United States Patent [19]

Dyksterhouse

[11] **3,742,564**

[45] **July 3, 1973**

[54] **TERMINAL CRIMPING APPARATUS**

[76] Inventor: **Robert M. Dyksterhouse**, R.R. 3, Charlevoix, Mich.

[22] Filed: **Nov. 3, 1971**

[21] Appl. No.: **195,165**

[52] **U.S. Cl.** ..... **29/203 D**

[51] **Int. Cl.** **H01r 43/04**

[58] **Field of Search** ..... 29/203 D, 203 DT, 29/203 R

[56] **References Cited**

UNITED STATES PATENTS

3,402,452 9/1968 Mraz ..... 29/203 D

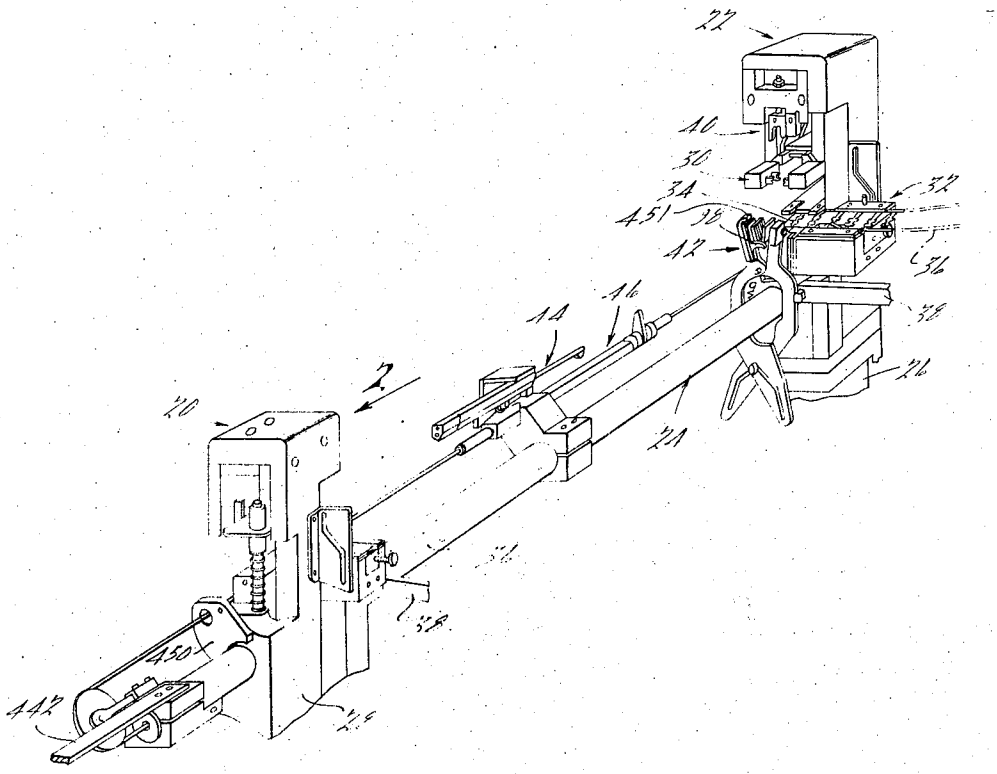
Primary Examiner—Thomas H. Eager

Attorney—J. King Harness, Robert L. Boynton et al.

[57] **ABSTRACT**

The present disclosure relates to an improved wire processing apparatus for making electric wire leads and harnesses including the cutting of the wire or wires, the cutting and stripping of the insulation from the end portions thereof, and the assembly of the components including the connection of the terminals thereto. The apparatus includes spaced head mechanisms each including wire cutting and insulation cutting and stripping means, and terminal securing means, and which holds the wire throughout the operation of these means. Cooperating with the head mechanisms is one or more wire feed means each of which moves through one of the head mechanisms to position an end portion of a wire in another of the head mechanisms and then returns through said one of the head mechanisms to position another portion of the wire in said one of the head mechanisms.

12 Claims, 33 Drawing Figures



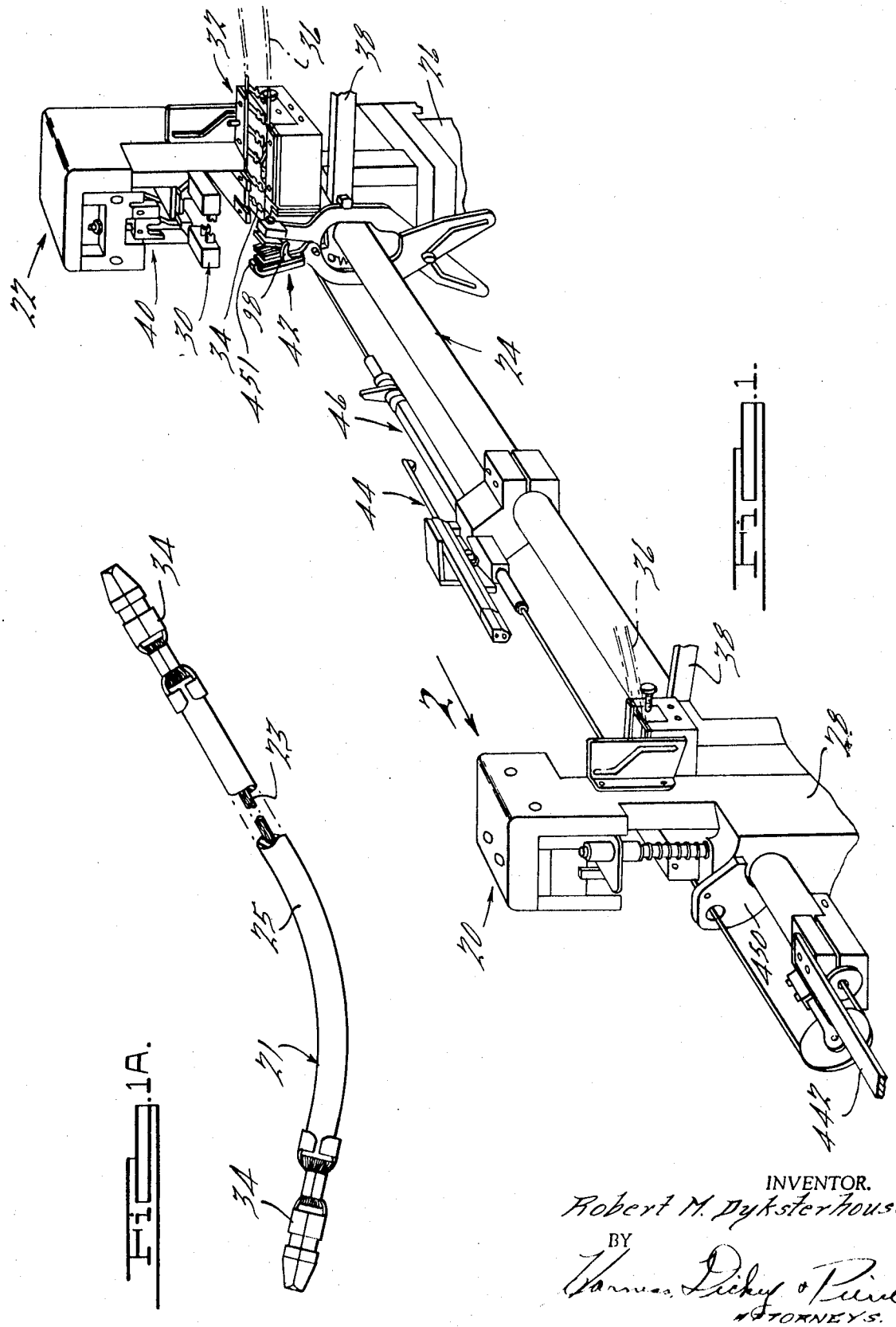


FIG. 1A.

FIG. 1.

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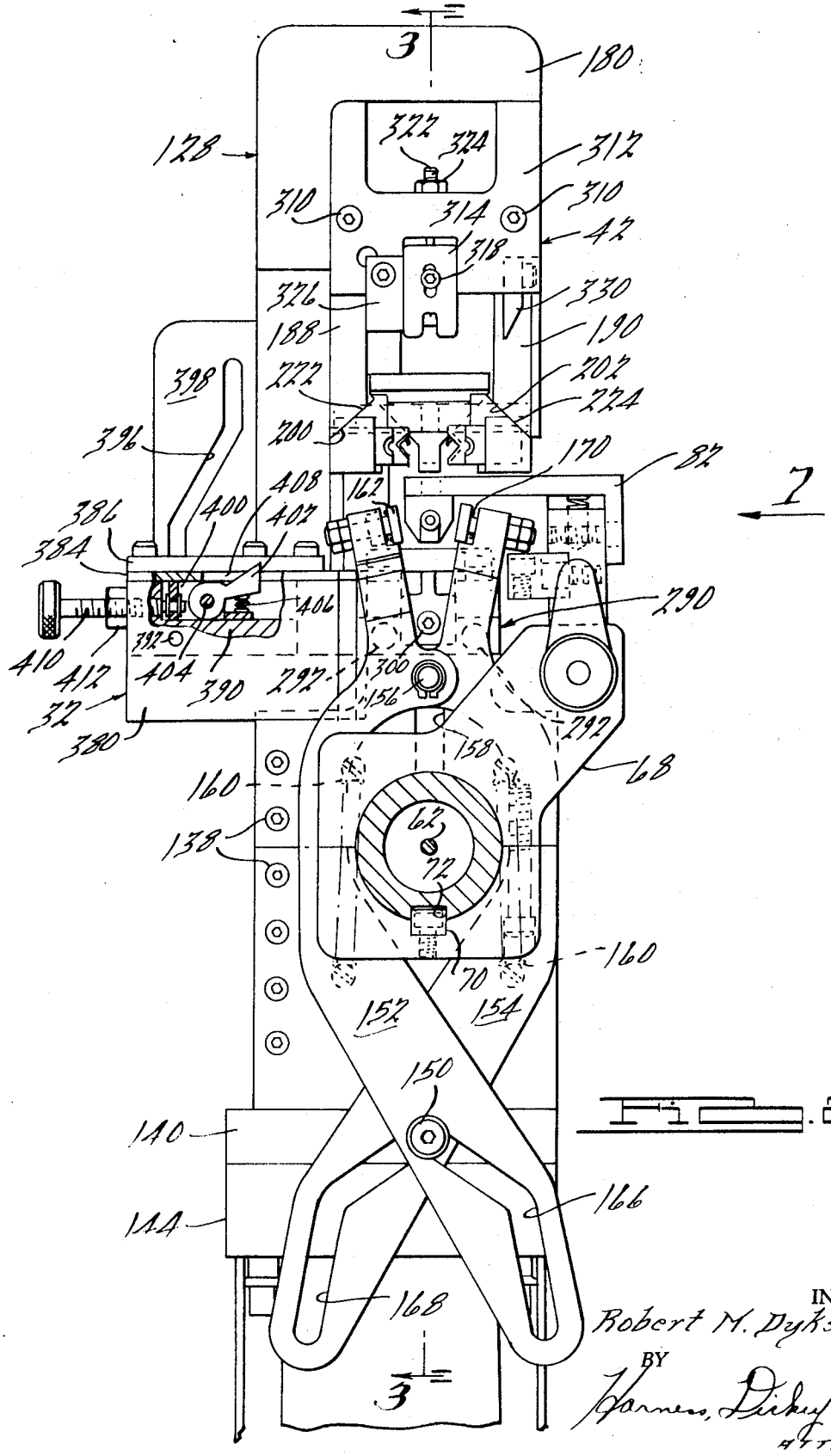


FIG. 2.

