

Feb. 1, 1944.

K. H. ANDREN

2,340,448

APPLYING TERMINAL TO WIRE SEGMENTS

Filed Jan. 31, 1940

9 Sheets-Sheet 1

Fig. 1.

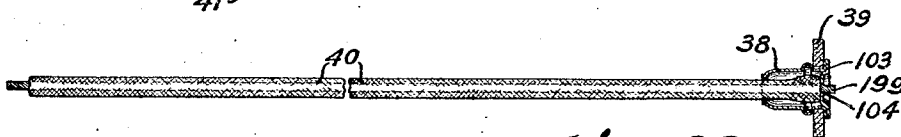
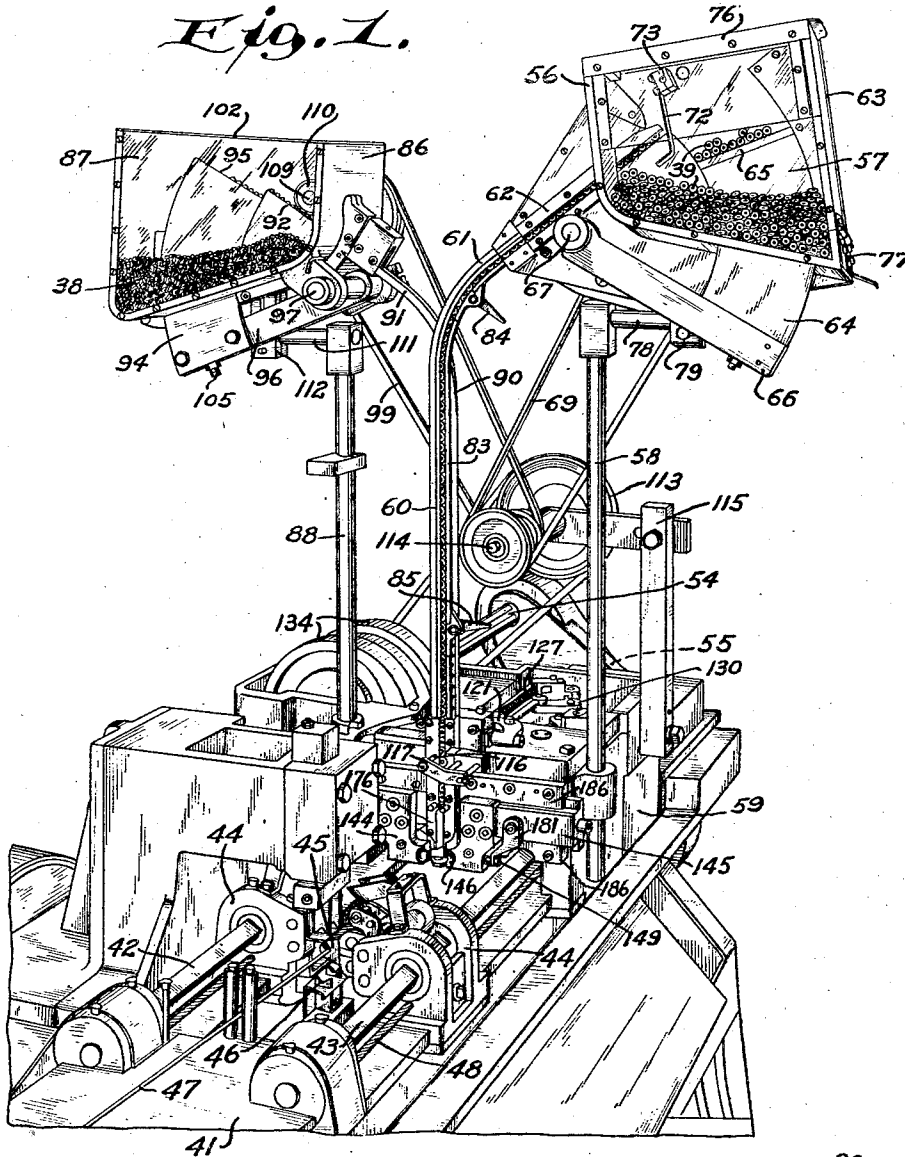


Fig. 32.

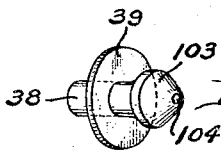


Fig. 31.

INVENTOR
K. H. Andren
BY
Morsell, Lieber & Morsell
ATTORNEYS.

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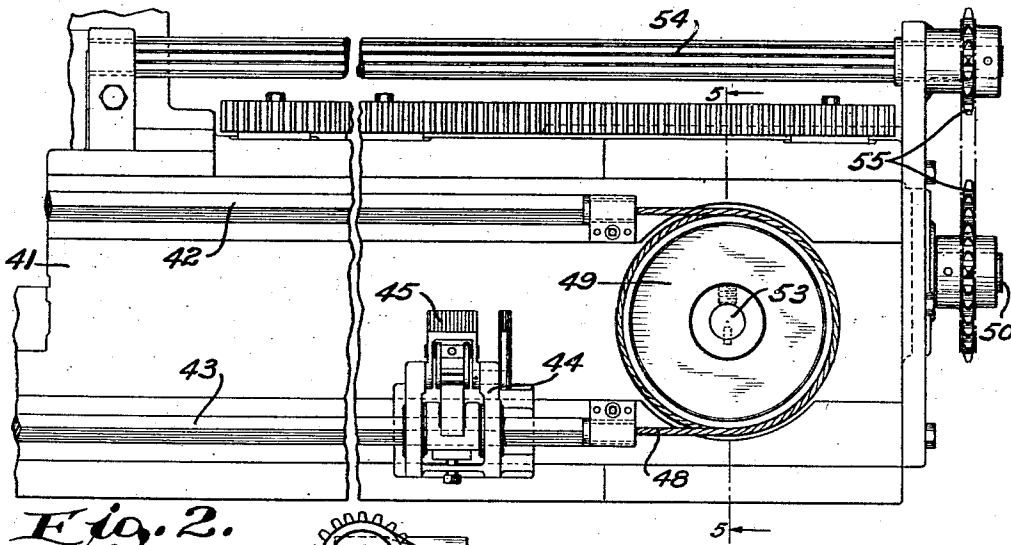


Fig. 2.

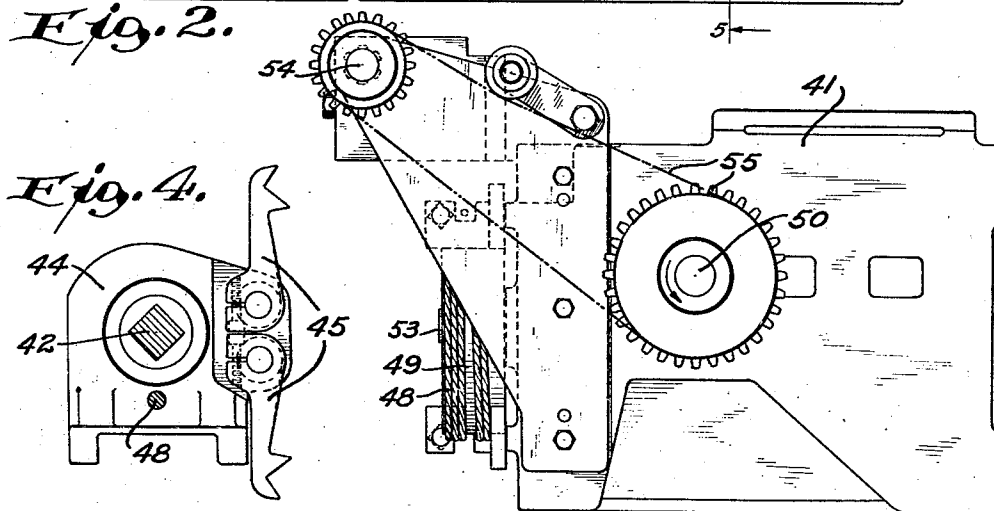


Fig. 4.

Fig. 3.

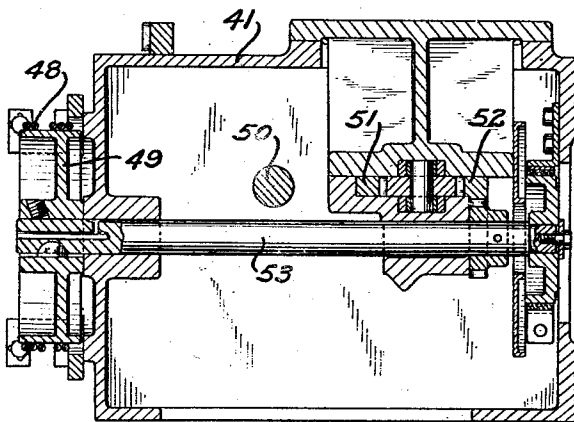


Fig. 5.

INVENTOR
K. H. Andren
BY
Morsell, Lieber & Morsell
ATTORNEYS.

Feb. 1, 1944.

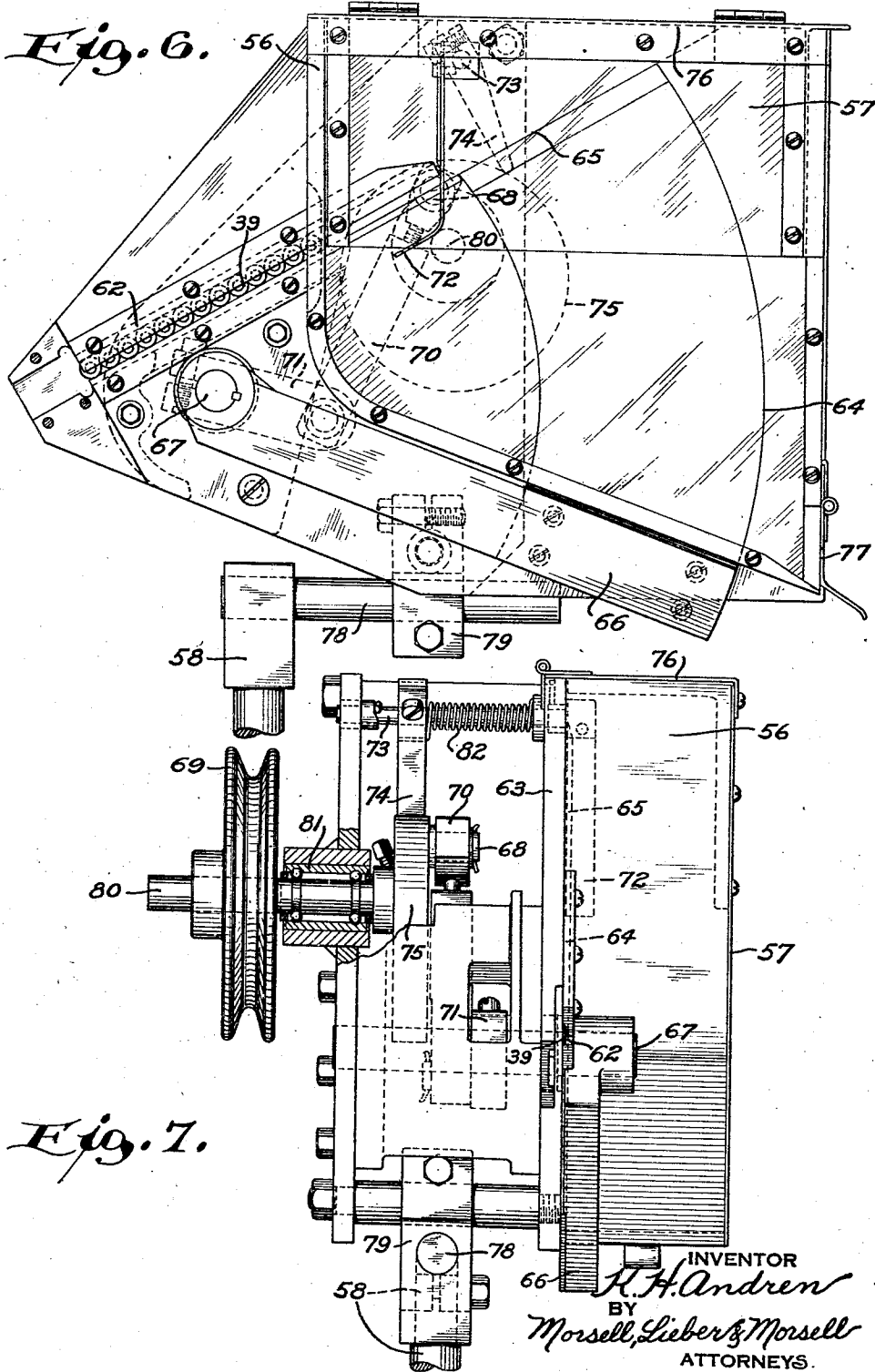
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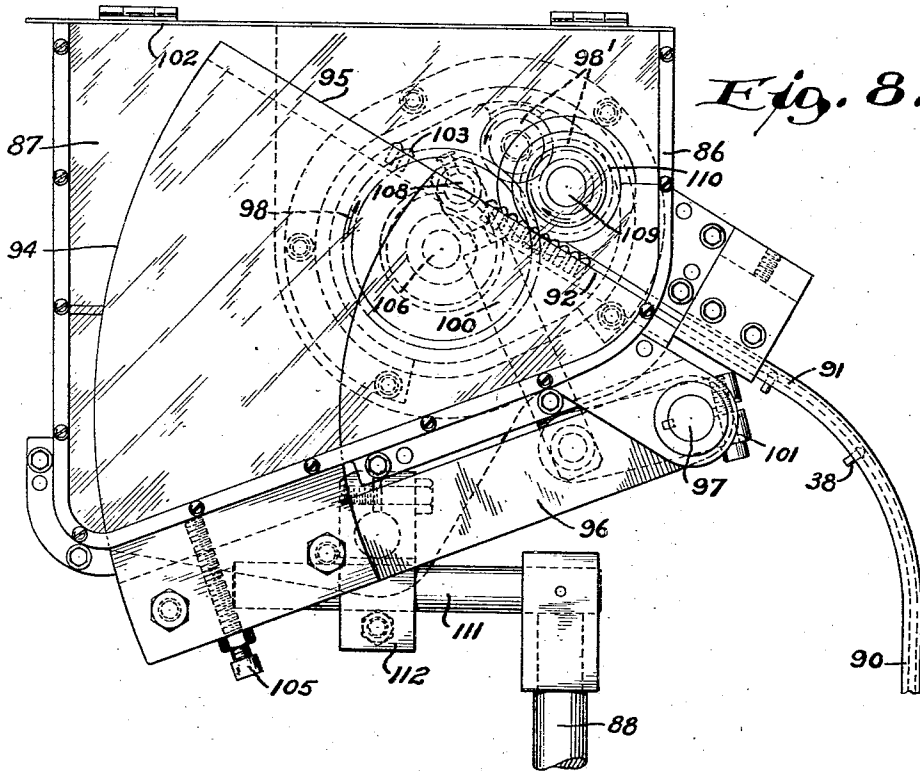


Fig. 8.

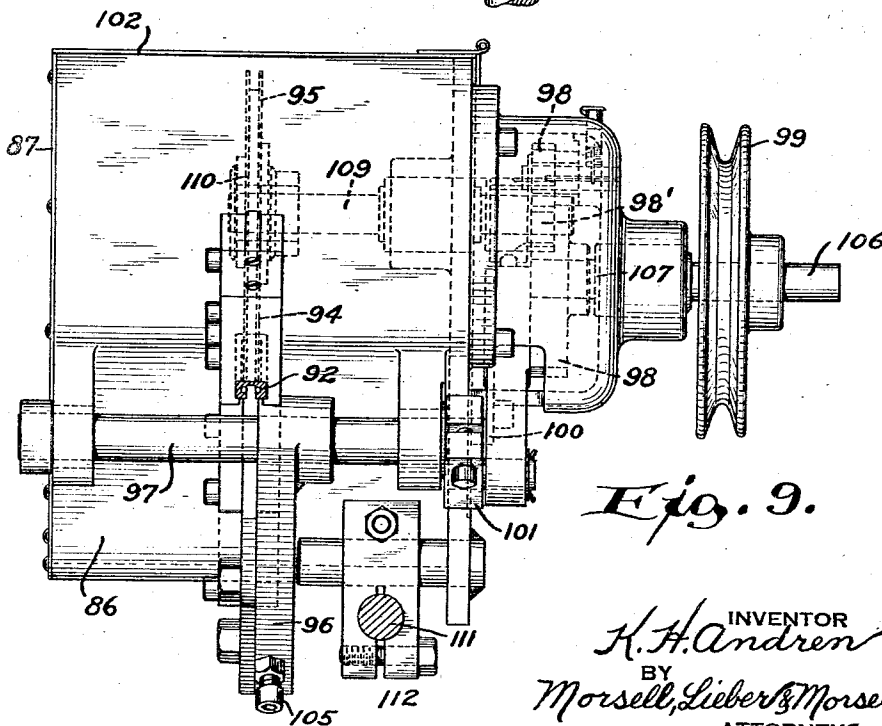


Fig. 9.

INVENTOR
K. H. Andren
BY
Morsell, Lieber & Morsell
ATTORNEYS.

Feb. 1, 1944.

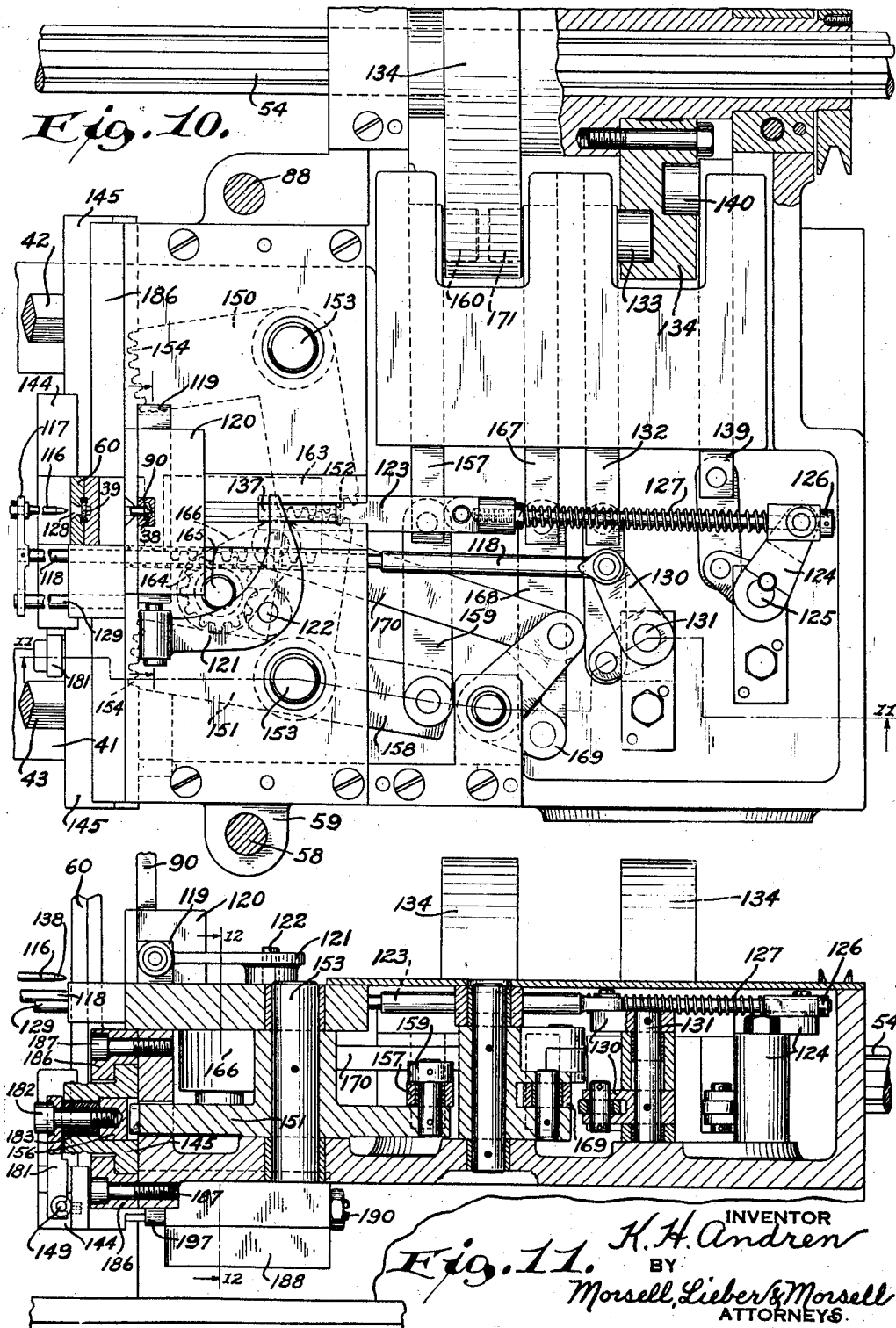
K. H. ANDREN

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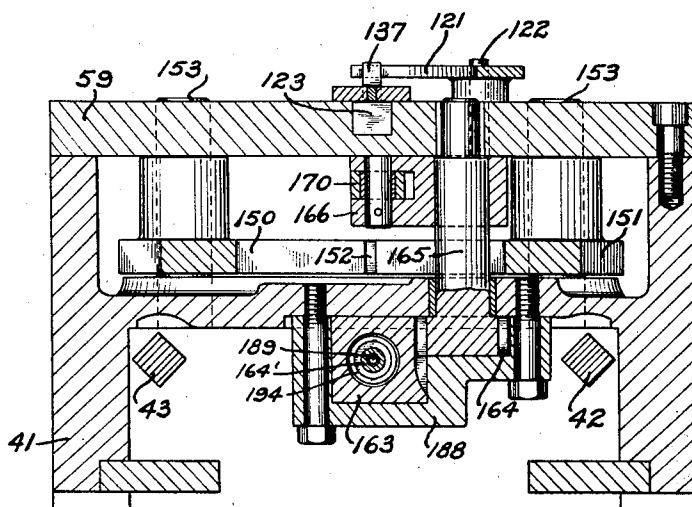
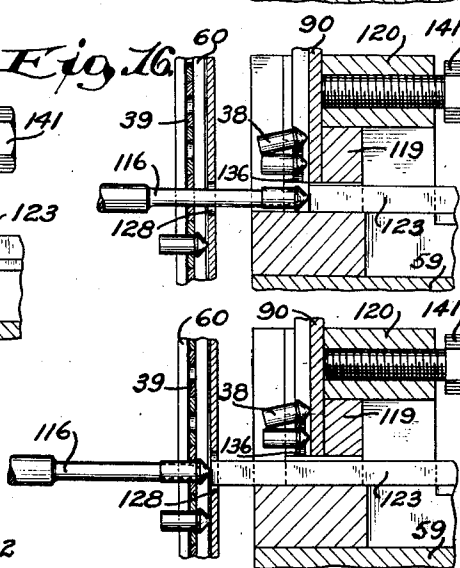
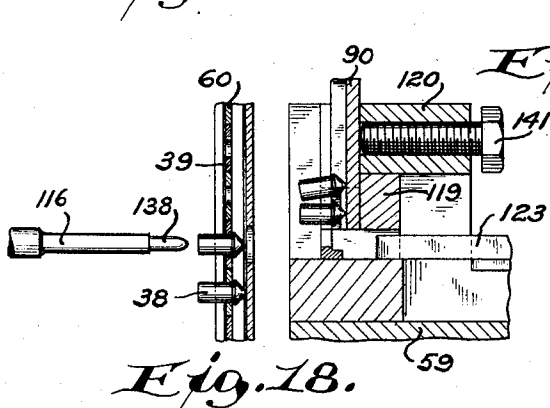
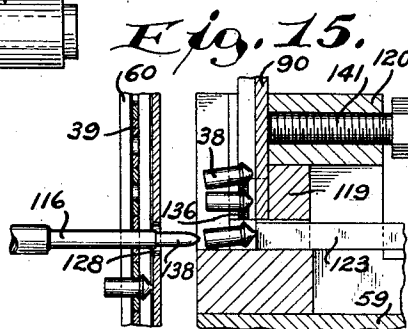
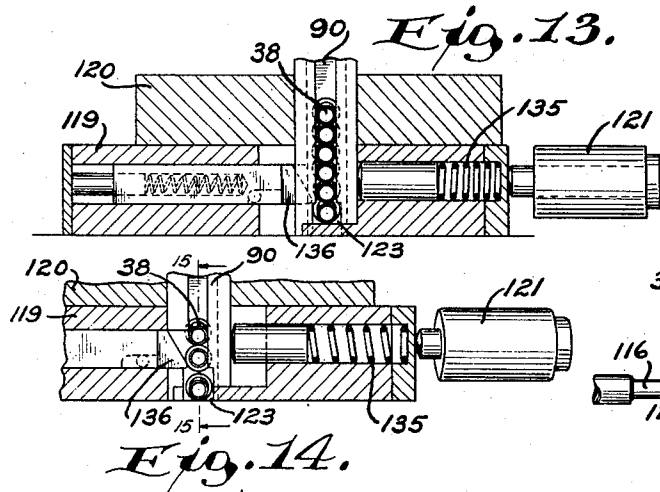


Fig. 12.
INVENTOR
K. H. Andren
BY
Morsell, Lieber & Morsell
ATTORNEYS.

Feb. 1, 1944.

K. H. ANDREN

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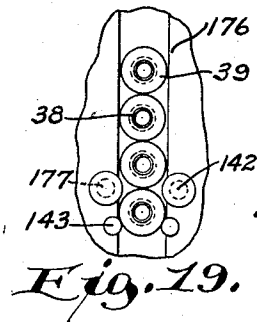


Fig. 19.

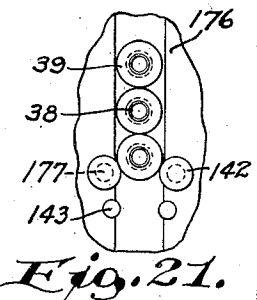


Fig. 21.

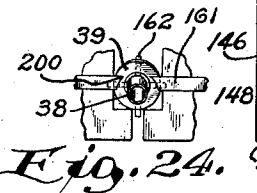


Fig. 24.

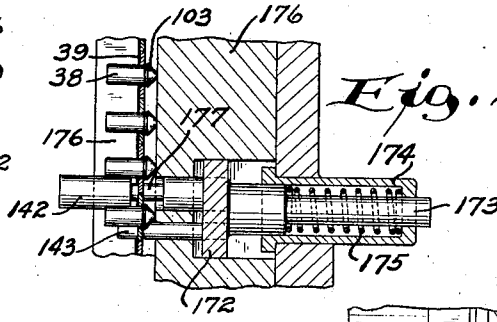


Fig. 20.

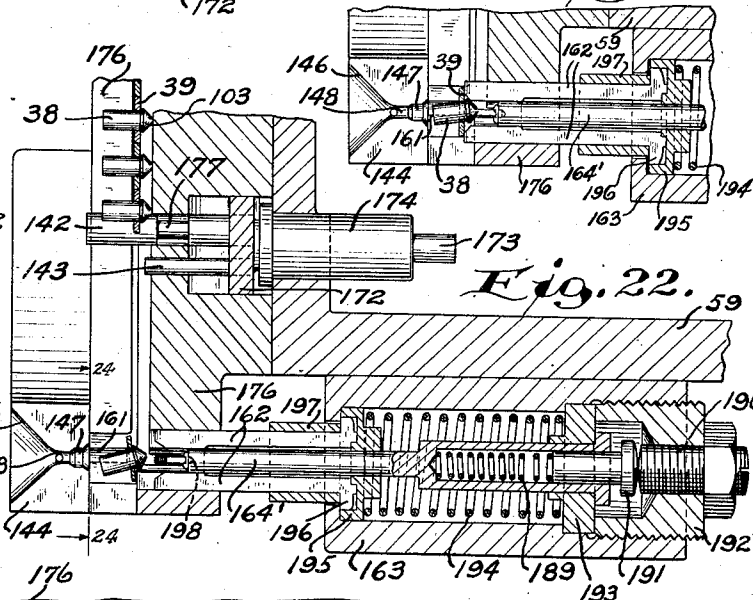


Fig. 23.

Fig. 22.

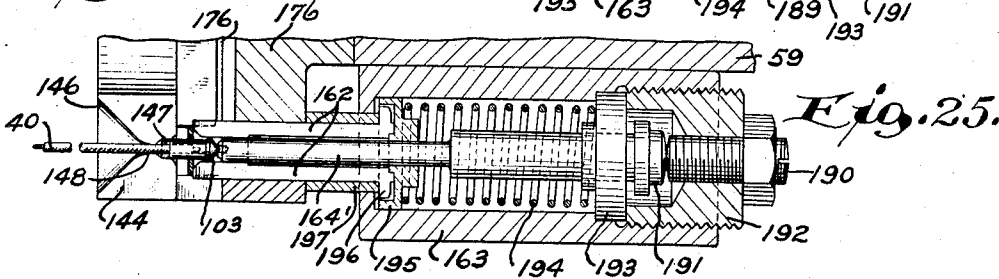


Fig. 25.

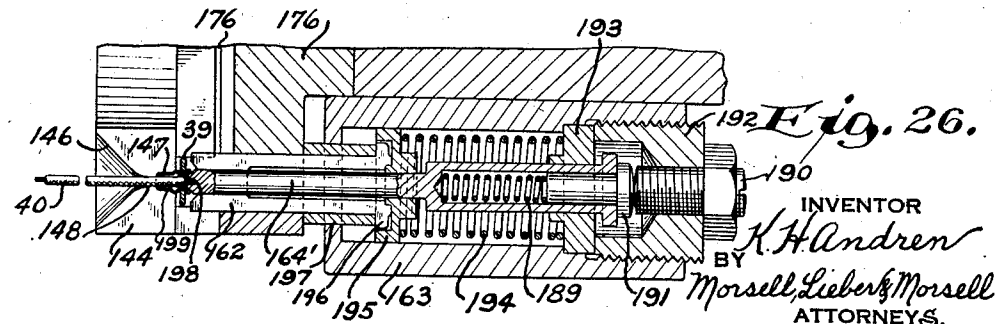


Fig. 26.

