated in the form shown in FIG. **14**, with opposed upstanding wire gripping ears **59***a* and somewhat longer opposed upstanding insulation gripping ears **59***b*.

A guide trackway or magazine **61** is attached to the frame **12** by a bracket **61***e* (FIG. **1**). It serves as a feed channel through which a strip of terminals is guided so that the foremost terminal is moved into proper position between the anvil **46** and the crimping dies. For simplicity, in the form of the device shown here, the feeding is done manually, but it is possible to provide other means for advancing the strip each time the tool is actuated.

The wire to be used is pre-stripped, having its conductor **62** exposed for a distance approximately the same as the axial length of the terminal ears **59***a*. The wire **62** is thrust into the crimping area until the wire end bears against a suitable wire stop such as that depicted at **66** (FIG. **7**). The wire stop means **66** may be formed as a tongue on the side plate **52**, with an end portion **66***a* projecting to act as an abutment against which the wire **62** may be positioned. When the wire is so located, the stripped area of the conductor **62** lies between the opposed wire gripping ears **59***a*, with the adjacent portion of the insulation **63** disposed between opposed insulation gripping ears. Actuation of the slide block **30**, by squeezing the handles **16** and **22** together, moves the dies toward the anvil, successively crimps the respective pairs of ears around the wire and the insulation, and shears the terminal from its carrier **60**. When the handles of the tool are opened, the completely terminated wire can be withdrawn.

OPERATION IN DETAIL

To minimize the force required to actuate the handles of the tool, and for other reasons which will be subsequently explained, the invention provides for sequential performance of the operations of crimping the ears **59***a* onto the wire conductor **62**, and of crimping the ears **59***b* onto the insulation **63** and shearing terminal **58** from the carrier strip **60**. The wire crimp die **40** is therefore arranged to advance into working position somewhat ahead of the insulation crimp die **42**. The relative location of the working faces of these dies as they advance can be seen in FIG. **6**, where the jaws of the wire crimp die **40** are shown in full lines, and the jaws of the insulation crimp die, which lies behind it, are shown dotted. The same relation is seen in FIG. **8**, where both dies are shown in full lines.

As one way of providing for an elevated or advanced position of die **40** with respect to die **42**, the parts on their adjacent faces are mutually recessed at **41** and **43** to house a compression spring **68** therebetween. The normal length of the spring is greater than that of the cavity, so it is under partial compression when confined therein. The spring thus tends to move die **40** in advance of die **42** on a closure stroke, and yet permits sliding movement of die **42** relative to die **40** by compression of the spring after die **40** has reached full closure position.

Wire crimp die **40** is preferably provided with a double U-form crimping seat **40b** to set the ears firmly into the wire **62**, and FIG. **9** illustrates the stage at which this operation has just been completed.

After the wire crimp has been set, and the die **40** cannot advance further, to allow for further advance of the die **42** provision must be made for some lost motion between the die **40** and the actuating mechanism. This is done by making the slot **40***a* somewhat longer, in the direction of movement, than is necessary to fit over the head **38** of the screw **36**, as seen in FIGS. **6** and **9**.

The next stage in the operation, as the actuating mechanism is further advanced, is seen in FIG. **10**, which is a section through the interface between dies **40** and **42**. The jaws of die **42** have engaged the ears **59***b* and formed them around the insulation **63**, so the attachment functions are complete. The shear blade actuator **44** has come into contact with the shear blade **48**, both shown dotted in FIG. **10**.

As seen in FIG. 11, upward movement of the shear blade **48** has sheared the terminal **58** from the carrier **60**, Die **42** has moved upward with relation to die **40**, resulting in compression of spring **68**.

It will be observed that the arrangement wherein the wire crimp die **40** is first advanced, by yieldable coupling means, provides important advantages. The crimping of terminal ears onto the wire will be fully and properly performed for a considerable range of wire sizes, and with a considerable tolerance for production variations in the thickness and temper of the terminal material. Yet oversize wire or terminal material will not cause such an increase in operating force requirements that the user would have difficulty in completing the crimp operation through the insulation crimp and cut-off stages.