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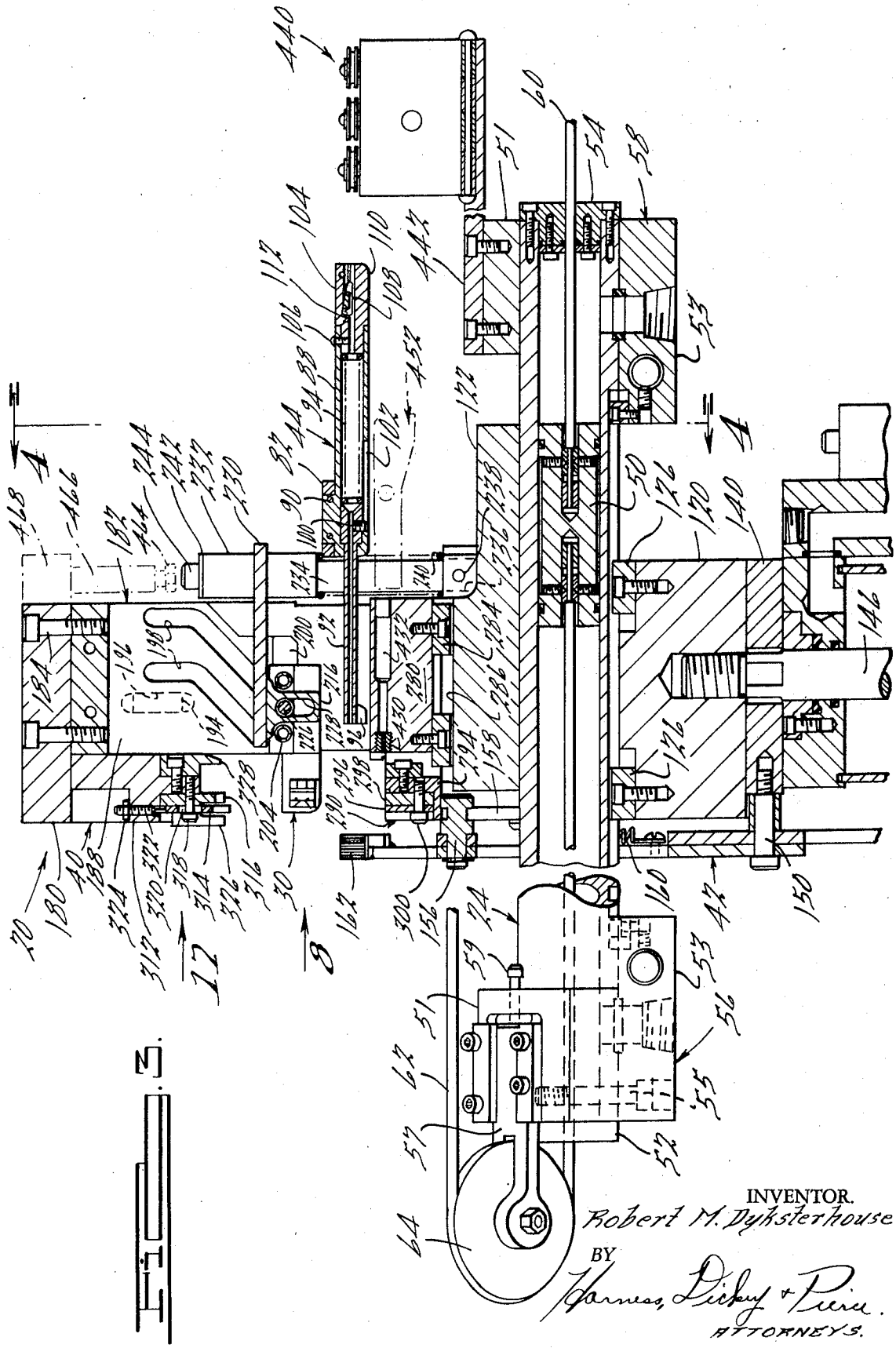


FIG. 2

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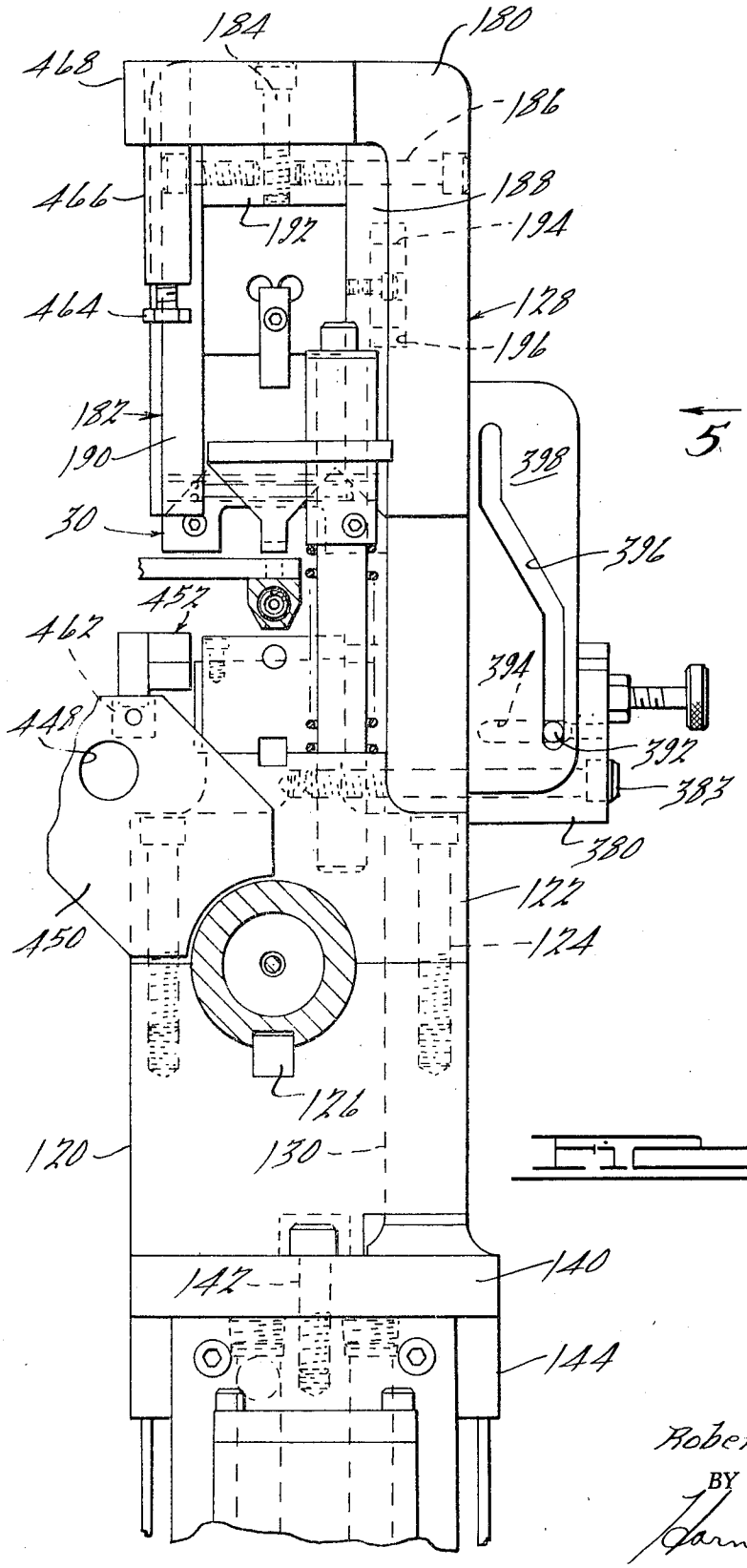


FIG. 4.

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FIG. 6.

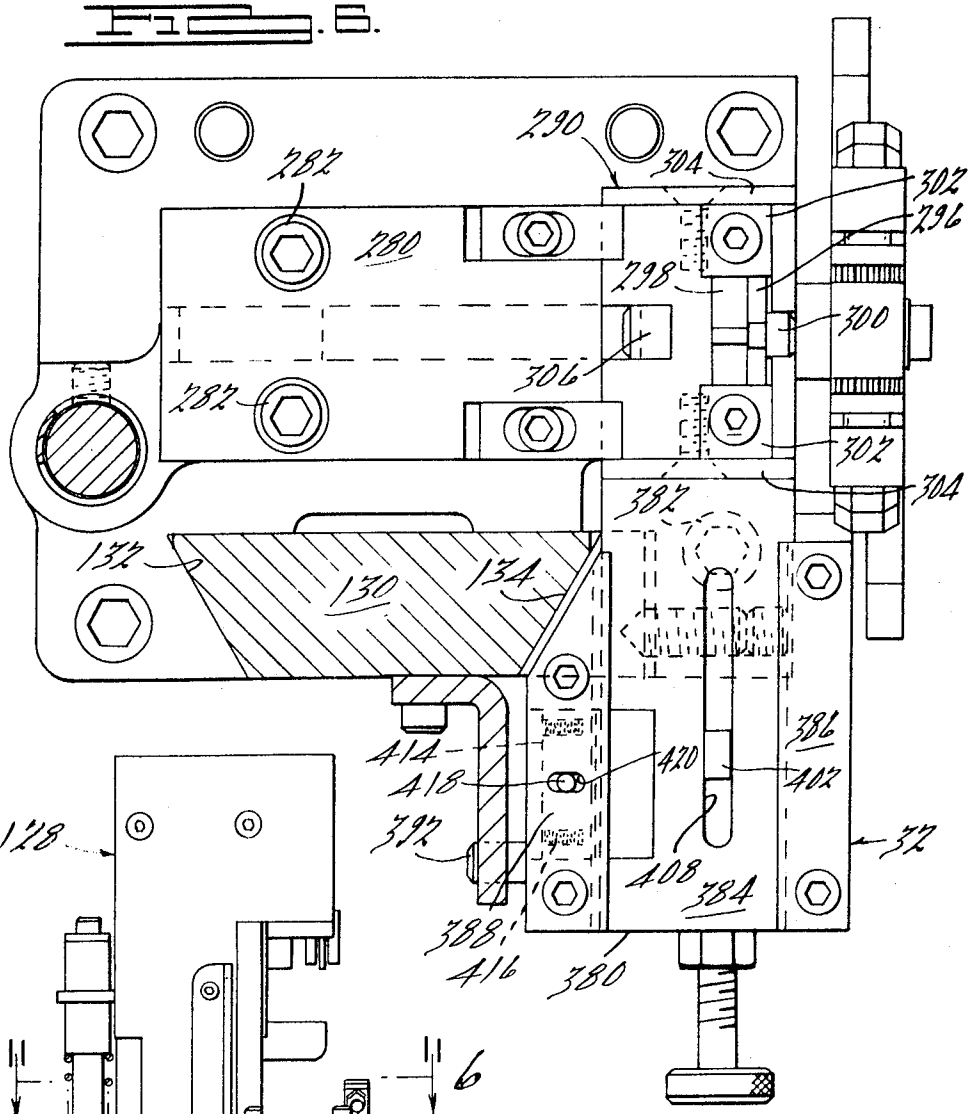
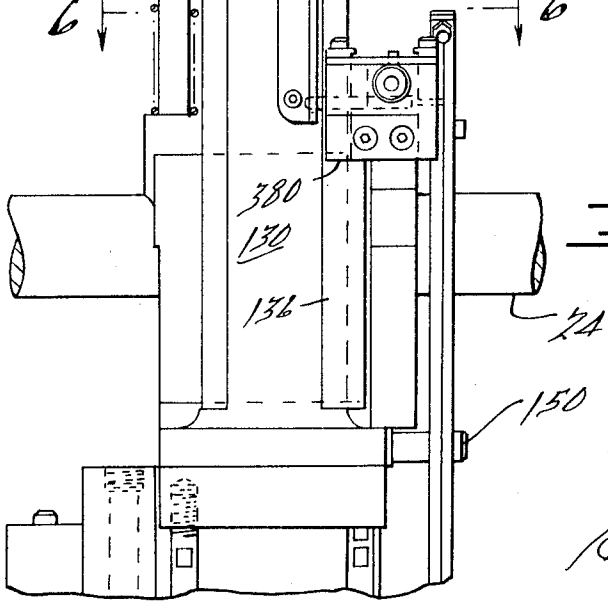


FIG. 5.



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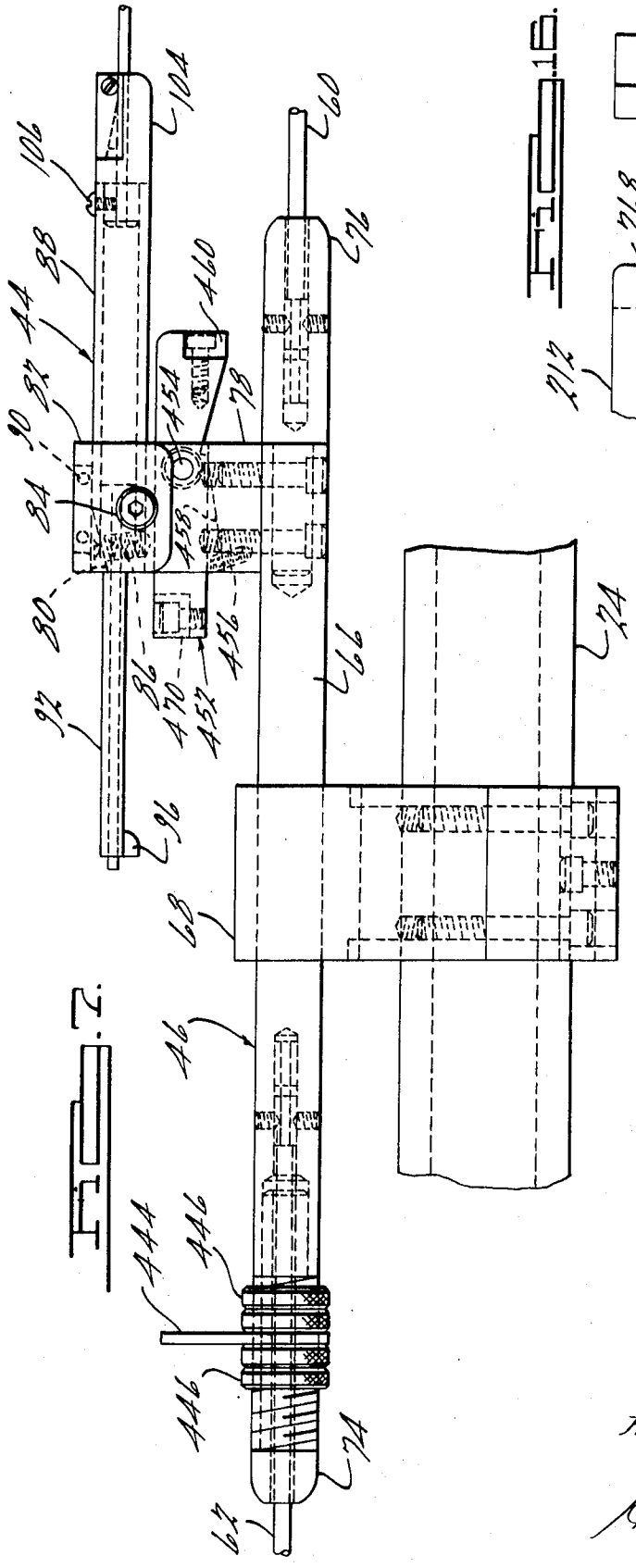


FIG. 17

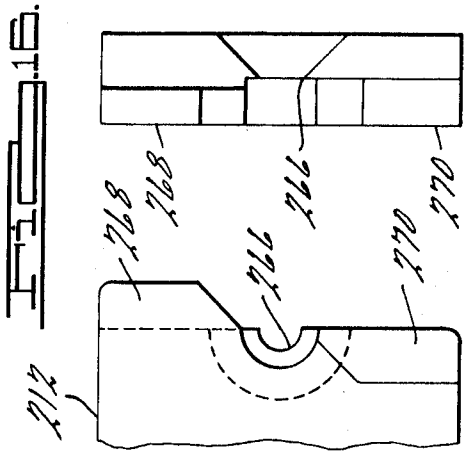


FIG. 16

FIG. 15

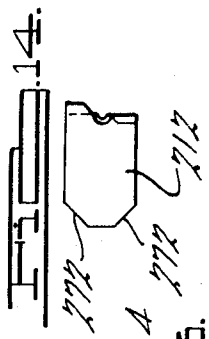


FIG. 14

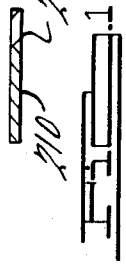
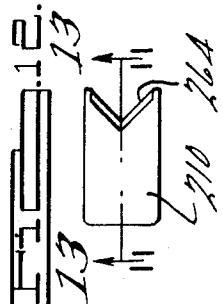
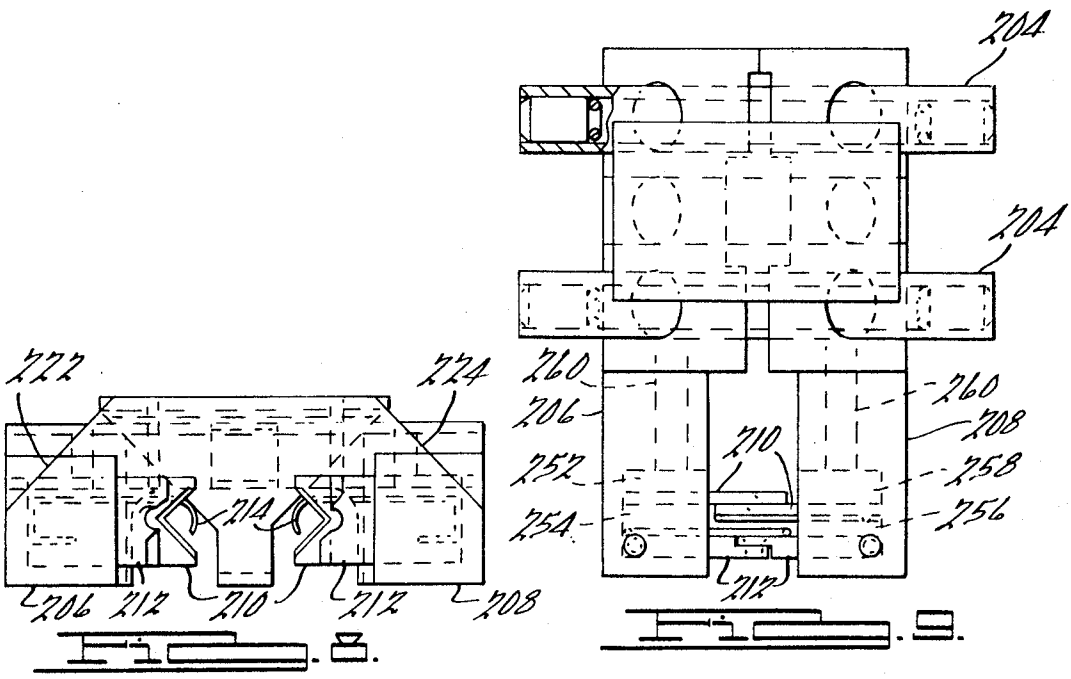
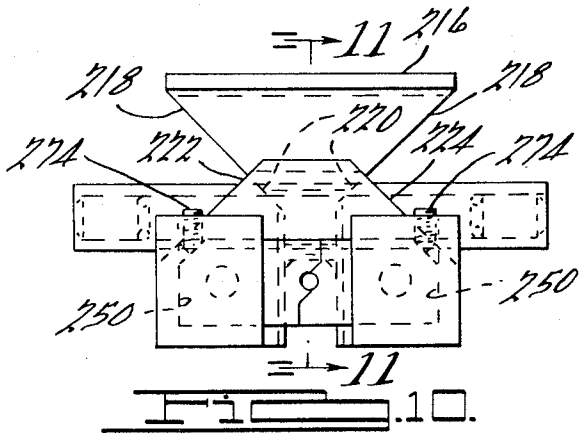


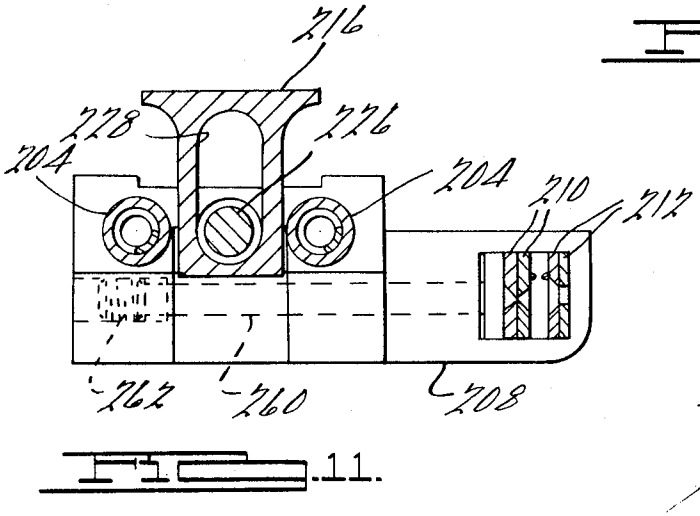
FIG. 13



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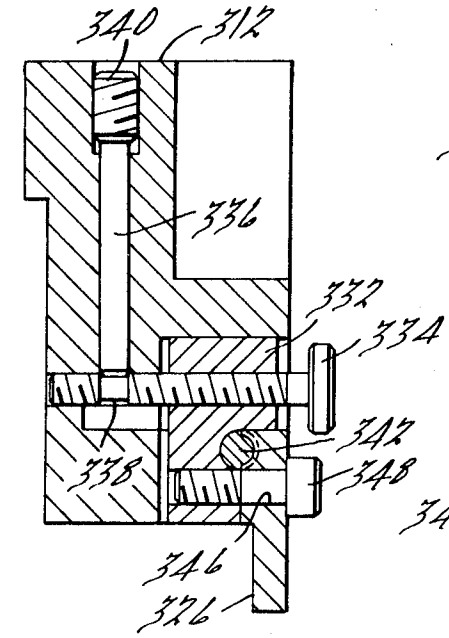


FIG. 16.

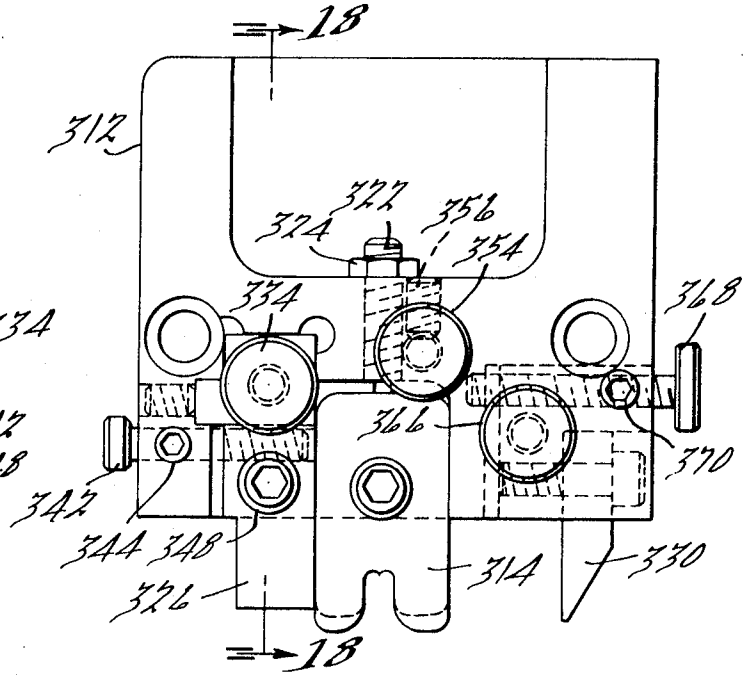


FIG. 17.

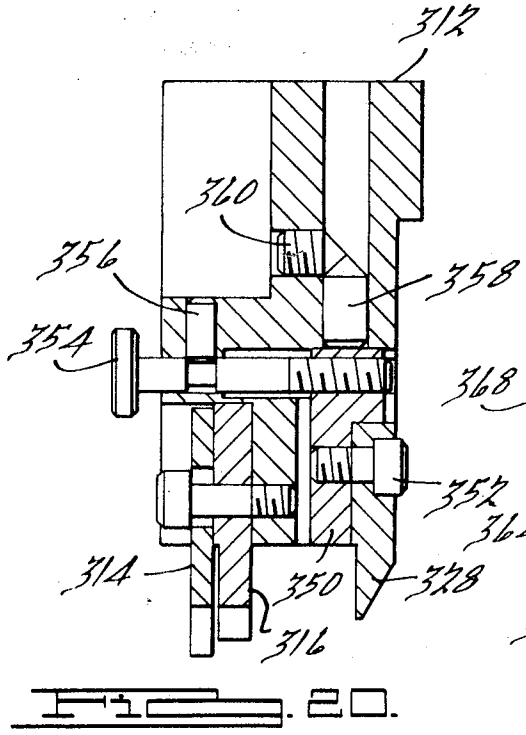


FIG. 20.

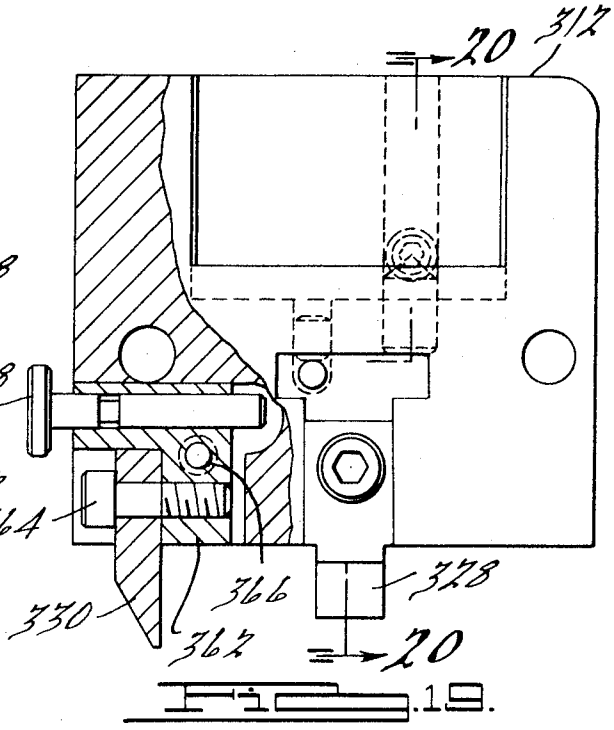


FIG. 19.

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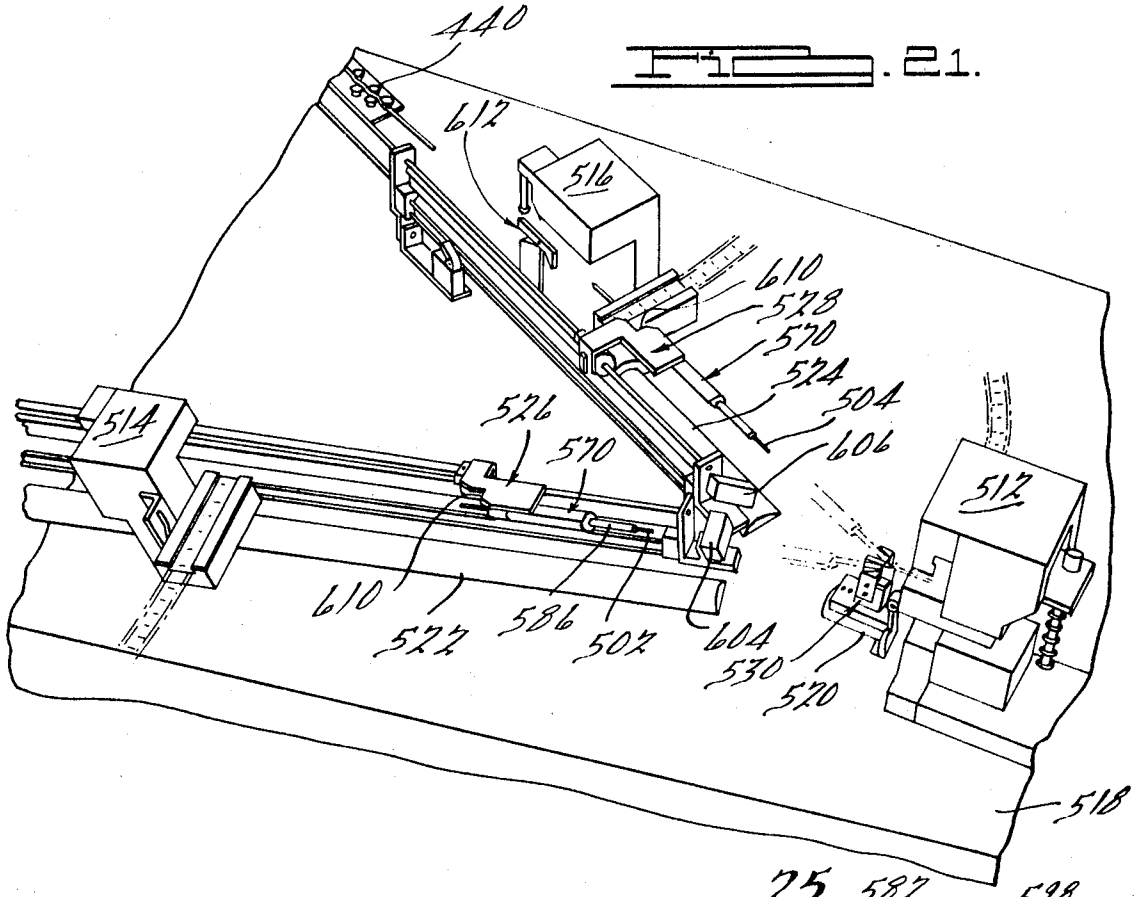


FIG. 21.

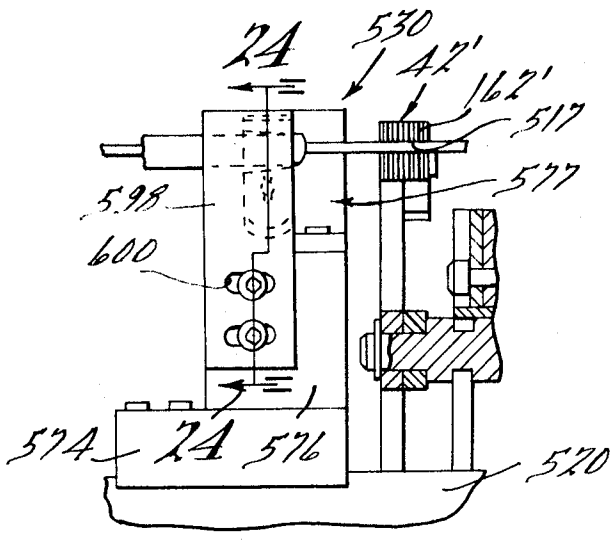


FIG. 23.

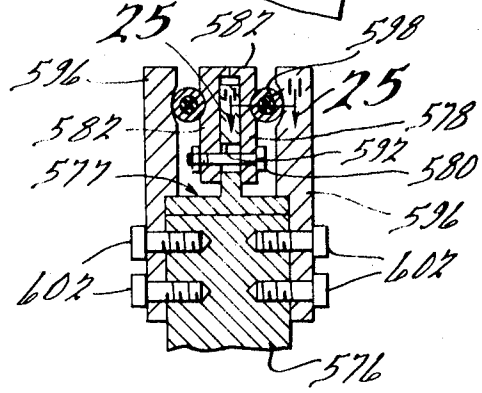


FIG. 24.

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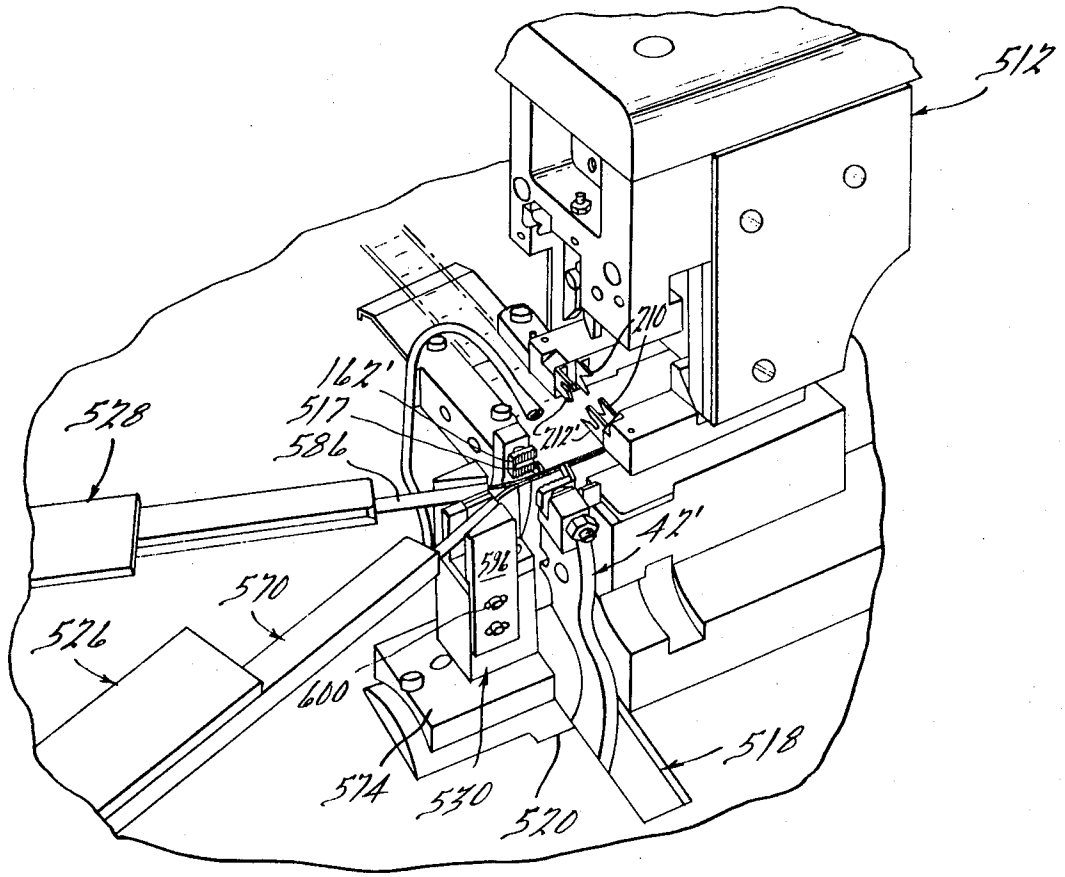


FIG. 22.

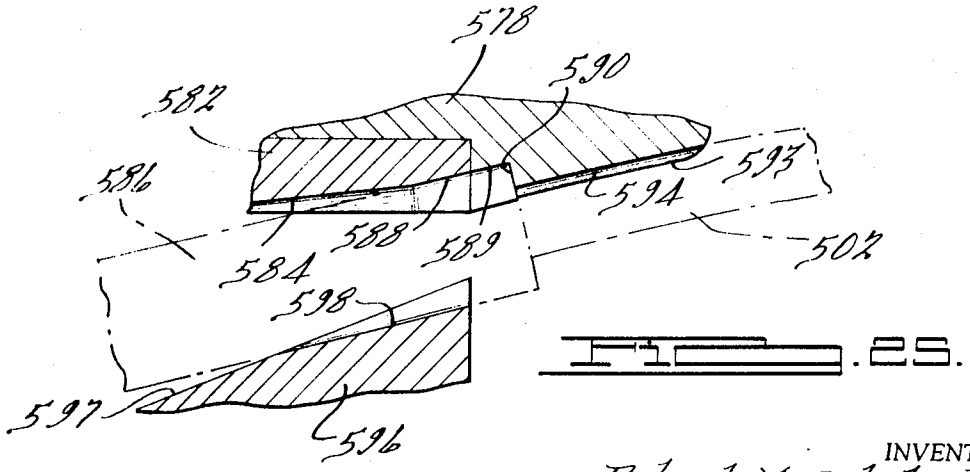


FIG. 25.

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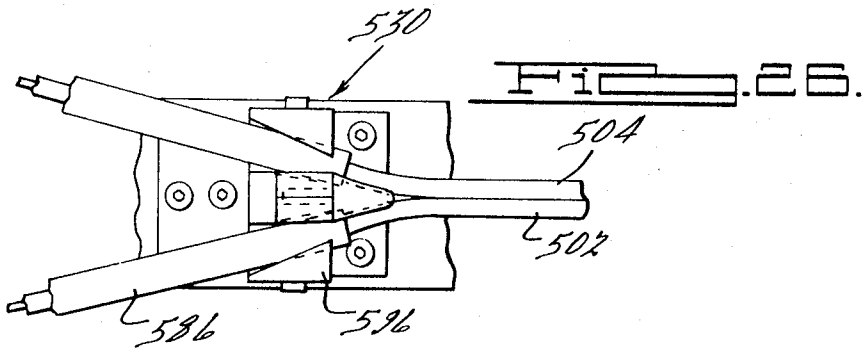


Fig. 26.

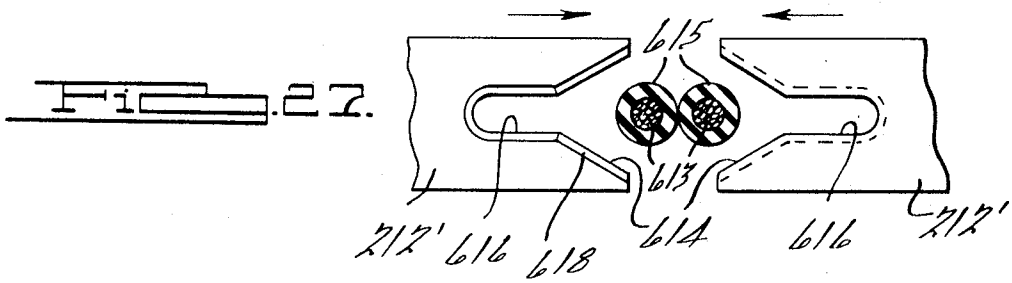


Fig. 27.

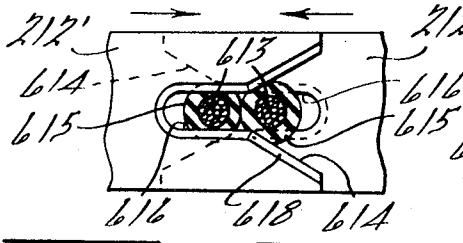


Fig. 28.

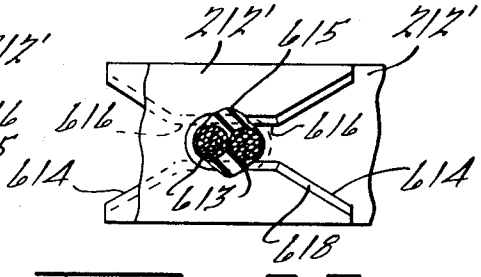


Fig. 29.

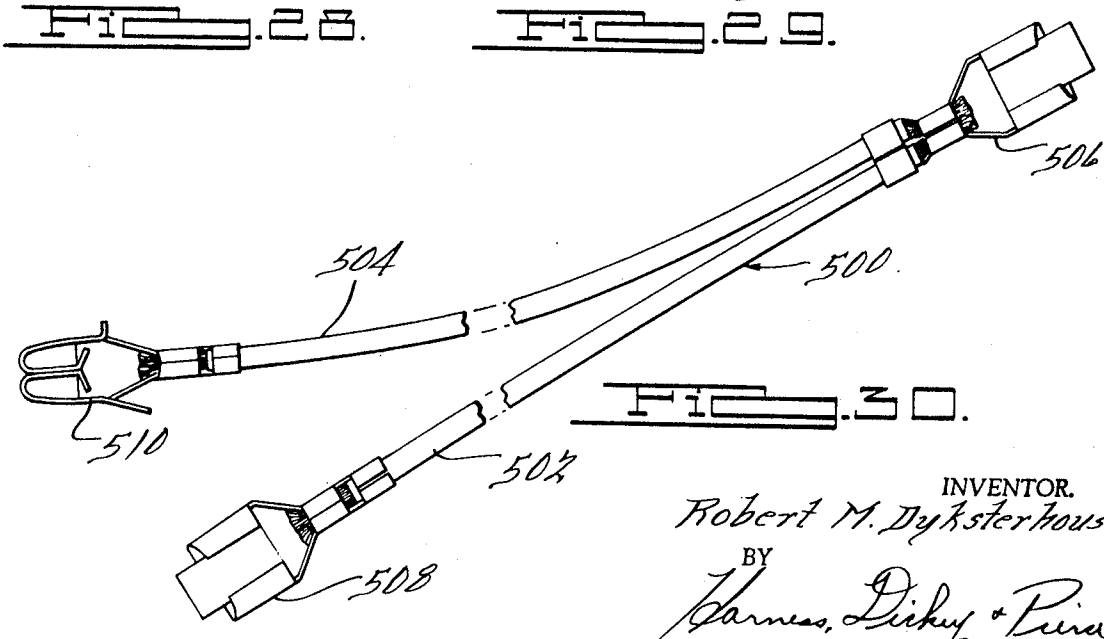


Fig. 30.