INVENTOR

K. H. Andren

BY

Morsell, Lieber & Morsell

ATTORNEYS.

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K. H. ANDREN

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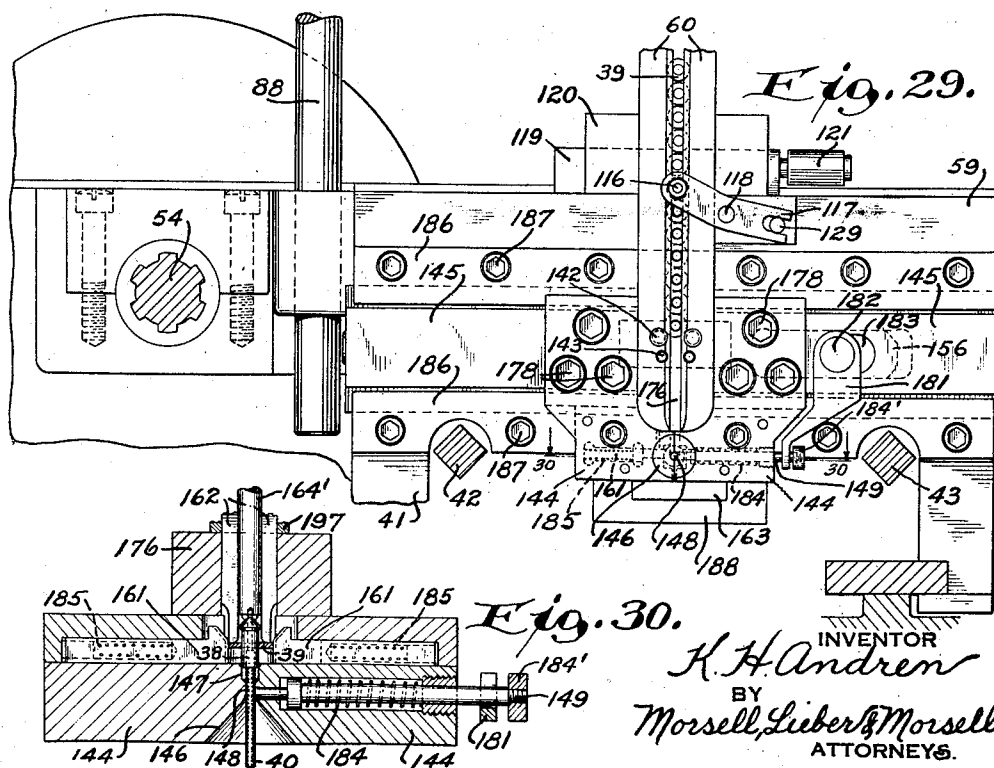
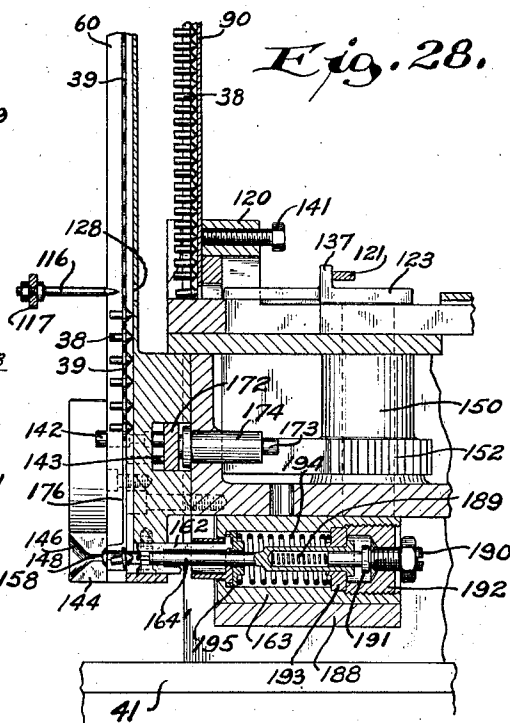
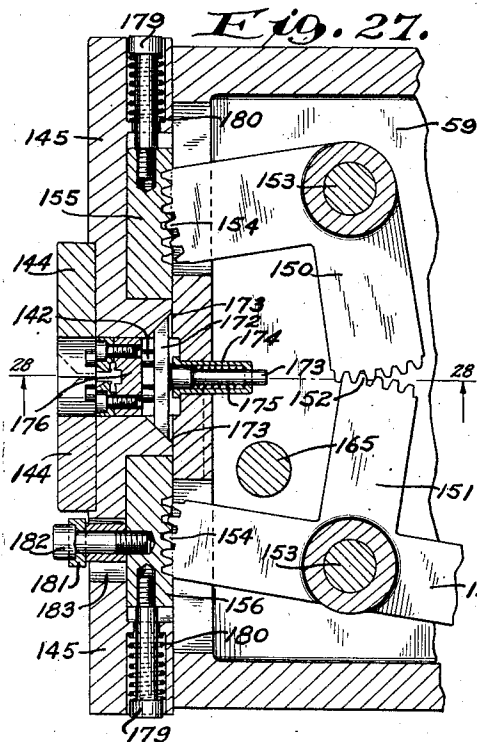


Fig. 30.

INVENTOR
H. H. Andren
BY
Morsell, Lieber & Morsell
ATTORNEYS.

Feb. 1, 1944.

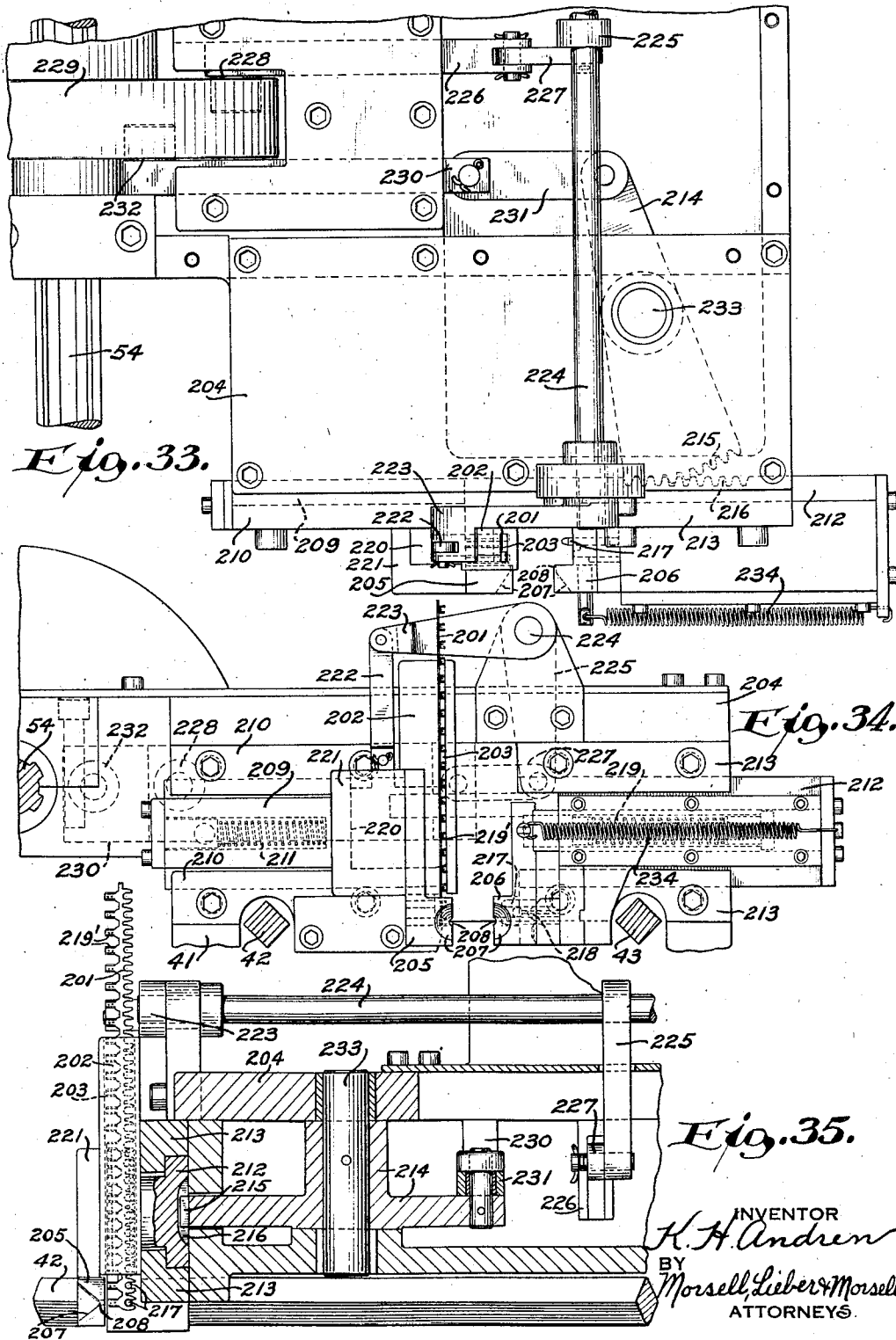
K. H. ANDREN

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APPLYING TERMINAL TO WIRE SEGMENTS

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UNITED STATES PATENT OFFICE

2,340,448

APPLYING TERMINALS TO WIRE SEGMENTS

Karl H. Andren, Milwaukee, Wis., assignor to
Artos Engineering Company, Milwaukee, Wis.,
a corporation of Wisconsin

Application January 31, 1940, Serial No. 316,535

18 Claims. (Cl. 29—33)

The present invention relates generally to improvements in the art of severing a continuous element such as a wire into predetermined lengths and of performing operations at the ends of the severed lengths, and relates more specifically to improved apparatus for cutting insulated wire into successive sections and for applying a terminal to an end of each section.

Generally defined, an object of this invention is to provide improved apparatus for severing insulated wire into lengths and for utilizing a definite motion of the wire to apply a terminal to an end of each severed length.

Another object of the invention is to provide improved apparatus for automatically applying terminals to successive wire segments, in a reliable and expeditious manner.

In the automobile, radio and other industries, it frequently becomes necessary to utilize many relatively short sections of insulated wire, of which each length may have a portion of the insulation stripped from one or both ends thereof, and may also have a terminal fitting of some kind rather firmly secured to at least one of its ends. Because of the fact that enormous quantities of these terminal sections, of varying predetermined lengths, are required, it is extremely desirable to be able to produce the completed assemblies rapidly and at minimum cost of production. Due to the fact that the types of terminals vary considerably for different classes of use, it has heretofore been a rather slow and tedious procedure to apply the diversified kinds of end terminals to the severed and stripped ends of the insulated wire lengths. While it has long been customary to sever a continuous wire into successive lengths and to strip the insulation from the severed ends by moving the separated sections longitudinally; it has not heretofore been proposed to utilize any definite movement of the successive severed wire lengths during formation thereof for the purpose of applying a terminal to an end of each section; and I have found that this can readily be done with a resultant great saving in time and handling of the cut pieces, and consequent saving in cost of production.

It is therefore a more specific object of my present invention to provide apparatus for utilizing definite movement of successive sections of insulated wire, while some operation is being performed thereon, to apply a terminal fitting to an end of each wire length or section.

Another specific object of the present invention is to provide various improvements in ma-

chines for quickly and effectively attaching diverse types of terminals to the ends of successive wires.

A further specific object of this invention is to provide new and useful apparatus for feeding wires and terminals or terminal assemblies, to a zone of application of the latter to the ends of the wires and in proper position.

Still another specific object of my invention is to provide improved mechanism for automatically and reliably assembling composite terminals, and for firmly attaching various types of terminals to wire ends.

An additional specific object of my invention is to provide an improved electrical terminal assembly which can be quickly and firmly secured to the end of a wire.

These and other specific objects and advantages of this invention will be apparent from the following detailed description.

A clear conception of two embodiments of this invention, and of the mode of constructing and of operating machines for producing the improved terminal assemblies, may be had by referring to the drawings accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a perspective view of one of my improved machines for applying bushing and washer type terminals to the corresponding ends of successive wires or wire segments;

Fig. 2 is a fragmentary top view of the wire feeding and severing mechanism of the assembly of Fig. 1;

Fig. 3 is an end elevation of the mechanism shown in Fig. 2;

Fig. 4 is an enlarged transverse vertical section through a part of the mechanism of Fig. 1, taken directly adjacent one set of wire feeding clamps and showing the clamps released or open;

Fig. 5 is a transverse vertical section through the feed mechanism of the terminal applying machine of Fig. 1;

Fig. 6 is an enlarged side elevation of the washer storing and feeding mechanism of the terminal applying machine of Fig. 1;

Fig. 7 is a similarly enlarged end elevation of the washer storing and feeding mechanism;

Fig. 8 is a likewise enlarged side elevation of the bushing storage and feeding mechanism of the machine of Fig. 1;

Fig. 9 is a similarly enlarged end elevation of the bushing storing and feed mechanism;

Fig. 10 is a part sectional top view of the final terminal attaching mechanism;

Fig. 11 is a vertical section through the assemblage of Fig. 10, taken along the irregular line 11—11;

Fig. 12 is another vertical section through the assemblages of Figs. 10 and 11, taken along the line 12—12 of Fig. 11;

Fig. 13 is an enlarged fragmentary section through a portion of the gravity feed mechanism for the terminal bushings, showing the holding latch withdrawn;

Fig. 14 is a similar view of the terminal bushing feed mechanism, showing the holding latch in active position;

Fig. 15 is a section through a fragment of the bushing and washer feed and assembly mechanisms, the section being taken along the line 15—15 of Fig. 14 and showing the alining pin piercing a washer and about to enter a bushing;

Fig. 16 is a view like that of Fig. 15, but showing the assembling pin after it has entered a bushing;

Fig. 17 is another similar view showing the alining pin after it has transferred a bushing into a washer;

Fig. 18 is still another similar view showing the transfer pin removed from a bushing and washer preliminary assemblage;

Fig. 19 is an end view of the composite bushing and washer assembly control for periodically feeding the successive terminal assemblages to the dies, showing an assemblage in position about to be released and with the retaining gibs removed;

Fig. 20 is a section through the control mechanism positioned as in Fig. 19;

Fig. 21 is another end view similar to that of Fig. 19, but showing the mechanism after release of a terminal assembly;

Fig. 22 is another section like that of Fig. 20 but having the die assemblage associated therewith, and showing the feed mechanism positioned as in Fig. 21;

Fig. 23 is a fragmentary section through the die assemblage, showing the initial action thereof in positioning a bushing for the reception of a wire end;

Fig. 24 is a transverse section through the die assemblage showing a terminal assembly ready for the reception of a wire, the section being taken along the line 24—24 of Fig. 22;

Fig. 25 is a more complete longitudinal vertical section through the die assemblage, showing the end of an insulated wire partially in a terminal bushing;

Fig. 26 is a section similar to that of Fig. 25, and showing the dies in the act of finally attaching a terminal;

Fig. 27 is a more complete horizontal sectional view of the terminal applying die assemblage and actuating mechanism;

Fig. 28 is a similarly more complete vertical section through the entire die and feed mechanisms, taken along the line 28—28 of Fig. 27;

Fig. 29 is a side view of the die and feed mechanisms of Fig. 28, showing the position thereof relative to the wire feeding and cutting mechanisms;

Fig. 30 is a horizontal section through the assemblage of Fig. 29, taken along the line 30—30;

Fig. 31 is an enlarged perspective view of one of the terminal bushing and washer assemblages;

Fig. 32 is a similarly enlarged central section

through one of the composite terminal assemblages applied to a section of insulated wire;

Fig. 33 is a top view of a fragment of a modified structure for automatically applying Y-terminals to successive wires or sections;

Fig. 34 is a side view of the mechanism of Fig. 33 looking in the direction of the wire feed or travel, and showing the relation of the terminal attaching mechanism to a wire cutting and feeding assemblage; and

Fig. 35 is a front or end view of the mechanism of Figs. 33 and 34, showing the mechanism and mode of feeding the terminals.

While the invention has been shown as having been embodied in only two types of machines for carrying on commercial exploitation of the new method, and for applying only two distinct types of terminals, it is not my desire or intent to thereby unnecessarily restrict the scope or utility of the improved apparatus.

Referring specifically to the embodiment of the invention disclosed in Figs. 1 to 32 inclusive, the mechanism shown therein is especially adapted to apply a composite terminal comprising a metal bushing 38 and an insulating washer 39 to the corresponding end of each of a succession of insulated wire sections 40, the bushings 38 and washers 39 appearing as in Fig. 31 before attachment to the wire, and as in Fig. 32 after final completion thereof. The mechanism for cutting the continuous insulated wire into sections 40 of any desired predetermined length and for stripping the corresponding end or ends of each of the successive sections, may be of any desired construction and as shown herein, this cutting and stripping mechanism is of the type shown in Olsen and Andren Patent No. 1,787,658, granted January 6, 1931, wherein each severed section 40 of wire is moved longitudinally away from the cutting plane or zone when stripping is being effected. Since this cutting and stripping mechanism is of well known construction, it will only be referred to generally, and the remainder of my present improved apparatus for carrying on my present improved process and for producing the improved terminals, consists primarily of an attachment or addition to such well known type of cutting and stripping machine and functions automatically during normal operation of the latter.

As shown in Fig. 1, the complete terminal producing assemblage for applying a bushing 38 and a washer 39 to the corresponding end of each wire section 40, comprises in general a cutting and stripping mechanism; a washer supply and gravity feed mechanism; a bushing supply and gravity feed mechanism; a washer and bushing assembling mechanism; and a final terminal positioning and attaching mechanism operable in timed relation to the cutting and stripping mechanism.

The cutting and stripping mechanism shown in Figs. 1 to 5 inclusive consists generally of a frame 41 having two parallel horizontal square shafts 42, 43 oscillatably supported thereon; a wire gripping and feed assembly 44 slidably mounted on each shaft 42, 43, each of these assemblies 44 having a pair of gripping jaws 45; a set of cooperating cutting and stripping knives 46 carried by slides in the frame 41 and being cooperable with the jaws 45, to sever the incoming wire 47 into successive sections 40 of any predetermined length, and to strip the insulation from the severed end of each section 40; a clamp or jaw shifting cable 48 coacting with a drum

49, to alternately move the gripping and feed assemblies 44 along the shafts 42, 43 in opposite directions; means for periodically oscillating the shafts 42, 43 to open and close the jaws 45 at predetermined intervals; and a main driving shaft 50 for the oscillating means and for reversing racks 51, 52 which drive the drum propelling shaft 53, the drive shaft 50 also being drivingly connected to a spline shaft 54 by means of chain gearing 55. When the machine is operating normally, the main shaft 50 is propelling the cutting and stripping mechanism to cause the assemblies 44 to intermittently feed successive lengths of wire 47 from a source of supply past the zone of severance, to also cause the knives 46 to sever the wire 47 into successive sections 40 of predetermined equal length while one set of jaws 45 is clamping the free end of the wire and the other set is clamping the same wire 47 adjacent the knives, to thereafter cause the segregated sections 40 and the entering wire 47 to be moved slight distances away from the cutting zone so as to strip the insulation off of both severed wire ends, and to finally cause the two sets of jaws 45 to reverse their positions with respect to the plane of cutting and stripping while the knives 46 are separated. The forward travel of each clamp assembly 44, past the knives 46 while separated, feeds a new length of wire 47 to cutting and stripping position, and the simultaneous rearward movement of the other clamp assembly 44 is effected with its jaws 45 spread apart as in Fig. 4; and the same type of cutting and stripping mechanism may be utilized in applying various types of terminals, but it is a feature of the present invention to utilize a definite movement of each severed section 40 so as to properly position the terminal for final attachment to the extreme end thereof.

