June 13, 1944. A. C. FRANKWICH ET AL 2,351,116

ARTICLE ASSEMBLING APPARATUS

Filed June 30, 1942 7 Sheets-Sheet 1

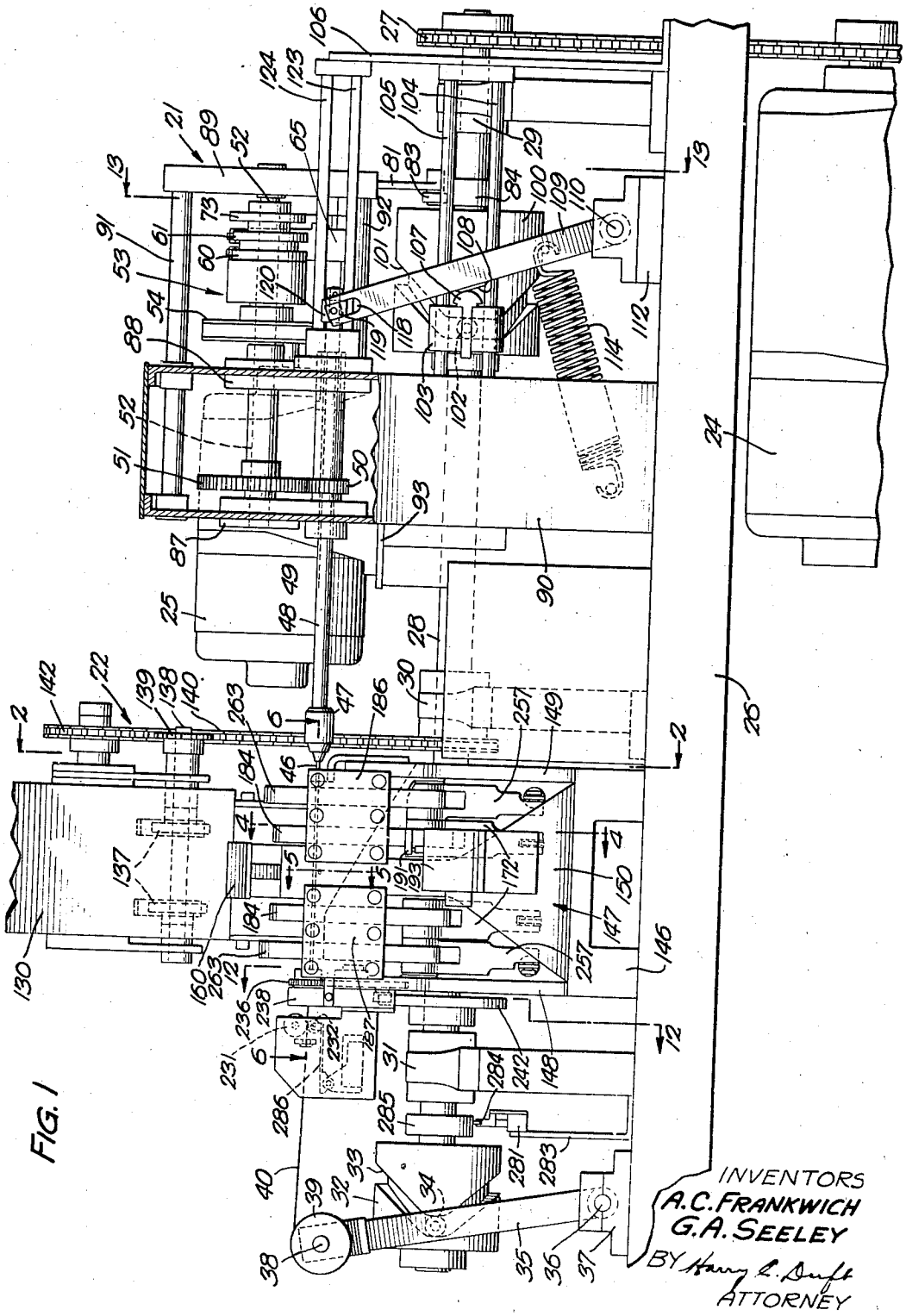


FIG. 1

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ARTICLE ASSEMBLING APPARATUS

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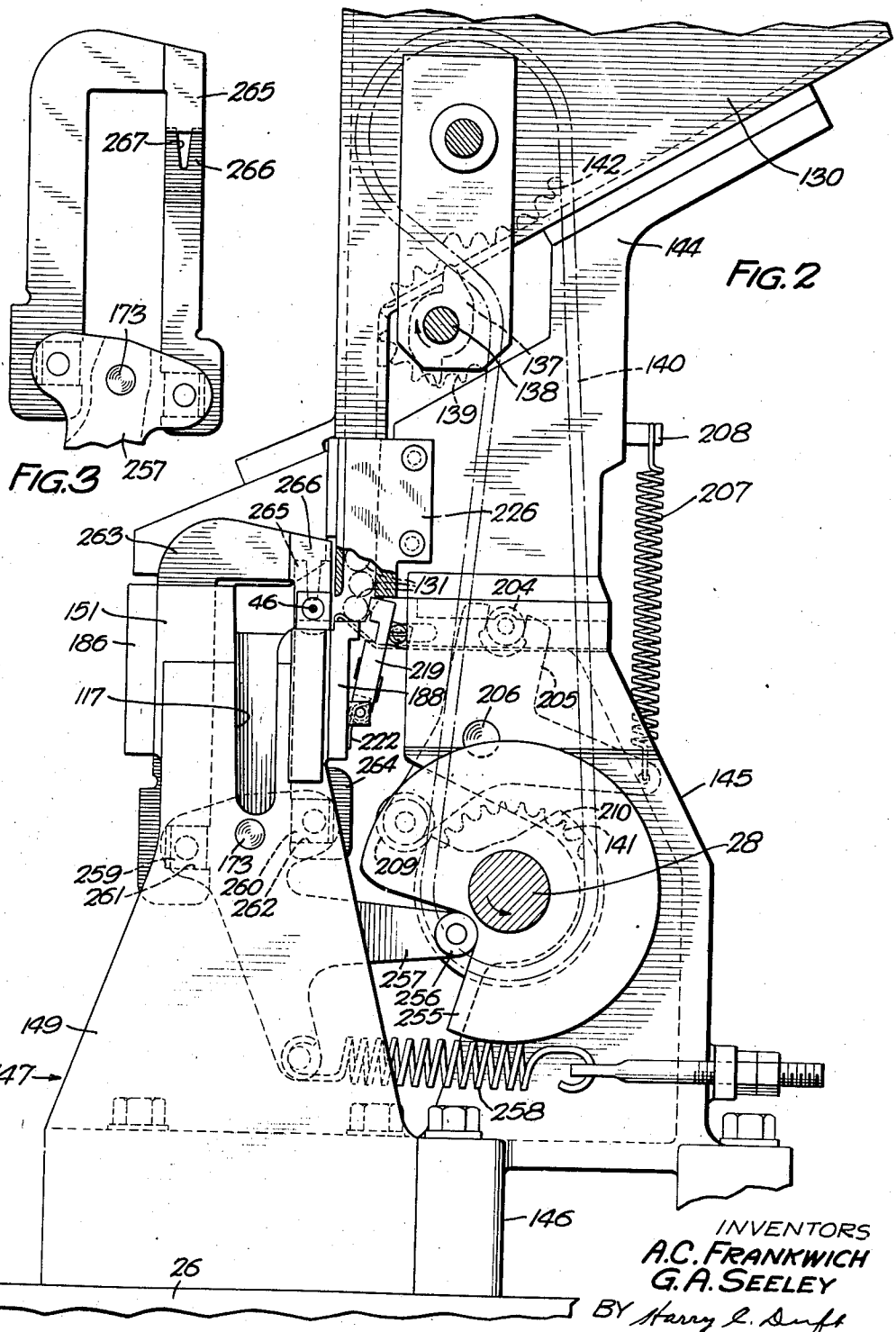


FIG. 3

FIG. 2

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ARTICLE ASSEMBLING APPARATUS

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FIG. 4

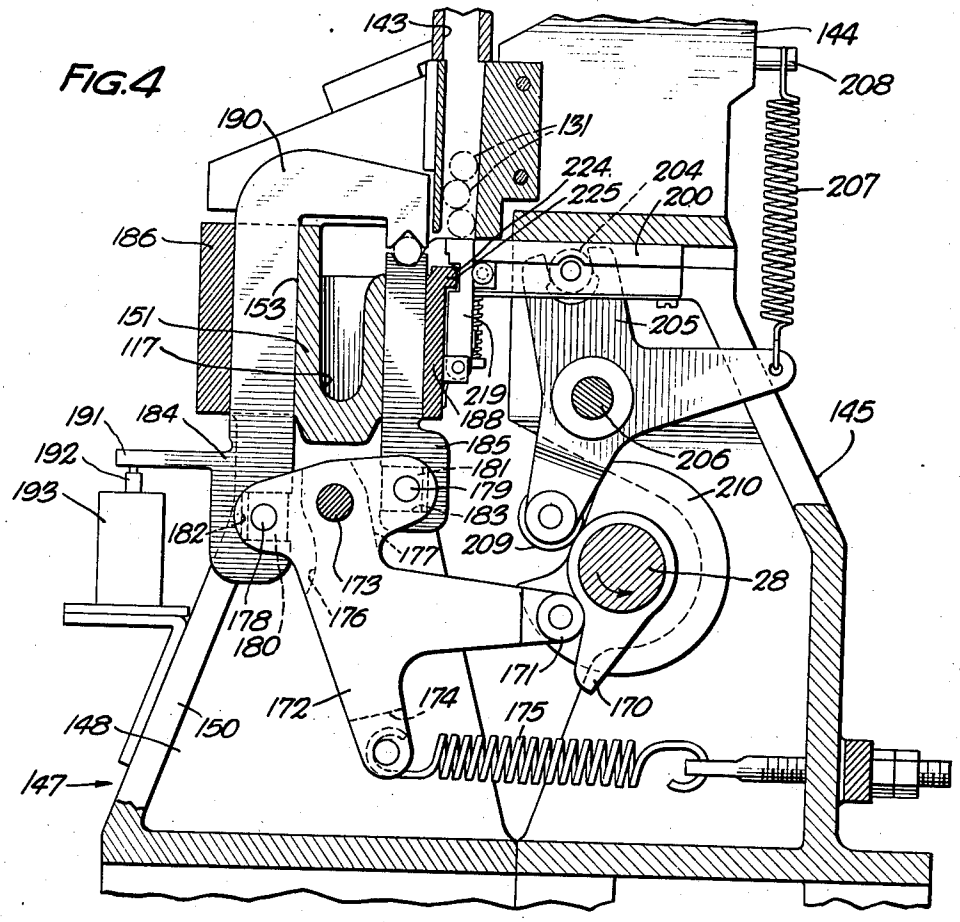
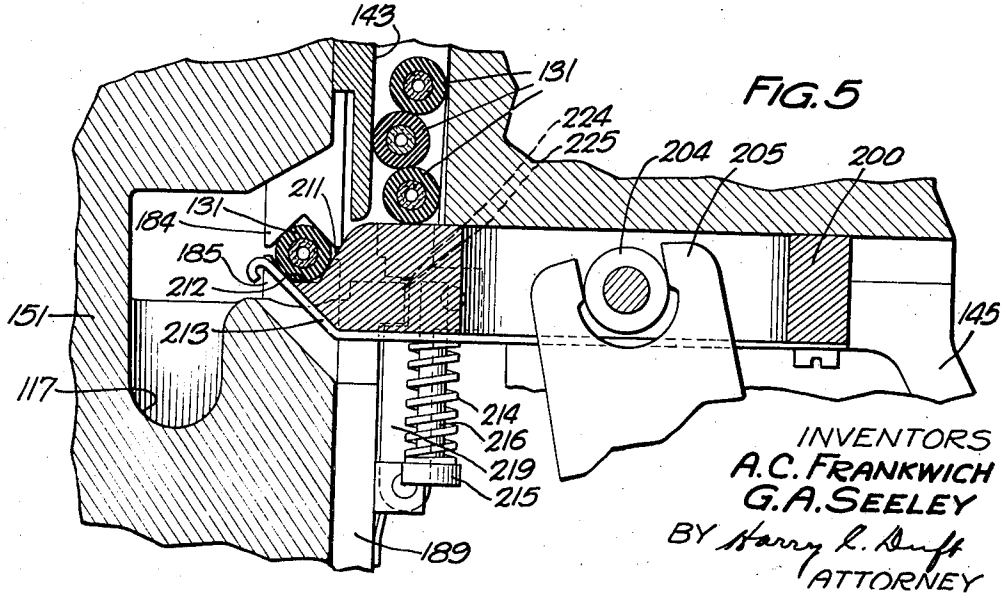


FIG. 5



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ARTICLE ASSEMBLING APPARATUS

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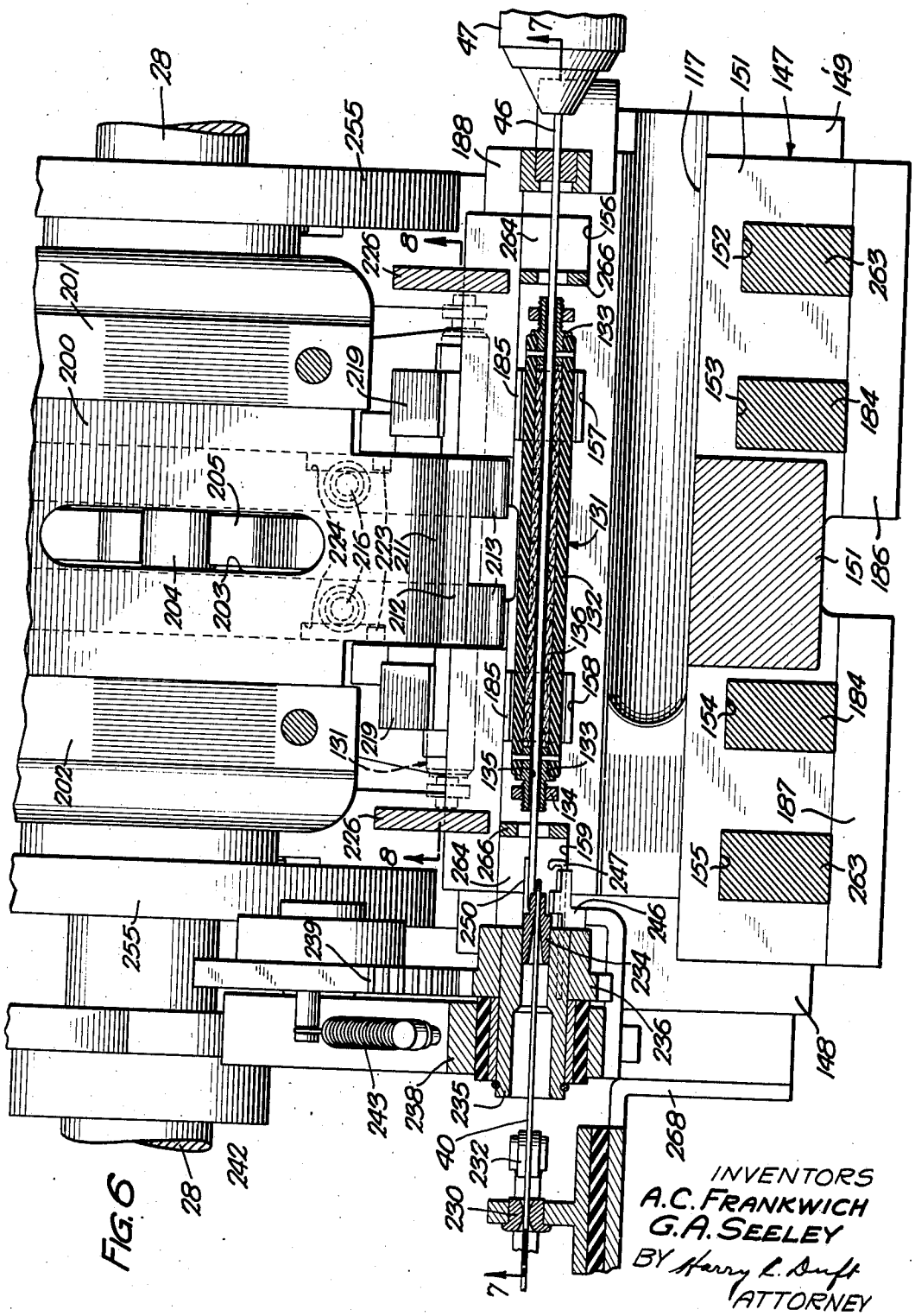


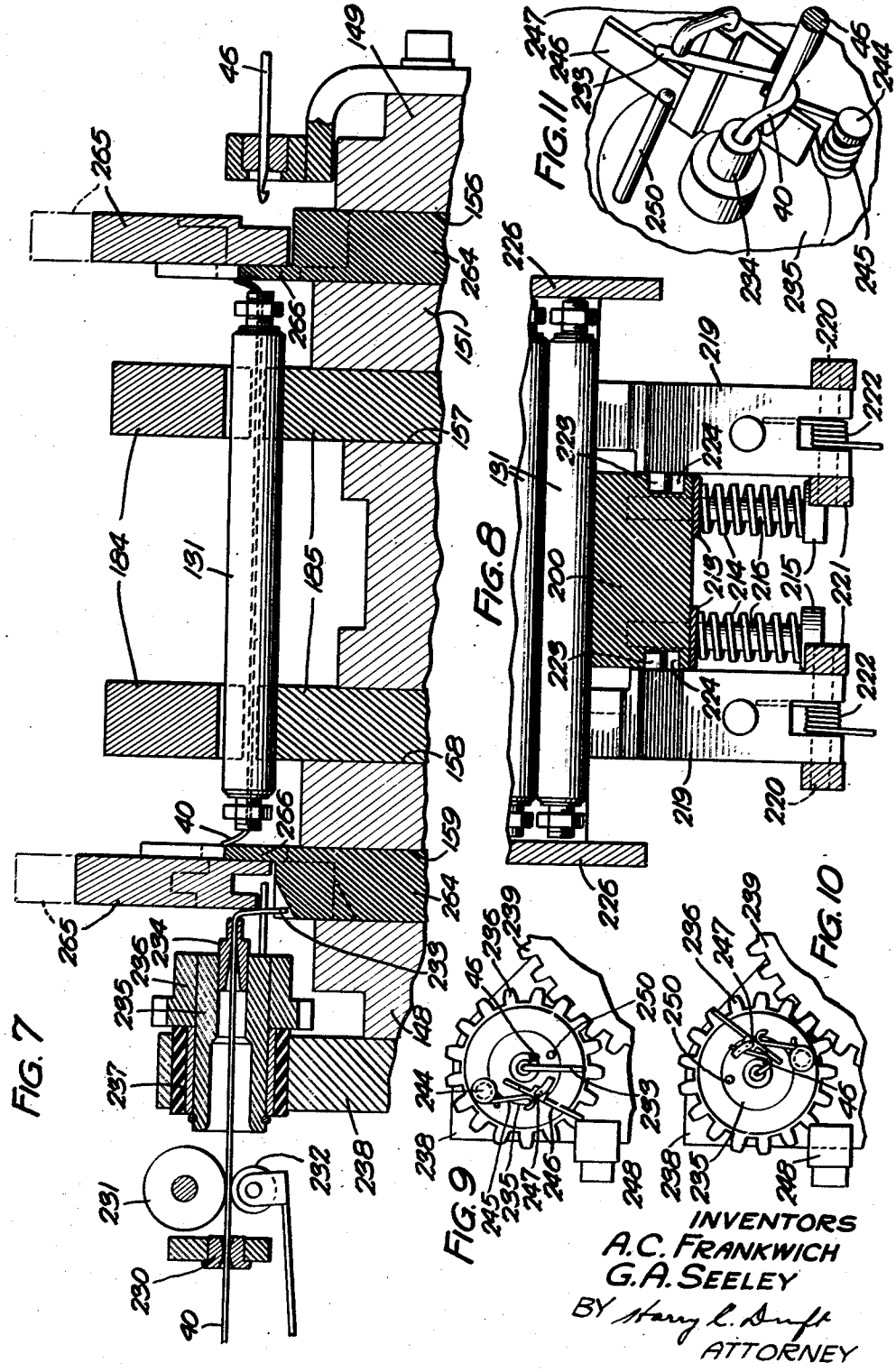
FIG. 6

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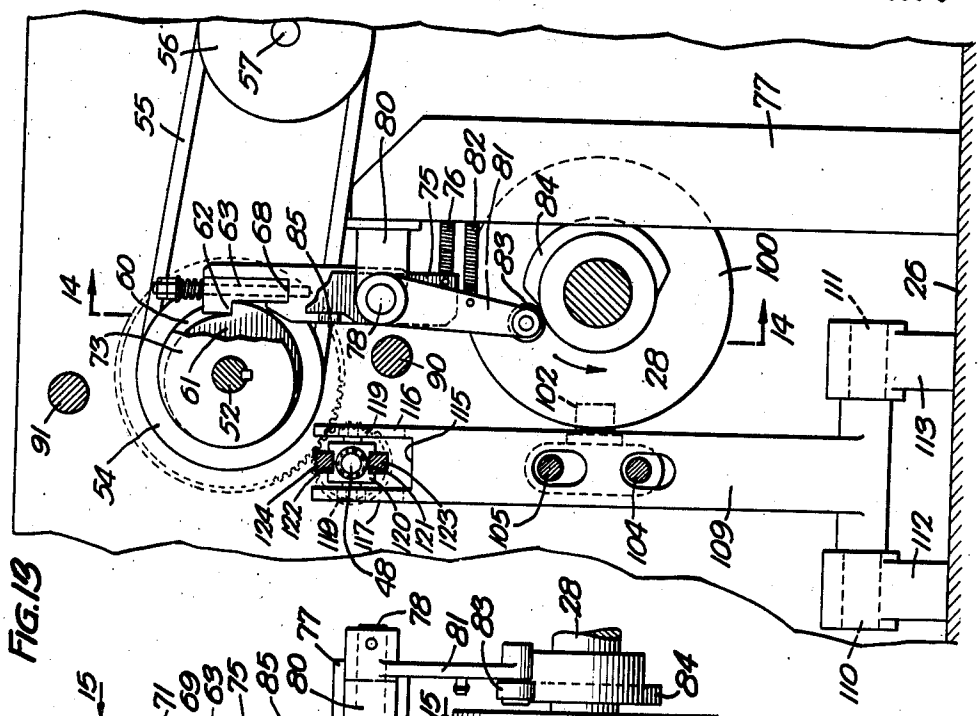


FIG. 13

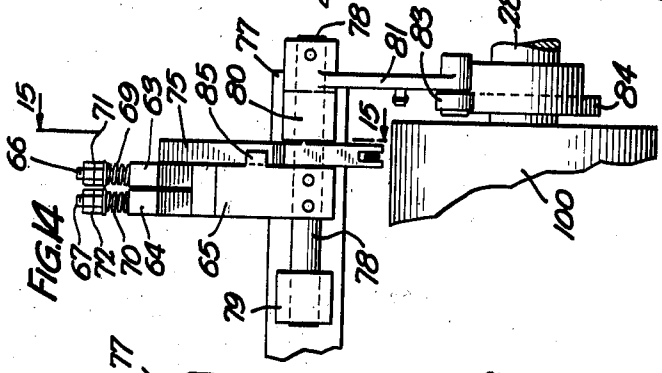


FIG. 14

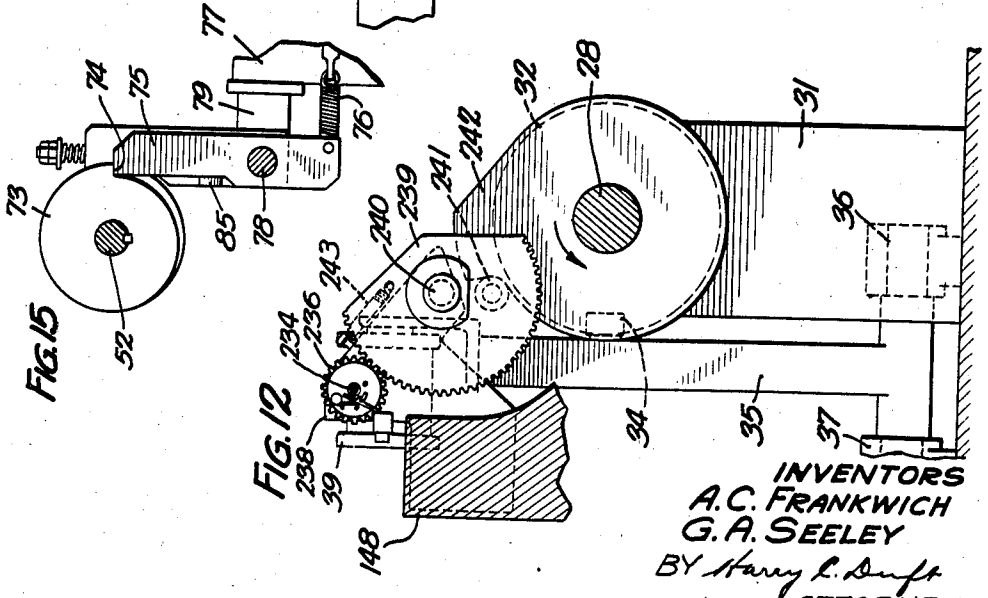


FIG. 15

FIG. 12

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ARTICLE ASSEMBLING APPARATUS

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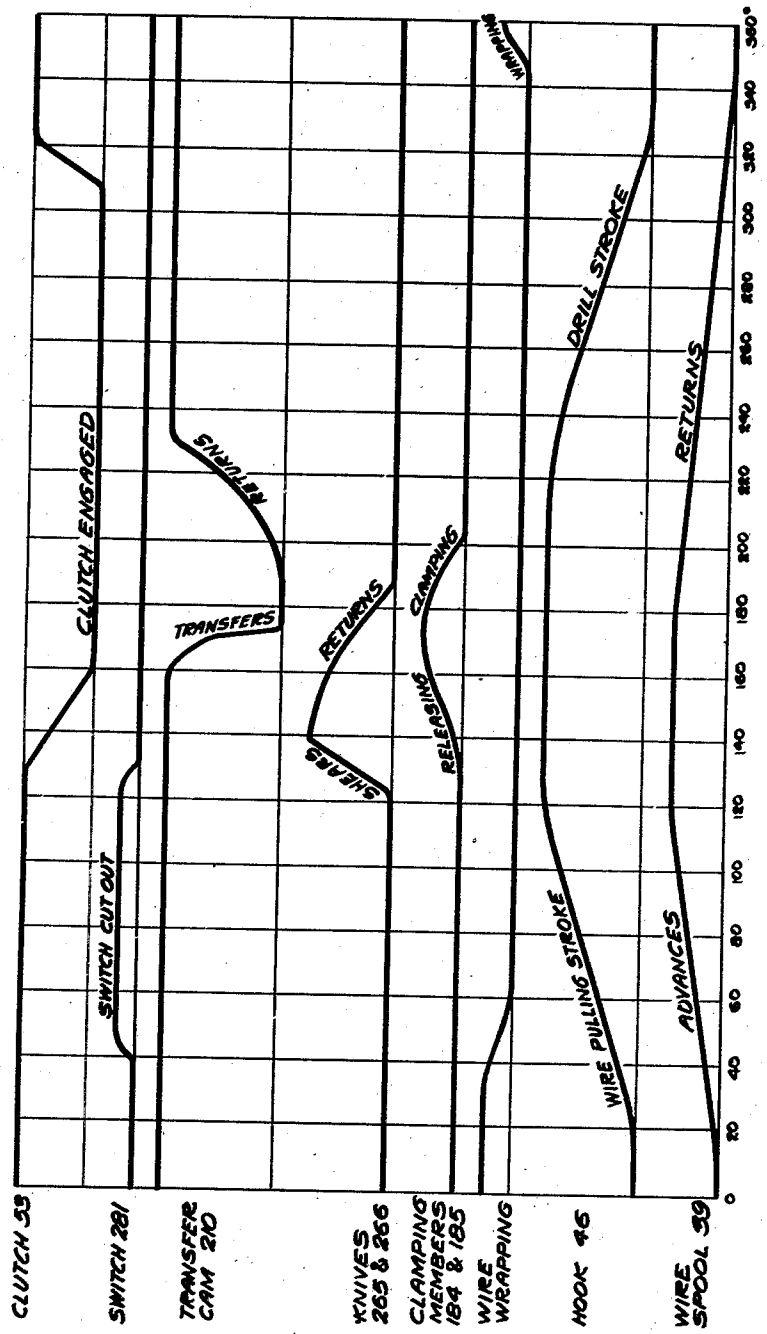


FIG. 16

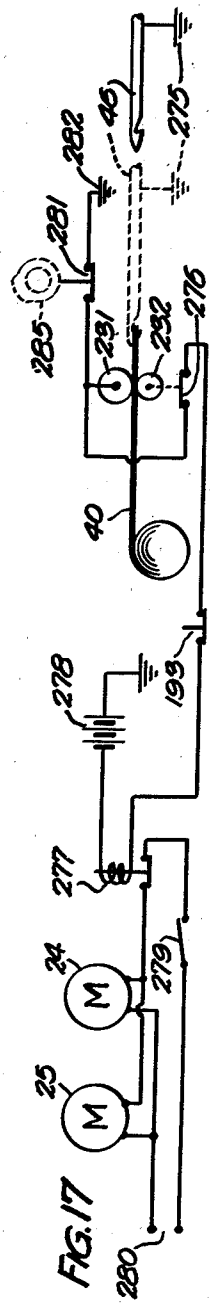


FIG. 17

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Patented June 13, 1944 2,351,116

UNITED STATES PATENT OFFICE

2,351,116

ARTICLE ASSEMBLY APPARATUS

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Application June 30, 1942, Serial No. 449,108

18 Claims. (Cl. 29—84)

This invention relates to article assembly apparatus and more particularly to an apparatus for assembling fuse wires in fuse shells.

It is an object of the present invention to provide a simple and efficiently operable apparatus for expeditiously assembling articles.

In accordance with one embodiment of the invention, an apparatus is provided wherein a reciprocating needle or hook is advanced through a fuse shell and then retracted to draw a fuse wire from a supply thereof through the shell. The needle is rotated during its advancement through the shell to clear a passage through the fuse shell lining and, after passing through the fuse shell toward the supply of wire, the needle is stopped in a predetermined position with the hook on the needle pointing downwardly in a position to be engaged by the end of a fuse wire which has been drawn from a supply during the last previous threading operation. The end of this fuse wire was bent down in the last operation and a lever travelling in a circular path is oscillated to wrap the fuse wire around the needle or hook so that the end hook portion of the needle will, upon retraction thereof, grasp the end of the fuse wire and draw it through the fuse shell. The supply of fuse wire is mounted upon an oscillatory arm so that during the pulling of the fuse wire through the fuse shell by the needle, the supply will rock toward the shell and after the wire has been completely drawn through the shell, knives on opposite sides of the shell are reciprocated to cut off and bend over the ends of the wire, thereby to hold it in the shell and to move the portion of the wire adjacent the supply into position to be engaged with the hook. The apparatus is provided with suitable controls whereby operation thereof is stopped when the supply of fuse shells or fuse wire is exhausted or when the fuse wire breaks during the process of drawing it through the shell.

A better understanding of the invention will be had by reference to the accompanying drawings, wherein

Fig. 1 is a front elevational view of an apparatus embodying the invention, parts being broken away to illustrate more clearly some other parts of the apparatus;

Fig. 2 is a vertical sectional view on a large scale, taken substantially along the line 2—2 of Fig. 1 in the direction of the arrows showing a portion of the mechanism for feeding the fuse shells to an assembly point;

Fig. 3 is a fragmentary detailed view, also taken along the line 2—2 and showing the mechanism which cuts off the ends of the fuse wire in its open position;

Fig. 4 is a fragmentary vertical sectional view taken substantially along the line 4—4 of Fig. 1 in the direction of the arrows showing part of the fuse shell feeding and clamping mechanisms;

Fig. 5 is a fragmentary vertical sectional view taken substantially along the line 5—5 of Fig. 1 in the direction of the arrows showing, on an enlarged scale, a portion of the fuse shell feeding mechanisms;

Fig. 6 is an enlarged plan sectional view taken substantially along the line 6—6 of Fig. 1 in the direction of the arrows and showing the wire feeding or threading needle or hook in its advanced position preparatory to drawing a fuse wire through a fuse shell;

Fig. 7 is a fragmentary vertical sectional view taken along the line 7—7 of Fig. 6 and showing the hook or needle in its retracted position after having drawn a length of fuse wire through a fuse shell and after the fuse wire has been cut off from the supply;

Fig. 8 is a fragmentary vertical sectional view taken along the line 8—8 of Fig. 6 in the direction of the arrows showing some details of the mechanism for feeding the fuse shells to their assembly position;

Figs. 9 and 10 are enlarged fragmentary end elevational views of the mechanism for wrapping the end of the fuse wire around the needle or hook, Fig. 9 showing the apparatus in the position it occupies prior to wrapping the end of the wire around the hook and Fig. 10 showing the apparatus in the position it occupies after the end of the wire has been wrapped around the hook or needle;

Fig. 11 is a fragmentary detailed perspective view of the apparatus shown in Figs. 9 and 10 on a further enlarged scale;

Fig. 12 is an enlarged fragmentary sectional view taken substantially along the line 12—12 of Fig. 1 in the direction of the arrows showing the relative position of the various mechanisms involved in feeding and wrapping the fuse wire around the needle and shows, on a smaller scale, some of the mechanisms shown in Figs. 9, 10 and 11;

Fig. 13 is an enlarged fragmentary vertical sectional view taken substantially along the line 13—13 of Fig. 1 in the direction of the arrows showing the clutch mechanism which controls rotation of the needle during the advancement of the needle through the fuse shell;

Fig. 14 is a vertical sectional view taken substantially along the line 14—14 of Fig. 13 in the direction of the arrows;

Fig. 15 is a detailed vertical sectional view taken along the line 15—15 of Fig. 14, Figs. 13, 14 and 15, when considered together, illustrating the mechanism for controlling the rotation of the needle;

Fig. 16 is a timing diagram illustrating the approximate time of operation of the various mechanisms which cooperate in the apparatus; and

Fig. 17 is a circuit diagram of the control circuit for stopping the operation of the apparatus when the fuse shell or wire supply is exhausted or when the needle will not pass through the fuse shell.

In the drawings, the needle operating mechanism 21, the shell handling mechanism 22 and the fuse wire handling mechanism 23 are shown generally in Fig. 1, which illustrates their relative positions. A pair of motors 24 and 25 supply the driving power for the apparatus, the motor 24 being mounted beneath a bench or table 26 and the motor 25 being mounted above the bench or table 26. The motor 24 drives all of the apparatus with the exception that the needle is rotated by the motor 25, as will be described more in detail hereinafter, and is resiliently urged in one direction and positively driven in the opposite direction by mechanisms controlled by the motor 24. The motor 24 is interconnected by means of a chain drive 27 with a main shaft 28 which extends substantially throughout the length of the apparatus and has a series of cams mounted upon it. The shaft 28 is rotatable in bearings 29, 30 and 31, which are suitably mounted on the table 26. At its left end, the shaft 28 carries a cam 32 having a cam groove 33 in which a cam roller 34 rides. The roller 34 is mounted on a lever 35, which is, in turn, pivoted on pivot pin 36 mounted in a block 37, which is suitably secured to the table 26. The upper end of the lever 35 has a stud shaft 38 fixed to it about which a supply spool 39 carrying a supply of fuse wire 40 is freely rotatable. From the foregoing, it will be apparent that cam 32 will rock the lever 35 about its pivot pin 36 once for each rotation of the shaft 28 to advance the supply spool 39 toward the center of the apparatus and then to move it back to the position shown in Fig. 1 for a purpose to be explained hereinafter.

The shaft 28 also serves to impart reciprocation to a needle 46 fixed in a chuck 47 which is mounted upon the end of a reciprocable and rotatable shaft 48. The shaft 48 is splined, as shown at 49, to a gear 50, which meshes with a gear 51 whereby rotation may be imparted to the shaft 48 through the action of the gears 50 and 51 while the shaft 48 may be reciprocated axially of the gear 50. The gear 51 is mounted upon a shaft 52, which is adapted to be rotated by the motor 25 through the action of a clutch 53 and a pulley 54. The pulley 54 is driven through a belt 55 and a second pulley 56 mounted on the shaft 57 of the motor 25. The clutch 53 may be of any suitable construction which may be stopped to accurately position the shaft driven therethrough each time the clutch is disconnected from the driven shaft. In the present embodiment of the invention, a clutch has been chosen which includes a pair of discs 60 and 61. The clutch disc 61 in this particular type of clutch is arranged so that it will effect a disengagement of the clutch when its movement with the shaft 52 is blocked and, accordingly, the disc 60 is provided with a notch 62 adapted to be engaged by a resilient abutment 63, which, together with a resilient abutment 64, is mounted upon a lever 65 (Fig. 14), rods 66 and 67 being threaded into the lever 65 and extending through the abutments 63 and 64. The abutments 63 and 64 are urged down into engagement with notches 68 (Fig. 15) cut in the lever 65 by springs 69 and 70, respectively, encircling the rods 66 and 67 and positioned between the abutments 63 and 64 and lock nut assemblies 71 and 72, respectively.

Also fixed to the shaft 52, as shown most clearly in Figs. 14 and 15, is a disc 73 having a notch 74 formed on its surface for engagement by a latch member 75. The latch member 75 is normally urged to rotate in a counter-clockwise direction (Figs. 13 and 15) by a coil spring 76 attached to its lower end and to a support member 77 which extends upwardly from the table 26 to support a shaft 78. The lever 65 is fixed to the shaft 78, about which the latch member 75 is freely rotatable. The support member 77 carries a pair of bearings 79 and 80, in which the shaft 78 is oscillatable, the shaft normally being urged to the position shown in Fig. 13 by a cam lever 81 interconnected with the support member 77 by a coil spring 82. Spring 82 urges the lever 81 to the position where a cam roller 83 mounted upon its lower end will bear against the surface of a cam 84. The lever 65 is provided with a lug 85 extending out over the face of the latch member 75 so that when the lever 65 is rocked through the action of the cam lever 81 and shaft 78, the latch member 75, as well as both of the abutments 63 and 64, will be disengaged from the surface of their respective discs 73, 60 and 61. The cam 84 is mounted upon and fixed to the shaft 28 and thus, for each revolution of the shaft 28, will cause the shaft 52 to be rotated a number of times while the cam roller 83 is in engagement with the high portion of cam 84 and each time the shaft 52 is stopped after having been driven through the clutch 53, the shaft will be stopped in exactly the same position, where, due to the engagement of the gear 51 with gear 50, the needle 46 carried by shaft 48 will be positioned with its hook pointed downwardly, as shown in Figs. 6 and 11. The shaft 52 is journalled in bearings 87, 88 and bearing plate 89. The bearings 87 and 88 are supported by the side walls of a housing 90, which also serve to support a pair of rods 91 and 92, which extend to the right (Fig. 1) to support the bearing plate 89. The housing 90 is also provided with an extending portion 93, which serves to support the motor 25 in a raised position with respect to the table 26.

In addition to the mechanism for imparting rotation to the needle 46, the needle is adapted to be reciprocated and this is effected by a cam 100 mounted upon the shaft 28 and having a cam groove 101 in which a cam roller 102 travels. The cam roller 102 (Figs. 1 and 14) is mounted upon a travelling block 103 which rides upon a pair of rods 104 and 105. The rods 104 and 105 are supported at their left end (Fig. 1) by the housing 90 and at their right end are supported by a bracket 106. Mounted on the block 103 is a camming member 107 adapted to engage a cam surface 108 on a lever 109. The lever 109 is provided with pivot studs 110 and 111, which extend into bearing blocks 112 and 113, respectively, and is urged to rotate in its pivot studs in a counter-clockwise direction (Fig. 1) by

a contractile spring 114, which tends to hold the cam surface 108 against the camming member 107. At its upper end, the lever 109 has a slot 115 formed in its forming two side portions 116 and 117, which are, in turn, slotted as shown at 118 (Fig. 1) to receive slidable blocks 119. The blocks 119 are pivotally connected with a rectangular sleeve 120. The sleeve 120 will thus be reciprocated upon oscillation of the lever 109 and since the shaft 48 is freely rotatable in, but movable with the sleeve 120, the sleeve 120, through the action of lever 109, will impart reciprocation to the shaft 48, thus to reciprocate the needle 46. The sleeve 120 is notched, as shown at 121 and 122 to receive a pair of guide rods 123 and 124, respectively, between which the sleeve is slidable, the guide rods serving as rails to support the right end (Fig. 1) of the shaft 48 during its reciprocation with respect to the gear 50 to which the shaft 48 is splined.

In the shell handling mechanism 22, there is provided a hopper 130 (Figs. 1 and 2) in which a supply of fuse shells 131, as most clearly illustrated in Figs. 6, 7 and 8), may be positioned. These fuse shells comprise a tubular member 132 of insulating material, in the ends of which there are suitably fixed metallic end members 133 threaded to receive positioning nuts 134. The end member 133 is provided with a central aperture 135, which is in alignment with an aperture in a tubular member of flame resistant material, such as asbestos tubing 136. It is into this tubing of asbestos that the fuse wire 40 must be inserted. The hopper 130 may be of any suitable construction and is provided with agitator members 137 mounted upon a shaft 138, which carries at its outer end a sprocket 139 adapted to be driven by a chain 140, which passes around a chain driving sprocket 141 mounted on the shaft 28 and over an idler sprocket 142, which causes the chain 140 to bear against the sprocket 139. Thus, the agitator 137 will be rotated in the direction indicated by the arrows in Fig. 2 to agitate parts in the hopper 130 and cause them to assume a horizontal position in a vertically extending outlet passage 143 of the hopper 130. The hopper and its cooperating parts are mounted upon the upper portion of an irregularly shaped frame member 144, which extends upwardly from a cam housing 145, in turn mounted upon a pedestal 146 mounted on the bench or tables 26. The cam housing 145 has positioned within it and mounted upon the shaft 28 a series of cams for operating the mechanisms which feed the shells from the hopper passage 143 to position to have the fuse wires inserted in them and other cams for clamping the shells in position to have the fuse inserted in them and for cutting off the ends of the fuse wire 40. Positioned on the pedestal 146, in front of the cam housing 145, is an irregularly shaped casting 147. The casting 147 has formed integrally with it a pair of side plates 148 and 149 and a central support member 150, which, together with the side plates 148 and 149, support a main slide supporting block 151, which has a series of eight grooves 152 to 159, inclusive, formed in them (Figs. 6 and 7) for receiving the slidable parts which effect the clamping, shearing or cutting operations on the fuse shell and fuse wire, respectively. The upper mid portion of casting 147 has a plate 160 mounted thereon for serving to support the lower ends of the members which form the passage 143 from the hopper to a position to be carried over to a clamping position.

On the shaft 28, within the cam housing 145, there are provided a pair of cams 170 of exactly the same construction which have cooperating with them cam rollers 171 mounted upon the ends of clamp actuator levers 172 (Figs. 1 and 4). The clamp actuator levers 172 are pivoted on a rod 173 and have slots at their upper and lower portions, the slot 174 in the lower portion receiving the end of a contractile spring 175 which normally urges the lever 172 to rock in a counter-clockwise direction about the rod 173. Slots 176 and 177 in the upper end of the lever have pins 178 and 179, respectively, fixed in them about which blocks 180 and 181, respectively, are freely pivoted. The blocks 180 and 181 ride in slots 182 and 183, respectively, formed in clamping members 184 and 185, respectively, the clamping members being slidable in the slots 153 and 154 and 157 and 158 formed in the casting or slide supporting block 151, suitable retaining plates 186, 187, 188 and 189 being provided for holding the clamping members 184 and 185 in place in their respective slots. The clamping members 184 are bent over at their top ends, as indicated at 190 and when the lever 172 is in the position shown in Fig. 4, the clamping member 184 will be urged downwardly and the clamping member 185 will be urged upwardly to grip a fuse shell 131 between the notched ends of the clamping members. One of the clamping members 184 is provided with a projection 191, which moves in alignment with a plunger 192 of a highly sensitive electrical switch 193. This switch 193 is adapted to be actuated for control purposes when there is no fuse shell between the clamping members 184 and 185 and will be actuated by depressing its plunger 192 when the clamping member 184 moves beyond the position which it will occupy when clamping a fuse shell 131 between it and a cooperating clamping member 185.

The fuse shells are fed to the clamping members 184 and 185 by a carrier slide 200, which is reciprocated in timed relation to the operation of the clamping members (Figs. 2, 5, 6 and 8). The slide 200 is slidable in ways 201 and 202, which are positioned at the top of the cam housing 145. The slide 200 is provided with a slot 203, in which there is freely rotatable a roller 204 adapted to be engaged by the opposite sides of a bifurcated bell crank lever 205. The bell crank lever 205 is pivotally mounted on a pivot rod 206 and is normally urged to rotate in a counter-clockwise direction by a contractile spring 207, which engages one of the arms of the bell crank and extends up to and is secured on a pin 208 extending outwardly from the frame member 144. The bell crank lever 205 carries a cam roller 209, which rides on the surface of a cam 210, which is, in turn, fixed to the shaft 28. Thus, for each rotation of the shaft 28, the bell crank lever 205 will be oscillated once about its pivot rod 206 to tend to advance and to retract the carrier slide 200. At its forward end, the carrier slide, as best seen in Fig. 5, is tapered downwardly, as shown at 211, to provide a shoulder 212, on which a fuse shell 131 may rest while the fuse shell is held in its forward position and clamped in that position by the clamping members 184 and 185. Cooperating with the shoulder 212 and downwardly tapering surface 211 is a spring member 213 fixed, at its right end (Fig. 5), to a portion of the carrier slide 200. There are two spring members 213 positioned on the underside of the carrier slide 200 and in order to adequately support a fuse shell 131, bolster

springs 214 are provided for holding the spring members 213 in their upper postion when a shell 131 is positioned thereon. The bolster springs 214 engage the underside of the springs 213 and the upper surface of the heads 215 formed on rods 216 threaded into the underside of the carrier slide 200. The slide 200 will, therefore, carry a shell 213 from a position in vertical alignment with the passage 143 over into alignment with the clamping members 184 and 185 where the shell will be clamped by the clamping members and retraction of the carrier slide 200 to the right will cause the springs 214 to be compressed and the spring 213 to bend thereby to pass under the shell 131 held in the clamping members and return to position to receive another shell. Since, at the time the carrier slide 200 is moved to the left (Fig. 5), the clamping members 184 will be disengaged from a shell 131 resting on the lower clamping member 185, the end of the spring 213 will push a shell, into which fuse wire has been threaded over into a trough 117 formed in the casting 147, down which the completed fuse will slide to thus eject a completed fuse from the apparatus.

In order to prevent jamming of the fuse shells 131 at the point where they are discharged from the passageway 143 onto the carrier slide 201, are a pair of shell supporting levers 219 (Figs. 2 and 8) for holding the supply of shells 131 in the passage 143 until the carrier slide 200 is retracted to a predetermined point. The two shell supporting levers 219 are of exactly the same construction and are pivoted on the retaining plates 188 and 189 by means of pivot pins 220, which extend through the levers 219 and into brackets 221 suitably mounted on the plates 188 and 189. The levers 219 are normally urged to rotate in a counter-clockwise direction (Fig. 2) by springs 222, which encircle the pivot pins 220 and engage the plates 188 and 189 and the levers 219. The levers 219 are provided with pins 223, which extend into slots 224 formed in the carrier slide 200 and the springs 222 urge the levers 219 to follow the carrier slide 200 when the carrier slide moves to the left (Figs. 2, 4 and 5). However, the carrier slide travels farther to the left than the levers 219 and, therefore, during the latter part of movement of the carrier slide 200 to the left (Fig. 2), the levers 219 will not travel with it but will stop with their notches 224 engaged with shoulders 225 on the retaining plates 188 and 189, in which position the top surface of the levers 219 are directly under the shells 131 in the passage 143. Furthermore, the levers 219 will remain in the position shown in Figs. 4 and 5 for a short time after the carrier slide 200 starts to move to the right and after the carrier slide 200 has moved a short distance to the right, the levers 219 will start to follow it, thereby to permit a shell to move downwardly to the passage 143 into the nest formed by the springs 213 and the sloping surface 211 of the carrier slide. It should be noted that the fuse shells 131 in the lower portion of the passage 143 are held between plates 226, which are fixed to the frame member 144 and that these plates will hold the fuse shells in the proper position in the passage 143.

After a fuse shell has been fed from the hopper 130 through the passage 143 and transferred by the carrier slide 200 into alignment with the clamping members 184 and 185 and has been clamped in position by the clamping members, the needle operating mechanism 21 will operate to feed the needle 46 through the fuse shell preparatory to drawing fuse wire 40 through the shell. When the apparatus is in this condition, the needle 46 will occupy the position shown in Figs. 6, 9, 10 and 11 and the fuse wire 40, having been threaded through a sizing die 230 and between control rollers 231 and 232, will be positioned as shown in Figs. 6 and 7 with its end bent over as indicated at 233 (Figs. 7 and 9), the fuse wire 40 having been passed through a guide sleeve 234. The guide sleeve 234 is set into a hollow shaft 235, to which a gear segment 236 is suitably fixed. This gear segment 236 is freely rotatable in an insulating bearing 237, which is, in turn, supported by an irregularly shaped plate 238. The irregularly shaped plate 238 is fixed on the side plate 148 (Fig. 12) and thus rotatably supports the gear 236 and hollow shaft 235 in position, where the gear 236 meshes with a gear segment 239. The gear segment 239 is mounted on a stud shaft 240.

Fixed to the gear segment 239 is a cam roller 241 in alignment with a cam 242 mounted on the shaft 28. Once in each rotation of the shaft 28, the cam roller 242 will engage with and drive the gear segment 239 through a part of a revolution to rotate the gear 236 and effect the wrapping of the end of the fuse wire around the needle 46. The gear segment 239 is urged to remain in the position shown in Fig. 12 by a contractile spring 243 fixed to the plate 238 so that after oscillation by the cam 242, the gear segment 239 will return to the position shown in Fig. 12. The right end of the gear 236 (Fig. 7), as most clearly shown in Figs. 9, 10 and 11, has a pin 244 fixed in it about which a spring 245 is wound. The spring 245 bears against an irregularly shaped lever 246 pivotally mounted on a bent pin 247. The lever 246 is thus urged to remain in the position shown in Fig. 9 while rotating bodily about the fuse wire 40 when the shaft 235 and gear 236 are rotated. The bent-over pin 247 serves the double purpose of pivotally supporting the lever 246 and acts to effectively bend the fuse wire 40 around the point of the needle 46 when the needle is retracted to draw the fuse wire through the fuse shell 131. As seen most clearly in Figs. 9, 10 and 11, the lever 246, in its inoperative position, is in engagement with an abutment 248 and, upon rotation being imparted to the shaft 235 and gear 236, the lever 246 is carried around with them and the needle 46 having been moved up into a position where its hooked end is beyond the bent end 233 of the fuse wire 40, the lever 246 will carry the bent end 233 of the wire around with it, the pin 247 passing over the bent end 233 of the fuse wire 40 to insure that the fuse wire will be wrapped on the hook portion of the needle 46. When the gear 236 and shaft 235 have been rocked to their ultimate position, as shown in Figs. 10 and 11, the fuse wire will be bent around the needle 46. The gear 236 and shaft 235 will remain in this position for a short time after the needle 46 starts retracting to the left (Fig. 7), thereby to hold the fuse wire in the notch of the needle. As the needle 46 is retracted, the bent-over portion of the bent pin 247 will be engaged by the free end of the fuse wire to bend the fuse wire sharply around the hooked portion of the needle 46. Continued movement of the needle 46 to the right (Figs. 1, 6 and 7) will result in the fuse wire being drawn through the fuse shell 131.

If the needle 46 does not draw the fuse wire 40 through the shell 131 and leaves a loop of wire

bent by the lever 246, a pin 250 on the end of the hollow shaft 235 will, upon the return of the shaft 235 to normal, bend the fuse wire back to the position shown in Fig. 9.

After a length of fuse wire has been drawn through the shell 131, cams 255 mounted on the shaft 28 will, due to the engagement thereof by the cam rollers 256 mounted on the ends of irregularly shaped levers 257, rock the levers 257 about pivot rod 173. The construction of the levers 257 is substantially the same as the construction of the levers 172 and the levers 257 are urged to rock in a counter-clockwise direction by coil springs 258 (Fig. 2). The levers 257 have pivoted in them camming blocks 259 and 260 which are slidable in cam slots 261 and 262 formed in knife actuating slides 263 and 264 carrying upper and lower knives 265 and 266, respectively (Figs. 2 and 3). In Fig. 3, the knives 265 and 266 are shown in their open position and in Fig. 2 they are shown in the closed position after having cut off the fuse wire at both ends of the fuse shell 131. When the knives 265 and 266 are in their open position, the V-shaped notch 267 will permit the passage between the knives of the needle 46 and after the fuse wire has been drawn through a fuse shell 131, the cams 255 will become effective to cut off the fuse wire at both ends of the shell and bend down the bent-over portion 233 of the fuse wire preparatory to hooking it onto the needle the next time the needle is advanced to engage it.

It should be noted that the sizing die 230 is insulatedly mounted on a bracket 268 and, as pointed out hereinbefore, the shaft 235 and gear 236 are also insulated from the remainder of the machine. Therefore, the fuse wire 40 is out of electrical contact with the machine unless the fuse wire is engaged by the hook 46. By reference to Fig. 17, it will be noted that the machine framework and hook 46 are connected to ground and that a circuit will be completed from ground at 275 through the hook 46 and through a switch 276 and the switch 193 to the winding of a relay 277, the other side of the winding of which is connected to grounded battery at 278. The relay 277 controls the flow of current to operate the motors 24 and 25 through a master start switch 279. The motors 24 and 25 are thus supplied with current from a current source 280 upon closure of the switch 279 if the switches 273 and 276 and a cam actuated switch 281 are closed, the cam actuated switch 281 serving to connect ground at 282 through switches 276 and 193 to the winding of the relay 277. The switch 281, as shown in Fig. 1, is mounted upon a bracket 283 secured to the table 26 and carries a cam roller 284 in the path of a cam 285 mounted upon the shaft 28. The cam 285 is arranged to maintain switch 281 closed at all times when the needle 46 is not in electrical conducting connection with the fuse wire 40 and through the fuse wire 40 and switches 276 and 193 to the relay 277. Thus, when the needle 46 should be engaging the fuse wire 40 to maintain the motor circuit through energizing relay 277 and such connection is broken for any reason, for example, by the fuse wire breaking in being drawn through the fuse shell 131, the motors 24 and 25 will be stopped. However, in the interval when the needle 46 is not supposed to be engaging the fuse wire 40, the circuit to the relay 277 will be maintained from ground at 272 through the closed switch 281 and closed switches 276 and 193 to the relay 277. If, for example, the supply of fuse wire 40 is exhausted, the roller 232, which is mounted upon the end of a spring pressed lever 286, will move upwardly and permit the switch 276 to open. Similarly, the circuit from ground at 282 or 275 may be broken upon actuation of switch 193 due to the absence of a fuse shell 131 between the clamping jaws 184 and 185 when the clamping jaws close.

A better understanding of the invention may be had by reference to the following brief description of the operation thereof when considered in conjunction with the timing diagram shown in Fig. 16. If it be assumed that a supply of fuse wire 40 has been mounted upon the supply spool 39 and the end of the wire has been fed between the contact roller 231 and switch actuating roller 232, thence through the guide sleeve 234 and bent over as shown at 233, and if it be further assumed that a supply of fuse shells 131 has been placed in the hopper 130, the apparatus is in condition for operation and the switch 279 may be closed to initiate operation of the apparatus. In the timing diagram (Fig. 16) the cycle of operation is shown as starting with the needle 46 in the position shown in Figs. 1 and 6 and with the end of the wire 40 wrapped around the end of the needle. This cycle has been chosen arbitrarily since the apparatus may be stopped at any time by opening the switch 279. However, starting with the just described conditions, closure of the switch 279 will supply power to the motors 24 and 25. The first revolution of shaft 28 will pull the fuse wire 40 to the right (Figs. 1, 6 and 7) until the hook reaches the position shown in Fig. 7. As the hook 46 moves to the right (Fig. 1), the wire supply spool 39 will also be moved to the right due to the action of cam 32 and lever 35. In this manner, the wire will be pulled through the fuse shell 131. As soon as the wire has been pulled a short distance away from the guide sleeve 234, the cam 242 will become effective to permit spring 243 to rock the gear segment 239 back to the position shown in Fig. 12, thereby carrying the mechanisms which wrap the wire around the end of the needle 46 back to the position in which they are shown in Fig. 9. During the portion of the stroke of the hook 46 to the right, switch 281 will be opened by its cam 285 and if the wire breaks at any time during the stroke of pulling it through the fuse shell, the apparatus will be stopped due to the breaking of the circuit to the relay 277 through the wire 40. Shortly after the needle 46 reaches its right hand position, as shown in Fig. 7, the cam 285 will release switch 281 and permit it to close, thereby to hold the motor circuits energized. Just shortly after the switch 281 closes, the cam 255 will be effective to permit spring 258 to actuate the knives 265 and 266, thus to shear the ends of the wire adjacent the fuse shell 131. As the cam 255 returns the knives 265 and 266 to their normal position, cam 210 will become effective to actuate the carrier slide 200. The springs 213 will push the loaded fuse shell 131, through which a section of fuse wire 40 has been inserted, into the trough 117 and will carry a second fuse shell 131 into position between the clamping members 184 and 185. As soon as a new fuse shell 131 has been placed between the clamping members 184 and 185, the clamping members will close to grip the fuse shell 131 between them and shortly after they have engaged the fuse shell, the carrier slide 200 will be shifted to the position shown in Fig. 2. As the carrier slide

200 moves to the position shown in Fig. 2, the springs 214 will be compressed to permit the retaining springs 213 to pass under the fuse shell 131 held by the clamping members 184 and 185 and after the slide 200 has travelled a short distance, the levers 219 will be actuated by the carrier slide to move out from under the row of fuse shells 131 in the passage 143, thereby to permit a new fuse shell to drop onto the carrier slide. If no fuse shell is fed to the clamping members 184 and 185, switch 193 will be opened by the projection 191 and the operation of the apparatus will be stopped. However, if a fuse shell is properly positioned between the clamping members 184 and 185, the hook 46 may be advanced through the fuse shell 131 held by the clamping members 184 and 185. Just before the hook 46 starts to travel through a fuse shell 131, cam 84 on shaft 20 will cause clutch 53 to engage and start rotation of the hook or needle 46. Simultaneously with the advancement of the hook or needle 46 to the left (Figs. 1, 6, 7 and 8), the supply spool 39 will be cammed away from the sleeve 234 to unwind a new section of fuse wire 40 from the supply spool. As soon as the hook or needle 46 approaches the left end of its stroke (Fig. 1), clutch 53 will be disengaged and latch member 75 will properly position the hook 46 in the position shown in Fig. 11. As soon as the hook 46 has reached its extreme left-hand position (Figs. 1 and 6), cam 242 will become effective to drive the gear 236 counter-clockwise, as viewed in Figs. 9, 10, 11 and 12, to wrap the bent-down end 233 of the fuse wire 40 around the hook portion of the hook or needle and the operation may then be repeated.

What is claimed is:

1. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said shell, means engageable with fuse material and movable in a circular path for causing fuse material to be moved around and hooked by said needle, means for advancing and retracting said needle through the shell, means for rotating the needle during its movement in one direction through the shell, and actuators for operating said several means in timed relation one to another.

2. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said shell, means movable in a circular path about the end of the needle for engaging and moving a strand of fuse material to hook it on said needle, means for advancing and retracting said needle through the shell, means for rotating the needle as it is advanced through the shell to clear the shell, and means operable in a predetermined cyclic order for actuating said several means in timed relation one to another.

3. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said shell, an oscillatable means operable to engage a strand of fuse material and wrap it around the end of the needle for hooking the strand of fuse material on said needle, means for advancing and retracting said needle through the shell, means for rotating the needle during its movement in one direction through the shell, and means for actuating the several means in proper timed relation.

4. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said shell, means movable about an axis eccentric to the axis of the needle to engage a strand of fuse material and wrap it about the needle for hooking a strand of fuse material onto said needle, means for advancing and retracting the needle through the shell, means for cutting and bending the ends of the fuse material drawn through the shell by the needle, and means for actuating the several means in proper timed relation.

5. A fuse assembling machine comprising a rotatable threading needle, means for feeding a supply of fuse element material in strand form to a predetermined position, means movable in an arcuate path to bend the fuse element material around the needle for hooking the end of said material on said threading needle, means for advancing said threading needle to position to receive the end of said material and for retracting said threading needle to thread the material through a shell, means for rotating the threading needle during its advancement, means for operating said several means in proper timed relation including an electric control, and circuit means for said control including said needle in the circuit for interrupting the operation of the said last-mentioned means when the needle fails to advance the strand of fuse element material.

6. A fuse assembling machine comprising a rotatable threading means, means for feeding a supply of fuse element material in strand form to a predetermined position, means at said predetermined position for hooking the end of said material on said threading means, means for resiliently urging said threading means to position to receive the end of said material and for positively retracting said threading means to thread the material through a shell, a common drive means for actuating the several aforementioned means in proper timed relation one to another, and means operable under control of said common drive means for rotating the threading means during its advancement.

7. A fuse assembling machine comprising a rotatable threading means, means for feeding a supply of fuse element material in strand form to a predetermined position, means movable at said predetermined position for engaging the end of said material and wrapping it around said threading means, means for resiliently urging said threading means to position to receive the end of said material and for positively retracting said threading means to thread the material through a shell, and means for operating said several means in proper timed relation.

8. A fuse assembling machine comprising a rotatable threading means, means for feeding a supply of fuse element material in strand form to a predetermined position, means for hooking the end of said material on said threading means, means for resiliently urging said threading means to position to receive the end of said material and for positively retracting said threading means to thread the material through a shell, means operable in timed relation to the before-described means for cutting off and bending the ends of said fuse element, and means for actuating the several means in proper timed relation.

9. A fuse assembling machine comprising a hopper for fuse shells, a clamp for holding a fuse shell during the insertion of a fuse element therein, means for transferring shells from the hopper to the clamp, a rotatable threading means, means for directing a supply of fuse element material in strand form to a predetermined position, means for hooking the end of said material

on said threading means, means for advancing said threading means to position to receive the end of said material and for retracting said threading means to thread the material through a shell, means for rotating the threading means during its advancement, and means for actuating the several means in proper timed relation.

10. In a fuse threading apparatus, means for drawing a fuse wire through a shell, means for positioning a shell to receive said fuse wire, means for supplying fuse wire to a position to be fed through a shell, means for operating said several means in proper timed relation including driving means, a motor circuit for controlling the supply of power to operate said driving means and means controlled by the fuse wire for interrupting said motor circuit.

11. In a fuse threading apparatus, means for drawing a fuse wire through a shell, means for positioning a shell to receive said fuse wire, means for supplying fuse wire to a position to be fed through a shell, means for operating said aforementioned means in proper timed relation including driving means, a motor circuit for controlling the supply of power to operate said driving means, means controlled by the fuse wire for interrupting said motor circuit, and means operable by the fuse shell positioning means for also interrupting said motor circuit if no shell is present in said positioning means.

12. In a fuse threading apparatus, means for feeding a supply of fuse wire to a predetermined point, a fuse threading needle, means for moving said needle to position adjacent said predetermined point, and means for attaching the fuse wire to the needle including a lever movable bodily in a circular path around the needle for engaging the end of the fuse wire and bending it around the needle.

13. In a fuse threading apparatus, means for feeding a supply of fuse wire to a predetermined point, means for bending the free end of said fuse wire at an angle to the direction of feeding thereof, a fuse threading needle, means for moving said needle to position adjacent said predetermined point, and means for attaching the fuse wire to the needle including a lever movable bodily in a circular path concentric with the direction of feeding of the fuse wire around the needle for engaging the bent-over end of the fuse wire and bending it around the needle.

14. In a fuse threading apparatus, means for advancing a fuse threading needle to a predetermined point, means for feeding a fuse wire in a path parallel to the feed of said needle, means for bending said fuse wire at right angles to the path of feed of said needle adjacent said predetermined point, means rotatable about the path of feed of fuse wire for wrapping the end of the fuse wire around the end of the needle including a lever movable in a circular path concentric with the path of feed of the fuse wire and eccentric of the path of feed of the needle to wrap the fuse wire around the end of the needle, and means engaging said lever and positioned in the path of the fuse wire to engage the fuse wire and cooperate with the needle to attach the fuse wire on the needle.

15. In a fuse threading apparatus, means for advancing a fuse threading needle to a predetermined point, means for feeding a fuse wire in a path parallel to the feed of said needle, means for bending said fuse wire at right angles to the path of feed of said needle adjacent said predetermined point, means rotatable about the path of feed of the fuse wire for wrapping the end of the fuse wire around the end of the needle including a lever movable in a circular path concentric with the path of feed of the fuse wire and eccentric of the path of feed of the needle to wrap the fuse wire around the end of the needle, means engaging said lever and positioned in the path of the fuse wire to engage the fuse wire and cooperate with the needle to attach the fuse wire on the needle, and means mounted on said means rotatable about the path of feeding of the fuse wire for straightening the bend put in the fuse wire by the wrapping lever if the fuse wire is not properly attached to the needle.

16. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said fuse shell, automatically operated means for causing fuse material to engage said needle, means for advancing and retracting said needle through the shell, means for rotating the needle during its movement in one direction through the shell including an intermittently driven element connected to the advancing and retracting means, and motor-driven means for actuating said several means in timed relation one to another.

17. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said shell, means engageable with the fuse material and movable for causing the fuse material to engage said needle, a chuck for supporting said needle, a shaft for supporting said chuck, means operable intermittently for reciprocating the shaft, a common drive means for operating said several means in proper timed relation, means operable intermittently for rotating the shaft during its movement in one direction, and drive means for said last-mentioned means rendered operative under control of the common drive means.

18. A fuse threading machine comprising means for holding a fuse shell, a needle insertable through said shell, means for attaching an end of a supply of fuse material to said needle, a splined shaft, means for reciprocating said shaft, a chuck mounted on one end of said shaft for holding said needle, and a gear splined to said shaft for imparting rotation to the shaft during a portion of its reciprocatory motion.

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