# United States Patent [19]

Gudmestad

[11] 3,909,900

[45] Oct. 7, 1975


[54] APPARATUS FOR PRODUCING ELECTRICAL CONDUCTORS


[75] Inventor: **Ragnar Gudmestad**, West Allis, Wis.

[73] Assignee: **Artos Engineering Company**, New Berlin, Wis.



[22] Filed: **May 22, 1974**

[21] Appl. No.: **472,491**

[52] **U.S. Cl.** ................................ **29/203 DT**; 29/628

[51] **Int. Cl.**[2] ........................................ **H01R 43/04**

[58] **Field of Search** ........... 29/33 M, 203 R, 203 D, 29/203 DT, 203 DS, 628, 629, 630 R, 630 A, 427; 72/324; 113/119



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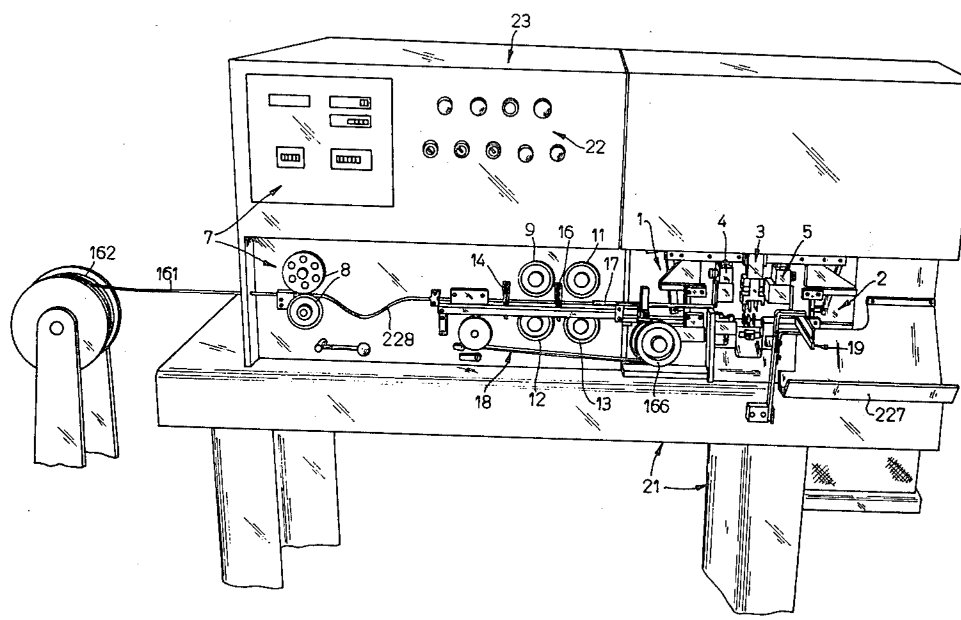
*Primary Examiner*—C. W. Lanham
*Assistant Examiner*—James R. Duzan
*Attorney, Agent, or Firm*—James E. Nilles



[57] **ABSTRACT**

Insulated wire stock is gripped at longitudinally spaced portions by a pair of clamp assemblies and cut in two by a wire and insulation cutting assembly between the clamp assemblies. The relatively adjacent ends of the cut wire are pulled apart by the clamp assemblies so as to strip the cut insulation therefrom and bring the stripped wire ends beyond a pair of terminal crimping assemblies at opposite sides of the cutting assembly. Reverse movement of the clamp assemblies then brings the stripped wire ends into the crimping assemblies, and after terminals have been attached to the stripped wire ends, the stock and severed wire length are released and reverse movement of the clamp assemblies is continued to bring them back to their starting positions. A wire transfer mechanism and slotted bracket collect successively cut off wire lengths to which terminals have been attached. Brushes suppress whipping of the moving wire stock.

**16 Claims, 33 Drawing Figures**

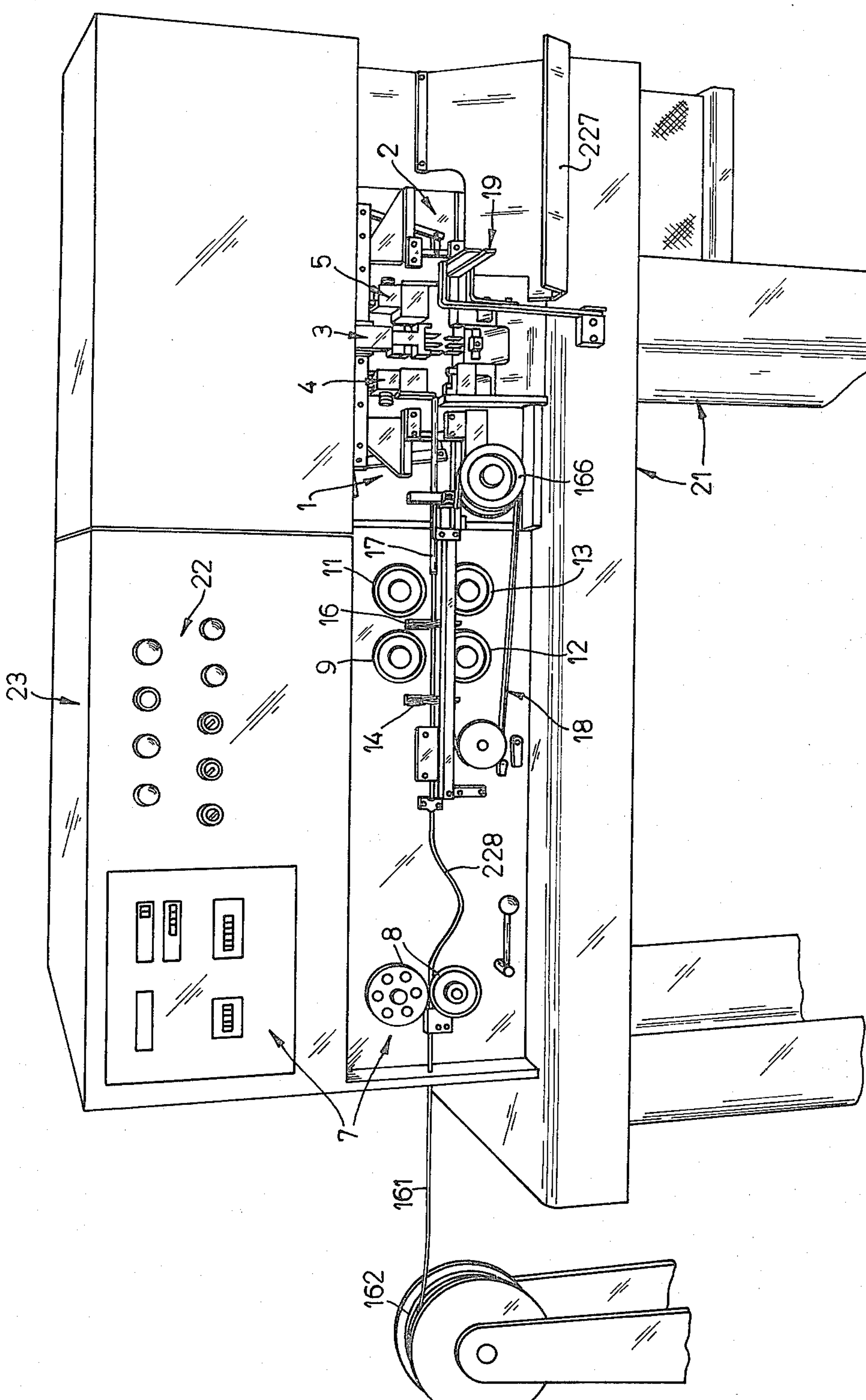



FIG. 1

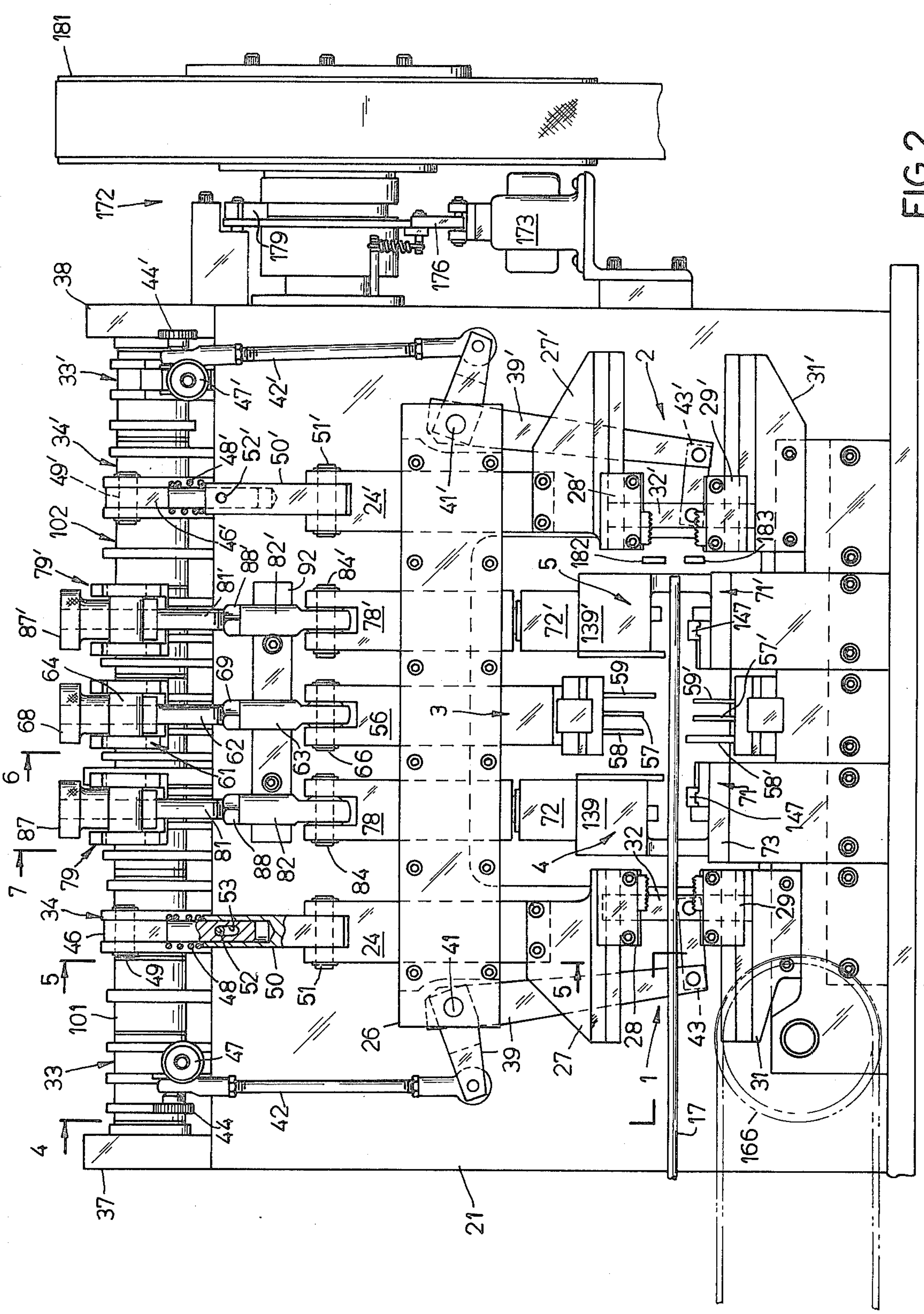


FIG. 2

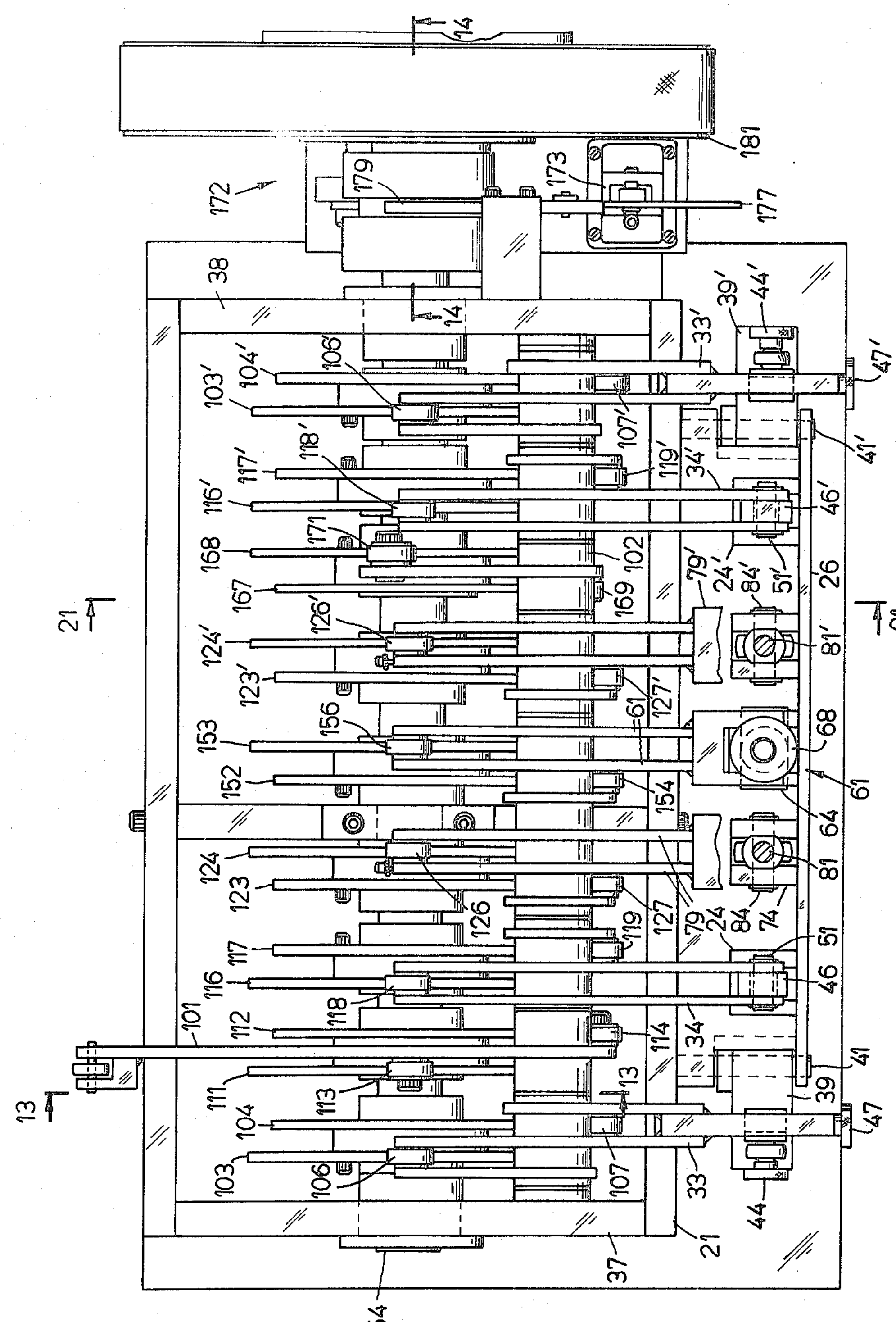


FIG.3

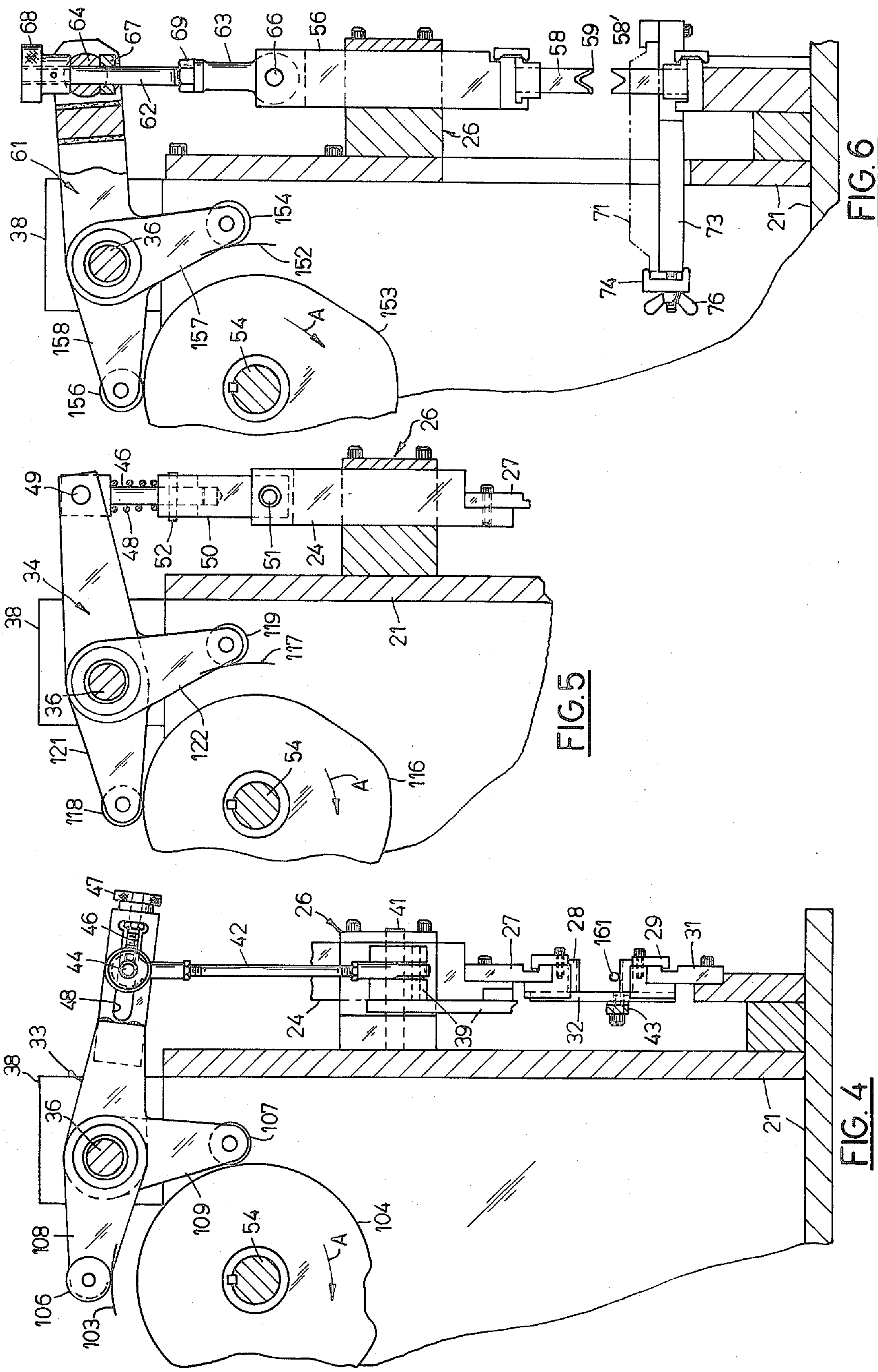


FIG. 6

FIG. 5

FIG. 4

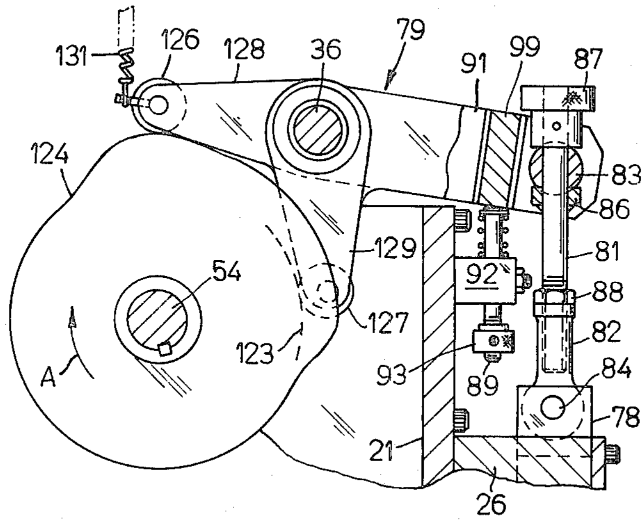



FIG. 8

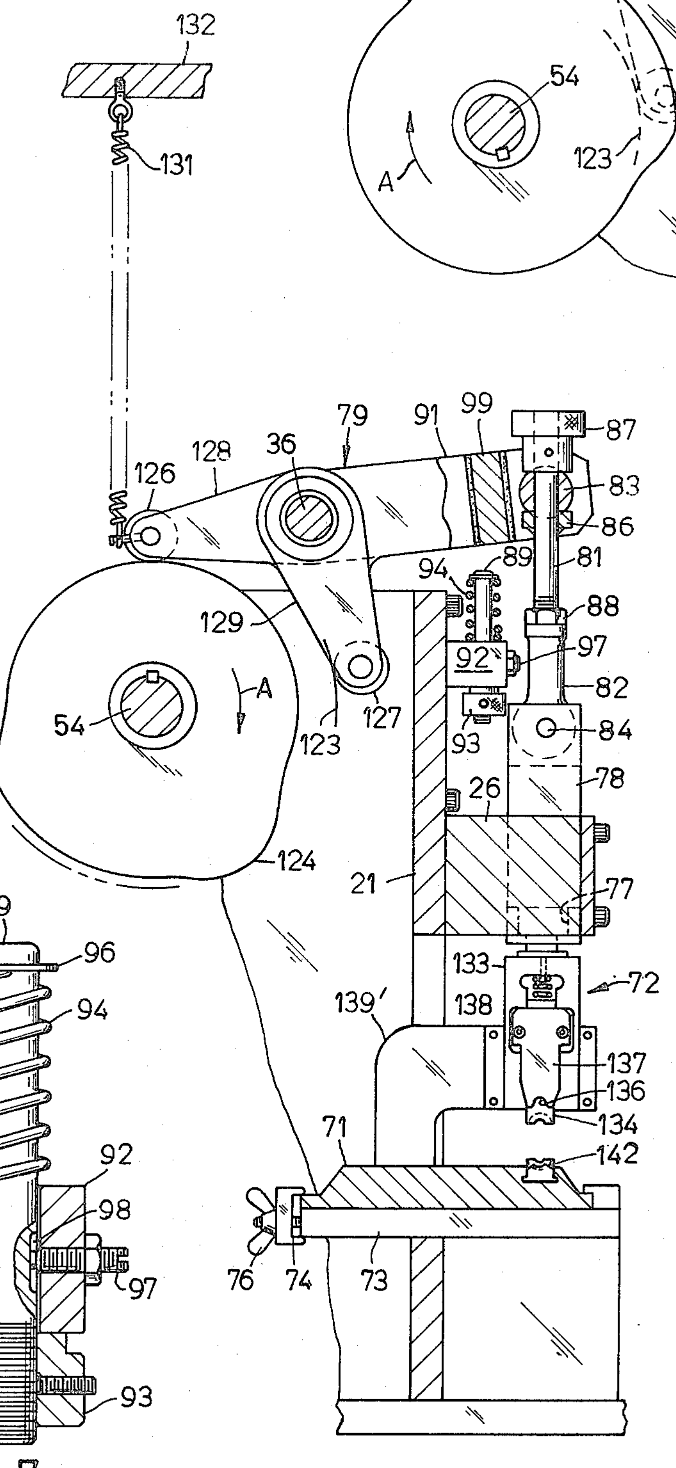



FIG. 7

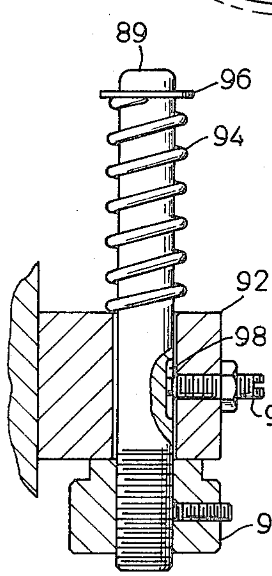



FIG. 7a

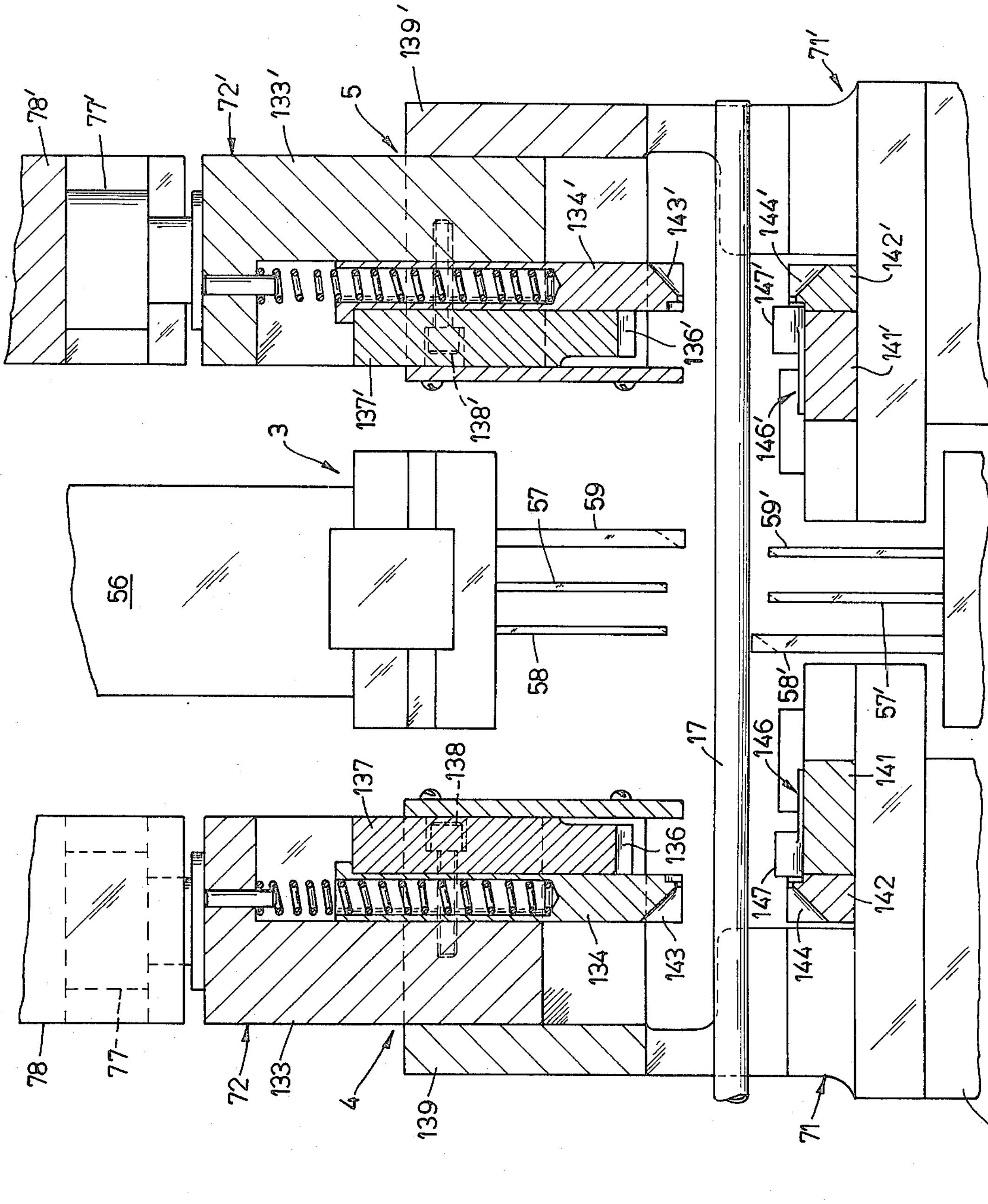

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FIG. 9

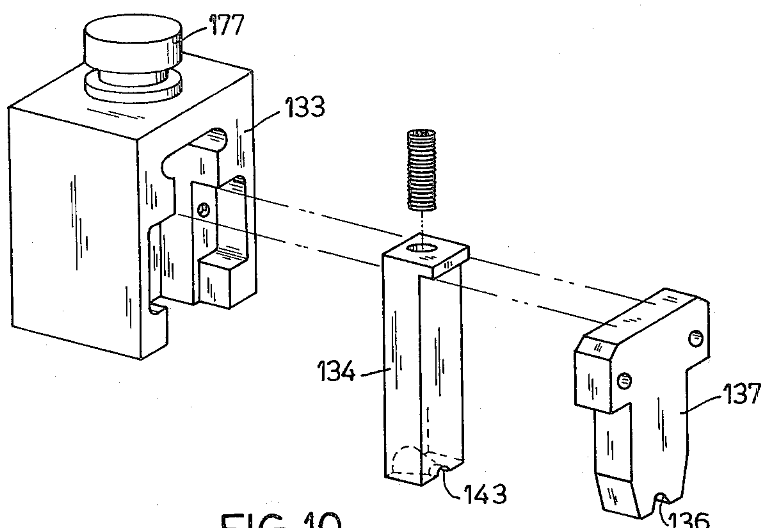


FIG. 10

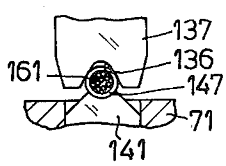


FIG. 11

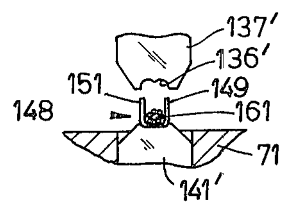


FIG. 12

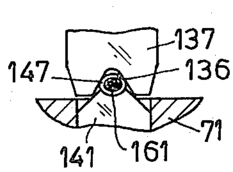


FIG. 11a

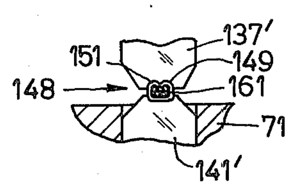


FIG. 12a

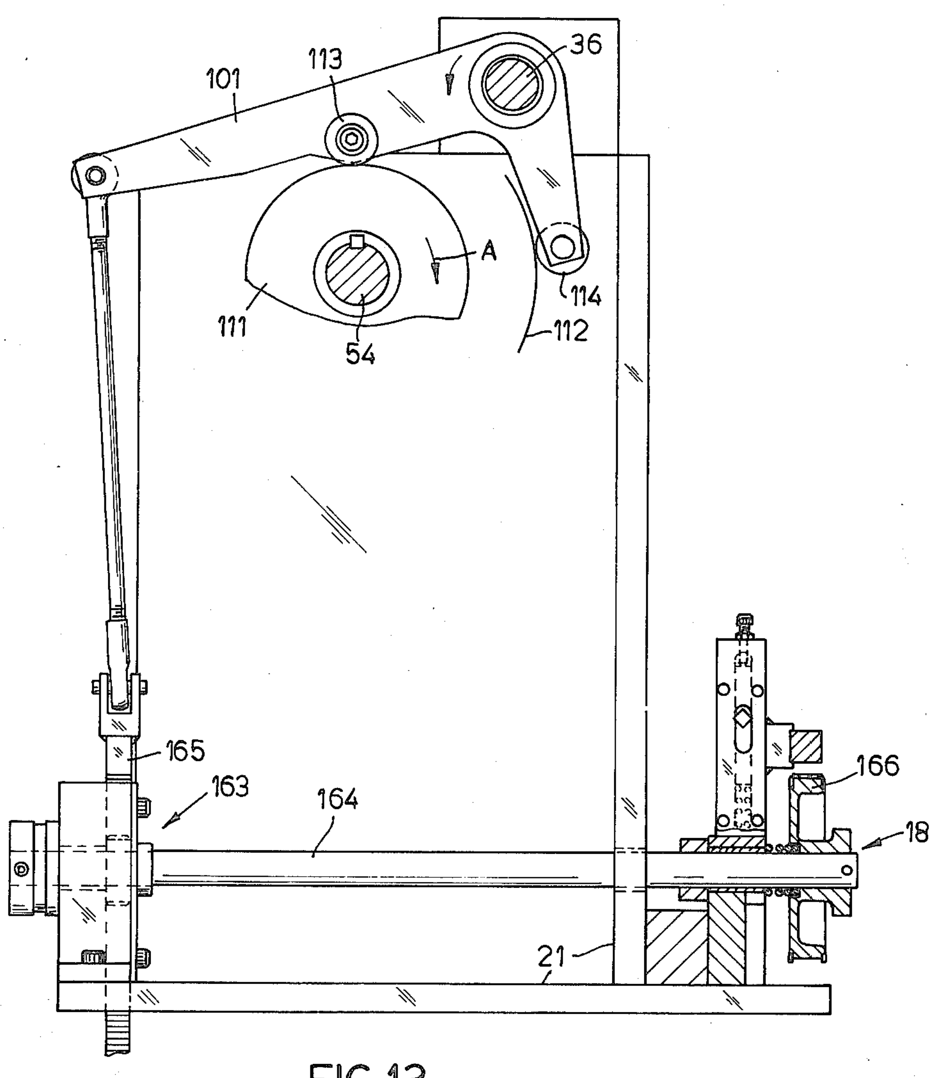


FIG.13

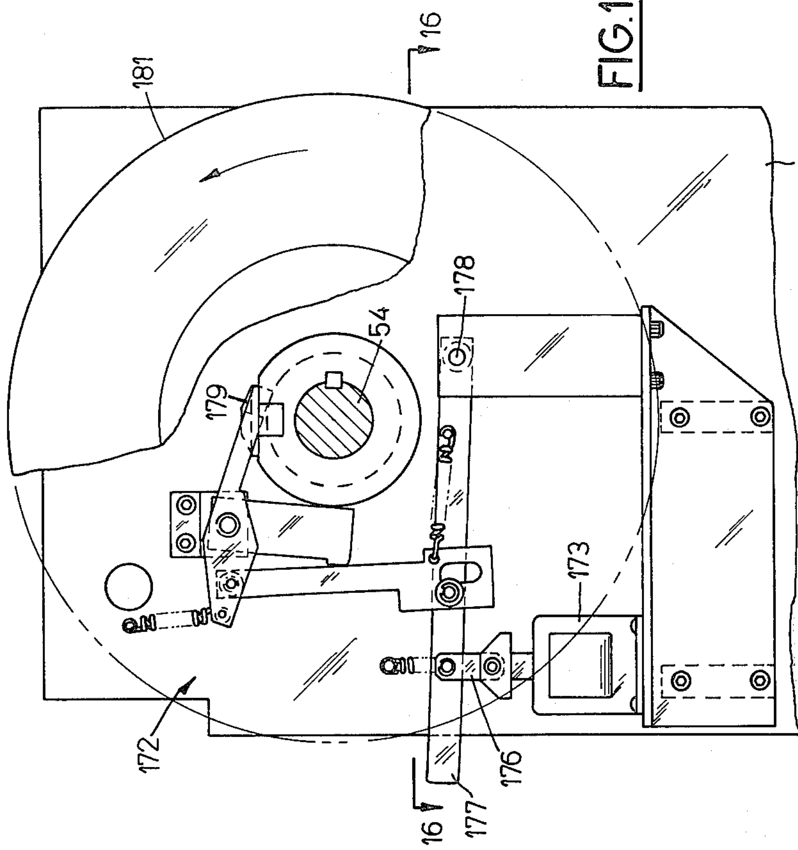


FIG.15

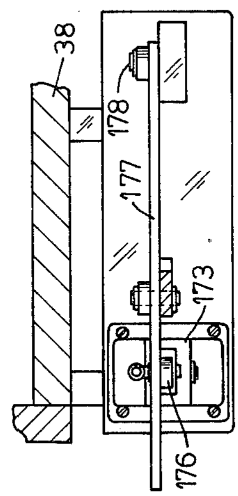


FIG.16

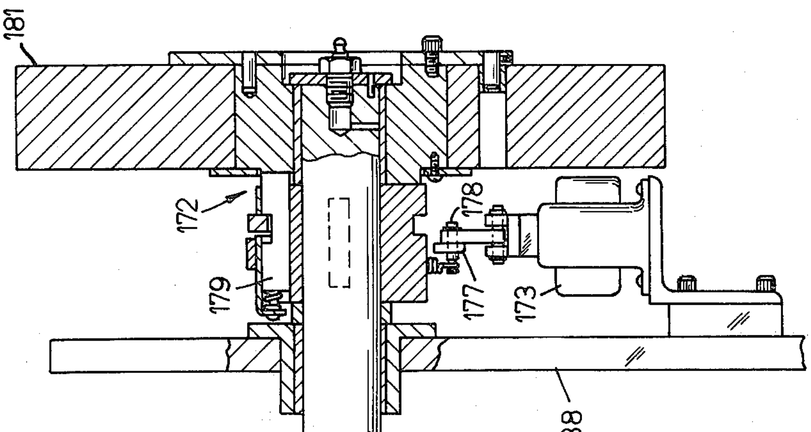


FIG.14

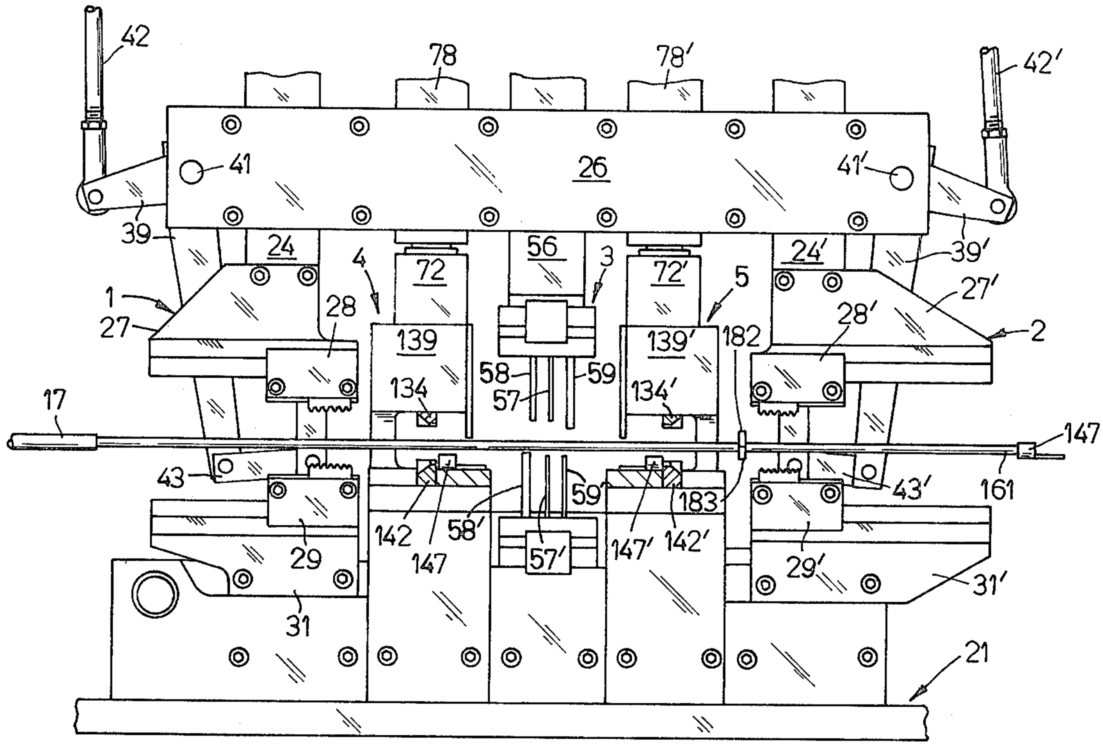
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FIG. 17

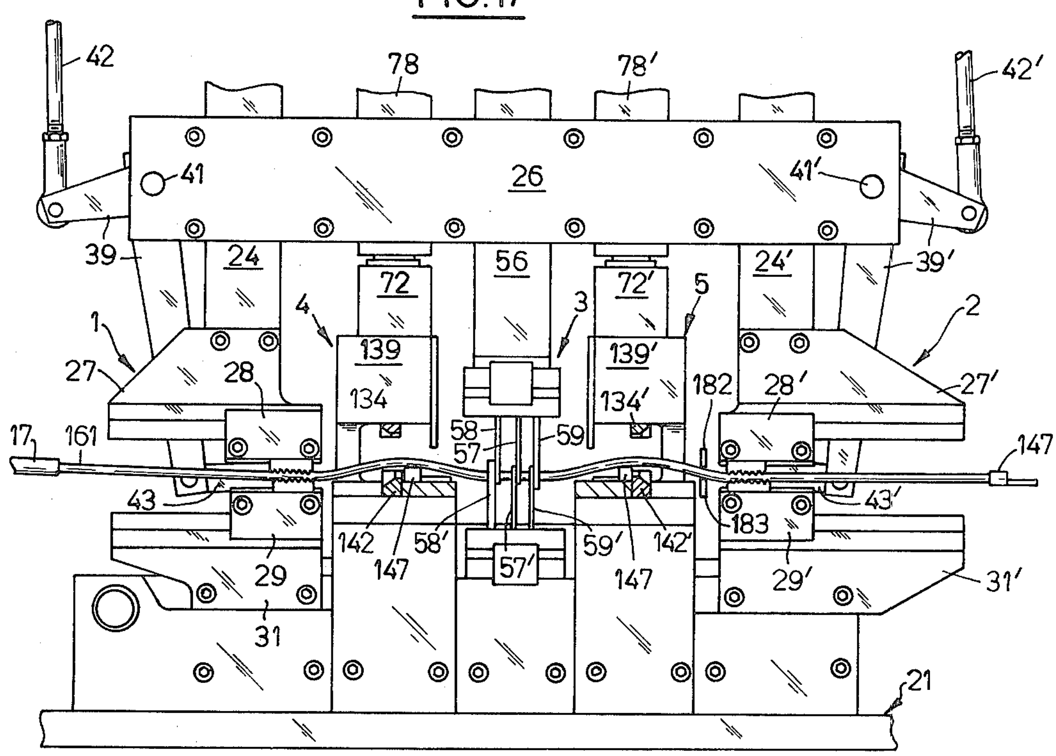
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FIG. 18

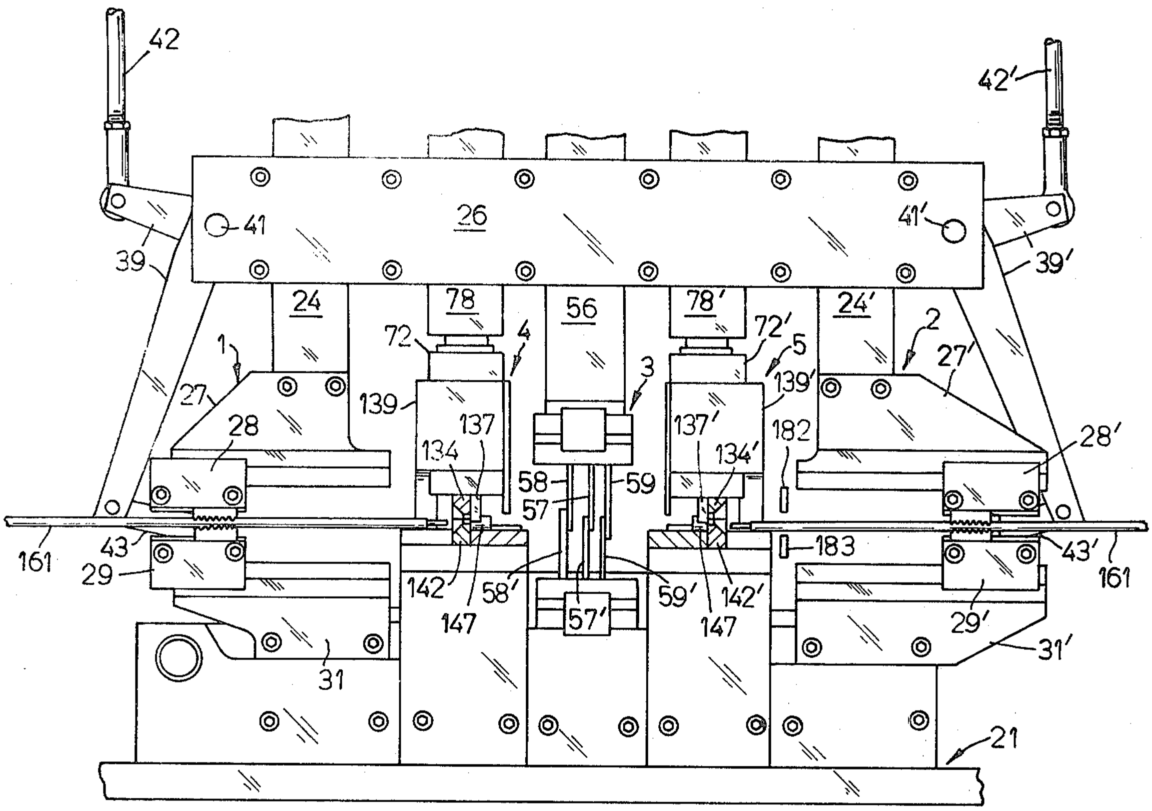
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FIG. 19

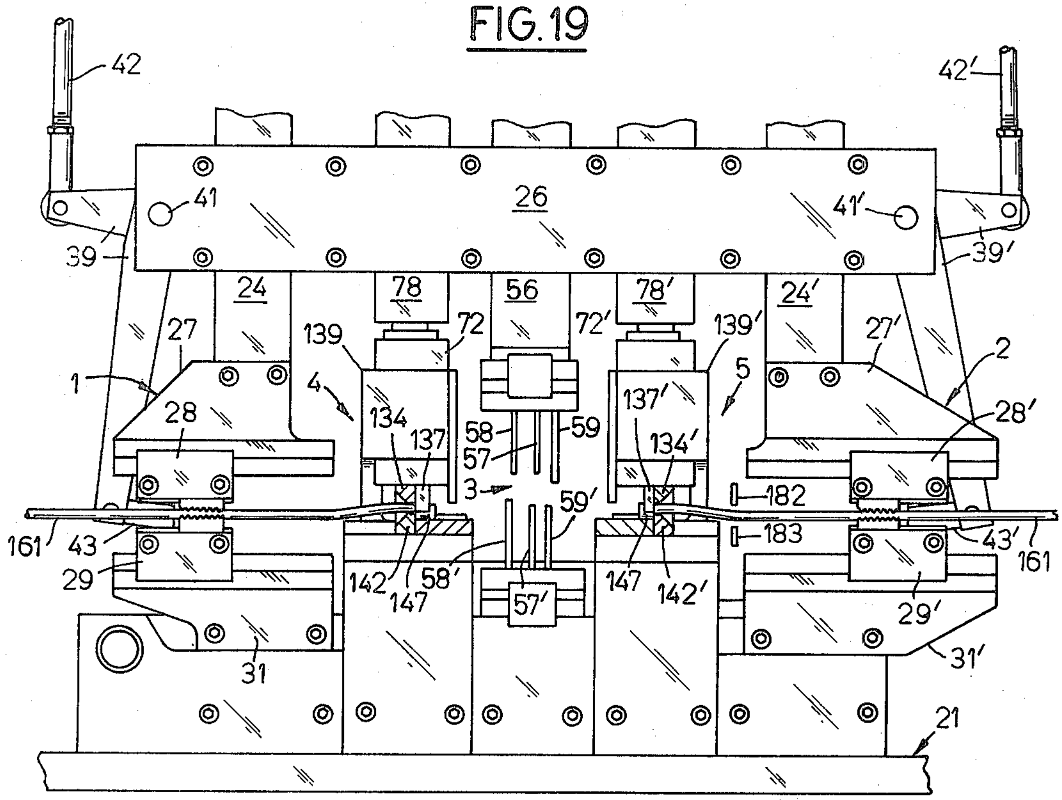
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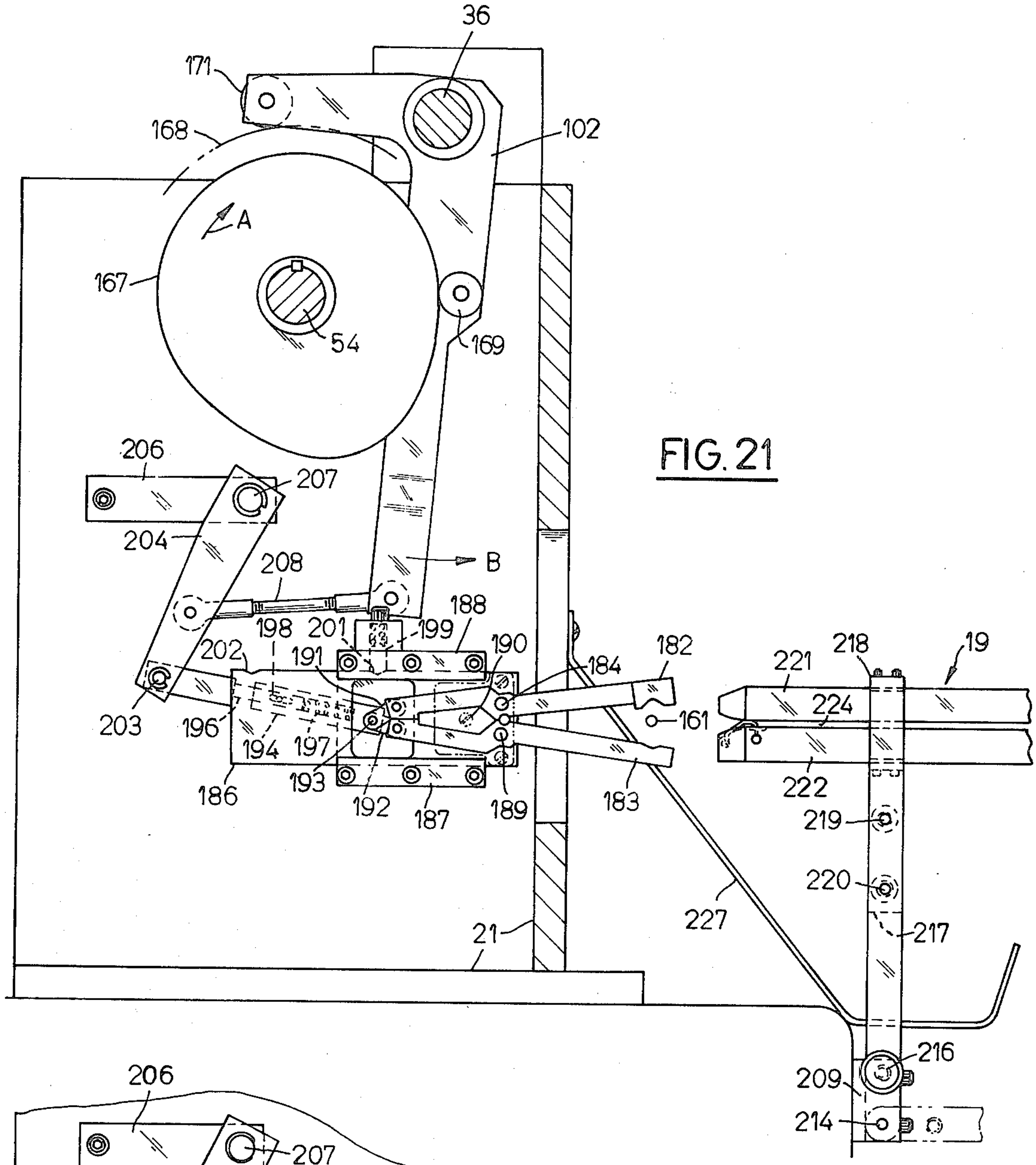
FIG. 20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171
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A
167
54
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207
204
208
B
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182
221
218
19
224
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FIG. 21

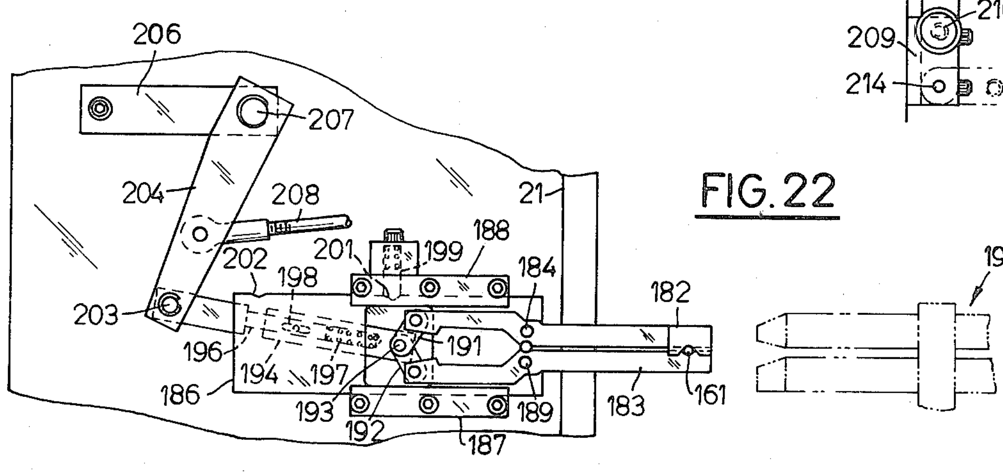
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FIG. 22

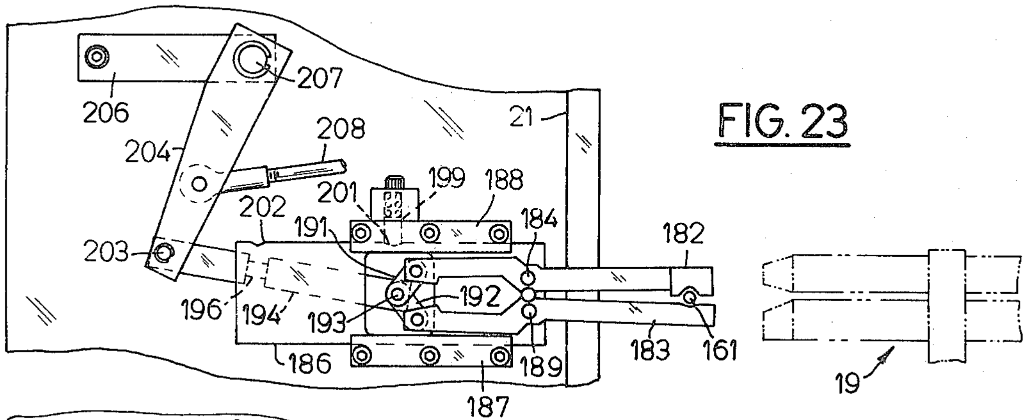



FIG. 23

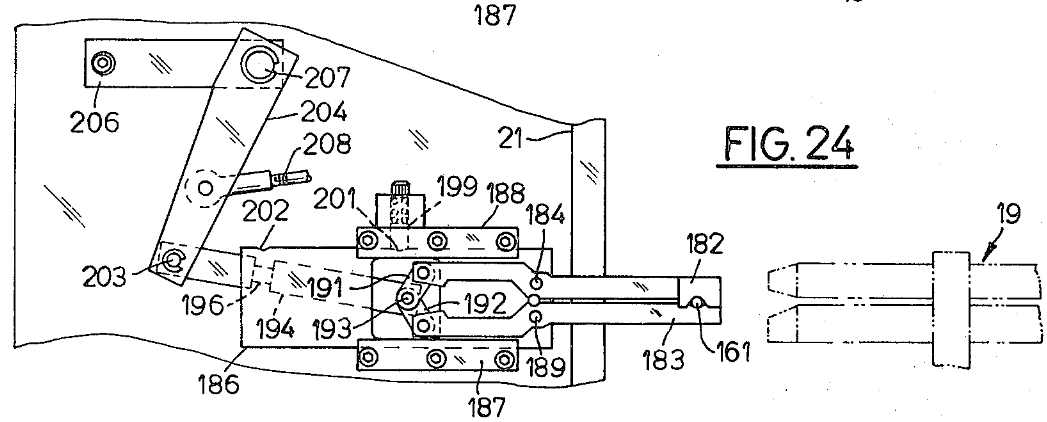



FIG. 24

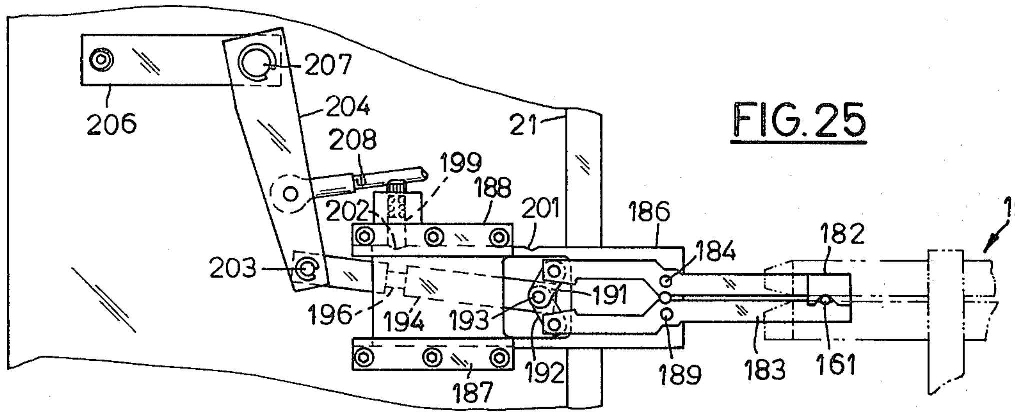



FIG. 25

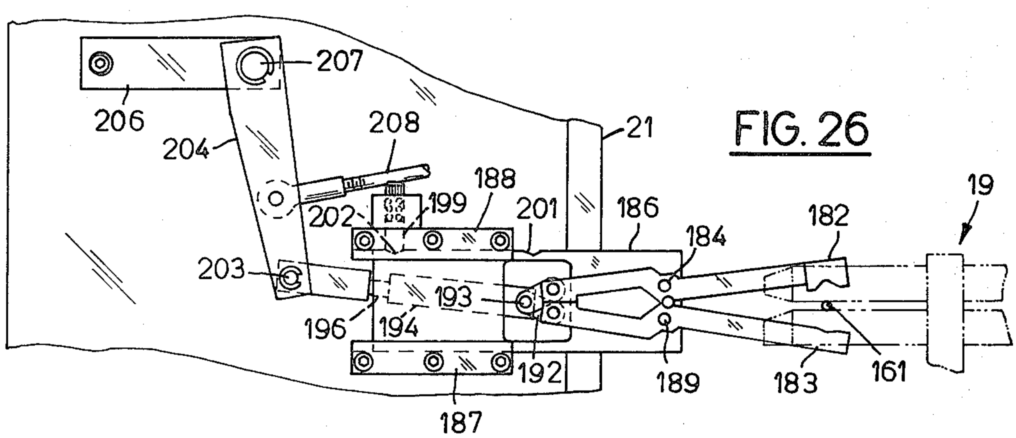



FIG. 26

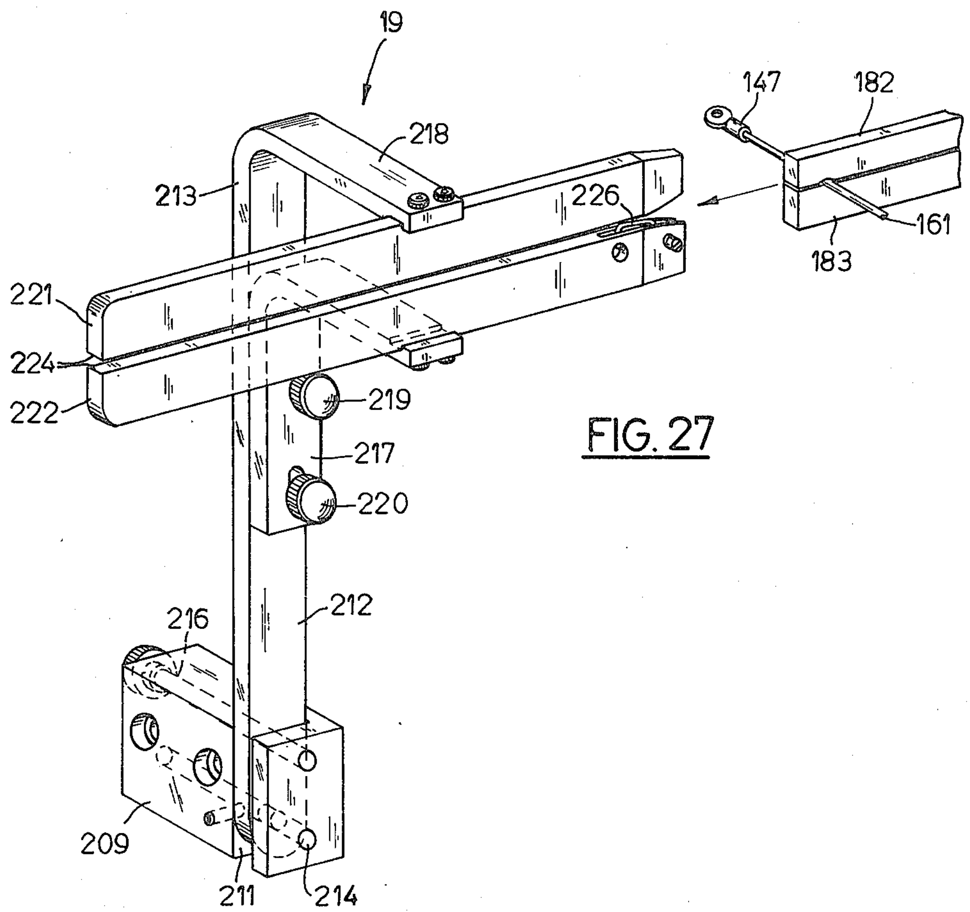



FIG. 27

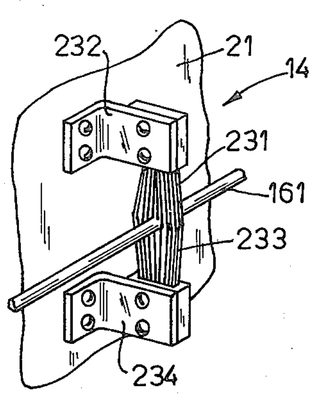



FIG. 29

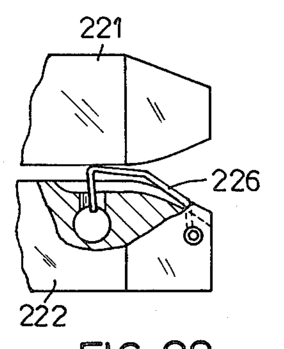
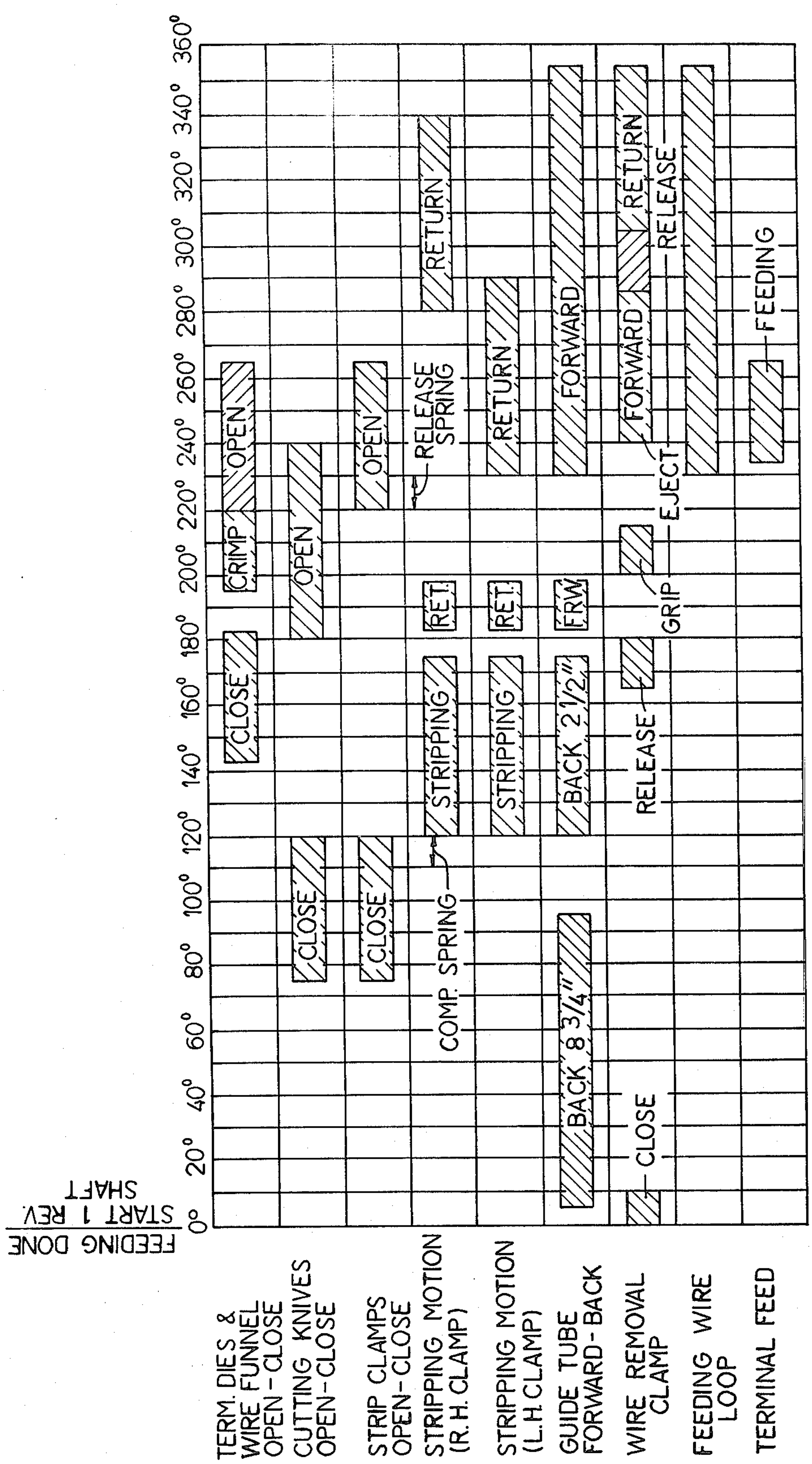



FIG. 28



FEEDING DONE
START 1 REV. SHAFT
0°
20°
40°
60°
80°
100°
120°
140°
160°
180°
200°
220°
240°
260°
280°
300°
320°
340°
360°
TERM. DIES & WIRE FUNNEL OPEN-CLOSE
CLOSE
CRIMP
OPEN
CUTTING KNIVES OPEN-CLOSE
CLOSE
OPEN
STRIP CLAMPS OPEN-CLOSE
CLOSE
OPEN
STRIPPING MOTION (R.H. CLAMP)
COMP. SPRING
STRIPPING
RET.
RELEASE SPRING
RETURN
STRIPPING MOTION (L.H. CLAMP)
STRIPPING
RET.
RETURN
GUIDE TUBE FORWARD-BACK
BACK 8 3/4"
BACK 2 1/2"
FRW.
FORWARD
WIRE REMOVAL CLAMP
CLOSE
RELEASE
GRIP
EJECT
FORWARD
RETURN
FEEDING WIRE LOOP
RELEASE
TERMINAL FEED
FEEDING


FIG. 30

# APPARATUS FOR PRODUCING ELECTRICAL CONDUCTORS

## BACKGROUND OF THE INVENTION

The invention relates to the manufacture of electrical conductors from insulated flexible wire stock, and it is concerned more particularly with an apparatus which will automatically produce such conductors of any desired length and with a terminal attached to both or at least to one of their opposite ends.

Apparatus to accomplish this have heretofore been developed wherein insulated wire stock is gripped at longitudinally spaced portions by a pair of clamp assemblies and cut in two by a wire and insulation cutting assembly between the clamp assemblies. In such prior art apparatus, as shown for instance in my U.S. Pat. No. 3,672,025 issued on June 27, 1972 for "Terminal Applicator," the relatively adjacent ends of the cut wire are pulled apart by the clamp assemblies so as to strip the cut insulation therefrom. A pair of terminal crimping assemblies are arranged at opposite sides of the wire and insulation cutting assembly and the stripping strokes of the clamp assemblies are continued until the stripped wire ends have been pulled into the crimping assemblies sufficient distances for attachment of open barrel terminals thereby by operation of the crimping assemblies.

While the apparatus of my mentioned prior patent is fully satisfactory to produce electrical conductors of any desired length with an open barrel terminal attached to both or to one of their opposite ends, it is not capable to produce conductors with closed barrel terminals attached thereto. Also, the prior art apparatus is not readily useable for wire and terminal sizes other than the wire and terminal size for which it is designed, and in that respect it has been somewhat deficient from a commercial standpoint.

## SUMMARY OF THE INVENTION

The present invention provides an improved apparatus for producing electrical conductors which takes care of certain disadvantages and shortcomings of the prior art, particularly with respect to the use of closed barrel terminals and with respect to different wire sizes, insulation thicknesses, and terminal types and sizes.

With this in view, the invention contemplates the provision of an apparatus of the mentioned character in which relatively adjacent ends of cut wire stock are pulled apart by a stripping stroke of sufficient length to move the stripped wire ends through and beyond a pair of terminal crimping assemblies, and in which reversal of the stripping strokes brings the stripped wire ends back into the crimping assemblies for attachment or either open barrel or closed barrel terminals thereto.

The invention further provides an improved apparatus of the mentioned character incorporating provisions for adjustment of its various operating components to accommodate different wire sizes, insulation thicknesses and terminal sizes.

The invention further provides an improved mechanism for collecting the produced conductors, and it also provides an improved wire stock feeding mechanism which will suppress whipping of the wire stock while it is being advanced into a set of feed rollers.

## DRAWINGS

The foregoing features and advantages of the invention will become more fully apparatus as this disclosure proceeds with reference to the accompanying drawings wherein:

FIG. **1** is an elevational front view of a conductor manufacturing apparatus embodying the invention;

FIG. **2** is an enlarged view of part of the apparatus shown in FIG. **1**;

FIG. **3** is a top view of FIG. **2**;

FIG. **4** is a section on line **4—4** of FIG. **2**;

FIG. **5** is a section on line **5—5** of FIG. **2**;

FIG. **6** is a section on line **6—6** of FIG. **2**;

FIG. **7** is a section on line **7—7** of FIG. **2**;

FIG. **7***a* is an enlarged sectional detail view of a yieldable stop shown in FIG. **7**;

FIG. **8** shows a portion of FIG. **7** with parts moved to different positions of adjustment;

FIG. **9** shows a portion of FIG. **2** on an enlarged scale with parts broken away and shown in section;

FIG. **10** is an exploded perspective view of a terminal crimping plunger;

FIGS. **11** and **11***a* are partial views of a crimping assembly for a closed barrel terminal;

FIGS. **12** and **12***a* are partial views of a crimping assembly for an open barrel terminal;

FIG. **13** is a section on line **13—13** of FIG. **3**;

FIG. **14** is a section on line **14—14** of FIG. **3**;

FIG. **15** is an end view of FIG. **14** with parts broken away and shown in section;

FIG. **16** is a section on line **16—16** of FIG. **15**;

FIGS. **17** to **20** are diagrammatic views illustrating parts of FIG. **2** moved to different positions of adjustment;

FIG. **21** is a section on line **21—21** of FIG. **3** and includes a conductor collecting bracket omitted in FIG. **3** but shown in FIG. **1**;

FIGS. **22–26** show parts of FIG. **21** moved to different positions of adjustment;

FIG. **27** is a perspective view of a conductor collecting bracket;

FIG. **28** is an enlarged view of part of FIG. **27**;

FIG. **29** is a perspective view of wire steadying brush assembly; and

FIG. **30** is a timing chart of the machine operation.

## DETAILED DESCRIPTION

Generally, the apparatus shown in FIG. **1** involves three wire processing components which are of principal interest in connection with the present invention; these are:

first, a pair of left and right wire clamping assemblies designated respectively by the reference numerals **1** and **2**;

second, a central wire and insulation cutting assembly **3**; and

third, a pair of left and right terminal crimping assemblies designated respectively by the reference numerals **4** and **5**.

In addition to these wire proceeding components the apparatus shown in FIG. **1** incorporates a computerized wire measuring device **7** including a pair of encoding rollers **8**; a wire feed mechanism including an upper pair of feed rollers **9** and **11**, and a lower pair of feed rollers **12** and **13**; a first set of wire steadying brushes **14** at the wire inlet side of the feed rollers **9** and **12**; a second set of wire steadying brushes **16** between the upper feed roller **9**, **11** and the lower feed rollers **12** and **13**; a reciprocable wire guide tube **17**; a belt type drive mechanism **18** for the guide tube **17**; a finished conductor removal mechanism (FIGS. **21** through **26**) which is located between the right wire clamping assembly **2** and the right terminal crimping assembly **5**; and a slotted bracket structure **19** for collecting finished conductors as will be explained more fully hereinbelow. All of these components are mounted on a bench type main frame **21** which also mounts electric driving motors and associated circuitry, not shown, for operating the apparatus. A control panel **22** for the electric circuitry is mounted in a housing **23** which, as shown in FIG. **1**, also partly covers the processing assemblies **1–5** but which is omitted in FIGS. **2** and **3**.

## The Wire Clamping Assemblies

As shown in FIG. **2**, the left wire clamping assembly **1** comprises a wire clamping slide **24** which, as shown in FIG. **5**, is guided for vertical up and down movement in a stationary bracket assembly **26** on the frame **21**. At its lower end the slide **34** has an enlarged botton section **27** (FIG. **2**), and a wire clamping block **28** is shiftably mounted on the bottom section **27** for horizontal and is shiftably mounted on the bottom section **27** for horizontal back and forth movement thereon. A complementary wirer clamping block **29** below the clamping block **28** is shiftably mounted for horizontal back and forth movements of a guide bracket **31** which is secured in a vertically and horizontally fixed position on the frame **21**. A vertical tie bar **32** is secured at its lower end to the wire clamping block **29** and extends upwardly through a vertical guide passage in the block **28**. The vertically reciprocable slide together with the horizontally slideable blocks **28, 29** and tie bar **32** form a reciprocable wire clamping assembly which is operatively mounted on the frame **21**.

Actuating means for the wire clamping assembly **1** comprise two triple armed levers **33** (FIG. **4**) and **34** (FIG. **5**); link means connecting the lever **33** with the tie bar **32** of the wire clamping blocks **28, 29**; and link means connecting the lever **34** with the vertically reciprocable slide **24**. The levers **33** and **34** are rockably mounted on the frame **21** in axially aligned relation to each other, a supporting shaft **36** for these levers being mounted at its opposite end in walls **37** and **38** (FIG. **3**) of the frame **21**.

The link means which connect the triple armed actuating lever **33** with the tie bar **32** of the wire clamping blocks **28, 29** comprise a bell crank lever **39** (FIG. **2**) which is pivoted on the bracket **26** of the frame **21** by means of a horizontal pivot pin **41** extending in right angle relation to the supporting shaft **36** for the actuating levers **33, 34**. One end of the bell crank lever **39** is connected to the associated actuating lever **33** by a first link element **42**, and the other end of the bell crank lever **39** is connected to the tie bar **32** by a second link element **43**. Adjusting means are provided, as shown in FIG. **4**, whereby the first link element **42** may be connected to its associated actuating lever **33** at different radial distances from the pivot center thereof, that is, from the axis of the shaft **36**. Such adjusting means comprise a pivot pin **44** for the upper end of the link **42**, and a threaded eye bolt **46** which is rotatable manually by a knurled knob **47** so as to move the pivot pin **44** sidewise back and forth in an elongated slot **48** of the actuating lever **33**.

The link means which connect the triple armed lever **34** (FIG. **5**) with the wire clamping slide **24** comprises a pair of telescopically interconnected link elements **46** and **50**, and associated biasing means in the form of a coil spring **48** which resiliently opposes contraction of the link elements **46** and **50**. A pivot pin **49** connects the link element **46** with the lever **34**, and another pivot pin **51** connects the link element **50** with the clamping slide **24**. Expansion of the telescopically interconnected link elements **46** and **50** under the pressure of the spring **48** is limited by a lost motion connection comprising a crosspin **52** on the link element **50** and an oblong slot **53** (FIG. **2**) in the link element **46**.

The right wire clamping assembly **2** (FIG. **1**) is an opposite hand duplicate of the left wire clamping assembly **1**, and the reference numerals which in FIGS. **2** and **3** are applied to the parts of the left assembly are also applied, with primes added, to the corresponding parts of the right wire clamping assembly. The actuating levers **33'** and **34'** for the right wire clamping assembly are rockably mounted on the same shaft **36** which mounts the actuating levers **33** and **34** of the left wire clamping assembly.

The actuating levers **33, 34** and **33', 34'** are rocked on the shaft **36** in timed relation to each other by rotary cam means on a drive shaft **54** as shown in FIGS. **4** and **5** and which will be explained more fully hereinbelow.

## The Wire and Insulation Cutting Assembly

The wire and insulation cutting assembly **3** (FIG. **1**) is mounted on the frame **21** centrally between the wire clamping assemblies **1** and **2**. As shown in FIGS. **2** and **6**, it comprises a cutting tool slide **56** which like the wire clamping slides **24, 24'** is guided for vertical up and down movement in the stationary bracket assembly **26** of the frame **21**. Fixedly secured to the lower end of the slide **56** is a cutting blade assembly comprising a central wire stock severing blade **57** and two insulation cutting blades **58, 59** at opposite sides, respectively, of the severing blade **57**. A complementary cutting blade assembly comprising a central wire stock severing blade **57'** and insulation cutting blades **58', 59'** is fixedly mounted on the frame **21** below the vertically reciprocable side **56**. Each of the blades **57, 58, 59** and **57', 58', 59'** is provided with a V-shaped notch having sharpened cutting edges as is well known in the art.

Actuating means for the wire and insulation cutting assembly **3** comprise a triple armed lever **61** (FIG. **6**) which is rockably supported on shaft **36** and link means of adjustable effective length connecting the lever **61** with the upper end of the cutting tool slide **56**. As shown in FIGS. **2** and **6**, such link means comprise a rod **62** and and associated rod end **63**, a cylindrical swivel block **64** in a forked end portion of the lever **61**, and a pivot pin **66** connecting the rod end **63** to the upper end of the cutting tool slide **56**. The rod **62** is rotatable about its axis within the swivel block **64**, and it is retained thereon against axial shifting by a shoulder **67** and a knurled knob **68** which is pinned to the upper end of the rod **62**. The lower end of the rod **62** is screw threaded into the rod end **63** and locked against turning therein by a jam nut **69**. Upon loosening of the jam nut the rod **62** may be turned manually by the knob **68** in order to lengthen or shorten the effective length of the link connection between the lever **61** and the cutting tool assembly **56, 57, 58**.

The actuating lever **61** is rocked on the shaft **36** in timed relation to the actuating levers **33, 34** and **33'**, **34'** for the wire clamping assemblies **1** and **2** by rotary cam means on the drive shaft 54 as shown in FIG. 6 and as will be explained more fully hereinbelow.

In order to remove waste pieces of insulation from the spaces between the stock severing and insulation cutting blades a suitable ejector mechanism may be provided which is not shown but is well known in the art.

## The Terminal Crimping Assemblies

The left terminal crimping assembly 4 (FIGS. 1 and 7) comprise a lower stationary die section, generally designated by the reference numeral 71, and an upper vertically reciprocable die section generally designated by the reference numeral 72. The lower die section 71 (FIG. 7) is detachably mounted on a bracket 73 of the frame 21 by means of a clamping block 74 and a wing nut 76, and the upper die section 72 (FIG. 7) is detachably connected by means of a heading 77 to the lower end of a vertically reciprocable tool slide 78. As shown in FIGS. 2 and 7, the tool slide 78, like the wire clamping slide 24 and the cutting tool slide 56, is guided for vertical up and down movement in the stationary bracket assembly 26 of the frame 21.

Actuating means for the left terminal crimping assembly 4 (FIG. 1) comprises a triple armed lever 79 (FIG. 7) which is rockably supported on shaft 36, and link means of adjustable effective length connecting the lever 79 with the upper end of the crimping tool slide 78. As shown in FIGS. 2 and 7, such link means comprise a rod 81 and associated rod end 82, a cylindrical swivel block 83 in a forked end portion of the lever 79, and a pivot pin 84 connecting the rod end 82 to the upper end of the tool slide 78. The rod 81 is rotatable about its axis within the swivel block 83, and it is retained thereon against axial shifting by a shoulder 86 and a knurled knob 87 which is pinned to the upper end of the rod 81. The lower end of the rod 81 is screw threaded into the rod end 82 locked against turning therein by a jam nut 88. Upon loosening of the jam nut 88 the rod 81 may be turned manually by the knob 87 in order to lengthen or shorten the effective length of the link connection between the lever 79 and the crimping tool slide 78.

The actuating lever 79 for the crimping tool slide 78 is rocked in timed relation to the actuating levers 33, 34 and 33′, 34′ for the wire clamping assemblies 1 and 2 and the actuating lever 61 for the cutting tool assembly 3 by rotary cam means on the driving shaft 54 as shown in FIGS. 7 and 8, and as will be explained more fully hereinbelow.

As shown in FIGS. 7 and 8, yieldable stop means are provided on the frame 21 in cooperative relation in the actuating lever 79 for the terminal crimping assembly 4, such stop means comprising a vertically reciprocable spring loaded plunger 80 below the overhanging radial arm 91 of the triple armed lever 79. The plunger 89 has an externally threaded portion which extends slideably through a smooth vertical bore of a mounting block 92, and on which a knurled knob 93 is axially adjustable below the block 92. A coil spring 94 reacts between the block 92 and a collar 96 at the upper end of the plunger 89 to urge the knob 93 axially against the under side of the block 92. A set screw 97 on the block 92 projects into an axial groove 98 of the plunger 89 to keep the plunger from turning within the block 92. Back and forth rocking movement of the lever 79 about the axis of its supporting shaft 36 brings a web 99 of the lever arm 91 into and out of engagement with the upper end of the plunger 89 as shown by FIGS. 7 and 8.

The right terminal crimping assembly 5 (FIG. 1) is an opposite hand duplicate of the left crimping die assembly 4, and the reference numerals which in FIGS. 2 and 3 are applied to the parts of the left terminal crimping assembly are also applied, with primes added, to the corresponding parts of the right terminal crimping assembly. The actuating levers 79, 79′ for the left and right terminal crimping assemblies are coaxially mounted on the shaft 36 which also mounts the actuating levers 33, 34 and 33′, 34′ for the left and right wire clamping assemblies 1 and 2, and the actuating lever 61 for the wire and insulation cutting assembly 3.

A duplicate of the yieldable stop plunger assembly shown in FIG. 7*a* is provided for the right crimping tool actuating lever 79′ (FIG. 2), and such duplicate assembly is mounted on the end of block 92 opposite to the end which carries the yieldable stop plunger assembly for the left crimping tool actuating lever 79.

As previously mentioned, the herein disclosed apparatus for producing electrical conductors also includes a belt type drive mechanism 18 (FIG. 1) for a wire guide tube 17, and it also includes a finished conductor removal mechanism in the space between the right wire clamping assembly 2 and the right terminal crimping assembly 5. As will be explained more fully hereinbelow with reference to FIG. 13, a cam operated bell crank lever 101 for the belt type drive mechanism 18 is rockably mounted on the shaft 36, and as shown in FIGS. 2 and 3 the bell crank lever 101 is positioned between the triple armed actuating levers 33 and 34 for the left wire clamping assembly 1. As will further be explained hereinbelow with reference to FIG. 21, a cam operated bell crank lever 102 for the finished conductor removal mechanism is rockably mounted coaxially with the actuating levers 33, 101, 34, 79, 61, 79′, 34′ and 33′ on the shaft 36, and as shown in FIGS. 2 and 3, the bell crank lever 102 is positioned between the triple armed actuating lever 79′ for the right terminal clamping assembly 5 and the triple armed actuating arms 34′ for the right wire clamping assembly 2.

## The Timing Cams

The triple armed actuating lever 33 (FIG. 4) for the left wire clamping assembly 1 is rocked back and forth on the shaft 36 by a pair of conjugated cam discs 103 and 104 (FIG. 3) which are keyed to the drive shaft 54. Cam follower rollers 106 and 107 on radially diverging arms 108 and 109 of the actuating lever 33 are arranged to ride along the peripheries of the cam discs 103 and 104 while the shaft 54 rotates these cam discs through a full turn in the direction of arrow A in FIG. 4.

The bell crank lever 101 (FIG. 13) for the tube drive mechanism 18 is rocked back and forth on the shaft 36 by a pair of conjugated cam discs 111 and 112 (FIG. 3) which are keyed to the drive shaft 54. Cam follower rollers 113 and 114 on the arms of the bell crank lever 101 are arranged to ride along the peripheries and the cam discs 111 and 112 as they are rotated by shaft 54 through a full turn in the direction of arrow A in FIG. 15.

The triple armed actuating lever 34 (FIG. 5) for the left wire clamping assembly 1 is rocked back and forth on the shaft 36 by a pair of conjugated cam discs 116 and 117 (FIG. 3) which are keyed to the shaft 54. Cam follower rollers **118, 119** on radially diverging arms **121** and **122** (FIG. **5**) of the actuating lever **34** are arranged to ride along the peripheries of the cam discs **116, 117** as they are rotated by shaft **54** through a full turn to clockwise direction as indicated by the arrow A in FIG. **5.**

Back and forth rocking movement of the triple armed crimping die actuating lever **79** (FIG. **7**) on the axis of the shaft **36** is controlled by a pair of conjugated cam discs **123** and **124** (FIG. **3**) which are keyed to the drive shaft **54**; by a pair of cam follower rollers **126** and **127** on arms **128** and **129** of the lever **79**; by a coil spring **131** which is hooked at one end to the arm **128** of the lever **79** and which is anchored at its other end to a shelf portion **132** of the frame **21**; and by the resilient stop plunger **89.** The coil spring **131** tends to swing the lever **79** clockwise, as seen in FIG. **7**, about the shaft **36,** and this swinging tendency of the lever **79** is opposed by coaction of the roller **127** with the cam disc **123,** and it is assisted by coaction of the roller **126** with the cam disc **124.** The cam disc **123** is contoured so that its coaction with the roller **127** will take up the tension of the spring **131** during an initial turn of the shaft **54** in the direction of arrow A in FIG. **7,** and so that upon continued clockwise rotation of the shaft **54** the spring **131** may urge the web **99** on lever **79** into engagement with the stop plunger **89.** When the web **99** of lever **79** engages the stop plunger **89** the crimping tool slide **78** will have moved downward to a position above the stationary crimping die section **71** which is determined by the axially adjusted position of the knob **93** (FIG. **7***a*) on the stop plunger **89.** That is, when the knob **93** is positioned close to the lower end of the plunger **89** the tool slide **78** will be stopped at a relatively large distance above the stationary die section **71**; and upward adjustment of the knob **93** on the plunger **89** reduces the height at which the slide **78** will be stopped above the stationary die section **71** when the web **99** of lever **79** engages the projected stop plunger **89.**

After the projected stop plunger has been engaged by the web **99** of lever **79** the contracting tension of the coil spring **131** will be overbalanced by the expanding pressure of the coil spring **94** and, upon continued rotation of the cam disc **123** in the direction of arrow A, the peripheral edge of the cam disc **123** will recede from the roller **127** while clockwise swinging of the lever **79** is arrested by the stop plunger **89.** As the cam disc **123** continues to rotate in the direction of arrow A, the peripheral edge of the cam disc **124** will engage the roller **126** on the arm **128** of lever **79** and force the lever **79** to swing downward against the pressure of the coil spring **94** as illustrated by FIG. **8.** The cam disc **124** is contoured in such a manner that its coaction with the roller **126** during continued rotation of shaft **54** in the direction of arrow A will lower the tool slide **78** to a position of maximum downward adjustment, and then let the cam disc **123** rock the lever **79** anticlockwise in opposition to the tension of the coil spring **131** and thereby restore the tool slide **78** to its fully raised position in which it is shown in FIGS. **2, 7** and **9.**

The upper die section **72** (FIG. **9**) of the left terminal crimping assembly comprises a plunger **133** which is connected by the head lug **77** to the lower end of the tool slide **78,** and a reciprocable spring loaded gate plate **134** which is mounted within the crimping plunger **133** for up and down sliding movement relative thereto. A terminal crimping cavity **136** is formed on a plate member **137** which is secured to the plunger **133** by cap screws **138** (FIG. **9**).

The lower die section **71** of the left terminal crimping assembly has a stationary upper portion **139** (FIG. **9**) in which the crimping plunger **133** is guided for up and down movement in centered relation to a stationary crimping anvil **141** of the lower die section. A stationary gate plate **142** complementary to the reciprocable gate plate **134** is incorporated in the lower die section in vertical alignment with the gate plate **134** of the upper die section.

FIG. **9** shows the tool slide **78,** the crimping plunger **133** and the gate plate **134** at their maximum vertical spacing from the lower die section **71,** the same as in FIG. **7.** Initial clockwise rotation of the cam discs **123** and **124,** as explained hereinbefore, brings the web **99** of the crimping tool actuating lever **79** into engagement with the upwardly projected stop plunger **81.** At the same time the reciprocable gate plate **134** is lowered into edgewise engagement with the stationary gate plate **142,** as shown in FIG. **19.** In that condition, a semi-conical recess **143** (FIG. **9**) in the lower end of the reciprocable gate plate **134** and a complementary semi-conical recess **144** in the upper part of the stationary gate plate **142** cooperate to form a wire inlet funnel of the left terminal crimping assembly.

In FIG. **9** a closed barrel terminal **146** is shown seated on the crimping anvil **141** of the stationary lower die section **71.** The downward movement of the tool slide **78** which brings the gate plate **134** into edgewise abutment with the gate plate **142** (FIG. **17**) also lowers the crimping cavity **136** of the crimping plunger **133** upon the tubular portion **147** of the terminal **146.** This condition is illustrated by FIG. **11** and engagement of the converging sides of the crimping cavity **136** centers the terminal on the anvil **141** without, however, distorting its tubular shape. While the terminal is held in place on the crimping anvil by the partly lowered crimping plunger the stripped end of a conductor wire, as will be explained more fully hereinbelow, is pushed into the barrel **147** of the terminal through the wire inlet tunnel formed by the semi-conical recesses **143, 144.** Continued lowering of the tool slide **78** in opposition to the expanding pressure of the coil spring **94** (FIG. **7***a*) as illustrated in FIG. **8** then performs the actual crimping operation as illustrated by FIG. **11***a*.

Conventional mechanism, not shown, is provided to place closed barrel terminals successively upon the crimping anvil **141** after each lifting stroke of the crimping plunger **133.** Such terminals may vary in size, depending upon the size of the wire to which they are to be attached. The initial downstroke of the plunger **133** which lowers the crimping cavity **136** upon the barrel of the terminal may be adjusted by means of the knob **93** (FIG. **7***a*) as necessary to bring the crimping cavity **136** into centering, non-crimping engagement with terminal barrels of different diameters. To accommodate terminals of relatively large barrel diameters the knob **93** will have to be adjusted downward on the stop plunger **89,** and if the terminals have a relatively small barrel diameter the knob **93** will have to be adjusted upward on the plunger **89.**

In addition to adjusting the projected position of the stop plunger **89** by means of the knob **93,** the effective length of the link connection between the actuating lever **79** and the tool slide **78** may be adjusted, as has already been explained with reference to FIG. 7, by turning the knob **87** after loosening of the jam nut **88.** Such length adjustment of the link connection between the lever **79** and the tool slide **78** will provide the variable crimping pressures which are required to firmly attach closed barrel terminals of different barrel diameters to their associated wires. That is, in case of a heavy wire and a correspondingly large diameter terminal barrel the link connection between the lever **79** and the tool slide **78** will be adjusted to a shorter effective length than in case of a light wire and a correspondingly small diameter terminal barrel, and vice versa.

In lieu of closed barrel terminals such as the terminal **146** shown in FIGS. **9, 11** and **11***a*, barrel terminals may be placed successively upon the crimping anvil **141** by suitable mechanism, not shown, after each lifting stroke of the crimping plunger **133.** FIG. **12** shows such a terminal **148** with upstanding side wings **149** and **151.** The crimping cavity **136'** of the plunger plate **137'** is suitably shaped to fold the wings **149, 151** over the conductor wires by a crimping stroke of the tool slide **78** (FIG. 2). The explanations hereinbefore with reference to the resiliently yieldable stop plunger assembly **89,** 93, 94 (FIG. 7*a*), and the adjustable link connection between the actuating lever **79** and the tool slide **78** are also applicable

when the apparatus is used to produce conductors with open barrel terminals attached thereto. In that case the stop plunger **89** is adjusted by means of the knob **93** to an upwardly projected position which stops downward movement of the tool slide **78** at the moment when the crimping cavity **136** engages the upstanding wings **149, 151** of the open barrel terminal **148.** Continued descent of the tool slide **78** then folds the wings **149, 151** into their crimped condition as shown by FIG. 12*a*. Here again the projected position of the stop plunger **89**, and the effective length of the link connection between the lever **79** and the tool slide **78** may be varied to accommodate different terminal and wire sizes.