ANVIL-SHEAR BLADE DETAILS

Referring to FIG. **5**, the anvil **46** comprises compositely the depending anvil portion **46a**, adapted to back up the crimping of the ears **59*a***, and the anvil portion **46*b***, adapted to back up the crimping of ears **59*b***. The anvil has formed at one side an opposed pair of trackways **50** for the shear blade **48**. The latter is slidably disposed adjacent the insulation-receiving anvil portion, which has a planar shearing face **47** for cooperation with a complementary shearing face and edge **49** of shear blade **48**. Responsive to upward movement of the shear blade initiated by the shear blade actuator **44**, the shear blade moves against the bias of a compression spring **72** seated within a suitable recess **72*a*** formed in the top end of the blade **48** (FIGS. **4, 6 – 11**). The blade member **48** is provided with a stop ledge **48*b***, which limits its downward movement by engagement against a stop shoulder **46c** of the anvil **46** (FIG. **11**). A slot **49*a*** receives the terminal carrier strip **60**, and the lower, outer corner of the slot is the functional shearing edge.

A recessed area **49*b*** (FIG. **5**) provides a guideway which assists the user in directing a wire into proper position. FIG. **7** shows how the wire passes through it. The recessed area, cooperating with a corresponding recess on the lead edge of the shear blade actuator **44**, prevents crushing of the wire when the actuator engages the shear blade. Upon such engagement, the shear blade is moved upward, and the result can be understood by reference to FIGS. **7** and **11**. In FIG. **7** the carrier strip **60** is shown in section, passing through the slot **49a** in the shear blade. It will be apparent that when the blade moves upward, carrying the strip **60** with it, the shearing action of the lower lip of the slot **49*a*** against the surface **47** of the anvil will separate the strip from the adjacent end of the terminal **58**. This stage is illustrated in FIG. **11**.

The handles of the tool are then allowed to open, which causes the dies **40** and **42** to retract from their engagement with the terminal **58**, so that the wire with the terminal attached can be withdrawn. Also, the shear blade actuator retracts, and under the force of spring **72**, the shear blade moves back down to its initial position, with stop ledge **48*b*** resting against stop shoulder **46*c***. The terminal strip can then be further advanced.

TERMINAL STRIP FEED MEANS

The trackway or magazine **61** provided to receive terminal strips is of a T-shape configuration in cross-section, as seen most clearly in FIG. **3**. It is open at both ends and along one lateral side **61*a***, from which the terminals **58** project. The opposite lateral side forms the guide channel portion **61*b*** within which the carrier strip **60** is slidably conducted. A depending channel portion **61*c*** is provided for receiving and guiding the insulation gripping ears **59*b***. The trackway is attached to the tool frame **12** by a bracket **61e** in such a way that a strip inserted through the track comes into proper alignment with the anvil.

After an operation cycle is completed, the strip of terminals is manually advanced to bring the next terminal into proper position, and the tool is ready for insertion of another wire. The operator need not lay the tool down, nor the strip of terminals, as is necessary with some earlier devices.

As the strip is successively advanced with each operation, the carrier **60** moves on through a slot **64** in the frame **12**, and the portion of the carrier which projects from the rear of the frame can be grasped to advance the strip after the latter has been used to the point where it is not conveniently accessible from the front of the tool.

An important feature of the arrangement of the tool and feed means described is that the functional end of the terminal **58** projects outside the confines of the magazine trackway and of the tool, and thus is not limited in size or conformation by the device used to attach it to the wire. The term "functional end" is used to refer to that portion of the terminal opposite the end where the crimp ears are located. The functional end is the part of the terminal used to connect to other circuit elements after the terminal has been crimped to a wire. While the terminal is shown in the drawings as having a ring or loop end, it may just as well be any of the other known conformations — spade, tab, receptacle, taper pin, etc. Since this end of the terminal does not have to be accommodated in the device, no adjustments or accessories are necessary to enable the use of terminals with functional ends of any of the various types.

WIRE SIZE SETTING

A highly desirable feature in a tool of the kind described is the capability of use on wire of various conductor gauges with a minimum of inconvenience, and preferably without the necessity for changing separable parts or attachments. Some available crimping tools are designed to work with wire of various gauges, but require removal of one crimping sub-assembly and insertion of another when a change of wire gauge must be accommodated. This is a substantial inconvenience, and further involves the risk of loss of the extra sub-assemblies.

The fundamental requirement to accommodate wire of various gauges is a variation in the closure distance, that is, the distance between the anvil and the crimping dies at the full stroke position in the operating cycle, giving a crimp height designated as H in FIG. **9**.

To permit selection of this distance, the present invention provides a setting lever **37** attached to and projecting radially from the screw **36**; the lever can be

selectively positioned on one side or the other of a projection **54***a* on the lower portion of the side plate **54**. In FIG. 1 the lever is shown in the space at the right of projection **54***a*, and marking on the side plate **54** designates this as the proper position for use with wire of gauges in the range **24–28**.