Referring more specifically to Figs. 1, 6 and 7, the improved washer supply and gravity feed mechanism shown therein comprises in general a washer supply receptacle 56 having a transparent front 57 and adapted to receive an abundant quantity of fibre washers 39; a support 58 for vertically and laterally adjustably supporting the receptacle 56 from an auxiliary frame 59 which is adjustably secured to an end of the main frame 41; an approximately vertical washer guide 60 having an upper inclined end portion 61 extending laterally therefrom into the receptacle 56 and being aligned with an adjustable inclined guide-way 62 on the rear wall 63 of the receptacle; a segment plate 64 oscillatable in close proximity to the wall 63 within the receptacle 56 and having a top rail 65 alineable with the guide-way 62 when the segment plate 64 is in uppermost position; an arm 66 swingably suspended upon a pivot shaft 67 and secured to the lower portion of the plate 64 externally of the receptacle 56; an eccentric driving crank 68 operable by a V-belt drive 69 and being connected by means of a link 70 to an auxiliary arm 71 secured to the shaft 67, to oscillate the plate 64; and a feed control finger 72 adjustably secured to a pivot shaft 73 and being operable by means of an arm 74 secured to said shaft and coacting with the eccentric surface 75 of the crank 68. The washer receptacle 56 has an upper cover 76 for the admission of a fresh supply of washers 39, and is also provided with a small door 77 at the lower end of its inclined bottom for permitting removal of the excess washer supply. The receptacle support 58 is provided with a lateral extension 78 from which the receptacle 56 is ad-

justably suspended by means of a clamping element 79 which serves to permit proper adjustment of the washer guide 60; and the segment plate 64 which is oscillatable by the arm 66, is movable with minimum clearance through a slot formed in the inclined bottom of the hopper or receptacle 55 in close proximity to the rear wall 63. The upper pulley of the V-belt drive 69 is secured to a shaft 80 to which the eccentric crank 68 is also attached, and this shaft 80 is journaled in a bearing 81 as shown in Fig. 7; and the suspension shaft 73 for the finger 72 and arm 74 is embraced by a coil spring 82 which constantly urges the lower end of the arm 74 in contact with the revolving eccentric surface 75. The washer feed guide 60 has a side portion 83 which is provided with two releasable gates 84, 85 shown in Fig. 1 and these gates can be quickly opened in order to relieve congestion caused by defective washers.

Referring to Figs. 1, 8 and 9, the improved bushing supply and gravity feed mechanism shown in these views, comprises in general a bushing supply receptacle 86 having a transparent front 87 and adapted to hold an abundant supply of bushings 38; a support 88 for adjustably supporting the receptacle 86 from the auxiliary frame 59 secured to the main frame 41; an approximately upright bushing guide 90 having an upper inclined portion 91 extending laterally into the receptacle 86 and aligned with an inclined guide trough 92 disposed centrally within the supply receptacle; a segment plate 94 oscillatable centrally within the receptacle 86 and having a top rail 95 alineable with the guide trough 92 when the plate 94 is in its uppermost position; an arm 96 swingably suspended upon a pivot shaft 97 and rigidly secured to the lower portion of the segment plate 94 externally of the receptacle 86; and a train of gearing 98 operable by a V-belt drive 99 and being connected by means of a crank link 100 to an auxiliary arm 101 secured to the shaft 97, in order to oscillate the plate 94. The bushing receptacle 86 is provided with an upper cover 102 for permitting convenient introduction of a supply of bushings 38, and each of the bushings 38 has an enlarged end or conical head 103 pierced by a small apex hole 104, as shown in Fig. 31. The heads 103 form shoulders adapted to rest upon the rail 95 and trough 92 as shown in Fig. 8; and the segment plate 94 is adjustable to bring the rail 95 into proper alinement with the trough 92, by means of an adjusting set screw 105. The segment plate 94 is oscillatable with slight clearance through a central slot in the inclined bottom of the receptacle 86 to cause the trough 95 to become buried in the mass of bushings 38 when the plate 94 moves to its lowermost position. The upper pulley of the V-belt drive 99 is secured to a shaft 106 to which the larger of the gears 98 is also secured, and this shaft 106 is journaled in a bearing 107; and this larger gear carries a crank pin 108 for operating the link 100 which oscillates the plate 94. The large gear 98 meshes with an idler which in turn meshes with a smaller gear 98', and the latter drives a shaft 109 which carries a grooved roller 110 coacting with the inclined guide trough 92, see Fig. 8. The bushing hopper support 88 is also provided with a lateral extension 111 to which the receptacle 86 is adjustably secured by means of a clamp 112, and the V-belt drives 69, 99 may both be driven from the spline shaft 54 by means of a

belt drive 113 coacting with a counter shaft 114 carried by a bracket 115, see Fig. 1.

Referring specifically to Figs. 1 and 10 to 18, inclusive, the improved washer and bushing assembly mechanism which is associated directly with the lower portions of the vertical guides 50, 90, comprises in general a horizontally reciprocable washer piercing pin 116 carried by a cross head 117 which is movable by a rod 118 slidably supported by the auxiliary frame 59; a bushing control slide 119 slidably supported in a guide block 120 carried by the frame 59, and being movable laterally of the bushing guide 90 by means of a curved lever 121 swingably suspended from the frame 59 by a pivot pin 122; and a bushing ram or projector 123 slidable through the block 120 transversely of the guide 90 and of the control slide 119, and being movable in axial alignment with the pin 116 by means of a bell-crank 124 swingable upon a pin 125 and coacting with the end of the projector 123 through a rod 126 and spring 127. The guide 60 has an opening 128 therein through which the pin 116 is adapted to pass, and the cross-head 117 is guided for parallel movement by a guide pin 129, see Figs. 10 and 11. The rod 118 is reciprocable to move the pin 116 back and forth through the opening 128, by means of a bell-crank 130 mounted on a pin 131 carried by the frame 59, and the bell-crank 130 is oscillatable upon the pin 131 by a slide 132 having one end pivotally attached to the bell-crank and provided with an actuating roller 133 coacting with a groove in the cam 134 operatively secured to the spline shaft 54. The bushing control slide 119 which is operable by the curved lever 121 in one direction, is movable in the opposite direction by a relatively heavy spring 135, and the slide 119 is provided with a spring pressed latch 136 which is cooperable with the successive gravitating bushings 38 in the manner shown in Figs. 13 and 14, to check the feed and control the delivery of bushings 38 to the transfer zone. The lower extremity of the bushing guide 90 is disposed directly above the path of travel of the transfer slide or projector 123, and the control lever 121 is oscillatable about the pin 122 by means of lug 137 formed integral with the bushing projector 123 see Figs. 10 and 12. The pointed end 138 of the pin 116 is of reduced diameter so as to snugly fit the bushings 38, and the projector 123 is reciprocable by the bell crank 124 while this bell crank is periodically oscillatable about the axis of the pin 125 by means of a slide 139 having an actuating roller 140 coacting with another groove in the cam 134. The lower end of the guide 90 is secured by means of a set screw 141, and the removable portion 83 of the washer guide 50 permits proper feeding of the washers 39 to the washer and bushing assembly mechanism.

Referring especially to Figs. 19 to 30 inclusive, the improved mechanism for finally positioning and attaching the washer and bushing assemblies to the successive wire sections 40, comprises in general sets of upper and lower feed plungers 142, 143 respectively, cooperable with the washers 39 of the successive washer and bushing assemblies to drop the same in succession toward the dies; a pair of cooperating die blocks 144 carried by horizontally movable slides 145, and having a conical guide recess 146 and a bushing confining socket 147 connected by a wire receiving opening 148, interposed therebetween; a wire clamping pin 149 slidable laterally of the

opening 148 in one of the blocks 144; a pair of oscillatory bell cranks 150, 151 having intermeshing teeth 152 and being pivotally mounted on pins 153 carried by the frame 59, the bell cranks 150, 151 also having teeth 154 engaging rack blocks 155, 156, the latter of which is connected to the wire clamping pin 149, and the rack blocks 155, 156 being carried by the slides 145; a slide 157 reciprocable in the frame 59 and having one end connected to an arm 158 on the bell crank 151 by a link 159 while its opposite end carries a roller 160 coacting with a groove in the cam 134 whereby the die blocks 144 and the pin 149 are actuated; a pair of spring pressed washer engaging and centering plates 161 carried by the die blocks 144; a set of four radially disposed and elongated bushing centering and washer engaging bars 162 carried by a reciprocable rack block 163 and having a reciprocable die plunger 164 disposed centrally therein in alignment with the die opening 148; a pinion 164 coacting with teeth on the side of the block 163 and being carried by a shaft 155 journaled in the frame 59 and having a crank 166 secured thereto; and another slide 167 reciprocable in the frame 59 and having one end connected by a link 168 to one arm of a bell crank 169 which has its other arm connected by a link 170 to the crank 166, while the opposite end of the slide 167 carries a roller 171 coacting with another groove in the cam 134.

The upper feed plungers 142 and the lower plungers 143 are mounted upon a spring pressed plate 172 having opposite inclined ends cooperable with wedge surfaces 173 formed on the die carrying slides 145 as clearly shown in Fig. 27; and the plate 172 is guided by a pin 173 coacting with a fixed casing 174 and is normally urged by a spring 175 toward the vertical washer and bushing assembly guide 176 which is a continuation of the washer guide 60. The upper plungers 142 have recessed medial portions 177 and are spaced apart far enough so that the successive washers 39 can gravitate between the portions 177 as in Fig. 20, but these washers 39 cannot drop past the plungers 142 when the plate 172 is forced rearwardly to compress the spring 175, by the approaching slides 145 as in Figs. 21 and 22. The lower plungers 143 are closer together than the plungers 142, but are also shorter than the upper plungers; and when the plungers 143 are positioned as in Figs. 19 and 20, the lower bushing and washer assembly is held in place, whereas withdrawal of the plungers 143 as in Figs. 21 and 22 permits this lower assembly to drop toward the dies. It is to be noted, that the plungers 142, 143 are operable automatically when the dies 144 and slides 145 are moved toward and away from each other, to drop the successive washer and bushing assemblies toward the dies. The die blocks 144 are removably attached to the horizontal slides 145 by means of cap screws 178 as shown in Fig. 29, and are movable with a dwell toward each other when the slides 145 are moved by the oscillating bell cranks 150, 151 coacting with the rack blocks 155, 156 respectively. The rack blocks 155, 156 are slidably mounted in aligned recesses in the slides 145 and are resiliently connected to these slides by bolts 179 and compression springs 180, and the block 155 has a bracket 181 secured thereto by means of a cap screw 182 extending through a slot 183 in the adjacent slide 145. The wire clamping pin 149 which is slidable in one of the die blocks 144, is pressed toward the die recesses 148 by means of a spring 184 and has its outer end provided with a plate 184' which is

normally engaged by the bracket 181 to keep the spring 184 compressed and the pin 149 away from the recesses 148. The slides 145 are guided by plates 186 held in place by cap screws 187; and when the bell cranks 150, 151 are swung toward each other, they positively move the rack blocks 155, 156, and these blocks then move the slides 145 toward each other through the springs 184. During the initial part of this movement of the slides 145, the die blocks 144 may be brought together under resilient pressure and the wire segment 40 may be advanced longitudinally within the recesses 148; but as the rack block 156 is advanced inwardly to move the bracket 181 away from the plate 184, the spring 184 becomes effective to urge the pin 149 into clamping engagement with the wire segment 40 as in Fig. 30. The washer centering plates 161 are pressed toward each other by springs 185, and serve to frictionally resist the forward movement of the washers 39 by the bars 162 thus positioning these washers perpendicular to the wire axis and raising the adjacent bushings 38 into alinement with the approaching wire ends.

The rack block 153 is slidably supported upon a fixed bracket 188 secured to the frame 59, and the die plunger 164' which is carried by this block 153 centrally of the bars 162, is disposed concentric with the die opening 148 and is constantly urged toward this opening by a compression spring 189 one end of which presses against the plunger 164' and the opposite end of which reacts against an adjusting screw 190 through a pin 191, see Figs. 22, 25 and 26. The screw 190 coacts with a screw threaded plug 192 which in turn coacts with a plate 193, and another compression spring 194 is interposed between the plate 193 and a disk 195 engaging the ends of the bars 162. These bar ends are provided with lateral projections 196 which are engageable with a stop collar 197 for limiting the movement of the bars 162 toward the die blocks 144 while permitting continued movement of the rack block 153 and die plunger 164' in that direction. The extreme end of the plunger 164' is provided with a recess 193 which is adapted to strip the insulation from the wire end and to receive the stripped end 199 of each wire segment 40 as these wire ends pass through the holes 100 in the bushings 38; and the set of washer positioning plates 161 have chamfered ends 200 for positioning the successive bushing and washer assemblies for proper reception of the wires when these assemblies drop from the pins 143 through the guide 176, see Figs. 24 to 26, inclusive. While the spring pressed plates 161 carried by the die blocks 144 are adapted to engage the peripheries of the successive washers 39 to center the terminal assemblages, the plate ends 200 and the bars 162 are cooperable with the opposite faces of these washers 39 so as to hold the washers and the bushings 38 in proper position when the wire ends are admitted and the dies become effective to finally attach these parts to the wire segments 40.

During normal operation of the improved terminal producing assemblage shown in Figs. 1 to 30, inclusive, the receptacle 56 should first be supplied with a quantity of washers 39, and the receptacle 56 should be supplied with a quantity of bushings 38, as shown in Fig. 1. Assuming that all of the various parts have been adjusted for proper operation, and that the wire stock 47 is being supplied to the machine, as the main shaft 50 is rotated the various mechanisms will

be placed in operation and the wire cutting and stripping machine will be feeding successive lengths of the wire 47 horizontally and longitudinally of the frame 41, and will be automatically severing the wire into successive sections 40 of predetermined length. Immediately upon severance of each section 40, the section will be pulled by the clamps 45 away from the cutting zone and will be projected through the conical guide portion 146 of the dies 144 and through the opening 148 toward the zone of action of the final terminal attaching dies. The washers 39 and the bushings 38 will be fed in succession by the oscillating feed plates 64, 94 respectively, and by the action of gravity, through their respective guides 60, 90, and each washer 39 will have a bushing 38 inserted therein by means of the pin 116 and plunger 123 in the manner specifically illustrated in Figs. 13 to 18, inclusive. The latch 136 will control the feed of the bushings 38 and the downward movement of the washers 39 will be controlled by the pins 142, 143. As each washer 39 becomes alined with the pin 116, this pin will be moved through the washer and will be projected into the lowermost of the bushings 38, as clearly shown in Fig. 16. The plunger 123 will then be moved forwardly while the pin 116 is moved rearwardly, to cause the bushing 38 to be projected through the adjacent washer 39. The pin 116 will subsequently be withdrawn as in Fig. 18, thus completing the initial assembly.

When each washer 39 has been thus supplied with a bushing 38, the pins 142, 143 will control the lowering of the successive washer and bushing assemblies into the zone of action of the dies, in the manner clearly illustrated in Figs. 19 to 23 inclusive. As each of the washer and bushing assemblies drops into approximate alinement with the opening 148 of the dies 144, the plates 161, bars 162 and the plate ends 200 will become effective to right and hold the washer 39 in a vertical plane and will thus position the corresponding bushing in horizontal alinement with the opening 148 of the die blocks 144. During longitudinal advancement of the wire section 40, the end thereof will be projected through the opening 148 while the die blocks 144 are resiliently pressed together by the springs 180, and when the wire has been properly inserted the clamping pin 149 will become effective. The plates 162 will have been moved forwardly as in Fig. 25, in order to properly position the washer 39 and bushing 38 for reception of the wire end, and the plunger 164' will then be brought forwardly toward the die socket 147 and the extreme end 199 of the wire segment will be pushed through the opening 104 of the bushing, before complete distortion of the bushing takes place. The die plunger 164' will thereafter continue its motion toward the bushing 38 from the position shown in Fig. 25 to that shown in Fig. 26, thus distorting the bushing and completing the final attachment of the terminal assemblage to the wire section 40. Since the clamps 45 which feed the wire segments 40 toward the die blocks 144 are released when the clamping pin 149 becomes effective, the completed successive terminals are free to drop by gravity whenever the die blocks 144 are separated for the reception of a new wire segment.

This cycle of operations is automatically and rapidly repeated to thereby produce a succession of similar terminals each of which has the bushing 38 distorted as shown in Fig. 32 to firmly

clamp the washer 39 upon the bushing 38, and to furthermore firmly clamp the bushing 38 to the wire section 40. During the final operation of attaching these compound terminals, the conical head 103 of each bushing 38 will be distorted to produce a washer clamping flange, and to also firmly grip the end 199 of the wire, and if so desired, the die plunger 164' may be formed to rivet the wire end 199 over the adjacent portion of the bushing 38. It will therefore be noted that the improved assemblage shown in Figs. 1 to 30 inclusive functions automatically to cut and strip the wire sections 40 and to apply the compound terminals to the corresponding ends of the successive sections, and the definite longitudinal motion of each section 40 is obviously utilized to position the end of that section within the loosely assembled terminal assemblage.

Although the mechanism shown in Figs. 1 to 30 inclusive is especially adapted to utilize only a longitudinal movement of the wire segments 40 during application of compound terminal assemblages, I also utilize a predetermined lateral movement of the segments during the application of simple Y-type terminals to such segments 40. A mechanism especially adapted to attach a Y-terminal 201 to each wire segment 40, is shown in Figs. 33 to 35 inclusive, and this modified mechanism is applicable to the same cutting and stripping assemblage which has been previously described. The modified terminal applying mechanism comprises in general, an upright terminal feed guide 202 having a guide slot 203 for conducting a series of interconnected Y-terminals 201 downwardly toward the attaching zone, the guide 202 being fixedly attached to an auxiliary frame 204 carried by the main frame 41; a pair of relatively horizontally movable wire guiding die blocks 205, 206, each having a semi-conical wire guiding recess 207 and a guiding groove 208 contiguous with the recess 207; a horizontal slide 209 slidably supporting the die block 205 and being constantly urged in one direction toward the axis of advancement of the wire between guide plates 210 on the frame 204, by means of a compression spring 211; another horizontal slide 212 carrying the other die block 206 and being reciprocable between other guide plates 213, by means of a lever 214 having teeth 215 coacting with rack teeth 216 formed on the slide 212; a pair of terminal positioning pins 217 secured to the slide 212 and slidably penetrating parallel holes in the die block 206; a spring 219 interposed between the die block 206 and its carrying slide 212 for constantly resiliently urging the block 206 toward the block 205; mechanism for positively feeding the terminal strip downwardly by steps equal to the distance between the upper and lower positioning pins; a crimping die 218 carried by the one slide 212 and being cooperable with the successive terminal hubs 219' to crimp the same about the stripped ends of the wire sections 40; and driving mechanism for the terminal feed and die mechanisms.

The strips of interconnected Y-terminals 201 may be formed of sheet metal either within or before being admitted to the attaching mechanism, and the mechanism for feeding these strips downwardly through the guide slot 203 by steps equal to the distance between the positioning pins 217, comprises a vertically reciprocable feed slide 220 movable in a laterally movable guideway 221 carried by the die block 205, and connected by a link 222 to the swinging end of a lever 223; an oscillatory shaft 224 journaled on

the frame 204 and having the lever 223 secured to one end thereof, while its opposite end carries a crank 225; and a slide 226 slidably on the frame 204 and having one end connected to the crank 225 by a link 227, while its opposite end carries a roller 228 coacting with a groove in the cam 229 driven by the spline shaft 54. The mechanism for oscillating the toothed lever 214 to positively reciprocate the slide 212, consists of a slide 230 slidably on the frame 204 parallel to the slide 226, and having one end pivotally connected to the lever 214 by a link 231, while the opposite end of the slide 226 carries a roller 232 coacting with another groove in the cam 229. The toothed lever is swingably suspended from a pin 233, and a tension spring 234 connecting the die block 206 with its carrying slide 212 serves to retract the guide block 206 which also strips the terminals from the spacer pins 217.

During normal operation of the modified terminal applying assemblage, the cutting and stripping machine is operating as previously described, to cut the continuous wire into successive predetermined sections 40, and to perhaps strip a portion of the insulation from the end of each section. After the block 206 has been moved into engagement with the block 205 and is caused to dwell, the end of the wire is admitted through the funnel 207, and as the slide 212 and guide block 216 continue to advance they carry the guide block 205 and slide 209 along with them, thereby moving the wire end laterally into the adjacent hub 219 of the lowest terminal 201 while this terminal and the one directly above it are engaged by the pins 217. Since each terminal hub 219' has internal prongs adapted to pierce the wire insulation, it is necessary to move the wire ends laterally into these hubs after the ends have been moved longitudinally into proximity with the hubs. When the end of a wire 40 has been thus positioned, the continued movement of the slide 212 permits the crimping die 218 to become effective to wrap the hub 219 about the stripped end of the wire section. During this crimping operation, the lower Y-terminal 201 is also severed from the strip, and as the die blocks 205, 206 are subsequently separated, the completed terminal assemblage drops by gravity from the machine. In this manner the successive wire sections 40 are provided with terminals 201, and the definite longitudinal and lateral motion of each section 40 is utilized to position the opposite end of the section within the hub 219 of a terminal 201. The entire operation is automatic and the feeding of the successive terminals into position is effectively accomplished with the aid of the pins 217 and of the feeding slide 220.

From the foregoing detailed description it will be apparent that my present invention provides a simple and highly efficient machine for severing insulated wire into predetermined lengths, and for utilizing a definite motion to apply a terminal to an end of each severed section 40. The invention provides improved apparatus for performing the several steps of applying the terminals in a most reliable and expeditious manner, and the operation of the mechanisms is entirely automatic and may be carried on at relatively high speed. Either simple or compound terminals may be quickly and effectively attached to sections 40 of any desired length, and the terminals are firmly attached while each terminal is the same as the others. In the embodiment of the invention shown in Figs. 1 to 32 inclusive, the longitudinal stripping motion of

the wire segments is utilized alone to position the wire ends within the terminal assemblies; but in the embodiment of Figs. 32 to 35 inclusive, the wire ends are moved both longitudinally and laterally relative to the terminal hubs. The single terminals 201 may be completely formed directly within the terminal applying machine; and it is not necessary in some cases, to actually strip the ends of the wire segments to which the terminals are applied. The improved mechanisms have proven highly successful in actual commercial use, and have demonstrated their ability to produce perfect terminals at high speed and with minimum attention on the part of the operator.

It should be understood that it is not desired to limit this invention to the exact steps or to the precise details of construction of the apparatus herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

I claim:

1. In combination, means for severing successive sections of wire from a continuous wire and for moving the successive sections away from the zone of severance to strip insulation from the corresponding end of each section, means for feeding successive terminals into position for reception of the opposite corresponding ends of the severed sections when said sections are moved away from said zone, and means for permanently attaching each terminal to the adjacent section.

2. In combination, means for moving successive sections of wire longitudinally, a set of die blocks having surfaces for guiding the end of each section, means for feeding washers in succession toward said die blocks, means for feeding a succession of bushings toward said die blocks, means for inserting one of said bushings into each of said washers and for delivering the assemblages in succession to positions for reception of the ends of the successive wire sections, and means for distorting said bushings to permanently attach said washers to said wire section ends.

3. In combination, means for feeding washers toward a definite zone, means for simultaneously feeding bushings toward the same zone, means for inserting one of said bushings within each of the successive washers and for delivering the assemblages in succession to said zone, and means for applying each of said assemblages to a section of wire at said zone.

4. In combination, means for feeding washers toward a definite zone, means for simultaneously feeding bushings toward the same zone, means for inserting one of said bushings within each of the successive washers and for delivering the assemblages in succession to said zone, means for inserting the ends successive wire sections within the successive bushings at said zone, and means for distorting the bushings to permanently attach the washers thereto and the bushings to the wire ends.

5. In combination, means for feeding a continuous stream of washers edgewise toward a definite zone, means for independently feeding a continuous line of bushings toward said zone, means for inserting one of said bushings within one of said washers and for periodically delivering the successive assemblages to said zone, and means for inserting the ends of successive wire sections within the bushings of the successive assemblages.

6. In combination, means for feeding a con-

tinuous stream of washers edgewise toward a definite zone, means for independently feeding a continuous line of bushings toward said zone, means for inserting one of said bushings within one of said washers and for periodically delivering the successive assemblages to said zone, means for inserting the ends of successive wire sections within the bushings of the successive assemblages, and means for distorting the successive bushings to permanently attach said washers thereto and to simultaneously attach the bushings to the wire ends.

7. In combination, means for feeding a washer edgewise to a definite zone, means for feeding a bushing laterally toward said zone, means for assembling the bushing within the washer and for delivering the assemblage to said zone, and means for inserting the end of a wire within said bushing and for distorting the latter to permanently attach the assemblage to the wire end.

8. In combination, means for feeding a washer edgewise to a definite zone, means for feeding a bushing laterally toward said zone, means for moving the bushing axially into said washer to provide a temporary assemblage, means for delivering said assemblage to said zone in a predetermined position, and means for inserting the end of a wire within said bushing and for distorting the latter to permanently fasten the washer to the bushing and the assemblage to the wire.

9. In combination, means for severing successive sections from a continuous wire and for moving the successive sections longitudinally away from the zone of severance to bare the severed ends of the sections, means for feeding successive tubular terminals into position for immediate reception of the advancing opposite previously bared ends of the severed sections when said sections are moved away from said zone, and means for permanently attaching each terminal to the adjacent section immediately after said section has been projected within the terminal by virtue of its longitudinal movement away from said zone.

10. In combination, means for severing successive sections from a continuous wire and for moving the successive sections longitudinally away from the zone of severance to bare the severed ends of the sections, means for feeding successive tubular terminals into position for immediate reception of the advancing opposite previously bared ends of the severed sections when said sections are moved away from said zone, means for permanently attaching each terminal to the adjacent section immediately after said section has been projected within the terminal by virtue of its longitudinal movement away from said zone, and means for effecting free delivery of the united terminals and sections laterally of the direction of initial advancement of the sections and away from the terminal attaching zone.

11. In combination, means for severing successive sections of wire of predetermined length from a continuous wire and for moving the successive sections longitudinally away from the zone of severance to strip insulation from the end of each severed section, means for feeding successive tubular terminals into axial alignment with each severed wire section for immediate reception of the end of the section remote from said zone when the section is moved longitudinally after severance, and means for distorting each terminal to permanently attach the same to the inserted wire section end.

12. In combination, means for severing successive sections of wire from a continuous wire and for moving each section longitudinally away from the zone of severance to strip an end thereof, means for feeding successive tubular terminals into axial alinement with each severed wire section, means for conducting the end of each section remote from said zone into each terminal during movement of the section away from the stripping zone, and means for permanently attaching each terminal to the inserted wire end.

13. In combination, an upwardly movable member formed to periodically elevate diverse groups of washers from a jumbled mass and to roll the same in single file formation toward a definite zone, another upwardly movable member formed to periodically elevate diverse groups of bushings from a jumbled mass and to slide the same in single file formation toward the same zone, means for assembling the successive bushings within the successive washers at said zone and for subsequently delivering the successive assemblages from said zone, and means for thereafter inserting the ends of successive wires within said bushings and for permanently securing the assemblages to the wires.

14. In combination, means for periodically removing diverse groups of washers from a jumbled mass and for rolling the same in single file formation toward a definite zone, means for periodically removing diverse groups of bushings from a jumbled mass and for sliding the same in single file formation toward the same zone, means for moving the successive bushings of said bushing row axially through the successive washers of said washer row at said zone and for conducting the successive assemblages from the assembly zone, and means for thereafter inserting and securing the ends of successive wires within said bushings.

15. In combination, means for automatically removing diverse groups of washers from a jumbled mass and for rolling the removed washers in single file formation from the mass, means for automatically removing diverse groups of bushings from another jumbled mass and for sliding

the removed bushings in single file formation from said other mass, means for assembling the successive bushings within the successive washers during advancement of the two rows, and means for attaching each bushing assemblage to the end of a wire.

16. In combination, means for periodically removing diverse groups of washers from a jumbled mass and for edgewise rolling the washers in single advancing row formation, means for simultaneously periodically removing diverse groups of bushings from another jumbled mass and for arranging the removed bushings in single advancing row formation, means for assembling the successive bushings within the successive washers of the advancing rows, and means for thereafter attaching each bushing and washer assemblage to the end of a wire.

17. In combination, means for automatically removing diverse groups of washers from a jumbled mass and for advancing the same by gravity alone in single file formation, means for simultaneously automatically removing diverse groups of bushings from another jumbled mass and for advancing the same by gravity alone in single file formation, means for projecting the successive bushings of said bushing file axially through the successive washers of said washer file during advancement of the rows, and means for finally projecting the ends of successive wires into the successive bushings of the assemblages.

18. In combination, means for automatically removing diverse groups of washers from a jumbled mass and for arranging the washers in single advancing row formation, means for simultaneously automatically removing diverse groups of bushings from another jumbled mass and for arranging the removed bushings in single advancing row formation, means for inserting the bushings axially within the washers of the advancing rows, means for thereafter inserting the end of a wire in each bushing, and means for permanently attaching the bushings to the wires and the washers to the bushings.

KARL H. ANDREN.