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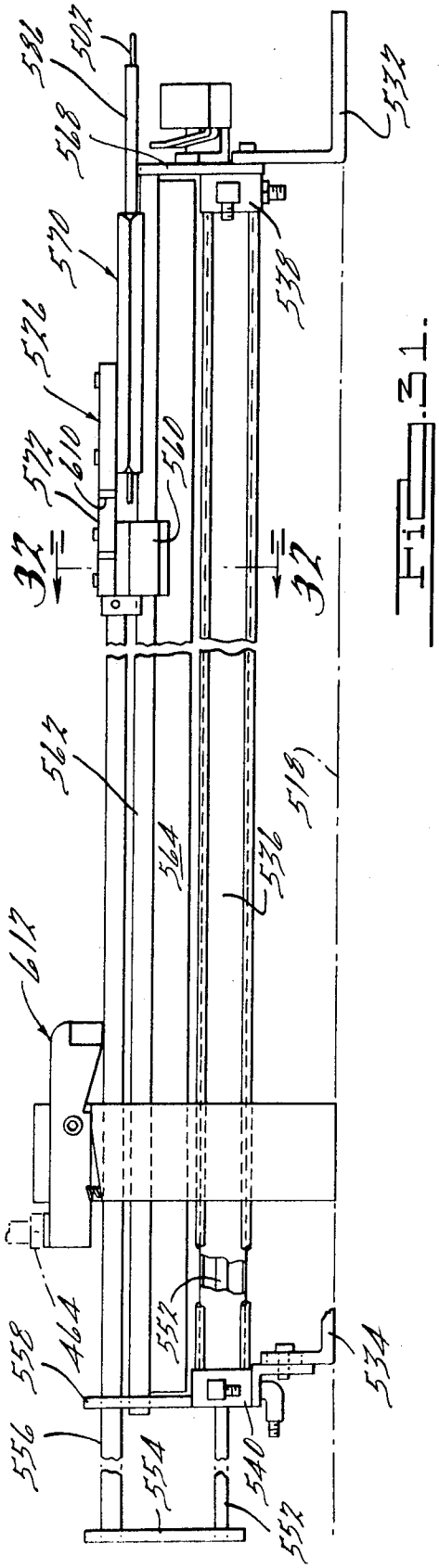


Fig. 31.

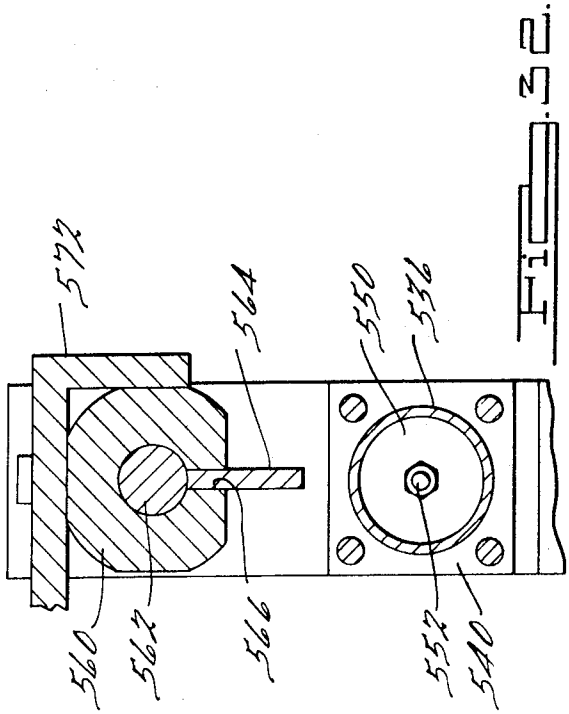


Fig. 32.

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TERMINAL CRIMPING APPARATUS

DESCRIPTION OF THE INVENTION

It is an object of the present invention to provide an improved apparatus of the above mentioned type in which the wire is held throughout the cutting of the wire, the cutting and stripping of the insulation, the placing of the wire in the terminals and the securing of the terminals thereto.

It is also an object to provide an improved apparatus of the above mentioned type including a pair of head mechanisms the distance between which controls the length of the lead to be made and a feed nozzle movable through one of the head mechanisms for positioning a length of wire between said head mechanisms in position to be held thereby and in which the nozzle returns through the same head mechanism to grip the wire between the length of wire to be cut by the head mechanisms and the source of supply.

Another object of the present invention is to provide an improved head mechanism for a wire processing apparatus including improved wire cutting and insulation cutting and stripping means and improved terminal securing means and which holds the wire securely throughout the operation of these means.

It is also an object of the present invention to provide an improved wire feed mechanism for a wire processing apparatus and an improved nozzle assembly through which the wire extends at all times.

It is also an object of the present invention to provide such an improved head mechanism adapted to secure a plurality of wires to a single terminal.

It is a further object of the present invention to provide such an improved wire processing apparatus including a combining unit adapted to position a plurality of wires for connection to a single terminal.

Another object of the present invention is to provide in a wire processing apparatus an improved head having improved means for cutting the insulation and stripping it from the wire.

A further object is to provide improved means for positioning the wire in the terminal to be attached thereto and for attaching the terminal to the wire.

Other and more detailed objects of the present invention will be appreciated from a consideration of the following specification, the appended claims and the accompanying drawings throughout the several views of which like reference characters designate like parts and wherein:

FIG. 1 is a broken perspective view of an embodiment of the invention adapted to make a single wire lead having a terminal secured to each end thereof;

FIG. 1A is a perspective view of a wire lead which may be made by the apparatus of FIG. 1;

FIG. 2 is an enlarged transverse vertical sectional view of the structure illustrated in FIG. 1 looking in the direction of the arrow 2;

FIG. 3 is a longitudinal sectional view of the structure illustrated in FIG. 2 taken substantially along the line 3—3 thereof;

FIG. 4 is a broken sectional view of the structure illustrated in FIG. 3 taken substantially along the line 4—4 thereof;

FIG. 5 is a broken reduced side elevational view of the structure illustrated in FIG. 4 looking in the direction of the arrow 5;

FIG. 6 is an enlarged transverse horizontal sectional view of the structure illustrated in FIG. 5 taken substantially along the line 5—5 thereof;

FIG. 7 is a broken enlarged elevational view of the wire feed mechanism illustrated in FIG. 2 looking in the direction of the arrow 7;

FIG. 8 is an enlarged elevational view of the cut and strip assembly illustrated in FIG. 3 looking in the direction of the arrow 8 and showing the assembly in the open position;

FIG. 9 is a plan view of the cut and strip assembly illustrated in FIG. 8 but showing the parts in their closed position;

FIG. 10 is an elevational view similar to FIG. 8, showing the assembly in its closed position;

FIG. 11 is a longitudinal section view of the structure illustrated in FIG. 10 taken substantially along the line 11—11 thereof;

FIG. 12 is an elevational view of one of the wire cutter blades of the cut and strip assembly;

FIG. 13 is a sectional view of the blade illustrated in FIG. 12 taken substantially along the line 13—13 thereof;

FIG. 14 is an elevational view of one of the insulation cutting and stripping blades of the cut and strip assembly;

FIG. 15 is a broken enlarged elevational view of the right hand end portion of the blade illustrated in FIG. 14;

FIG. 16 is an end elevational view of the blade illustrated in FIG. 15;

FIG. 17 is an enlarged elevational view of the terminal crimping and cutting assembly looking in the direction of the arrow 17 in FIG. 3;

FIG. 18 is a vertical sectional view of the structure illustrated in FIG. 17 taken substantially along the line 18—18 thereof;

FIG. 19 is a view partially in section and partially in elevation looking at the rear of the terminal crimping and cutting assembly as seen in FIG. 17;

FIG. 20 is a sectional view of the structure illustrated in FIG. 19 taken substantially along the line 20—20 thereof;

FIG. 21 is a broken perspective view of a modified embodiment of the invention adapted to produce a multiple wire wiring harness and showing some parts diagrammatically;

FIG. 22 is an enlarged broken perspective view of a part of the structure illustrated in FIG. 21;

FIG. 23 is a broken enlarged view of the combining unit illustrated in FIG. 22 and adjacent parts and looking in the direction of the arrow 23;

FIG. 24 is a broken sectional view of the structure illustrated in FIG. 23 and taken substantially along the line 24—24 thereof;

FIG. 25 is a greatly enlarged sectional view of the structure illustrated in FIG. 24 taken substantially along the line 25—25 thereof;

FIG. 26 is a plan view of the combining unit illustrated in FIG. 23 but with the head mechanism omitted for purposes of illustration;

FIG. 27 is an elevational view of the insulation cutting and stripping blades of the embodiment illustrated in FIG. 22 in the open position and shows the wires in section;

FIG. 28 is an elevational view similar to FIG. 27 but showing the blades in a partially closed position;

FIG. 29 is an elevational view similar to FIG. 27 but showing the blades in the full closed position;

FIG. 30 is a broken perspective view of a simple two wire wiring harness which may be made by the modified embodiment of the invention shown in FIGS. 21 to 32;

FIG. 31 is a broken elevational view of one of the wire feed mechanisms of this modified embodiment of the invention; and

FIG. 32 is a sectional view of the structure illustrated in FIG. 31 taken substantially along the line 32—32 thereof.

The improvements of the present invention, as will be appreciated from the following specification, may be embodied in an apparatus for making a single wire lead having a terminal connected to each end or in making a wiring harness having multiple wires having terminals selected ones of which may serve to interconnect selected ones of the wires. FIGS. 1 to 20 of the accompanying drawings illustrate an apparatus embodying the improvements of the present invention and adapted to make a single wire lead with terminals secured thereto. FIGS. 21 to 32 illustrate an apparatus also embodying the improvements of the present invention and adapted to produce a simple wiring harness including two wires and in which a single terminal connects the adjacent ends of the two wires and in which the other end of each of the two wires is connected to its own individual terminal.

Referring to FIGS. 1–20 of the drawings, the improved wire processing apparatus of the present invention there illustrated is adapted to make a single wire lead such as is generally indicated at 21 in FIG. 1A and including a conductor 23 covered with insulation 25 and having terminals 34 secured to the ends thereof. The apparatus generally comprises a stationary head 20 and a movable head 22 which are mounted on an elongated support 24 mounted on suitable base portions 26 and 28. The heads 20 and 22 are generally similar but oppositely facing, as seen in FIG. 1, and each includes a cut and strip assembly 30 for cutting the wire and cutting the insulation and stripping it from an end portion of the wire, a terminal feeding assembly 32 adapted to feed the end terminal 34 of a conventional terminal strip 36 into position, the terminal strip being carried on a reel (not shown) mounted on an arm 38 at each head. Each head also includes a terminal crimping and cutting assembly 40 which crimps the terminal to the wire and to the insulation and cuts the terminal 34 from the strip 36. Also, each head includes a clamp 42 which grips the wire and holds it throughout the cutting, stripping and terminal crimping and cutting operations. The wire is fed to the heads 20 and 22 in which it is held by the clamps 42, by a nozzle assembly 44 which is carried by a shuttle assembly 46 mounted on the elongated support 24 for movement therealong. As will be apparent from the following description, the construction is such that the nozzle, starting from a position in which it grips the wire between the stationary head 20 and a suitable source of supply of the wire, (that is, to the left of the head 20 as viewed in FIG. 1) moves through the stationary head 20 to position what may be called the leading end of the wire in the adjustable head 22 where is is grasped by the clamp 42 thereof, and then the nozzle 44 returns through the stationary head 20 to a position in which it again grips the wire between the head 20 and the source of supply. During this return movement the shuttle stops preliminarily when the nozzle assembly 44 has cleared the clamp 42 of the head 20 while the head 20 operates to close the clamp 42 thereof to hold the wire and then the shuttle 46 continues its movement to its final position in which the nozzle 44 is clear of the head 20 and in the above mentioned starting position. The operation of the heads 20 and 22 cuts the wire at both ends to provide the desired length, cuts and strips the insulation from both ends thereof and secures a terminal to each end thereof, all while securely holding the wire in the clamps 42.

More specifically, the elongated support 24 is in the form of a cylinder in which is mounted a piston 50 (see FIG. 3), the opposite end of the cylinder being closed by caps 52 and 54. Bracket assemblies 56 and 58 are mounted at the opposite ends of the cylinder and include connections so that fluid may be supplied to the cylinder 24 for moving the piston 50. The bracket assemblies 56 and 58 include upper and lower members 51 and 53 interconnected by screws 55 which also clamp the bracket assemblies 56 and 58 in place on the cylinder 24. A pair of cables 60 and 62 each has one end secured to one end of the piston 50. The cables extend through the cylinder end caps 52 and 54 and around the pulleys 64 supported at the opposite ends of the cylinder 24 on mounting plates 57 mounted on the brackets 56 and 58 and adjustable longitudinally of the cylinder 24 by means of screws 59. The other ends of the cables 60 and 62 are secured to opposite ends of the shuttle assembly 46 to move the shuttle in response to movement of the piston 50.

The shuttle assembly 46, as best illustrated in FIG. 7, includes a central bar portion 66 and is supported in a desired parallel relation to the cylinder 24 by a shuttle guide 68 which is slidably mounted on the cylinder 24 and slidably receives and supports the shuttle bar 66, the guide 68 being held against rotation relative to the cylinder 24 by a key 70 received in a keyway 72 in the cylinder 24. The shuttle assembly 46 has bullet-nosed end sections 74 and 76 for positioning the shuttle 46 relative to the heads 20 and 22 as hereinafter described.

The nozzle assembly 44 is mounted on one end of the shuttle bar 66 for limited pivotal movement relative thereto by a support 78 secured to the shuttle bar 66 and having an inclined stop surface 80, and an L-shaped bracket 82 mounted on the support 78 by the cap screw 84, and carrying the nozzle assembly 44. The bracket 82 may rotate about the axis of the screw 84 between the position illustrated in FIG. 7 and a position in which the horizontal portion of the bracket 82 engages the inclined stop surface 80. A spring 86 urges the bracket 82 to the position illustrated. This pivoting of the nozzle assembly 44 relative to the shuttle 46 occurs during the positioning of the wire end in the terminal at the adjustable head 22 as hereinafter described.