To change the setting, the tool handles are partially closed to elevate the screw lever **37** above the projection **54***a*, where it can be moved to the left side of the projection, in the space designated for wire of gauges in the range **18–22**. With a right-hand thread, the screw **36** enters the block **30** by a few thousandths of an inch, increasing the closure distance by that amount, to make a proper crimp on wire of larger gauge. The actual amount is determined by the angle through which the screw is turned, (illustrated in FIG. **12**) and the pitch of its thread. The pitch is selected to give a change in closure distance as required: for example, with **28** threads per inch, and a 50° swing of the lever, the adjustment is approximately 0.005 inch.

It is to be understood that initial spacing or relative positioning of tool members is made for the preset lever positions during manufacturing procedures to establish dimensions within the requisite tolerances for proper crimping. A tool in accordance with the invention, when properly set, will perform a cycle such as that herein described with the application of a force of approximately 17–18 pounds to the tool handles.

It will be apparent that the invention herein described provides a crimping tool which is compact and portable and which assures the making of a proper crimp joint regardless of the skill of the operator. It embodies simple means of selection and presetting for a choice of wire size ranges, without the use of separate parts which could be easily get lost. Once the wire size range is chosen and set, the operation of the tool involves only three extremely simple steps — movement of the foremost terminal of a strip into proper crimping position, insertion of a stripped wire against the stop, and squeezing of the handles. This is a sequence easily understood and one which can be performed without error even by an untrained technician.

The same tool, with no changes or attachments, can be used for a wide range of types and sizes of terminals, by reason of the arrangement previously described, whereby the functional end of the terminals projects from the trackway and from the tool, and thus is not limited in size or conformation by any dimensions of the tool.

The foregoing description of the present invention is only illustrative of a specific form which the invention may take. Still other modifications and variations will suggest themselves to persons skilled in the art. It is intended, therefore, that the foregoing detailed description be considered as exemplary only and that the scope of the invention be ascertained from the following claims.

That which is claimed is:

1. In a tool for attaching terminals to the end of stripped wires, wherein a mounting frame carries pliers-type handles, an anvil member, a slide member, and means actuated by said handles to cyclically move said slide member with relation to said anvil, the improvement consisting of a shear member arranged to cooperate in shearing relation with said anvil member, die means comprising first and second die members advanced sequentially by said slide member into operative crimping relation to said anvil, and a spring interposed between said slide member and said first die member, whereby said second die member may be further advanced after said first die member has attained full closure with respect to said anvil member, said shear member being advanced by further movement of said slide member into engagement with said anvil member to effect shearing action.

2. In a crimping tool for use with terminals having separate pairs of upstanding ears for engagement with stripped and insulated portions of a wire respectively, the improvement comprising, in combination, a first tool means including an anvil and a V-shaped die adapted to crimp a pair of ears therebetween on the stripped portion of a wire, and a second tool means including an anvil and a V-shaped die adapted to crimp a pair of ears therebetween on the insulated portion of a wire, and handoperated means including piller-type handles actuating said first and second tool means in sequence upon closure of said handles, said handoperated means including a spring interposed between said handles and said first tool means, permitting further movement of said second tool means after said first tool means has completed a crimp operation.

3. In a tool for attaching terminals to the end of stripped wires, wherein a mounting frame carries operating handles, an anvil member, a slide member, and means actuated by said handles to cyclically move said slide member with relation to said anvil, the improvement consisting of first and second die members advanced sequentially by said slide member into crimping relation to said anvil, a screw threaded into said slide member and engaging said die members, and setting means including a lever extending radially from said screw and a member mounted on said frame having a plurality of slots formed therein extending parallel to the axis of said screw, said lever being optionally movable into any one of said slots.

4. The invention as defined in claim 3, including yieldable means interposed between said screw and said first die member, permitting further movement of said second die member after said first die member has attained full closure with respect to said anvil member.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,710,610

DATED : January 16, 1973

INVENTOR(S) : William S. McCaughey

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 19, change "3,842,018" to -2,842,018-.

Column 2, line 10, change "removed" to -remove-.

Column 7, line 18, change "required:" to -required;-; line 35, cancel "be".

Column 8, line 30, change "handoperated" to -hand-operated-; same line, change "piller-type" to -plier-type-.

Signed and Sealed this

tenth Day of *February 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks