June 5, 1962 H. D. MITCHELL, JR., ETAL 3,037,268

APPARATUS FOR APPLYING CAPS TO ARTICLES

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FIG. 1.

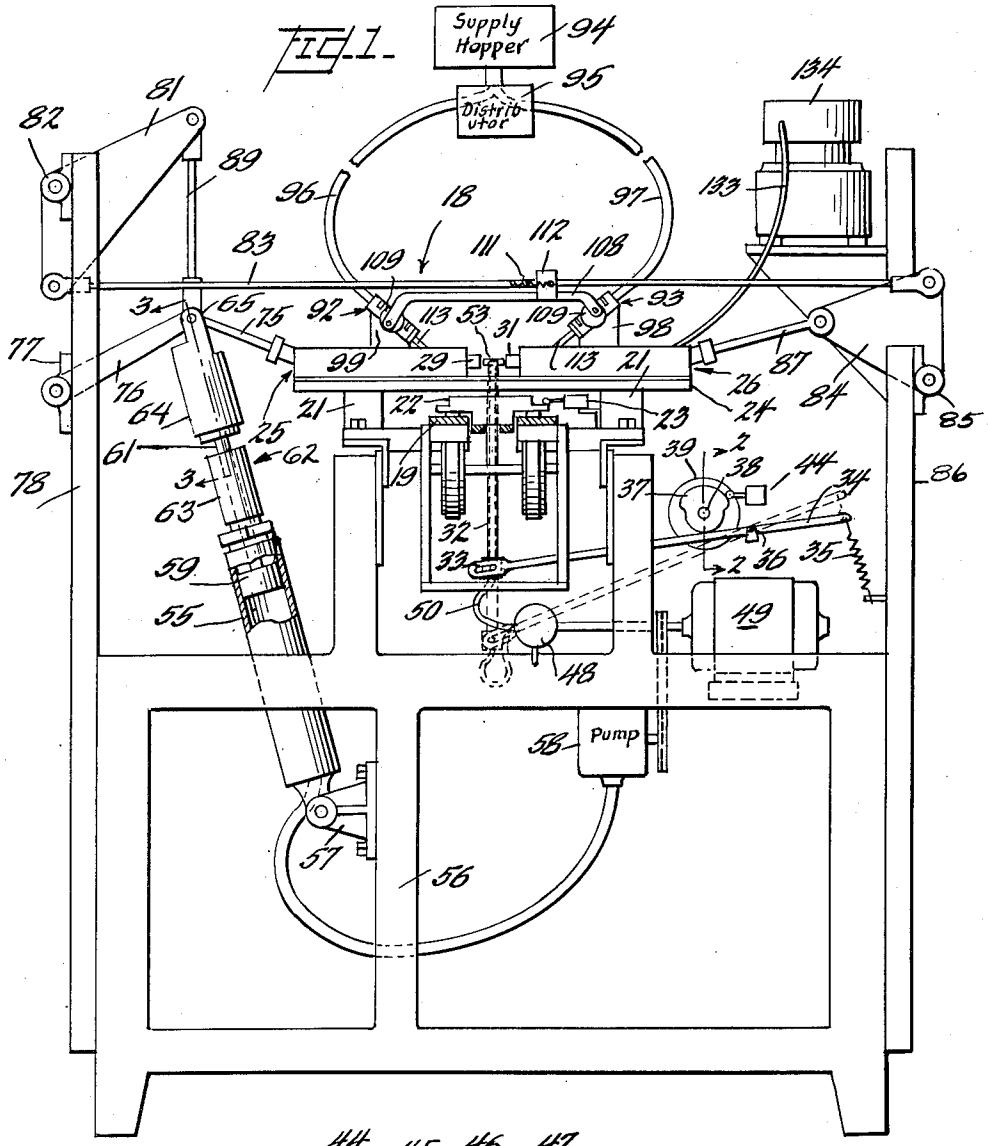
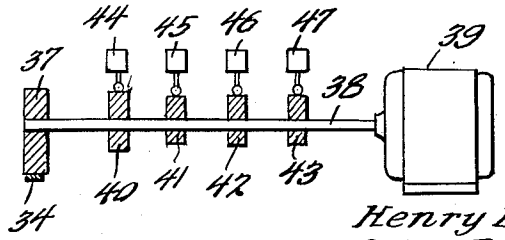



FIG. 2.




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APPARATUS FOR APPLYING CAPS TO ARTICLES

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FIG. 4.

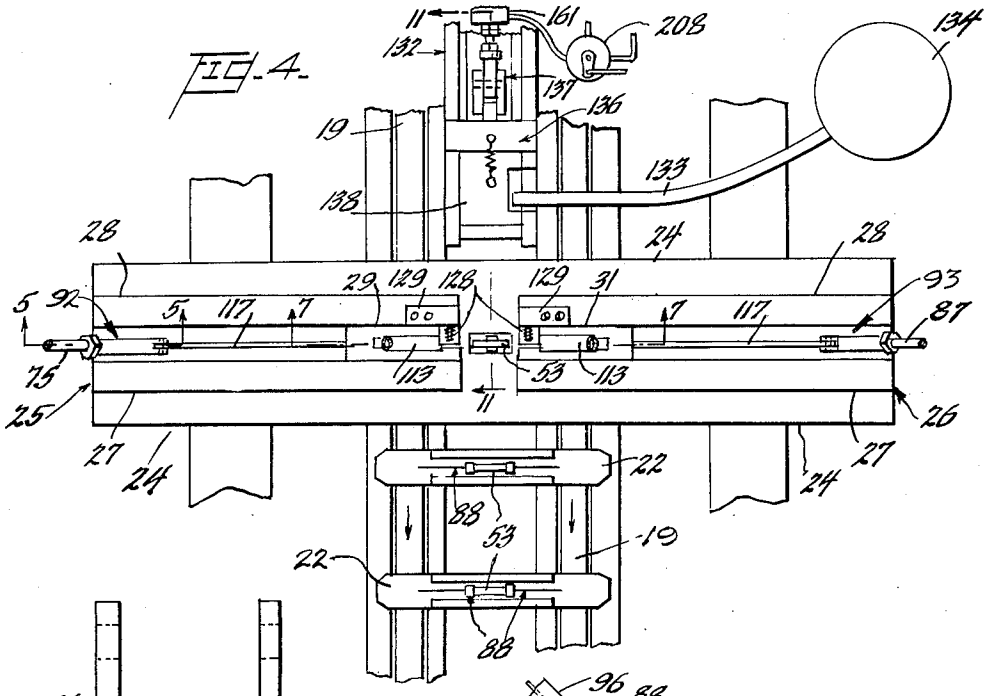



FIG. 3.

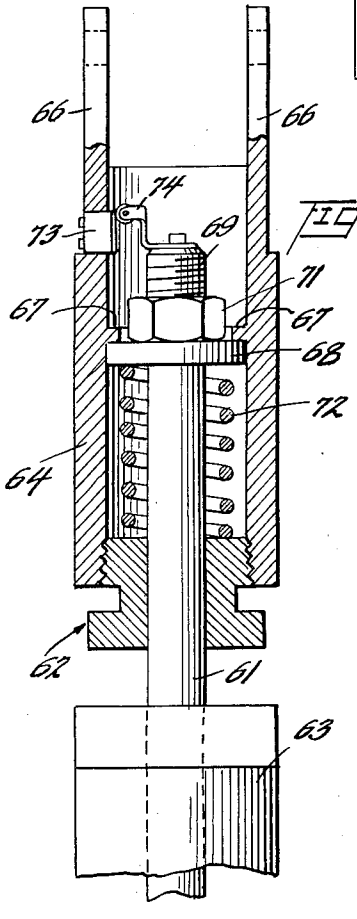



FIG. 5.

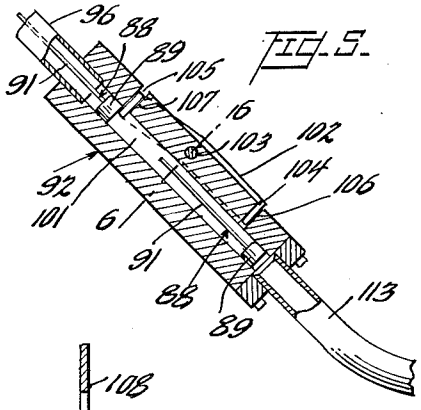
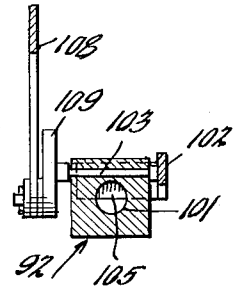



FIG. 6.




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FIG. 7.