The triple armed actuating lever **61** (FIG. **6**) for the wire and insulation cutting assembly **3** is rocked back and forth on the shaft **36** by a pair of conjugated cam discs **152** and **153** (FIG. **3**) which are keyed to the shaft **54.** Cam follower rollers **154** and **156** on radially diverging arms **157** and **158** (FIG. **6**) of the actuating lever **61** are arranged to ride along the peripheries of the cam discs **152, 153** as they are rotated by the shaft **54** through a full turn in clockwise direction as indicated by the arrow A in FIG. **6.** The cam discs **152** and **153** are contoured so that an initial clockwise turn of the shaft **54** will keep to the wire and insulation cutting assembly **3** at its fully raised position in which it is shown in FIG. **6.** Continued clockwise rotation of the shaft **54** will then lower the cutting assembly to its lowest position, keep it there for a time and finally raise it again to its starting position. As the severing blade **57** (FIG. 9) slides along the stationary companion blade **57'** during the descent of the tool slide **56,** the V-shaped cutting edge **159** (FIG. **6**) of the upper blade **57** moves past the corresponding V-shaped cutting edge of the lower blade **57'**. By this action wire stock **161** (FIG. **17**) which has been played out from a supply reel **162** (FIG. **1**) is cut in two as illustrated by FIG. **18.** At the same time the upper insulating cutting blades **58, 59** slide along the stationary lower companion blades **58'** and **59'**. This action only cuts through the insulation of the wire stock and preferably only to a depth slightly less than the full thickness of the insulation. The cutting depth of the blades **58, 58'** and **59, 59'** may be adjusted to accommodate different wire sizes and insulation thickness by lengthening or shortening the effective length of the link connection between the actuating lever **61** (FIG. **6**). After loosening the jam nut **69** on rod **62,** the knob **68** may be turned manually in one direction or the other in order to adjust the radial depth to which the wire insulation will be cut by the insulation cutting blades **58, 58'** and **59, 59'** while the actuating lever **61** is swung clockwise by the coaction of the cam disc **153** with the cam follower roller **156** during clockwise rotation of the shaft **54.**

The foregoing explanations regarding the actuation of the wire clamping assembly **1** (FIG. **1**) and the terminal crimping assembly **4** at the left side of the wire and insulation cutting assembly **3,** are also applicable to the wire clamping assembly **2** and to the terminal crimping assembly **5** at the right side of the wire and insulation cutting assembly **3.**

Briefly, the triple armed actuating lever **33'** for the right wire clamping assembly **2** is rocked back and forth on the shaft **36** by a pair of conjugated cam discs **103', 104'** (FIG. **3**) and associated cam follower rollers **106', 107'** corresponding to the cam disc **103, 104** and cam follower rollers **106, 107** of the left wire clamping assembly **1.** The cam disc **103', 104'**, like the cam discs **103, 104** are keyed to the drive shaft **54,** but the discs **103', 104'** are rotatively positioned on the shaft **54** in such relation to the discs **103, 104** that after a stripping stroke and partial reverse movement of each clamping assembly the return movement of the right clamping assembly **2** to its starting position will be delayed for a greater length of time than the return movement of the left clamping assembly to its starting position.

The triple armed actuating lever **34'** for the right wire clamping assembly **2** is rocked back and forth on the shaft **36** by a pair of conjugated cam discs **116', 117'** (FIG. **3**) and associated cam follower rollers **118', 119'** corresponding to the cam discs **116, 117** and cam follower rollers **118, 119** on the left wire clamping assembly **1.**

The triple armed actuating lever **79'** for the right terminal crimping assembly **5** is rocked back and forth on the shaft **36** by a pair of conjugated cam discs **123', 124'** and associated cam follower rollers **126', 127'** corresponding to the cam discs **123', 124'** and rollers **126, 127** of the left terminal crimping assembly **4.** The right terminal crimping assembly **5** is an opposite hand duplicate of the left terminal assembly **4,** and the same reference numerals which in FIG. **9** designate the various parts of the left terminal crimping assembly are applied, with primes added, to the corresponding parts of the right terminal crimping assembly. Like the left terminal crimping assembly **4,** the right terminal crimping assembly **5** is operable to attach either closed barrel terminals or open barrel terminals of different sizes to wires of different gauges and insulation thickness in the manner which has been explained hereinbefore with reference to the left terminal crimping assembly **4.**

As previously explained with reference to FIGS. **2** and **3,** a bell crank lever **101** is rockably mounted on the shaft **36** between the triple armed actuating levers **33** and **34** for the left wire clamping assembly **1.** The function of the bell crank **101** is to coordinate the back and forth movement of the wire guide tube **17** (FIG. **1**) with the operation of the wire processing components, that is, with the operation of the wire clamping assemblies **1** and **2**, with the wire and insulation cutting assembly **3**, and with the terminal crimping assemblies **4** and **5**. A rack and pinion drive **163** (FIG. **13**) connects the bell crank lever **101** with a rotary cross shaft **164** on the frame **21**, and the belt type drive mechanism **18** for the wire guide tube **17** includes a drive pulley **166** which is connected to the shaft **164**. Rotation of the shaft **54** (FIG. **13**) through one revolution in the direction of arrow A sequentially swings the bell crank lever **101** first clockwise about the shaft **36** by cooperation of the cam die **111** with the cam follower roller **113**, and then anti-clockwise by cooperation of the cam disc **112** with the cam follower roller **114**. The clockwise swing of the bell crank lever **101** lifts the rock **165** of the rack and pinion drive **163** and thereby causes rotation of the shaft **164** in a direction to move the wire guide tube **17** backward, that is, to the left in FIG. **1** beyond the left wire clamping assembly **1**. On the other hand, the anti-clockwise swing of the bell crank lever **101** lowers the rack **165** and thereby causes rotation of the shaft **164** in a direction to move the wire guide tube **17** forward, that is, to right in FIG. **1**, until the leading end of the tube **17** has moved somewhat beyond the wire clamping assembly **5**.

Reference has also been made hereinbefore to the cam operated bell crank lever **102** which, as shown in FIGS. **2** and **3**, is rockably supported on the shaft **36** between the triple armed actuating lever **79'** for the right terminal clamping assembly **5** and the triple armed actuating arm **34'** for the right wire clamping assembly **2**. The lever **102** is rocked back and forth on the shaft **36** by a pair of conjugated cam discs **167, 168** which are keyed to the drive shaft **54** (FIG. **21**) and by a pair of cam follower rollers **169** and **171** which are mounted on the diverging arms of the bell crank lever **102** in cooperative relation, respectively, with the cam discs **167** and **168**. The cam discs **167** and **168** are contoured so that initial clockwise rotation of the shaft **54**, that is, in the direction of arrow A in FIG. **21** rocks the lever **102** through a small angle in anti-clockwise direction as indicated by the arrow B in FIG. **21**. Continued clockwise rotation of the shaft **54** then causes step by step swinging movement of the lever **102** first in clockwise and then in anti-clockwise direction as will be more fully discussed hereinbelow with reference to the conductor removing mechanism shown in FIGS. **21–26**.

## One-Revolution Clutch

FIGS. **14, 15** and **16** show a one-revolution clutch of a well known type for transmitting driving power from an electric motor, not shown, to the cam drive shaft **54**. Reference may be had to my U.S. Pat. No. 3,653,412, issued on Apr. 4, 1972 for "Conveyor Transfer Unit" which discloses and describes in detail a one-revolution clutch of the same general type as shown in FIGS. **14–16** of the present application. Briefly, the clutch **172** is tripped by an electric solenoid **173** whose armature is connected by a link **176** to a release lever **177** pivotably mounted on a pin **178**. The pivotal movement of the release lever **177** releases a spring biased clutch pin **179** for movement into engagement with a jaw plate on fly wheel **181** as is generally understood in the art. The clutch **172** will produce one cycle of revolution of the cam drive shaft **54** each time an energizing signal is transmitted to the solenoid **173** while the flywheel **181** is continuously rotated by an electric motor and drive belt, not shown.

## Finished Conductor Removal Mechanism

As shown in FIG. **21**, were transfer means comprising a pair of wire gripping tongues **182** and **183** are operable by back and forth rocking movement of the bell crank lever **102** on the shaft **36**. The tongues and associated actuating linkage are located on the frame **21** in the space between the right terminal crimping assembly **5** and the right wire clamping assembly **2**. As shown in FIG. **17**, the tongues **182, 183** straddle conductor wire **161** which has been advanced through the guide tube **17** and through the open wire clamping assemblies **1** and **2**, the open wire and insulation cutting assembly **3** and the open terminal crimping assemblies **4** and **5**. The tongue **182** is pivotally mounted intermediate its ends by means of a pivot pin **184** on a transfer slide **186** which is guided for endwise back and forth movement on a channel block having parallel upper and lower guide straps **187** and **188**. The channel block together with the guide straps **187, 188** and the transfer slide **168** is rockably supported on the frame **21** by means of a horizontal pivot pin **190** whose axis extends at right angles to the plane of the transfer slide **186**. The tongue **183** is pivotally mounted, like the tongue **182**, intermediate its ends on the transfer slide **186** by means of a pivot pin **189**.

A toggle linkage for swinging the tongues **182, 183** back and forth about the pivot pins **184, 189** comprises a pair of short links **191, 192** that are pivoted respectively to the inner ends of the tongues **182** and **183**, and which are hinged together by a hinge pin **193**. A telescopically extensible and contractible actuating link for the toggle links **191, 192** comprises a tubular section **194** which is connected to the hinge pin **193**; a rod section **196** within the tubular section **194**; a coil spring **197** yieldably opposing contraction of the link sections **194, 196** and a lost motion connection **198** limiting telescopic expansion of the link sections **194, 196**. A spring loaded detent plunger **199** is engageable with a notch **201** of the transfer slide **186** to releasably retain the latter in its inwardly adjusted position in which it is shown in FIGS. **21, 22, 23** and **24**. Alternately, the detent plunger **199** is engageable with a notch **202** of the transfer slide **186** to releasably retain the latter in its outwardly adjusted position in which it is shown in FIGS. **25** and **26**.

The rod **196** of the telescopic actuating link for the toggle links **191, 192** is connected by means of a pivot pin **203** to the free end of a rocker arm **204** which is pivotally mounted on a fixed bracket **206** of the frame **21** by means of a pivot pin **207**. A link **208** connects the rocker arm **204** with the lower end of the bell crank lever **102**.

FIG. **21** shows the finished conductor removal mechanism in the condition to which it is adjusted by the coaction of the cam discs **167, 168** with the cam follower rollers **169, 171** when the cam drive shaft **54** is in its starting position, that is, in its rotatively adjusted position which places the tool slides **24, 24'**; **78, 78'**; and **66** to the fully raised positions in which they are shown in FIGS. **2** and **17**. Initial rotation of the cam drive shaft **54** from said starting position in clockwise direction, as indicated by the arrow A in FIG. **21**, brings the conductor removal mechanism to the position in which it is shown in FIG. **22**, and in which the tongues **182, 183** are held in gripping engagement with wire stock **161** by the expanding pressure of the coil spring **197** while the transfer slide is being retained in its inwardly adjusted position by the detent plug **199.**

Continued clockwise rotation of the cam drive shaft **54** then causes the wire and insulation cutting operation which is illustrated by FIG. **18** and during which the conductor removal mechanism remains in the condition in which it is shown in FIG. **22.** As the cam drive shaft **54** then continues its clockwise rotation it causes the wire pulling and insulation stripping operations which are illustrated by FIG. **19** and it also brings the conductor removal mechanism to the condition in which it is shown in FIG. **23.** The change from the FIG. **22** to the FIG. **23** condition of the conductor removal mechanism is effected by coaction of the cam discs **168** with the follower roller **171** which swings the bell crank lever **102** slightly clockwise on the shaft **36** and as a results relieves the wire **161** from the grip of the tongues **182, 183.** While the conductor removal mechanism remains temporarily in the FIG. **23** condition continued clockwise rotation of the cam drive shaft **54** causes a short reverse movement of the closed wire clamping blocks **28, 29** and **28′, 29′** from their positions of maximum spacing from each other (FIG. **19**) to their positions of intermediate spacing from each other (FIG. **20**) to bring the stripped wire ends into the barrels of the terminals in the crimping assemblies **4** and **5.** The length of conductor wire which has been severed from stock by the wire and insulation cutting assembly **3** is relieved from the grip of the tongues **182, 183** (FIG. **23**) while its stripped end is pushed into the barrel of the terminal in the right terminal crimping assembly **5,** and continued clockwise rotation of the cam drive shaft **54** will then bring the conductor removal mechanisms into the FIG. **24** position by coaction of the cam disc **167** (FIG. **21**) with the cam follower roller **169.**

After a terminal has been attached to the cut off wire length by the right terminal crimping assembly **5** the conductor removal mechanism will be moved to the FIG. **25** condition by coaction of the cam disc **167** with the follower roller **169** (FIG. **21**). In FIG. **25,** the transfer slide **186** is retained in its outwardly adjusted position by the detent plunger **199,** and the finished conductor which is still gripped by the tongues **182, 183** is presented in a laterally shifted discharge position free from the frame **21.** During the final part of a full clockwise turn of the cam drive shaft **54** the conductor removal mechanism is first adjusted from the FIG. **25** position of the position in which it is shown in FIG. **26,** and then from the FIG. **26** position to the starting position in which it is shown in FIG. **21.** During the wire shifting movement of the wire transfer mechanism from the FIG. **25** condition to the FIG. **21** condition the clamping assemblies **1** and **2** are moved in wire releasing condition from their positions of intermediate spacing (FIG. **20**) to their positions of minimum spacing from each other (FIG. **17**).

## Conductor Collecting Bracket

The conductor collecting bracket **19** which is shown in FIG. **1** at the side of the frame **21** toward which the finished conductor is shifted by the conductor removal mechanism (FIG. **26**) is shown in perspective at an enlarged scale in FIG. **27.** The view of FIG. **27** is taken from an observation point at the right end of FIG. **1,** and in addition to the bracket **19** it shows the end portions of the wire gripping tongues **182, 183** together with the gripped cut-off length of wire **161** in the same relation to the collecting bracket in which the tongues and wire are shown in FIG. **24.**

A mounting block **209** is bolted to the frame **21** and has a vertical slot **211** which straddles the long leg **212** of bracket angle **213.** A pivot pin connects the angle **213** to the block **209** for up and down swinging movement on a horizontal axis. A withdrawable locking pin **216** secures the angle **213** in the vertical position in which it is shown in FIGS. **1** and **27.** Another bracket angle **217** is connected to the leg **212** of the angle **213** at a vertical spacing from the short leg **218** of the latter. Connecting bolts **219** and **220** extend through oblong holes in the vertical leg of the angle **217** and permit up and down adjustment on the angle **217** in order to increase or decrease the spacing of the angle **217** from the leg **218** of the angle **213.** A pair of parallel wire collecting rails **221** and **222** are secured to the bracket angles **213** and **217** in the space between the horizontal legs thereof. The lower edge of the upper rail **221** is spaced from the upper edge of the lower rail **222** to define a wire collecting gap **224** therebetween. Both ends of the gaps **224** are open, but a catch spring **226** (FIG. **28**) is mounted on the lower rail **222** at the wire entrance end of the gap **224.** As the tongues **182, 183** of the wire removal mechanism move from the FIG. **24** position to the FIG. **25** position the finished conductor **161** will clear the catch spring **226** and become lodged in the gap **224.** The catch spring **226** will prevent discharge of the collected wires through the inlet end of the gap **224,** and after a number of finished conductors have accumulated in the gap **224** they may be slid out manually through the remote open end of the gap **224.** Up and down adjustment of the bracket angle **217** on the bracket angle **213** provides for adjustment of the gap **224** to accommodate wires of different diameters.