The nozzle assembly 44 comprises a hollow body 88 (see FIG. 3) secured to the bracket 82 by screws 90. Projecting from one end of the body 88 is a tubular nozzle 92 movable between the extended position illustrated and in which it is yieldably held by the spring 94 within the nozzle body 88 and a retracted position to which it may be moved by engagement of the stop 96 which extends downwardly from the outer end thereof with a target plate 98 on the clamp 42 of the movable head 22 (see FIG. 1) to retract the nozzle 92 to expose a length of the wire adjacent the leading end of the wire

as hereinafter described. The nozzle **92** is held against rotation relative to the body **88** by a set screw **100** mounted on the nozzle **92** and movable along the slot **102** in the body **88.** At its opposite end the body **88** carries a chuck housing **104** which is held in the body **88** by a screw **106** and provides a seat for the adjacent end of the spring **94.** The chuck housing **104** is hollow to receive the wire therethrough and has an inclined cam surface **108** facing its interior and a jaw element **110** movable along said surface for gripping the wire. It is urged along the surface **108** in a direction to grip the wire by a spring **112.** By virtue of this construction when the nozzle assembly **44** moves toward the movable head **22,** or toward the left as viewed in FIGS. **3** and **7,** it locks to the wire and pulls it with it whereas when it moves in the opposite direction the jaw **110** moves along the surface **108** to release the wire and the nozzle assembly moves freely along the wire. It will be appreciated that the improved nozzle assembly of the present invention may be used not only with electrical wire but with any continuous length of filament like material which is desired to be drawn from a coil or other source of supply and feed in the course of processing.

Turning now to the heads **20** and **22,** they are generally the same except that the movable or adjustable head **22** is symmetrically opposite to the stationary head **20** which is illustrated in FIGS. **2** through **6.** Except as hereinafter pointed out the following description of the stationary head **20** is accordingly equally applicable to the movable head **22.** Referring to these figures and initially to FIGS. **2, 3** and **4,** the head **20** comprises a lower base **120** and an upper base **122** which are secured together by screws **124** to mount the head on the support cylinder **24.** The lower base **120** is provided with keys **126** which are received in the keyway **72** of the cylinder **24** to align the heads relative to each other and relative to the shuttle guide **68.** A head actuating member **128** which is generally C-shaped, as seen in FIG. **2,** is mounted on the bases **120** and **122** for vertical sliding movement relative thereto by a vertically extending dovetail section **130** (see FIG. **6**) of the member **128** which slides between cooperating dovetail surfaces **132** and **134** formed on the bases **120** and **122** and on a dovetail gib **136** (see FIG. **5**) secured to the bases by screws **138** (FIG. **2**). The lower portion **140** of the member **128** extends horizontally and is secured by screws **142** to the upper end of a vertically disposed cylinder **144** which moves vertically relative to a stationary piston (not shown) mounted on a piston **146** secured to the lower base **120** and extending downwardly therefrom through the lower portion **140** of the actuating member **128** and into the cylinder **144.**

The lower portion **140** of the actuating member **128,** at the side thereof facing the other head carries a pin **150** for actuating the clamp **42.** As best illustrated in FIGS. **2** and **3** the clamp **42** comprises a pair of scissor-like arms **152** and **154** pivotally interconnected in spaced relation to their upper ends by a pivot pin **156** which, as shown in FIG. **3,** is mounted in a T-shaped slot **158** in the upper base **122.** This permits bodily movement of the clamp **42** downwardly from the upper position in which it is illustrated and to which it is urged by the springs **160,** to a lower position for positioning the wire in the terminal as hereinafter described. At their upper ends the arms **152** and **154** carry pads **162** for engaging the wire. Spaced below the pad **162** the arm **152,** at the movable head **22** only, carries the arcuately shaped target plate **98** extending between the arms **152** and **154** (see FIG. **1**). At the movable head **22** this target plate **98** is engaged by the stop **96** on the nozzle **92** to move the nozzle **92** into the nozzle body **88** and expose an end portion of the wire for positioning in the head **22** for gripping by the clamp **42** thereof. The arms **152** and **154** are each provided in their lower portions with slots **166** and **168** through which the clamp actuating pin **150** extends. The slots **166** and **168** are angled as shown to provide a quick closing during the initial downward movement of actuating pin **150.** The desired pressure on the wire is maintained by coil springs **170** between the arms **152** and **154,** and the pads **162.** When the pin **150** reaches the lower ends of the slots **166** and **168** further downward movement pulls the clamp **42** bodily downward against the action of the springs **160,** the pivot pin **156** moving downwardly in the T-shaped slot **158** in the upper base **122.** This downward movement of the clamp **42** moves the prepared wire end down into the terminal **34** to be secured thereto.

The actuating member **128** has a horizontally extending upper portion **180** spaced above its dovetail portion **130** and carries a cam assembly **182** secured thereto at the underside of the portion **180** by screws **184** and **186.** The cam assembly **182** actuates the cut and strip assembly **30** after the closing of the clamp **42** and before the downward movement thereof referred to above, and comprises a pair of vertically disposed parallel cam plates **188** and **190** interconnected by a spacer **192.** The cam plate **188** is positioned against the actuating member **128** and is located relative thereto by a key **194** received in a cooperating recess **196** formed in the member **128.** The cam plates **188** and **190** have cooperating pairs of slots **198** and at their lower ends the plates **188** and **190** have cooperating cam surfaces **200** and **202,** respectively.

The cut and strip assembly **30** is shown in detail in FIGS. **8** to **16** and is supported on the cam plates **188** and **190** by a pair of parallel horizontally disposed pins **204** the ends of which are received in the slots **198.** The assembly **30** comprises a pair of symmetrically opposite blade holders **206** and **208** each of which carries a wire cutter blade **210,** an insulation cutter blade **212** and a spring finger **214** for knocking the insulation, cut and stripped from the wire out of the assembly **30.** In their inoperative condition the blade holders **206** and **208** are held in spaced or open position as shown in FIGS. **2, 3, 4** and **8** by a spreader **216** having cam surfaces **218** which engage cooperating cam surfaces **220** on the blade holders **206** and **208.** The blade holders **206** and **208** are moved to their closed position illustrated in FIGS. **9** and **10** by the cam surfaces **200** and **202** of the cam plates **188** and **190** acting against cooperating cam surfaces **222** and **224,** respectively, on the blade holders **206** and **208.** The blade holders are slidably mounted on the pins **204** for movement between their open and closed positions and the spreader **216** is disposed between the pins **204.** Vertical movement of the spreader **216** relative to the blade holders **206** and **208** is limited by a pin **226** extending between the holders **206** and **208** and disposed between and in parallel relation to the pins **204** and which extends through a vertically extending slot **228** opening transversely through the spreader **216.**

When the actuating member **128** is in its upper position illustrated, the pins **204** supporting the cut and strip assembly are at the bottom of the slots **198** and the spreader **216** has been moved to cam the blade holders **206** and **208** to their open position, by a horizontal plate **230** which extends between the cam plates **188** and **190** for engaging the spreader **216** and is mounted on a sleeve **232** vertically slidable on a shaft **234** which is mounted in a socket **236** provided in the upper base **122** and in which it is held by a set screw **238.** The sleeve **232** is yieldably urged to the upper limit of its travel by a spring **240** urging the sleeve **232** against a washer **242** mounted on the upper end of the shaft **234** by a screw **244.**

The blade holders **206** and **208** have blade receiving recesses **250** in their adjacent faces and the wire cutter blades **210** and insulation cutter blades **212** are mounted therein and positioned as desired by spacers **252, 254, 256** and **258,** two of which, **254** and **256,** are recessed to hold the spring fingers **214** which act as insulation knock outs. The blades **210** and **212** and spacers **252, 254, 256** and **258** are held in place by lock pins **260** extending longitudinally through the blade holders **206** and **208** held in place by set screws **262.** The two wire cutter blades **210** are identical and are shown in FIGS. **12** and **13** and have cooperating V-shaped cutting edges **264.** As shown in FIG. **9** these blades **210** are disposed back to back so that the cutting edges **264** are in substantially the same plane. The insulation cutter blades **212** are also identical and are shown in detail in FIGS. **14** to **16.** Each has a semicircular cutting edge **266** and has a projecting portion **268** at one side of a horizontal centerline and a relief **270** at the opposite side of the centerline adapted to receive the projection **268** of the other blade **212** when such other blade is inverted relative to the first one, as shown in FIG. **9** so that the blades **212** are in back to back relation. As there shown, their cutting edges **266** are disposed in what may be called the central or mid-plane of the blade **212.** When the blade holders **206** and **208** are moved to their closed position, the wire cutter blades **210** completely sever the wire and the insulation cutter blades **212** cut through the insulation and the cutting edges **266** define an opening through which the wire conductor extends. To provide for accurate positioning of these blades **212** in the holders **206** and **208** they are provided with chamfered corners **272** against which act set screws **274** mounted in the holders **206** and **208.**

The end portion of insulation thus cut is stripped from the wire by bodily movement of the cut and strip assembly **30** off the end of the cut wire or to the right as viewed in FIG. **3.** This bodily movement is effected as follows. During the first portion of the downward movement of the actuator member **128** in addition to closing the clamp **42** on the wire, the cut and strip assembly **30** moves with the member **128** until it seats upon a cut and strip anvil member **280** which supports the assembly **30** in position to close on the wire. As the member **128** continues downwardly the cam surfaces **200** and **202** of the cam plates **188** and **190** cooperate with the blade holder cam surfaces **222** and **224** to close the blade holders **206** and **208** and cut the wire and insulation. During this movement the pins **204** ride up in vertically extending lower end portions of the slots **198.** As the actuating member **128** continues downward the pins **204** move through the inclined intermediate portions of the slots **198** and are cammed to the right as viewed in FIG. **3** carrying the cut and strip assembly **30** bodily to the right and stripping the cut insulation off the cut end of the wire. The anvil member **280** is secured to the upper base **122** by screws **282** and is accurately positioned relative thereto by keys **284** secured to the anvil **280** and received in a keyway **286** in the upper base **122.**

The terminal feed assembly **32** moves the end terminal **34** of the terminal strip **36** into position on a terminal anvil assembly **290** (see FIGS. **3** and **5**) supported on the upper base **122** and secured to the cut and strip anvil **280** by screws **292.** The terminal anvil assembly **290** cooperates with the terminal crimp and cut off assembly **42** and comprises a holder body **294** which carries an insulation crimp anvil **296** and a conductor crimp anvil **298** both of which are mounted on the body **294** by a screw **300.** The body **294** also carries a pair of square cut off plates **302** recessed in the upper surface thereof at opposite sides of the anvils **296** and **298** and a pair of rectangular cut off plates **304** secured to the opposite sides thereof. The body **294** also carries a fifth cut off plate **306** recessed in the opposite side thereof from the anvils **296** and **298.**

The crimp and cut off assembly **42** which is shown in detail in FIGS. **17** to **20,** is supported (as shown in FIG. **2**) at the upper side of the upper horizontal portion **180** of the C-shaped actuator member **128** by screws **310** extending through the holder body **312** thereof and into the edges of the cam plates **188** and **190.** An insulation crimp blade **314** and a conductor crimp blade **316** are mounted on the body **312** by a screw **318.** A slot **320** is provided in the blade **314** through which the screw **318** extends to permit vertical adjustment of the blade **314** which is controlled by a dog point set screw **322** which may be locked in place by a nut **324.** The crimp blades **314** and **316** cooperate with the anvils **296** and **298** to secure the terminal **34** to the end of the wire.