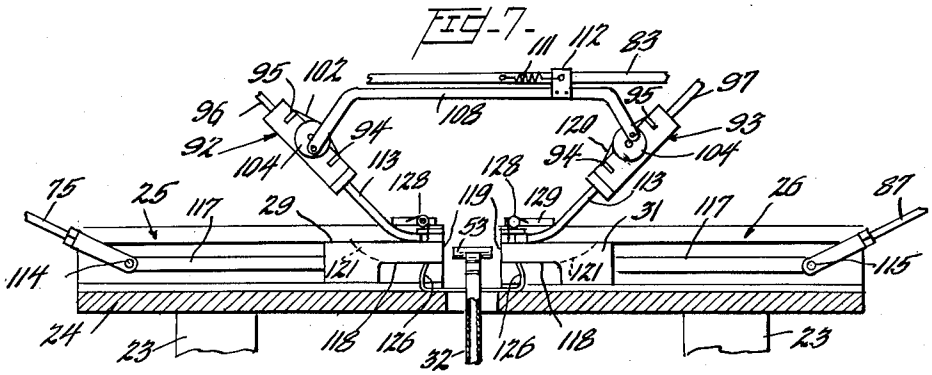



FIG. 8.

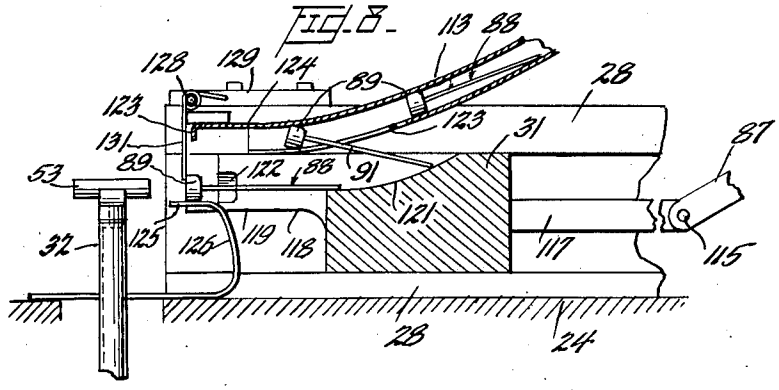



FIG. 9.

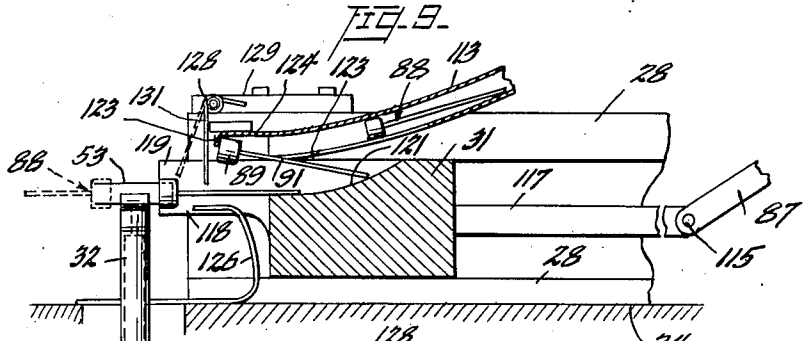
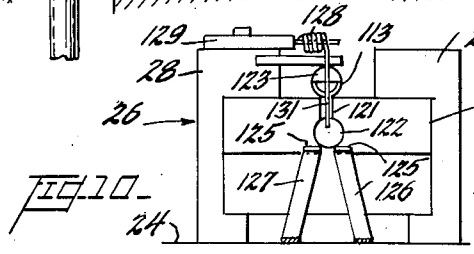



FIG. 10.




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APPARATUS FOR APPLYING CAPS TO ARTICLES

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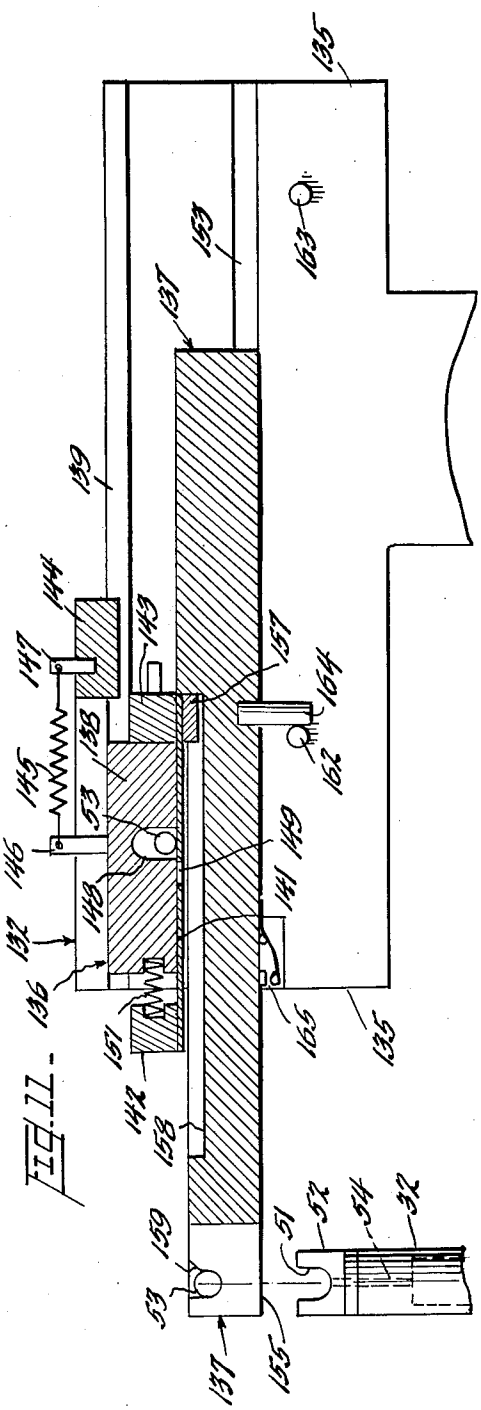


FIG. 11

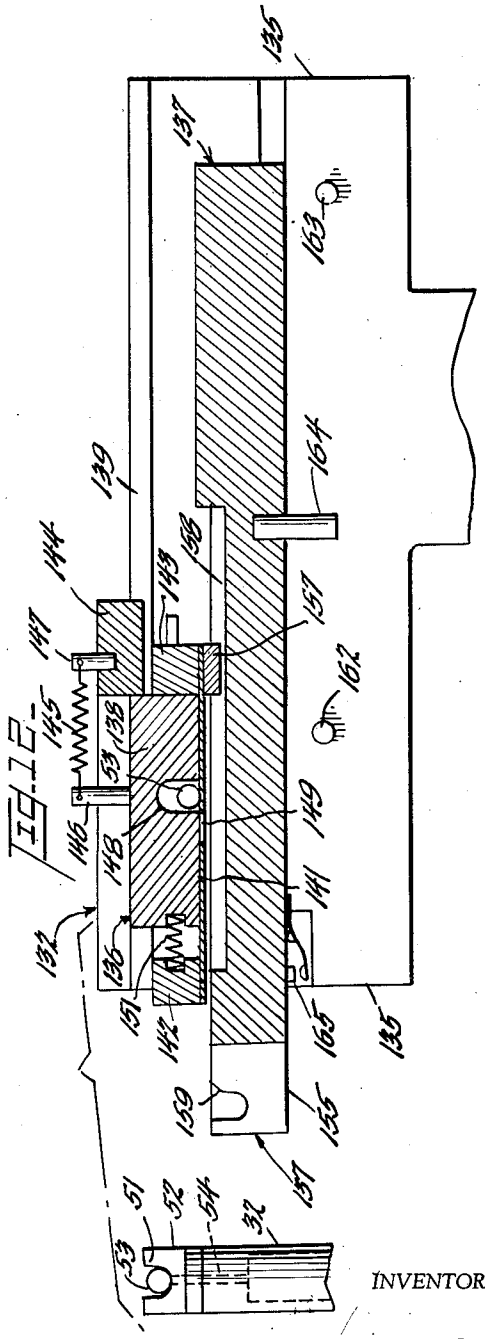


FIG. 12

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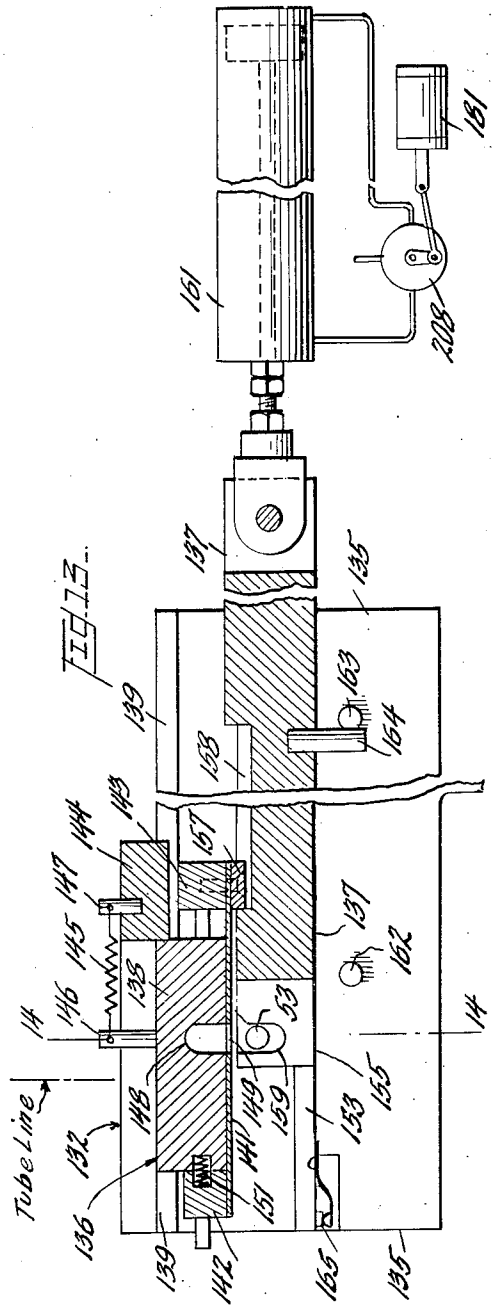
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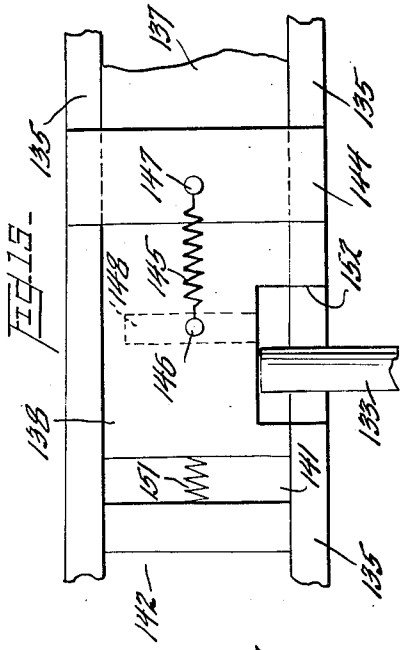
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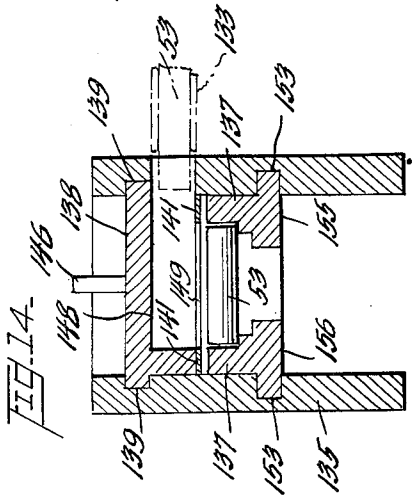
June 5, 1962 H. D. MITCHELL, JR., ETAL 3,037,268

APPARATUS FOR APPLYING CAPS TO ARTICLES

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APPARATUS FOR APPLYING CAPS TO ARTICLES

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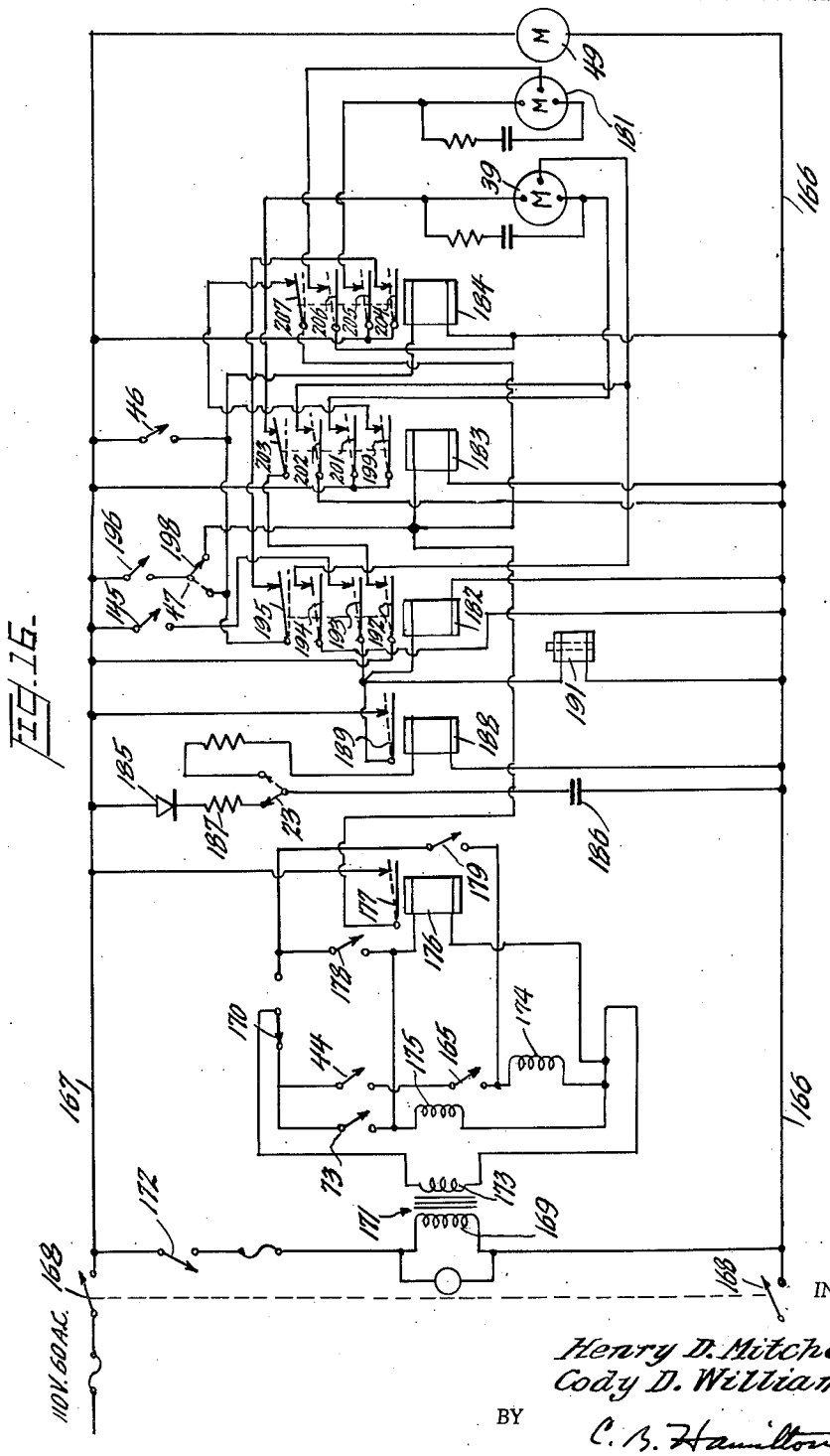



FIG. 16.

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APPARATUS FOR APPLYING CAPS TO ARTICLES

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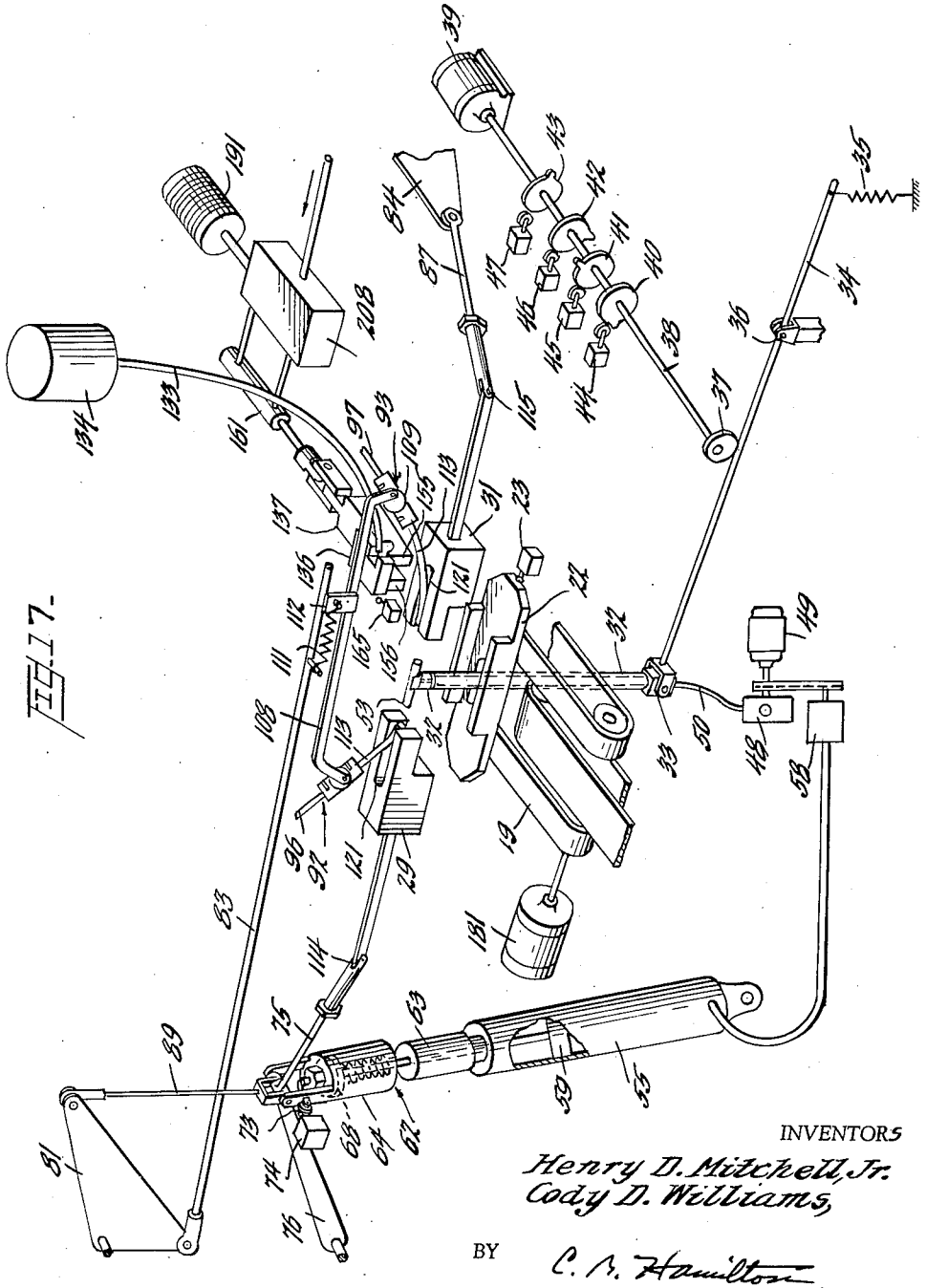


FIG. 17.

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United States Patent Office 3,037,268 Patented June 5, 1962



3,037,268

# APPARATUS FOR APPLYING CAPS TO ARTICLES

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Filed Mar. 18, 1959, Ser. No. 800,209
12 Claims. (Cl. 29—203)

This invention relates to an apparatus for applying caps to articles, and more particularly to an apparatus for automatically applying caps and wire lead assemblies to the ends of electrical components.

In the manufacture of electrical components such as resistors, capacitors, fuses, etc., it is necessary to apply caps or caps and wire lead assemblies to the ends of the article to provide protective closures and coaxial leads. Also, in the manufacture of certain types of resistors, for instance deposited carbon resistors, it is necessary to apply cap and wire lead assemblies to each of the ends of the resistor. The wire leads of the cap and wire lead assemblies form the coaxial terminals of the resistor thus assembled.

It is an object of this invention to provide an improved capping machine.

A further object is to provide a capping machine for simultaneously applying cap and wire lead assemblies to the ends of resistors.

In accordance with the above stated objects, apparatus embodying certain features of this invention includes a core feeding device for transferring components to be capped to a first horizontally disposed position a, vertically reciprocable pushrod for transporting the component from the first position to a second position, chucks disposed adjacent the ends of the component when supported in the second position, an escapement device for feeding caps to the chucks while in a cap-receiving position, and pneumatically actuated linkages connected to the chucks for reciprocating the chucks toward each other whereby the caps supported within the chucks are forced over the ends of the component.

Other features and advantages of the invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a front elevational view of an automatic capping machine of a preferred embodiment of the invention;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a partial plan view of a capping mechanism of the machine of FIG. 1;

FIG. 5 is an enlarged cross-sectional view taken along line 5—5 of FIG. 4 showing an escapement mechanism for feeding caps;

FIG. 6 is a cross-sectional view of the escapement mechanism taken along line 6—6 of FIG. 5;

FIG. 7 is an enlarged cross-sectional view taken along line 7—7 of FIG. 4 showing a pushrod supporting a resistor core between capping chucks;

FIG. 8 is an enlarged view of a capping chuck in a cap receiving position;

FIG. 9 is an enlarged view of a capping chuck in a capping position;

FIG. 10 is an end view of a capping chuck;

FIG. 11 is an enlarged cross-sectional view taken along line 11—11 of FIG. 4 showing a core-feeding device in an advance position;

FIG. 12 is a view silimar to FIG. 11 showing the core feeding device in an intermediate position;



FIG. 13 is a view similar to FIG. 11 showing the core-feeding device in a retracted position;

FIG. 14 is a cross-sectional view of the core-feeding device taken along line 14—14 of FIG. 13;

FIG. 15 is an enlarged partial plan view of the core-feeding device;

FIG. 16 is a diagrammatic view of an electric control circuit for a preferred embodiment of the automatic capping machine; and

FIG. 17 is a pictorial showing of a preferred embodiment of the automatic capping machine.

Referring to FIGS. 1, 4, and 17, a capping machine designated generally as the numeral 18, is mounted over a conveyor 19 on supports 21 disposed on either side of the conveyor 19. The conveyor 19 transports randomly spaced pallets 22 to and from the automatic capping machine and may be driven by any suitable means. A microswitch 23 supported adjacent the conveyor 19 is arranged to be actuated by each pallet 22 to stop the conveyor 19. A base plate 24 extends between and is secured to the supports 21. Slides 25 and 26 are spacedly mounted on the base plate 24 and each comprises a pair of spaced parallel U-shaped channel members 27 and 28 secured to the base plate 24. The U-shaped channel members 27 and 28 face each other to form the hollow rectangular slides 25 and 26. Rectangularly shaped chucks 29 and 31 are slidably mounted within the slides 25 and 26 and are reciprocated therein by pneumatic means from a cap and wire lead assembly receiving position to a capping position.

Referring to FIGS. 1 and 2, a hollow, reciprocable, vertically disposed pushrod 32 is connected to one end 33 of a lever 34 which is spring tensioned at a second end 35 and pivotally secured at a fulcrum point 36. The lever 34 is pivoted about the fulcrum point 36 by a cam 37 affixed to a shaft 38 which is rotated by a motor 39, thus reciprocating the pushrod 32 between an advanced capping position and a retracted position as shown in FIG. 1. Cams 40, 41, 42, and 43, also affixed to the shaft 38, actuate microswitches 44, 45, 46, and 47 adjacent the cams 40, 41, 42, and 43 in a desired sequence.

A vacuum pump 48, driven by a motor 49 and connected to the hollow pushrod 32 by a tube 50, creates a continuous vacuum within the pushrod 32. Referring to FIG. 11, an arcuate notch 51 in the end 52 of the hollow pushrod 32 forms a cradle for receiving a cylindrical article such as a resistor core 53. A narrow passage 54 formed in the base of the arcuate notch 51 opens into the chamber defined by the hollow pushrod 32, creating a vacuum support for the resistor core 53 when the vacuum pump 48 is operating.

Referring to FIGS. 1 and 3, a main air cylinder 55, pivotally mounted on a support 56 in a bracket 57, is operated by an air pump 58 driven by the motor 49. The main air cylinder 55 contains a double-acting piston 59 which is actuated by an electrical control valve, not shown. The main air cylinder 55, complete with an electric control valve, is commercially available and a detailed description need not be given. For instance, a Bellows electrically controlled air motor, pivot mounted, model BPEM-5C, manufactured by the Bellows Company, functions satisfactorily.

A shaft 61 secured to the double-acting piston 59 extends through a pressure-sensitive device 62. The pressure-sensitive device 62 comprises a spacer sleeve 63 rigidly secured to the end of the main air cylinder 55, and a second sleeve 64 slidably affixed to the shaft 61. An end 65 of the sleeve 64 is cut away to form a pair of yoke-like arms 66. An annular shoulder 67 formed in the sleeve 64 acts as a stop restricting upward movement of a head 68 adjustably secured to the end 69 of the shaft 61 by an adjusting nut 71. A compression

spring 72 in the sleeve 64 resists downward movement of the head 68 secured to the shaft 61 in its advance stroke.

A microswitch 73 mounted in the side wall of the second sleeve 64 above the annular shoulder 67 is arranged to reverse the piston 59 within the main air cylinder 55 when actuated by a roller arm 74 secured to the end 69 of the shaft 61.

A link 75 is pivotally connected between the chuck 29 and yoke-like arms 66, while a second link 76 is pivotally connected between the yoke-like arms 66 and a bracket 77 mounted on vertical upright support 78 adjacent the slide 25. A third link 79 is pivotally connected between the yoke-like arms 66 to a bell-crank lever 81 connected to mounting brackets 82 secured to the vertical support 78 at a point above the mounting brackets 77 to which the second link 76 is connected.

A tie rod 83 extends between the bell-crank lever 81 and a second bell-crank lever 84 pivotally connected to mounting brackets 85 secured to vertical supports 86. A link 87 pivotally connected to the bell-crank lever 84 is pivotally connected to the end of the chuck 31 mounted in the slide 26.

Referring to FIG. 5, caps or cap and wire lead assemblies 88, which comprise a cap 89 and a wire terminal 91 extending therefrom, are continuously fed, cap down, to escapement mechanisms 92 and 93 from a supply hopper 94 through a distributor 95 in supply tubes 96 and 97, respectively. The distributor 95 alternately feeds the cap and wire lead assemblies 88 into the tubes 96 and 97 as they are received from the hopper 94. The escapement mechanisms 92 and 93 are supported directly over the chucks 29 and 31 by supports 98 and 99 secured to the slides 25 and 26. The escapement mechanisms 92 and 93 are rectangular in shape and have a circular bore 101 extending therethrough of a diameter sufficient to permit the cap and wire lead assemblies 88 to advance through the escapement mechanisms 92 and 93 when the circular bores 101 are unrestricted. A rocker arm 102 is pivoted at its midpoint to a shaft 103 extending through and perpendicular to each of the escapement mechanisms 92 and 93. The rocker shaft 103 is positioned at approximately the midpoint of and at the top of each of the escapement mechanisms 92 and 93. Blades 104 and 105, formed on the ends of the rocker arms 102 and perpendicular thereto, are received in slots 106 and 107 cut into each of the escapement mechanisms 92 and 93. The slots 106 and 107 are disposed on either side of the rocker shaft 103 and open into the bores 101 so that the bores 101 are restricted by one of the blades 104 or 105 depending upon the position of the rocker arm 102.

A tie bar 108 is eccentrically connected to a point on the outer periphery of a circular plate 109 secured to the rocker shaft 103 of each of the escapement mechanisms 92 and 93. The tie bar 108 is substantially parallel with and adjacent to the tie rod 83 connecting the bell-crank levers 81 and 84. A tension spring 111 secured to a plate 112 affixed to the tie bar 108 is connected to the tie rod 83 so that horizontal movement of the tie rod 83 results in horizontal movement of the tie bar 108 and rotates the rocker shafts 103 which rock the rocker arms 102. The rocker arms 102 of each of the escapement mechanisms 92 and 93 are arranged to rock when the tie bar 108 moves to the left so that the blades 105 restrict the bore of each of the escapement mechanisms 92 and 93 simultaneously. This permits the whole line of cap and wire lead assemblies 88 in the storage tubes 96 and 97 to advance to the blades 104 in the slots 106. Movement of the tie bar 108 to the right rocks the rocker arms 102 so that the corresponding blades 104 are withdrawn from the slots 106 and the corresponding blades 105 are lowered into the slots 107 of the escapement mechanisms 92 and 93. This action permits one cap and wire lead assembly 88 in each of the escapement mechanisms 92 and 93 to slide down an exit tube 113 connected thereto. It can be seen that the blades 104 and 105 permit only one cap and wire lead assembly 88 at a time to be fed to each of the exit tubes 113, which transport them to a point directly above the chucks 29 and 31 mounted in the slides 25 and 26. Referring to FIG. 7, the chucks 29 and 31 are identical and the detailed description of only the chuck 31 will be given. The chucks 29 and 31 are reciprocated within the slides 25 and 26 by the toggle links 75 and 87 operating through toggle joints 114 and 115 and chuck connecting linkages 116 and 117. As shown in FIGS. 8, 9, and 10, an end 118 of the rectangularly shaped chuck 31 is bevelled, forming a finger projection 119. A groove 121, having a widened opening, is cut into the top surface of the chuck 31. The groove 121 bifurcates the finger projection 119 and extends into the body of the rectangular chuck 31. The overall length of the groove 121 is somewhat longer than the length of the cap and wire lead assemblies 88 to be received. A circular counterbore 122 formed in the end 118 of and at the base of the bifurcated finger projection 119 opens into the groove 121. The counterbore 122 is of sufficient size and depth to receive the caps 89 of the cap and wire lead assemblies 88. The exit tube 113 extends above the chuck 31 when it is in a withdrawn, cap and wire lead assembly receiving position. A slit 123, wide enough to pass the wire terminal 91 of a cap and wire lead assembly 88, but too narrow to pass the cap 89, is formed in the ends of the exit tubes 113. This permits the cap 89 to slide beyond the end of the exit tube 113 while the wire terminal 91 drops into the groove 121 formed in the chuck 31. A down-turned lip 123 formed on an overhanging portion 124 of the exit tube 113 deflects the cap 89 downward where it is supported between turned ends 125 of two flat springs 126 andf 127 fastened to the base plate 28 between the slides 29 and 31. A coil spring 128, formed of music wire, for example, is secured to a plate 129 which is affixed to and adjacent the end of the U-shaped channel 28.

A tang 131 of the coil spring 128 depends in front of the down-turned lip 123 of the exit tube 113 and of the chuck 31 in its retracted cap and wire assembly receiving position and prevents the cap and wire lead assembly 88 from escaping as it slides out of the exit tube 113. This assures that the cap 89 and the wire terminal 91 are positioned properly with respect to the chuck 31. The arrangement of the exit tube 113, flat wire springs 126 and 127, and the coil spring 128 with each of the chucks 29 and 31 is identical.

*Operation of Chucks*

Forward motion of the chucks 29 and 31 toward each other within the slides 25 and 26 from the cap and wire lead assembly-receiving position permits the tangs 131 of the coil springs 128 associated with each of the chucks 29 and 31 to wipe the caps 89 of the cap and wire lead assembly 88 back into the counterbore 122 in the end of the finger projections 119. This forces the wire terminal 91 into the groove 121 and seats the cap and wire lead assemblies 88 in the chucks 29 and 31. At this time the chucks 29 and 31 ride over the turned edges 125 of the flat springs 126 and 127. Continued forward motion of the chucks 29 and 31 toward each other causes the tangs 131 of the coil springs 128 to ride over and behind the caps 89 of the cap and wire lead assemblies 88. If for any reason a cap and lead assembly 88 should remain in one of the chucks 29 and 31 on their return stroke, the tangs 131 of the coil springs 128 will strip it from the grooves 121.

Referring to FIGS. 1, 11, 12, 13, 14, and 15, resistor cores 53 or other objects of like configuration are fed to a resistor core feeding device 132 in a supply tube 133 from a supply hopper 134. The core feeding device 132 is supported between the slides 25 and 26 on a

frame 135 secured to the base plate 24 and comprises a top slide 136 and a bottom slide 137.

The top slide 136 comprises a notched rectangular block 138 slidably disposed within top slideways 139 formed in the frame 135 on a thin metal base plate 141 extending between and secured to spaced arms 142 and 143. A top slide stop 144 limits movement of the rectangular block 138 within the ways 139 formed in the frame 135. A tension spring 145 is secured between pins 146 and 147 extending from the rectangular block 138 and the top slide stop 144 respectively. The resistor cores 53 are received in a groove 148 formed in the base of the rectangular block 138 when the mouth of the rigidly fixed supply tube 139 and the arcuate groove 148 are in alignment. A rectangular notch 152 formed in the side of the rectangular block 138, FIG. 15, receives the end of the tube 133, permitting the block to slide laterally with respect to the rigid tube 133 moving the groove 148 of the block 138 in and out of alignment with the mouth of the tube 133. An aperture 149, slightly larger than a resistor core 53, is formed in the thin metal base plate 141. When the rectangular block 138 is in a core loading position, the arcuate groove 148 and the aperture 149 are out of alignment. A compression spring 151 forces the rectangular block 138 into engagement with the arm 143 when the top slide 136 is in a core receiving position.

The bottom slide 137 is a rectangular member notched in one end to form parallel rectangular guide arms 155 and 156. A runner 157 depends from the arm 143 into a slideway 158 formed in the top face of the bottom slide 137. Corresponding arcuate notches 159 are formed in the ends of the guide arms 155 and 156 of a sufficient size to receive and support a resistor core 53. A double acting air cylinder 161 mounted adjacent the core feed device 132 is connected to and reciprocates the bottom slide 137 in the ways 153 in the frame 135 between a retracted and an advanced position with respect to the top slide 136. The double acting air cylinder 161 is connected to an air source, not shown, through a four-way air control valve 208 mounted adjacent thereto. Operation of the air control valve 208 is controlled by energization of a solenoid 191. The advanced and retracted positions are determined by the runner 157 riding in the slideway 158 formed in the bottom slide 137. Fixed stops 162 and 163 formed on the frame 135 co-operate with a stop pin 164 depending from the bottom slide 137 to limit its movement. A microswitch 165, positioned adjacent the core feed device 132 and on the frame 135, is pulsed each time the bottom slide 137 is withdrawn from the advance position.

*Operation of Core Feeding Device*

A resistor core 53 slides into the top slide 136 when the bottom slide 137 is in the advance position. The compression spring 151 urges the rectangular block 138 into engagement with the arm 143. In this position the arcuate groove 148 and the aperture 149 in the metal base plate 141 are out of alignment. When the air cylinder 161 is actuated, the bottom slide 137 moves toward its retracted position pulsing the microswitch 165. The top slide 136 moves with the bottom slide 137 by reason of the tension spring 145 connected thereto. Movement of the rectangular block 138 strips a resistor core 53 from the supply tube 133, the notch 152 permitting the rectangular block 138 to move with respect to the rigid supply tube 133. When the bottom slide 137 approaches its retracted position, the runner 157 reaches the end of the slideway 158 and further movement of the rectangular block 138 is restricted by the top slide stop 144. The bottom slide 137 will continue to move until the stop pin 164 engages the rear stop 163, forcing the arms 143 and 142 and the metal base plate 141 forward with respect to the stationary rectangular block 138 until the aperture 149 and the arcuate groove 148 are in alignment. At this time the resistor core 53 will fall into the arcuate notches 159 formed in the ends of the spaced arms 155 and 156. When the air cylinder 161 is reversed the bottom slide 137 containing the resistor core 53 moves to its advance position while the top slide 136 returns to the core receiving position where it again comes into alignment with the supply tube 133 and receives another resistor core 53 within the arcuate groove 148. The compression spring 151 urges the rectangular block into engagement with the guide arm 143 and the aperture 149 out of alignment with the groove 148.

Referring to FIG. 17, a pair of main leads 166 and 167 are shown connected to a 110 v. A.C. voltage source through a main switch 168. A primary winding 169 of a transformer 171 is connected through a switch 172 across the 110 v. A.C. voltage source while a secondary winding 173 of the transformer 171 is arranged to energize a capping circuit when the switches 168 and 172 are closed.

The capping circuit comprises an advance coil 174 and a retract coil 175 connected in series with the secondary winding 173 by the proper positioning of a switch 170, the pressure sensitive switch 73, the cam-actuated switch 44, and the bottom slide-actuated switch 165. The advance coil 174 is placed in series with the secondary winding 173 and energized when the double-pole double-throw switch 170 is thrown to the position designated "Auto," the single-pole single-throw microswitch 73 is open and both of the single-pole single-throw microswitches 44 and 165 are closed. Upon opening the microswitches 44 and 165 and closing microswitch 73, the retract coil 175 will be connected in series with and energized by the secondary winding 173. A relay 176 connected in parallel with the retract coil 175 is energized and closes normally open contacts 177.

When the switch 170 is thrown to the position designated "Manual," either the advance coil 174 or the retract coil 175 and the relay 176 may be energized by the secondary winding 173, depending upon the position of a pair of single-pole single-throw push button switches 178 and 179 connected in series with the switch 170.

By closing the push button switch 179 and opening the push button switch 178, the advance coil 174 will be energized, while reversing the switches 179 and 178 from the aforesaid positions energizes the retract coil 175 and the relay 176.

The remainder of the automatic capping machine control circuit comprises a conveyor motor 181, shown in FIGS. 16 and 17, the push rod motor 39, and the vacuum pump motor 49 connected in parallel across the leads 166 and 167. Operation of the motors 39 and 181 is controlled by a string of relays 182, 183, and 184 connected in parallel across the leads 166 and 167, while the motor 49, connected directly across the leads 166 and 167, is operated by closing the switch 168.

A rectifier 185 connected across the leads 166 and 167 charges a capacitor 186 through a charging resistor 187 and the pallet-actuated double-pole double-throw microswitch 23 connected in series therewith. Actuation of the switch 23 disconnects the capacitor 186 from the rectifier 185 and permits it to discharge through a relay 188 and close normally open contacts 189. Closure of the contacts 189 energizes a solenoid 191 and the relay 182 connected across the leads 166 and 167. Energization of the relay 182 closes normally open contacts 192, 193, and 194 and opens a normally closed contact 195. Closure of the contacts 192 and 194 places the push rod motor 39 across the leads 166 and 167, while closure of the contact 193 completes a hold circuit for the relay 182 between the leads 166 and 167 through the cam-actuated switch 45. Opening of the contact 195 breaks a hold circuit on the relay 184.

The relays 183 and 184 are connected across the leads 166 and 167 through a single-pole single-throw reset switch 196 and a double-pole double-throw cam-actuated moni-

tor switch 47. When the reset switch 196 is closed and a contact arm 198 of the cam-actuated monitor switch 47 is positioned as shown in FIG. 16, the relay 183 is energized. The relay 184 is energized when the contact arm 198 is thrown to the dotted position. Energization of the relay 183 closes normally open contacts 199, 201 and 202 and opens a normally closed contact 203, and actuation of the relay 184 closes normally open contacts 204, 205, and 206 and opens a normally closed contact 207.

Closure of the contacts 201 and 202 connects the push rod motor 39 across the leads 166 and 167 while closure of the contacts 205 and 206 places the conveyor motor 181 across the leads 166 and 167. Closure of the contact 204 completes a hold circuit for the relay 184 through the contact 203, which is controlled by the relay 183. Operation of the cam-actuated microswitch 46 also energizes the relay 184 to start the conveyor motor 181. It is to be noted that closure of the contact 177 by energization of the relay 176 energizes the relay 183 to start the push rod motor 39. Actuation of the switch 46, connected in series with the relay 183, by the cam 43 opens a hold circuit on the relay 183 through contacts 195, 207, and 199 to stop the motor 39 and energize the relay 184 to close the contacts 205 and 206 which starts the conveyor motor 181.

*Operation of the Automatic Capping Machine*

The operation of the invention is described in conjunction with FIGS. 1, 2, 16, and 17. Assume it is desired to automatically apply caps or cap and wire lead assemblies 88 to the ends of resistor cores 53 as they advance through a production line or as they are fed from a continuous source of supply 134. The resistor cores 53 are fed by means of gravity through the supply tube 133 to the core feeding device 132. At this time the top slide 136 is in a position to permit one resistor core 53 to slide into the arcuate groove 148 and the bottom slide 137 is in an extended advance position supporting a resistor core 53 in the corresponding notches 159 formed in the ends of the guide arms 155 and 156.

The cap and wire lead assemblies 88 to be applied to the resistor core 53 are fed through two supply tubes 96 and 97 from the supply hopper 94 to the escapement mechanisms 92 and 93 where they are fed one at a time to the chucks 29 and 31, respectively, through the exit tubes 113. Initially, the rocker arms 92 are turned so that the blades 94 are received in the slots 96 and the bores 101 of the escapement mechanisms 92 and 93 are restricted. The cap and wire lead assemblies 88 are contained in the supply tubes 96 and 97. The chucks 29 and 31 are in the cap and wire lead assembly receiving position and each supports an assembly 88.

Assuming the power is off and the push rod 32 is retracted, a work cycle of the capping machine is commenced by closing switches 168, 172, and the reset switch 196 connecting the 110 v. A.C. power source to conductors 166 and 167. Operation of the main switch 168 starts the vacuum pump motor 49 connected directly across the conductors 166 and 167 creating a continuous vacuum within the retracted push rod 32 while actuation of the switch 172 energizes the transformer 171. The switch 170 is turned to the automatic capping position. Operation of the switch 196 energizes the relay 184 through the switch 197 when the contact arm 198 is thrown to the dotted positions in FIG. 16. Energization of the relay 184 closes contacts 205 and 206, starting the conveyor motor 181 and the conveyor 19 which carries a plurality of randomly spaced pallets 22.

When the first pallet 22 trips the microswitch 23 mounted above the conveyor 19, the capacitor 186 is allowed to discharge and energize the relay 188 which closes the contacts 189 to energize the relay 182, closing contacts 192, 193, and 194 and opening contacts 195. The relay 188 drops out upon the discharge of the capacitor 186 but the relay 182 remains energized by reason of a hold circuit through the now closed contact 193 and the cam-actuated switch 45. Opening of the contact 195 breaks a hold circuit on the relay 184 to stop the conveyor motor 181 and position the pallet 22 directly over the pushrod 32. Closure of the contacts 192 and 194 starts the pushrod motor 39 and drives the cam shaft 38 and cam 37 in a counterclockwise direction. The pushrod 32 is driven upwardly through the pallet 22.

Actuation of the relay 188 and closure of the contacts 193 energizes the solenoid 191 which operates the four-way air control valve 208, connecting an air source, not shown, to the double-acting air cylinder 161. When the air cylinder 161 is actuated, the bottom slide 137, carrying a resistor core 53, is moved to the advance position. The push rod 32 continues its upward stroke and strips the resistor core 53 from the corresponding notches 159 in the guide arms 155 and 156 and transports it to the capping position between and adjacent the chucks 29 and 31 at which time the cam 41 on the cam shaft 38 trips the switch 44 and the cam 42 opens the switch 45.

Operation of the switch 45 opens the hold circuit on the relay 182 to open the contacts 193 and stop the pushrod motor 39. The solenoid 191, when the switch 45 is opened, is also de-energized to operate the four-way air valve 208 and reverse the double-acting air cylinder 161. This action returns the bottom slide 137 to its retracted position at which time the top slide 136 drops another resistor core 53 into the corresponding arcuate notches 159 in the guide arms 155 and 156 in preparation for a next cycle of operation. The switch 165, mounted adjacent the core feed device 132, is pulsed when the bottom slide 137 is retracted. Closing of the switch 44 and the pulsing of the switch 165 operates the main air cylinder 55.

As previously stated, the main air cylinder 55 contains the double-acting piston 59 which is controlled by momentarily energizing an advance or retract coil of a conventional electric air-control valve. For convenience the advance and retract coils of the electric control valve for the main air cylinder 55 are shown in FIG. 16 as advance and retract coils 174 and 175, respectively. Thus, pulsing of the switch 165 with the switch 170 in the "Auto" position momentarily energizes the advance coil 174 to actuate the double-acting piston 59 within the main air cylinder 55. It is to be noted that since the switches 44 and 165 are in series, the advance coil 174 can be energized only when both switches are closed. The cam 41 is arranged to close the switch 44 only when the pushrod 32 is in the capping position.

When the double-acting piston 59 moves downwardly on its advance stroke, the shaft 61 moves with it within the pressure-sensitive device 62. The compression spring 72 resists downward movement of the shaft 61, preventing relative movement between the sleeve 64 and the shaft 61. The sleeve 64 moves downwardly with the shaft 61 and the chucks 29 and 31 are moved toward each other within the slides 25 and 26 by reason of the toggle action of links 75, 76, and 79, the tie rod 83 connecting the bell crank levers 81 and 84 and the link 87. When the chucks 29 and 31 are moved toward each other the cap and wire lead assemblies 88 are forced into the grooves 121. Continued movement of the chucks 29 and 31 forces the caps 89 of the cap and wire lead assemblies 88 over the ends of the resistor core 53 supported in the vacuum cradle on the end of the push rod 32.

As the chucks 29 and 31 continue to move toward each other they engage the resistor core 53 supported on the pushrod 22, preventing the sleeve 64 from engaging the spacer sleeve 63. Forward motion of the chucks will continue until they meet a resistance to further movement which exceeds the resistance met by the shaft 61 against the compression spring. At that time the chucks 29 and 31 will stop. The shaft 61 will continue its downward stroke and move relative to the sleeve 64. It is to be noted that when there is no resistor core 53 on the pushrod 32, the sleeve 64 will engage the spacer sleeve 63 preventing

further movement of the chucks 29 and 31 and crushing of the pushrod 32. The capping pressure and the downward pressure on the head 69 on the shaft 61 within the pressure-sensitive device 62 increase until the caps 89 bottom on the ends of the resistor core 53 and further movement of the chucks 29 and 31 is prevented. When this occurs, the piston 59 and the shaft 61 continue to move downwardly because of the continuing air pressure and the compression spring 72 retracts permitting the roller arm 74 affixed to the end 69 of the shaft 61 to actuate the microswitch 73 mounted in the pressure-sensitive device 62 as shown in FIG. 3. Operation of the switch 73 energizes the retract coil 175 which reverses the double-acting piston 59 and the shaft 61, and withdraws the chucks 29 and 31 from the capping position to the cap and wire lead receiving position where they receive the assemblies 88 from the escapement mechanisms 92 and 93 in preparation for the next capping operation. The escapement mechanisms 92 and 93 are operated by reason of the horizontal back and forth motion of the tie bar 108 attached to the tie rod 83 which reciprocates the chucks 29 and 31.

A capping pressure sufficient to perform the desired capping operation is used and the microswitch 73 is arranged to reverse the main air cylinder 55 accordingly. The capping pressure may be varied as desired by the proper selection of the size of the compression spring 72 and adjusting the nut 71 on the threaded end 69 of the shaft 61. The stroke of the chucks 29 and 31 is determined by the spacing between the spacer sleeve 63 and the sleeve 64.

Actuation of the switch 73 by the roller arm 74 also energizes the relay 176 connected in parallel with the release coil 175. Operation of the relay 176 closes the contacts 177 and actuates the relay 183 which operates the motor 39 to drive the cam shaft 38 and the cam 37 in a clockwise direction. This retracts the push rod 32 from the capping position and deposits the capped resistor core 53 in the first pallet 22. A sufficient dwell time on the cam 37 allows the chucks 29 and 31 to be withdrawn before the pushrod 32 is retracted. As the pushrod 32 continues to the bottom of its stroke, the cam 43 momentarily closes the switch 46 to actuate the relay 184 which closes the contacts 205 and 206 and starts the conveyor motor 181. Contacts 204 are closed to complete a hold circuit for the relay 184 through normally closed contacts 195 controlled by the relay 182, while normally closed contacts 207 open to break a hold circuit through the normally open contacts 199 controlled by the relay 183 to stop the motor 39. The conveyor motor 181 will continue to operate until the second pallet 22 actuates the microswitch 23 to repeat the automaic capping cycle.

The pushrod 32 can be withdrawn at any time during a capping cycle by tripping the reset switch 196 which actuates the relay 183 to operate the motor 39 and bring the pushrod 32 down. The switch 47, operated by the cam 40 mounted on the cam shaft 38, is provided to monitor the reset switch 196 so that when the pushrod 32 is fully down and the switch 196 is closed, the contact arm 198 of the cam-actuated switch 47 is as shown in dotted lines in FIG. 16, and a circuit for the conveyor motor 181 is completed through the contacts 205 and 206 of the relay 184. When the pushrod is not fully down the contact arm 198 of the cam-actuated switch 47 is to the right as shown in FIG. 16, and a circuit for the pushrod motor 39 is completed through the contacts 201 and 202 of relay 183 and the pushrod 32 is retracted. It is to be noted that the switch 196 must be closed in order to start either of the motors 39 or 181 when the main switch 168 is operated.

As shown in FIG. 16, other features of the electrical control circuitry include the manual switches 178 and 179 for operating the chucks 29 and 31. Actuation of the push button switch 179 will energize the advance coil 174 and cause the chucks 29 and 31 to advance, while actuation of the push button switch 178 will energize the retract coil 175 to withdraw the chucks 29 and 31.

The time cycle for each capping operation can be varied by properly spacing the pallets 22 on the conveyor 19 and by adjusting the speed of operation of the main air cylinder 55.

It is to be understood that the above-described arrangement is simply illustrative of the application of the broad principles of the invention. Numerous other arrangements may be devised readily by those skilled in the art, which will embody the principles of the invention.

What is claimed is:

1. An article feeding device which comprises; a top slide including a pair of spaced arms slidably mounted in a frame, a base plate connected to and extending between the spaced arms, said base plate having an aperture therein, a grooved rectangular block slidably mounted between said arms and on said base plate, the groove in the rectangular block and the aperture in the base plate being out of alignment when the rectangular block is in an article receiving position and in alignment when the rectangular block is in an article feeding position; a bottom slide slidably mounted in the frame for receiving the article when the rectangular block is in an article feeding position and the bottom slide is in an article receiving position; means for feeding the article into the groove when the rectangular block is in an article receiving position; pneumatic means for reciprocating the bottom slide between the article receiving and unloading positions, means for returning the rectangular block to its article receiving position during the forward stroke of the bottom slide, means for moving the top slide with the bottom slide during a first portion of the return stroke of the bottom slide thereby stripping another article from the article supply means, and means for sliding the base plate with respect to the rectangular block whereby the article in the groove in the rectangular block falls through the aperture in the base plate into the bottom slide when the bottom slide reaches the article receiving position.

2. An article feeding device which comprises a pair of spaced arms slidably mounted in a frame, a base plate connected to and extending between the spaced arms, said base plate having an aperture therein, a grooved rectangular block slidably mounted between said arms and on said base plate, the groove in the rectangular block and the aperture in the base plate being out of alignment when the block is in a first position and in alignment when the rectangular block is in a second position, a bottom slide mounted in the frame for receiving the article from the top slide when the rectangular block is in the second position and the bottom slide is in an article receiving position, means for feeding an article into the groove when the rectangular block is in the first position, pneumatic means for reciprocating the bottom slide between the article receiving position and an extended position, means for returning the rectangular block to the first position during hte forward stroke of the bottom slide, means for moving the rectangular block with the bottom slide during a first portion of the return stroke of the bottom slide, and means for sliding the base plate with respect to the rectangular block during the remaining portion of the return stroke of the bottom slide whereby the article in the groove in the rectangular block falls through the aperture in the base plate into the bottom slide when the bottom slide reaches the article receiving position.