A conductor collecting trough **227** (FIG. **1**) is mounted on the frame **21** into which finished conductors may be dropped when the collecting bracket **19** is swung out of the way, after withdrawal of the locking pin **216,** as indicated in dotted lines in FIGS. **21.**

## Operation

The computerized measuring device **7** (FIG. **1**) and the wire feed mechanism comprising the feed rollers **9,** 11, 12 and 13 operate in a manner well known in the art. As wire stock **161** is pulled from the supply reel **162** by the feed rollers it moves toward the right of FIG. **1** together with the forwardly moving guide tube **17.** The moving wire stock frictionally rotates the encoding rollers **8** and after the desired wire length has been measured by the measuring device **7** a stop signal is emitted by the latter to the feeding mechanism, and a trip signal is also emitted to the solenoid **173** (FIG. **14**) of the one-revolution clutch **172.** At this moment the measured length of the uncut wire stock extends to the right from the open severing blades **57, 57′** as shown in FIG. **17.**

As an incident of the feeding of wire stock from the supply reel the wire is slackened between the encoding rollers **8** and the trailing end of the guide tube **17** to form a loop **228** (FIG. **1**). Mechanism for forming the loop **228** is well known in the art and disclosed for instance in my mentioned prior U.S. Pat. No. 3,672,025. Lateral whipping of the slackened wire as it is drawn forward into the feed roller assembly is suppressed by the set of steadying brushes **14** (FIG. **1**) which is shown at an enlarged scale in FIG. **29.** A tuft of upper bristles **231** (FIG. **29**) is attached to an angle bracket **232** on the frame **21** and straddles the wire stock **161** from above, and a tuft of lower bristles **233** is attached to an angle bracket **234** on the frame **21** and straddles the wire stock **161** from below. The same explanations apply to the set of steadying brushes **16** (FIG. **1**) which are mounted on the frame **21** between the rearward pair of feed rollers **9, 12** and the forward pair of feed rollers **11, 13.** The bristles of the brushes **16** straddle the retracted wire guide tube **17,** and when the tube **17** moves forward they engage the moving wire stock **161.**

When a trip signal is transmitted to the solenoid **173** (FIG. **2**) the cam drive shaft **54** becomes coupled to the rotating fly wheel **181** and when it has been turned by the latter through one full revolution, the clutch disengages itself and the shaft **54** comes to rest in the same rotated position from which it has been started. The chart of FIG. **30** shows the sequence of timed operations which take place during the mentioned full revolution of the shaft **54.**

During the first 10° of the turning of shaft **54** in the direction of arrow A (FIG. **21**) the wire gripping tongues **182, 183** move from the FIG. **21** position to the FIG. **22** position. At about the same time the wire guide tube **17** starts moving backward from its FIG. **2** position toward its retracted FIG. **17** position. While the tube **17** is moving backward, that is, when the shaft **54** has been turned **75** degrees from its starting position, the wire and insulation cutting tool slide **56** and the wire clamping tool slides **24, 24′** start moving downward from their FIG. **17** positions toward their FIG. **18** positions. Upon completion of a 120° turn of shaft **54** the wire stock has been gripped by the clamping blocks **28, 29** and **28′, 29′**; the wire stock has been cut in two; and the insulation of the cut off lead and of the remaining stock has been cut as shown by FIG. **18.**

Rotation of the shaft **54** from the 120° position to the 175° position pulls the relatively adjacent ends of the cut wire lead and of the remaining stock in opposite directions away from the wire and insulation cutting assembly **3** as illustrated by FIG. **19.** During this phase of the operating cycle the cut insulation is stripped from the severed wire lead as well as from the remaining stock, and the stripped wire ends are pulled beyond the crimping assemblies **5** and **4,** respectively. Also, during this phase of the operating cycle while the shaft **54** rotates from the 120° position to the 175° position the guide tube **17** is pulled back to its fully retracted position.

The crimping assemblies **4** and **5** start closing while the cut off wire lead and the remaining wire stock are being moved apart, and the wire inlet funnels (FIG. **19**) of the crimping dies are completed shortly after the stripping strokes of the wire clamping assemblies have been completed. Also, shortly before the stripping strokes of the wire clamping assemblies have been completed the wire gripping tongues **182, 183** start moving from the FIG. **22** position to the FIG. **23** position.

At the 180° position of the shaft **54** the conductor removal mechanism is in the FIG. **23** position, that is, the grip of the tongues **182, 183** upon the cut off wire lead is released so that the stripped end of the wire lead may be pushed into the barrel of the terminal in the crimping assembly **5** upon reversal of the stripping strokes which occurs when the shaft **54** turns from its 182° position to its 198° position. During this reversal of the stripping strokes the guide tube **17** is moved initially forward from its fully retracted position.

When the stripped wire ends have been pushed into barrels of the terminals (FIG. **20**) in the crimping assemblies **4** and **5,** the barrels are crimped while the shaft **54** rotates from its 195° position to its 220° position. Thereafter the crimping assemblies are opened by rotation of the shaft **54** from its 220° position to its 265° position, and the crimping die assemblies then stay open while the full turn of the shaft **54** is being completed.

The wire and insulation cutting assembly **3** is moved from its FIG. **18** position to its FIG. **20** position by rotation of the shaft **54** from its 180° position to its 240° position.

The wire clamping blocks **28, 29** and **28′, 29′** are moved from their wire gripping positions (FIG. **20**) to their wire releasing positions (FIG. **17**) by rotation of the shaft **54** from its 220° position to its 265° position.

The right wire clamping blocks **28′, 29′** are moved from their wire push back positions (FIG. **20**) to their fully returned positions (FIG. **17**) by rotation of the shaft **54** from its 280° position to its 340° position.

The left wire clamping blocks **28, 29** are moved from their wire push back positions (FIG. **20**) to their fully returned positions (FIG. **17**) by rotation of the shaft **54** from its 230° position to its 290° position.

The wire guide tube **17** is moved from its initially projected position to its fully projected FIG. **2** position by rotation of the shaft **54** from its 230° position to its 355° position.

The finished conductor removal mechanism is moved from its FIG. **23** position to its FIG. **24** position by rotation of the shaft **54** from its 200° position to its 215° position. Subsequently the finished conductor removal mechanism is moved from its FIG. **24** position to its FIG. **25** position by rotation of the shaft **54** from its 240° position to its 285° position; then from its FIG. **25** position to its FIG. **26** position by rotation of the shaft **54** from its 285° position to its 305° position; and finally from its FIG. **26** position to its FIG. **21** position by rotation of the shaft **54** from its 305° position to its 355° position.

The wire loop **228** (FIG. **1**) is taken up during rotation of the shaft **54** from its 230° position to its 355° position, and new terminals are moved into the left and right crimping assemblies during rotation of the shaft **54** from its 235° position to its 265° position.

When a production rum is started with a new wire supply the first operating cycle will produce a conductor with a terminal attached only to its trailing end. However, the second and all subsequent operating cycles will produce a conductor with a terminal attached to each end, provided that both crimping assemblies **4** and **5** are supplied with terminals. If terminals are supplied to only one of the crimping assemblies the produced conductors will of course have only one terminal attached thereto. If desired, closed barrel terminals may be supplied to one crimping assembly and open barren terminals may be supplied to the other in order to produce conductors with closed and open barrel terminals at their opposite ends.

## SUMMARY

The hereinbefore described mode of operation of the wire clamping assemblies 1 and 2, of the wire and insulation cutting assembly 3 and of the terminal crimping assemblies 4 and 5 is accomplished basically by the provision of three stage actuating means which are operable to adjust the clamping assemblies 1 and 2 to minimum, intermediate and maximum spacings from each other as illustrated by FIGS. 17, 20 and 19, respectively; and by the provision of actuating means for the wire and insulation cutting assembly 3 and for the terminal crimping assemblies 4 and 5 which are operatively interrelated with the three stage actuating means for the clamping assemblies. In the illustrated embodiment of the invention the three stage actuating means for the clamping assemblies 1 and 2 are represented by the cam actuated levers 34, 34', by the cam actuated levers 33, 33', and by the respective associated linkages. The actuating means for the wire and insulation cutting assembly are represented by the cam actuated lever 61 and its associated linkage; and the actuating means for the terminal crimping assemblies 4 and 5 are represented by the cam actuated levers 79, 79' and their respective associated linkages.

The hereinbefore described mode of operation of the finished conductor removal mechanism is accomplished basically by the provision of actuating means for wire transfer means which are operatively interrelated with the three stage actuating mechanism for the wire clamping assemblies 1 and 2, and with the actuating mechanisms for the wire and insulation cutting assembly 3, and with the actuating means for the terminal crimping assemblies 4 and 5. In the illustrated embodiment of the invention the actuating means for the wire transfer means are represented by the cam actuating lever 102 (FIG. 21) and its associated linkage including the rocker arm 204 and link 208, whose cooperative relation with the wire clamping assemblies 1 and 2, with the wire and insulation cutting assembly 3 and with the terminal crimping assemblies 4 and 5 has been described hereinbefore with reference to FIGS. 21 to 26.

I claim:

1. An apparatus for producing electrical conductors from insulated wire stock, comprising a frame; a pair of wire clamping assemblies operatively mounted on said frame for relative back and forth adjustment between positions of minimum, intermediate and maximum spacing from each other; a wire and insulation cutting assembly and a pair of terminal crimping assemblies at opposite sides thereof operatively mounted on said frame between said wire clamping assemblies; three stage actuating means operable to adjust said clamping assemblies to said minimum, intermediate and maximum spacings from each other; and actuating means for said cutting and crimping assemblies operatively interrelated with said actuating means for said clamping assemblies, whereby relatively adjacent end portions of a wire severed by said cutting assembly are stripped and pulled away from the latter beyond said crimping assemblies and whereby said stripped wire ends are subsequently pushed back into said crimping assemblies, respectively, preparatory to the attachment of terminals to said stripped wire ends by said crimping assemblies.

2. An apparatus as set forth in claim 1, wherein said crimping assemblies each comprise a pair of relatively movable die members, and wherein said actuating means for said crimping assemblies are operatively interrelated with said actuating means for said cutting and clamping assemblies so that said die members are moved to an initial engaging position preparatory to said push movement of said stripped wire ends into said crimping assemblies, and so that said die members are subsequently moved sequentially into terminal crimping and terminal releasing positions.

3. An apparatus as set forth in claim 1 and further comprising wire transfer means operatively mounted on said frame at one side of said cutting assembly for engagement with and disengagement with a wire length cut from stock by operation of said cutting assembly and provided with at least one terminal by operation of one of said crimping assemblies, and actuating means for said wire transfer means operatively interrelated with said actuating means for said clamping, cutting and crimping assemblies so that during wire shifting movement of said clamping assemblies from said positions of maximum spacing to said positions of intermediate spacing from each other said transfer means are disengaged from said cut wire length, and so that during wire shifting movement of said transfer means said clamping assemblies are moved in wire releasing condition from said positions of intermediate spacing to said positions of minimum spacing from each other.

4. An apparatus as set forth in claim 3 and further comprising a stationary bracket structure on said frame presenting an elongated gap extending in the direction of sidewise movement of said wire length and in straddling relation thereto.

5. An apparatus as set forth in claim 4 and further comprising pivot means supporting said bracket structure for swinging movement into and out of an operative position in which successively transferred wire lengths may be collected within said gap, and releasable lock means for securing said bracket structure in said operative position.

6. An apparatus as set forth in claim 1 wherein said actuating means for said clamping assemblies, for said wire and insulation cutting assembly, and for said crimping assemblies comprise a series of independently rockable actuating levers mounted on said frame in axially aligned relation to each other; link means operatively connecting said levers, respectively, with said clamping, cutting and crimping assemblies; and rotary cam means mounted on said frame in cooperative relation to said actuating levers for rocking said actuating levers in timed relation to each other.

7. An apparatus as set forth in claim 6, wherein the link means interconnecting said cutting assembly and its respective actuating lever comprise a link element of adjustable effective length.

8. An apparatus as set forth in claim 6 wherein the link means interconnecting said crimping assemblies and their respective actuating levers each comprise a link element of adjustable effective length.

9. An apparatus as set forth in claim 6 and further comprising yieldable stop means on said frame in cooperative relation to the actuating levers for said crimping assemblies, and spring means tending to urge said actuating levers for said crimping assemblies into engagement with said stop means.

10. An apparatus as set forth in claim 9 wherein said yieldable stop means comprise a pair of plungers reciprocably mounted on said frame and each having an axially adjustable abutment cooperable with said frame so as to determine a variable limit position of each of said

plungers, and resilient means urging said plungers into said limit positions.

**11.** An apparatus for producing electrical conductors from insulated wire stock comprising a frame including an elongated, horizontally extending stationary bracket structure; a pair of vertically reciprocable tool supports slidably mounted independently of each other on opposite end portions, respectively, of said bracket structure; a vertically reciprocable wire and insulating cutting assembly and a pair of vertically reciprocable terminal crimping assemblies at opposite sides thereof slidably mounted on said bracket structure between said tool supports; a pair of complementary wire clamping blocks shiftably connected with each of said tool supports in back and forth movable relation to said cutting assembly; actuating levers for said tool supports, for said cutting and crimping assemblies and for said clamping tools rockably mounted on said frame in axially aligned relation to each other; link means operatively connecting said levers, respectively, with said tool supports, with said cutting and crimping assemblies and with said clamping tools; and rotary cam means mounted on said frame in cooperative relation to said actuating levers for rocking the latter in timed relation to each other.

**12.** Apparatus as set forth in claim **11** wherein the link means interconnecting said tool supports and their respective actuating levers each comprise a pair of telescopically interconnected link elements and associated biasing means resiliently opposing contraction of said link elements.

**13.** An apparatus as set forth in claim **11** wherein the link means interconnecting said wire clamping blocks with their respective actuating levers each comprise a bell crank lever pivoted on said frame, a first link element connecting one end of said bell crank lever with the associated actuating lever, and a second link element connecting the other end of said bell crank lever with the associated wire clamping tool.

**14.** An apparatus as set forth in claim **13** and further comprising adjusting means for said first link element whereby the latter may be connected to its associated actuating lever at different radial distances from the pivot center thereof.

**15.** In an apparatus for producing electrical conductors by successively cutting desired lengths of insulated wire from stock and removing portions of insulation therefrom, the combination of a wire feed roller assembly; an axially reciprocable wire guide tube in cooperative relation with wire discharged by said feed roller assembly; and stationary brush means adapted to straddle and laterally steady wire being fed into said feed roller assembly.

**16.** The combination set forth in claim **15** wherein said brush means are located in the path of axial movement of said guide tube so that axial movement of the latter toward and away from said feed roller assembly will bring said guide tube into and out of cooperative engagement with said brush means.

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