For cutting the terminal **34** from the strip **36** the cut off and crimp assembly **40** includes a front cut off blade **326,** a rear cut off blade **328** and a side cut off blade **330.** The blade **326** cooperates with one of the plates **302** at the stationary head **20** and with the other of the plates **302** at the movable head **22.** Similarly, the blade **330** cooperates with one of the plates **304** at the head **20** and with the other at the head **22.** The front cut off blade **326** is carried by a holder **332** adjustably mounted on the body **312** by a screw **334** having a threaded engagement with the holder **332** and held against longitudinal movement relative to the body **312** by a pin **336** extending into an annular relief **338** on the screw **334,** the pin **336** being held in place by a set screw **340.** The blade **326** is adjustable relative to the holder **332** by a screw **342** which has a threaded engagement with the blade **326** and is held against longitudinal movement in the body **312** by a dog point set screw **344.** To permit this latter adjustment the aperture **346** through which the screw **348** extends to mount the blade **326** on the holder **332** is elongated in the direction of the screw **342.**

The rear cut off blade **328** is mounted on a holder **350** by a screw **352** and the holder **350** is adjustably mounted on the body **312** by a screw **354** threadedly engaging the holder **350** and held against longitudinal movement in the body **312** by a dog point set screw **356.** For locking the screw **354** in adjusted position a cone-pointed lock pin **358** is mounted in the body **312**

for applying downward pressure on the holder **350** in response to movement of a cone-pointed set screw **360.**

The side cut off blade **330** is mounted on a holder **362** by a screw **364** and the holder **362** is mounted on the body **312** by a screw **366.** Adjustment of the holder **362** relative to the body **312** may be effected, when the screw **366** is loosened, by a screw **368** threadedly engaging the holder **362** and held against longitudinal movement in the body **312** by a dog point set screw **370.** To permit such adjustment the aperture in the body **312** through which the screw **366** extends is elongated in the direction of the screw **368** and the aperture in the holder **362** through which the set screw **370** extends to engage the screw **368** is also elongated in the direction of the screw **368.**

Referring to FIGS. **1, 2, 4, 5** and **6,** the terminal feed assembly **32** comprises a housing **380** mounted on the upper base **122** and secured thereto by screw **382.** The housing **380** extends at right angles to the support cylinder **24** adjacent the actuator member **128** and at an elevation adapted to feed terminals onto the terminal anvil assembly **290.** Mounted on the housing **380** is a terminal feed plate **384** adapted to support the terminal strip **36** as it is fed toward the terminal anvil **290,** the edges of the strip **36** being confined under guides **386** and **388** overlying opposite edge portions of the plate **384.** Below the plate **384** the terminal feed housing **380** carries a pawl slide **390** having an actuating pin **392** extending laterally through a slot **394** in the side of the housing **380** and riding in a generally vertical slot **396** in a cam plate **398** carried by the actuator member **128.** A pawl holder **400** carries a pawl **402** pivotally supported thereon by a pivot pin **404** and urged upwardly by a spring **406,** to its operative position illustrated in which the pawl **402** projects through a slot **408** in the plate **384** for engaging the terminal strip **36** during movement of the pawl slide **390** to the right as viewed in FIG. **2.** During movement in the opposite direction the pawl **402** pivots down and moves along the underside of the terminal strip. Adjustment of the pawl **402** is provided by a screw **410** threadedly mounted in the pawl slide **390** and having its inner end connected to the pawl holder **400** for longitudinal movement therewith while permitting rotation relative thereto. The screw **410** may be locked in position by a nut **412.** To provide a desired amount of drag against free movement of the terminal strip **36** and hold it in the position to which it is fed by the pawl **402** and to hold the strip during return movement of the pawl **402,** a rectangular drag plate **414** is recessed in the guide strip **388** and the terminal feed plate **384** and is provided with a pair of springs **416** for urging it against the adjacent edge of the terminal strip **36.** The drag plate **414** may be manually retracted, as during threading of the terminal strip **36** along the terminal feed plate **384,** by a pin **418** extending upwardly through a slot **420** provided in the guide strip **388.**

Removal of scrap terminal strip pieces from the terminal anvil **290** is facilitated by the provision of an air nozzle **430** (see FIG. **3**) mounted in the cut and strip anvil **280** and to which air may be supplied through a passage **432** therein.

In operation of the apparatus fluid is supplied to the cylinders **24** and **144** through suitable conduits and in response to suitable controls for effecting operation of the apparatus as described herein. What may be called the starting position is generally as illustrated in FIG. **3,** except for the piston **50,** which to facilitate illustration thereof is shown adjacent the right hand limit of its travel whereas its correct position for this condition is at the left hand limit of its travel, and except for the nozzle assembly **44** which is shown for illustrative purposes in a position in which it stops temporarily as herein described during its return movement. Its starting position is further to the right than illustrated in FIG. **3.** In the starting position the movable head **22,** not illustrated in FIG. **3,** is in the same position as the stationary head **20** there illustrated. One end of an insulated wire is lead from a suitable source of supply through a wire straightener **440** (see FIG. **3**) carried on an arm **442** secured to the bracket **58** on the right hand end of the support cylinder **24.** The wire is then inserted through the nozzle assembly **44** from right to left so that it projects beyond the end of the nozzle **92.** When operation of the apparatus is then initiated, fluid is supplied to the cylinder **24** to the left of the piston **50** causing the shuttle **46** to be moved to the left by the cable **62** and to carry the nozzle assembly **44** to the left through the stationary head **20** and toward the movable head **22,** which is illustrated at the right hand side in FIG. **1.** As the nozzle assembly approaches the head **22** the nozzle stop **96** engages the target plate **98** carried by the clamp **42** sliding the nozzle **92** into the body **88** and exposing a length of the wire which projects beyond the clamp **42** into the head **22.** The shuttle nose piece **74** carries a target plate **444** adjustably mounted thereon by lock nuts **446** and which engages a switch (not shown) which stops the supply of fluid to the cylinder **24** and initiates the operation of the head **22** by supplying fluid to the cylinder **144** thereof. As the shuttle assembly **46** approaches this limit of its travel the shuttle nose piece **74** enters an aperture **448** in a shuttle guide **450** formed on the upper base member **122** of the head **22** which also provides the stop determining the position of the shuttle assembly **46** at this limit of its travel.

During the initial operation of the head **22** the clamp **42** thereof is closed to grip the wire. After operation of the terminal crimping and cut off assembly **40** a switch is actuated to supply fluid under pressure to the opposite end of the cylinder **24** causing the shuttle assembly **46** to return toward the head **20** and its starting position. Throughout this return movement the wire is held by the clamp **42** of the head **22** and nozzle assembly **44** freely slides along the wire. As the shuttle assembly **46** approaches its starting position, it is temporarily stopped in the position in which the nozzle assembly **44** is positioned as illustrated in FIG. **3.** For effecting this stop the support **78** (see FIG. **7**) mounted on the shuttle bar **66** which carries the nozzle assembly **44** also carries a shuttle reverse travel stop **452** pivotally mounted thereon by a bolt **454** and movable between its normal horizontal position illustrated and in which it is yieldably held by spring **456,** and a counter clockwise pivoted position in which it stops against inclined surface **458.** The above mentioned temporary or initial stop of the shuttle assembly **46** is effected by a pad **460** on the reverse travel stop **452** engaging a wear plate **462** on the shuttle guide **450** of the head **20** (see FIG. **4**) when the return travel stop **452** is in its normal position illustrated. At the same time a switch is operated initiating operation of the head **20** by supplying fluid to the cylinder **140** thereof. During the initial movement

of the head **20** the clamp **42** thereof closes to grip the wire.

The remainder of the operation of the heads **20** and **22** is identical except as noted below. As the head actuating member **128** of each head continues its downward movement after closing its clamp **42** to hold the wire, the cut and strip assembly **30** is lowered onto the anvil **280** and actuated to cut the wire and to cut the insulation in spaced relation from the cut end of the wire and strip the cut piece of insulation from the end of the wire. The closing of the cut and strip assembly **30** is effected by the cam plates **188** and **190** through the cooperation of their cam surfaces **200** and **202** with the cam surfaces **222** and **224** on the cutter blade holders **206** and **208.** To accurately control the length of the product and to accurately position the end of wire and insure proper stripping, the wire is cut at both ends although only a short piece is cut off at the leading end of the head **22.** The insulation is stripped from the wire by the bodily movement of the cutter blade holders to the right as viewed in FIG. **3** by the cooperation of the pins **204** with the cam slots **198** in the cam plates **188** and **190.**

Also, during the downward movement of the head actuating member **128** the terminal feed assembly **32** feeds the end terminal **34** of the terminal strip **36** into position on the terminal anvil assembly **290.** It will be appreciated that a wide variety of different terminals may be employed and that the components of the terminal anvil assembly **290** and of the terminal crimping and cutting assembly **40** may be varied in form and position for use with differing terminals and terminal trips. Actuation of the terminal feed assembly **32** as the actuating member **128** moves downwardly is by the cam plate **398** which through the cooperation of its cam slot **396** with the pin **392** advances the pawl slide **390** and pawl **402** to the right as seen in FIG. **2** along the terminal plate **384.**

After the terminal feed assembly **32** has fed the end terminal into position on the terminal anvil assembly **290** the wire is lowered into position in the terminal **34.** This is effected through the pin **150** carried by the head actuating member **128** as the pin **150,** after reaching the lower ends of the slots **166** and **168** in the clamp arms **152** and **154,** continues to move downwardly and pulls the clamp **42** downwardly and moves the wire held thereby down into the terminal **34.** At the head **22,** where this operation takes place before the nozzle assembly **44** starts its return toward the head **20,** the pivotal mounting of the nozzle assembly **44** on the support **78** permits the lowering of the wire end into the terminal **34** without excessive bending of the wire. To further assist in preventing sharp bending of the wire the clamp **42** of the head **22** carries a hook **451** which pulls the end of the nozzle **92** down as the clamp **42** moves down. This does not occur at the head **20** since the nozzle assembly **44** returns through the head **20,** the clamp **42** thereof closes to hold the wire and the cut and strip assembly is actuated before the wire end is lowered into the terminal **34** by the clamp **42.** Also, it will be appreciated that if desired the return movement of the shuttle **46** may be initiated as soon as the clamp **42** of the head **22** is closed, in which event the hook **451** and the pivotal mounting of the nozzle assembly **44** may be eliminated.

In the final downward movement of the head actuating member **128** the terminal crimp and cut assembly **40** moves down to cooperate with the terminal anvil assembly **290** to crimp the terminal **34** to the bare wire end and to the adjacent insulation and to cut the terminal **34** from the terminal strip **36.**

Also during this downward movement of the head actuating member **128** of the head **20** the pivoted shuttle return stop **452** is disengaged from the wear plate **462** against which it initially stopped, by an adjustable stop release member in the form of a screw **464** threaded in the lower end of a sleeve **466** carried by a support **468** secured to the member **128** as shown in FIG. **4.** In this preliminary stop position the shuttle bullet nose **76** (see FIG. **7**) has entered the aperture **448** in the shuttle guide **450** of the upper base member **122** (see FIGS. **1** and **4**). The disengagement of the pivoted stop **452** is effected by the screw **464** coming down on a wear pad **468** mounted at the other end of the pivoted stop **452** from the pad **460.** The stop release member **464** is adjusted so that it will trip the pivoted stop **452** as soon as the blades **210** of the cut and strip assembly **30** have cut the wire. Upon this unlocking of the pivoted stop **452** the shuttle assembly **46** continues its movement carrying the nozzle assembly **44** further to the right, beyond the position illustrated in FIG. **3** avoiding any interference by it with the operation of head **20.** The final stop position of the shuttle assembly **46** and the nozzle assembly **44** carried thereby is determined by engagement of the end of the square shuttle bar **66** and the bracket **78** carried thereby with the shuttle guide **450** of the head **20.** The stop release member **464** and its mounting, and the pivoted return stop member **452** are shown in broken lines in FIG. **3** for illustrative purposes although they are actually located ahead of the section, their actual position being shown in full lines in FIG. **4.**

As the actuating member **128** of each head returns to its raised position as a result of the reversal of the fluid pressure in the cylinder **140** thereof, which preferably occurs simultaneously in both of the cylinders **140,** the clamp **42** thereof releases the wire and is returned to its raised position illustrated, by the springs **160** and cut and strip assembly **30** is returned to its open position through the cooperation of the spreader **216** and the plate **230.** For continuous operation when the head members **128** return to their raised positions the pressure in the cylinder **24** is reversed and another cycle is started.

The above described apparatus also has the advantage of readily lending itself to adjustment of the length of wire to be cut simply by loosening the bolts **124** which clamp the upper and lower base members **120** and **122** together to grip the cylinder **24.** It will be appreciated, of course, that any other suitable means may be employed for clamping the head in the desired position of adjustment on the cylinder **24.**

FIGS. **21** to **32** of the drawings illustrate another embodiment of the invention adapted to produce wiring harnesses such for example as that illustrated in FIG. **30.** It will be appreciated, of course, that harnesses having additional wires and terminals may be readily made by modifying the apparatus to provide the necessary heads and wire feed mechanisms. In the harness **500** there illustrated it will be noted that the wires **502** and **504** may be of different lengths, as there illustrated, and the adjacent ends of the two wires are connected to a common terminal **506.** The other ends of the wires **502** and **504** have individual terminals **508** and **510** connected thereto.

The heads 512, 514 and 516 employed in this embodiment of the invention are generally the same as the heads 20 and 22 except as described below. More specifically, the heads 512 and 514 are the same as the head 22 except that the clamp 42' thereof does not include the target plate 98 which is provided on the clamp 42 of the head 22, and except for the fact that the cut and strip assembly 30' of the head 512 has differently shaped insulation cutting and stripping blades 212' as hereinafter described. Also, the clamp jaws 162' of the head 512 have a longitudinally extending groove 517 to receive the wire as hereinafter described. The head 516 is generally the same as the head 20. In this embodiment of the invention the heads 512, 514 and 516 are supported on a base frame 518 through rod sections 520, 522 and 524 which correspond in size and external configuration to the cylinder 24 upon which the heads 20 and 22 of the above described embodiment are mounted. In this embodiment the head 512 is called the stationary head and the heads 514 and 516 are adjusted along their supporting rod sections 522 and 524 to provide the desired length of the wires 502 and 504.

The heads 514 and 516 have associated therewith wire feed mechanisms generally indicated at 526 and 528 which are identical except that one is symmetrically opposite to the other, and, accordingly, only the wire feed mechanism 526 is described and illustrated in detail herein. These wire feed mechanisms 526 and 528 are each adapted to pull a length of wire from a continuous source of supply through wire straighteners 440, and through heads 514 and 516, and to feed the leading end portions thereof through a combining unit 530 to position the ends of the wires in the head 512 in position to be gripped by the clamp 42 thereof. In this embodiment, after the clamp 42 of the head 512 grips the leading ends of the wires 502 and 504, the wire feed mechanisms 526 and 528 start their return travel toward the heads 514 and 516 and move through the heads 514 and 516 prior to the closing of the clamps 42 thereof to hold the wires.

As is best seen in FIG. 21 these feed mechanisms 526 and 528 form a V as viewed from above, with the wire combining unit 530 at the point of the V. Referring to FIG. 31 it will be seen that the feed mechanism 526 is mounted on the base 518 by end brackets 532 and 534. The rod sections 522 and 524 are also mounted on the base 518 parallel to and outwardly of the feed mechanisms 526 and 528.