3. An automatic capping machine for applying cap and wire lead assemblies to the ends of resistor cores which comprises reciprocable means for feeding the resistor cores to a core-loading position, reciprocable means passing through the core-loading position for receiving and transporting the resistor core from the loading position to a capping position on the upward stroke of the reciprocal means and for transporting the capped resistor cores to an unloading position on the downward stroke of the reciprocable means, cap holding means disposed on either side of the capping position for receiving

and supporting cap and wire lead assemblies, means for feeding cap and wire lead assemblies in unison to each of the holding means in a cap and wire lead assembly receiving position, means actuated by the reciprocable means during a first portion of the upward stroke of the reciprocable means for actuating the resistor core feeding means to position a core to be capped in the core-loading position before the reciprocable means passes through the core-loading position, pneumatic means actuated by the reciprocable means upon transporting the core to the capping position for moving the cap holding means to the capping position whereby the caps of the cap and wire lead assemblies are simultaneously forced on the ends of the resistor core, and means actuated by the holding means upon forcing the caps on the core for returning the holding means to the cap and wire lead assembly receiving position and for retracting the reciprocable means whereby the capped resistor core is transported to the unloading position.

4. An automatic capping machine for applying cap and wire lead assemblies to the ends of resistor cores which comprises means for feeding the resistor cores to a loading position, a reciprocable pushrod for stripping the resistor cores from the loading position and for transporting the resistor cores to a capping position on an upward stroke of the pushrod and for transporting capped resistor cores from the capping position to an unloading position on the downward stroke of the pushrod, slotted chucks disposed on either side of the capping position for holding cap and wire lead assemblies, the cap and wire lead assemblies being slidably supported within the slots in the chucks, a cap and wire lead assembly feed chute above each chuck, escapement means for feeding cap and wire lead assemblies in unison into each of the slots in the chucks when in a cap and wire lead receiving position, means actuated by the pushrod in a first portion of its upward stroke for actuating the resistor core feeding means to position a core to be capped in the loading position, means actuated by the pushrod upon stripping the core from the loading position and transporting the core to the capping position for advancing the horizontally disposed chucks to the capping position whereby the caps of the cap and wire lead assemblies are simultaneously forced on the ends of the resistor core, means actuated by the horizontally reciprocating chucks upon forcing the caps on the core under a predetermined amount of pressure for returning the chucks to the cap and wire lead assembly receiving position, and means actuated by the chucks upon a partial withdrawal of the chucks from the capping position for withdrawing the pushrod from the capping position and transporting the capped resistor core to an unloading position.

5. A capping machine for forcing caps onto the ends of cylindrical articles which comprises article feeding means for transporting a succession of articles to be capped to a capping position and for transporting capped articles to an unloading position, a pair of reciprocable chucks for holding and forcing caps on the ends of the article while in the capping position mounted adjacent the capping position, linkages connected to each of the chucks, a tie rod interconnecting the linkages, pneumatic means connected to the linkages and responsive to the article feeding means for reciprocating the tie rod whereby the chucks are reciprocated between a cap-receiving position and a capping position to force caps held by the chucks onto the ends of the articles on a forward stroke of the rod and returned to the cap-receiving position on a return stroke of the tie rod, electrical means for reversing the pneumatic means to reverse the stroke of the tie rod and to withdraw the chucks to the cap-receiving position when the chucks meet a predetermined resistance opposing further movement toward each other, and means connected to the tie rod for simultaneously feeding a cap to each of the chucks upon the completion of the return stroke of the tie rod and the chucks are in the cap-receiving position.

6. In an article assembling apparatus, means for supporting a first article, an assembling device mounted for movement toward and away from said first article, means on said assembling device for supporting a second article, a casing attached to said assembling device, a rod having an enlarged head mounted for movement within said casing, an internal lip formed on the casing, resilient means interposed between said casing and head for urging said head into engagement with said lip and said casing to move with said rod, means for advancing said rod to impart movement through said resilient means to said casing to advance said assembling device whereby said second article moves into engagement with said first article whereupon said resilient means are compressed to permit the rod to move relative to the casing, and means rendered effective by relative movement of said rod with the casing for interrupting operation of said advancing means.

7. A pressure-sensitive switching device for a capping machine which comprises a double-acting air cylinder, an electrically controlled valve for reversing the air cylinder, a source of air pressure connected to the air cylinder, a shaft having an adjustable head reciprocated by the air cylinder, a switch actuator arm connected to the end of the shaft, a sleeve having an annular shoulder therein surrounding the headed shaft and forming a cylinder for the headed shaft, a compression spring for resisting movement of the headed shaft within the sleeve and holding the headed shaft against the annular shoulder, a pair of oppositely disposed reciprocable chucks for holding and simultaneously forcing caps under pressure on the ends of an article supported therebetween on a forward stroke of the chucks, linkages interconnecting the chucks and the sleeve whereby downward movement of the headed shaft against the compression spring imparts downward movement to the sleeve to actuate the chucks through the interconnecting linkages in a forward stroke to force the caps onto the articles, and a switch actuated by the switch actuator arm upon relative movement between the sleeve and the headed shaft for operating the electrically controlled valve to reverse the air cylinder and return the headed shaft to the foremost extended position when the resistance to further movement of the chucks on the forward stroke exceeds the resistance of the compression spring to downward movement of the headed shaft within the sleeve permitting relative movement between the headed shaft and the sleeve.

8. In an article feeding device the combination of first slide means having a groove for receiving an article, means for feeding articles into said groove, second slide means mounted for movement on said first slide means and having an aperture extending therethrough for holding an article in said groove, said second slide means also having a projection extending therefrom, resilient means engaging said second slide means for urging said projection into engagement with said first slide means to maintain said aperture and groove out of alignment, third slide means having a recess therein for receiving an article, means on said third slide means engaging said projection when said recess is aligned with said aperture for moving said second slide means against the force of said resilient means to align said aperture with said groove, and means connected to said third slide means for advancing said second and third slide means whereby an article advances from said groove, through said aligned aperture and into said aligned recess.

9. In an assembling apparatus, a pair of oppositely disposed article-assembling devices, means for mounting said devices for movement toward and away from each other, chutes terminating at each of said devices for feeding articles to said devices, an escapement mechanism located in each feed chute for controlling the passage of articles therethrough, a first linkage connected to a

first of said devices for moving said device toward a second of said devices, a second linkage connected to said second device for moving said second device toward said first device, drive means for advancing the first linkage to move the first device, a rod driven by said first linkage for advancing said second linkage, and means drivingly connected to said rod for simultaneously operating said escapement mechanisms to feed articles to said assembly devices.

10. In an article assembly mechanism, means for supporting a first article, reversible drive means, a shaft having a head thereon driven by said drive means, a hollow movable sleeve enclosing said head and provided with shoulders at the opposite ends thereof, a spring mounted between said head and one of said shoulders and driven by said head for imparting movement thereof to said sleeve, a pair of oppositely disposed reciprocable chucks for holding a pair of second articles therein, linkages interconnecting said chucks and said movable sleeve for moving said chucks forwardly toward said first article upon movement of said sleeve to force said second articles into engagament with said first article, and switch means actuated by movement of said head relative to said sleeve upon the resistance to forward motion of the chucks exceeding the compression force of said spring for operating said reversible drive means to move said chucks away from said first article.

11. In an article feeding device, means for supplying articles, a first slide provided on the under side thereof with a groove for receiving articles from said supply means, a second slide having an aperture extending therethrough for holding articles in said groove, projecting means fixed to each end of said second slide for limiting movement of said slide relative to said first slide, a spring for urging a first of said projecting means against said first slide to maintain said aperture out of alignment with said groove, a third slide having an article receiving recess therein movable into alignment with said aperture, means for advancing said third slide to locate an article received in said recess at a transfer position, means movable through said transfer position for removing said article from said recess, means for controlling said advancing and removing means to sequentially position first said recess and second said removing means at said transfer position, means actuated by said controlling means for reversing said advancing means, and an abutment fixed to said third slide rendered effective by said advancing means reversing for engaging said first projecting means and advancing said second slide against the force of said spring to align said recess and aperture whereby an article is permitted to advance from said groove into said recess.

12. In an article feeding device, a stop member, means for feeding articles, a first slide having a groove on the underside thereof for receiving articles fed from said feeding means, a first spring for urging said slide against said stop member to maintain said groove and feeding means out of alignment, a second slide mounted beneath said first slide for holding an article within said groove, said second slide having an aperture extending therethrough, a projection mounted on each end of said second slide, a second spring for urging said second slide against a first of said projections to normally maintain said aperture and recess out of alignment, a third slide having an article receiving recess and an abutment engaged to said first projection for imparting advancement of said third slide to said second slide, said third slide having an article receiving recess therein aligned with said aperture when said abutment is engaged to said first projection, reciprocating means connected to said third slide for advancing said slides against the force of said first spring to align said groove of said first slide with said feeding means whereby an article is advanced from said feeding means into said groove, and means on said third slide engaging said first projection during a return stroke of said reciprocating means for advancing said second slide against the force of said second spring to align said aperture with said groove whereby said article received in said groove falls through said aperture into the recess in the third slide.

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