The feed mechanism 526 includes a fluid cylinder 536 having end caps 538 and 540 provided with connections 542, 544, 546 and 548 through which fluid may flow to and from the opposite ends of the cylinder Within the cylinder 536 the piston 550 is connected to a piston rod 552 which extends outwardly through the rear cylinder cap 540 and is connected by a tie plate 554 to a shuttle drive rod 556 which extends parallel to and in spaced relation above the cylinder 536. The rod 556 extends through and is guided by a plate 558 mounted on the cylinder end cap 540. At its forward end the rod 556 is connected to a shuttle 560 which is slidably mounted on a way 562 having a depending plate portion 564 extending through a slot 566 in the shuttle 560 to maintain it aligned relative to the way 562. The way 562 is disposed between and parallel to the cylinder 536 and the shuttle drive rod 556 and is rigidly mounted in the plate 558 at its rear end and at its forward end in a mounting plate 568 secured to the front cylinder cap 538.

The nozzle assembly 570 is generally similar to the nozzle assembly 44 of the above described embodiment and is supported on the shuttle 560 by an offset bracket 572 which extends laterally relative to the feed mechanism 526 so as to support the nozzle assembly 570, parallel to and directly over the head supporting rod section 522 and aligned with the head 514 so that upon the feed mechanism 526 returning through the head 514 it positions the wire for gripping and holding by the clamp 42 thereof. The nozzle assembly 570 is mounted on the bracket 572 in the same manner that the nozzle assembly 44 is mounted on the bracket 82 and differs from the nozzle assembly 44 only in that it does not include the stop 96.

Referring to FIGS. 22 to 36, the combining unit 530 provides abutments for stopping the forward travel of the nozzle 586 of each of the wire feed mechanisms 526 and 528 so that a length of each wire 502 and 504 will be fed into the head 512. The combining unit 530 also serves to accurately position the nozzles 586 and to guide the wires as they move toward the head 512 so that they will be positioned between the clamp jaws 162' in position to be received in the grooves 517 when the clamp 42' closes. In this embodiment the combining unit 530 has a base 574 mounted on the rod support 520 closely adjacent the clamp 42' of the head 512. Base 574 has an upwardly extending pedestal portion 576 on the top of which is mounted a head 577 of generally inverted T-shape (see FIG. 24) and having a vertically disposed flange 578 positioned to bisect the angle between the nozzles 586. A pair of inner guide plates 582 are secured to opposite sides of the flange 578 at the mid-portion thereof by a bolt 580 extending through a vertically extending slot 592 in the flange. The guide plate 582 has a cylindrical surface 588 adapted to receive and accurately position the end of the nozzle 586. It also has a conically shaped guide surface 584 for guiding the nozzle 586 into the cylindrical surface 588. To the right of the guide plate 582 (see FIG. 25) a cylindrical surface 589 is formed in the flange 578 and the vertical adjustment of the guide-plate 582 permitted by the slot 592 permits alignment of the cylindrical surfaces 588 and 589. At the inner end of the cylindrical surface 589 is a stop shoulder 590 adapted to engage the end of the nozzle 586 to stop its movement. The continuing movement of the shuttle 560 causes an end portion of the wire (502 in FIG. 25) to project beyond the end of the nozzle and into the head 512. To guide the wire as it is projected in this manner the flange 578 beyond (to the right in FIG. 25) the shoulder 590 has a slightly curved surface 593 having a groove 594 adapted to receive and guide the wire. The combining unit 530 also includes a pair of outer guide plates 596 having guide surfaces 597 for cooperating with the guide surfaces 584 to guide the nozzles 586 into the cylindrical surfaces 588. Each plate 596 also includes a surface 598 adapted to engage the nozzle 586 and hold it against the cylindrical surface 588 and thus guide it to the stop 590. It will noted, however, that the surface 598 is vertically extended to accommodate vertical adjustment of the element 582 (see FIG. 24). The lower portions of the plates 596 overlie the opposite sides of the pedestal 576 and have horizontally elongated slots 600 through which extends bolts 602 for securing the guide plates 596 to the pedestal

576. It will be appreciated that because of the inclination of the guide surface 598 on the plate 596, that movement of the guide plate 596 as permitted by the slots 600 provides adjustment for accurately holding the nozzle 582 against the cylindrical surface 588 as it moves to the stop 590.

In the operation of this embodiment of the invention wires 502 and 504 are lead from suitable sources through wire straighteners 440 and fed through the nozzle assemblies 570 so that they project beyond the outer ends of the nozzles 586. It will be appreciated that in the starting positions of the feed mechanisms 526 and 528, the nozzle assemblies 570 are disposed to the left of the heads 514 and 516 rather than in the intermediate positions illustrated in full lines in FIG. 21. When operation of the apparatus is initiated fluid is supplied to the left hand ends of the cylinders 536 causing the shuttles 560 to move to the right carrying the nozzle assemblies 570 toward the combining unit 530. To insure that the head 512 will not operate to close the clamp 42 thereof until both wire ends are in place the apparatus includes switches diagrammatically illustrated at 604 and 606 which close when the shuttles 560 reach the full limit of their travel toward the combining unit 530. DUring the latter part of this movement the nozzle 586 (which corresponds to the nozzle 92 of the first embodiment) abuts the stop 590 after which the nozzle 586 telescopes into the nozzle body 608 (which corresponds to the nozzle body 88) and a length of wire is fed out of the end of the nozzle 586, along the groove 594 of the stop and guide element 582 and into the head 512 in position to be gripped and held by the clamp 42 thereof. When the ends of both of the wires 502 and 504 have been fed to this position and the switches 604 and 606 both actuated operation of the head 512 is initiated to close the clamp 42 thereof. As soon as this clamp has closed the wire feed mechanism 526 and 528 start their return toward the heads 514 and 516. At each of these heads when the end of the nozzle 586 has returned past the clamp 42 a return stop surface 610 on the bracket 572 engages a stop 612 (similar to the stop 452) which is pivotally mounted on the frame 518 and yieldably held in position for engagement by the stop surface 610. This temporarily stops the shuttle 560 and initiates operation of the head closing the clamp 42. As in the earlier described embodiment, stop release member 464 on the head is adjusted so that it trips the pivoted stop 612 when the wire has been cut, to disengage the stop 612 from the stop surface 610 permitting continued return movement of the shuttle 560 to withdraw the nozzle assembly 570 so as to prevent interference thereof with the operation of the head.

The construction and operation of the heads 514 and 516 for cutting the wire, cutting and stripping the insulation and attaching the terminals is the same as above described for the head 20. Referring to the head 512, the only differences from the head 22 are the above described variation in the clamp 42 to hold the two wires in side by side relation and the below described difference in the insulation cut and strip blade 212'.

Referring to FIGS. 27, 28 and 29, the insulation cut and strip blades 212' are identical and have a cutting edge the outer portion 614 of which is generally V-shaped and leads to a narrow horizontally extending slot portion 616 having a width substantially equal to the diameter of the wire conductor 613. The blades 212' are beveled as indicated at 618 so that the cutting edges 614 and 616 are at one face of the blade 212'. As seen in FIG. 27, one of the blades 212' is reversed relative to the other so that the cutting edges of the left blade are at the rear face and the ones on the right blade are at the front face thereof.

The blades 212' are mounted in the same manner as the above described blades 212, but are disposed so that in moving to their closed position illustrated in FIG. 29 they move with their adjacent faces in which the cutting edges 614 and 616 are formed, overlying each other so that the cutting edges of both blades 212' are substantially in the same plane. In the closed position the cutting edges 616 of the two blades 212' define an elongated opening the length of which is substantially equal to the combined diameters of the conductors 613. As the blades 212' move from the open position to the partially closed position shown in FIG. 28 they cut the insulation 615 at the top and bottom of the wires. As the blades 212' continue to move to their full closed position (FIG. 29) they squeeze the conductors together and cut the insulation 615 at the outer side of each conductor 613, that is, the side thereof which is remote from the other conductor. In this movement the insulation 615 is squeezed out from between the conductors, upwardly and downwardly as shown in FIG. 29. The thus incompletely cut insulation 615 readily breaks off during the insulation stripping movement of the cut and strip assembly.

The wire cutter blades 210 in this embodiment are of the same construction as the blades 210 of the earlier described embodiment.

As in the earlier described embodiment the pressure in the cylinders actuating the heads 512, 514 and 516 is preferably reversed simultaneously and when the actuating members of these heads have returned to their raised positions the pressure is reversed in the cylinders 536 and a new cycle is started.

While only two specific embodiments of the invention have been illustrated and described herein, it will be readily appreciated by those skilled in the art that numerous modifications and changes may be made without departing from the spirit of the present invention.

I claim:

1. A head mechanism for use in an insulated wire processing apparatus comprising a base, a head reciprocably mounted on said base, clamp means mounted on said base, terminal feeder means mounted on said base, cut and strip means mounted on said head for cutting the wire to be processed thereby and cutting the insulation and stripping it from an end portion of the wire, terminal crimping means mounted on said head, first cooperating means on said base and head effective upon movement of said head in one direction relative to said base for actuating said clamp means to grip the wire, second cooperating means on said base and head effective upon such movement to position said cut and strip assembly for operation upon the wire and to actuate said assembly to cut the wire and to cut the insulation and strip the cut insulation from the end portion of the wire, third cooperating means on said base and head effective upon such movement of the head relative to the base for actuating said terminal feeder means to position a terminal for attachment to the wire, and anvil means on said base cooperating with said crimping means upon a predetermined movement of

said head relative to said base for crimping said terminal for attaching it to the wire.

2. A head mechanism as defined in claim 1 including means effective upon movement of said head relative to said base in the opposite direction to open said cut and strip means and position it out of the path of movement of the wire.

3. A head mechanism as defined in claim 1 including fourth cooperating means on said base and head for moving the end portion of the wire into a terminal positioned by said terminal feeder means for attachment of the terminal thereto.

4. A head mechanism as defined in claim 3 wherein said fourth cooperating means includes means for moving said clamp means.

5. A wire process apparatus adapted to make a wiring harness including two wires connected to a single terminal, said apparatus including a head mechanism having a clamp adapted to hold the two wires and means for preparing wire ends for attachment to a terminal and means for attaching a terminal to the wire ends, a pair of wire feed mechanisms angularly disposed relative to each other and including nozzle means for projecting a length of wire beyond the end thereof, and a combining unit disposed adjacent said clamp of said head mechanism and having means for actuating each of said nozzle means to effect said projection of a length of wire beyond the end of each of said nozzle means, and means for guiding each of said lengths of wire through said clamp and into position in said head mechanism and means for operating said head mechanism when both of said lengths of wire are in position to close said clamp to hold said lengths of wire and prepare wire ends for attachment of a terminal thereto and complete the attachment of a terminal thereto.

6. The combination defined in claim 5 wherein each said nozzle means includes a nozzle body, a nozzle mounted in said body for telescoping movement relative thereto, said combining unit including a pair of angularly disposed stops adapted to be engaged by the ends of said nozzles to effect said projection of lengths of wire beyond the ends of said nozzles.

7. The combination defined in claim 6 wherein said combining unit includes means for guiding said nozzles into engagement with said stops.

8. The combination defined in claim 5 wherein each said means for guiding said length of wire includes a groove in said combining unit adapted to pass the length of wire there along and slightly arcuately shaped to cause said lengths of wire to extend in side by side parallel relation in said clamp and in said head mechanism.

9. The combination defined in claim 8 wherein said clamp has mating grooves adapted when said claim is closed to receive said wires therein and hold them in side by side parallel relation and against movement through the clamp.

10. A wire processing apparatus comprising first and second head mechanism, each operable to cut the wire and secure a terminal thereto and including a clamp for holding the wire during operation of the head mechanism, a wire feed nozzle adapted to draw wire from a source of supply, means operable to move said nozzle through said second head mechanism and toward said first head mechanism to position a length of wire between and in said head mechanisms and to return said nozzle through said second head mechanism to grip the wire between said length of wire and the source of supply of the wire prior to operation of said second head mechanism to cut the wire, and means for operating said head mechanisms and said means for moving said nozzle.

11. A head mechanism for use in a wire processing apparatus comprising a base, a head reciprocably mounted on said base, wire clamp means mounted on said base, terminal feeder means mounted on said base, cutter means mounted on said head for cutting the wire to be processed thereby, terminal crimping means mounted on said head, first cooperating means on said base and head effective upon movement of said head in one direction relative to said base for actuating said clamp means to grip said wire, second cooperating means on said base and head effective upon movement of said head relative to said base in said direction to actuate said cutter means to cut the wire, third cooperating means on said base and head effective upon movement of the head relative to the base in said direction for actuating said terminal feeder means to position a terminal for attachment to the wire, and anvil means on said base cooperating with said crimping means upon movement of said head relative to said base in said direction for crimping said terminal for attaching it to the wire.

12. A head mechanism for use in a wire processing apparatus comprising a base, a head reciprocably mounted on said base, clamp means mounted on said base, means for positioning a wiring harness component on said base, cutter means mounted on said head for cutting the wire, first cooperating means on said base and head effective upon movement of said head in one direction relative to said base for actuating said clamp means to grip said wire, said cooperating means on said base and head effective upon movement of said head relative to said base in said direction to actuate said cutter means to cut the wire, third cooperating means on said base and head effective upon movement of said head relative to said base in said direction to actuate said means for positioning said component, and fourth cooperating means on said base and head effective upon movement of said head relative to said base in said direction to attach said component to said wire.

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