Sept. 18, 1962 E. J. BRYNER ETAL 3,054,167

CAPPING MACHINE

Filed July 29, 1960 8 Sheets-Sheet 1

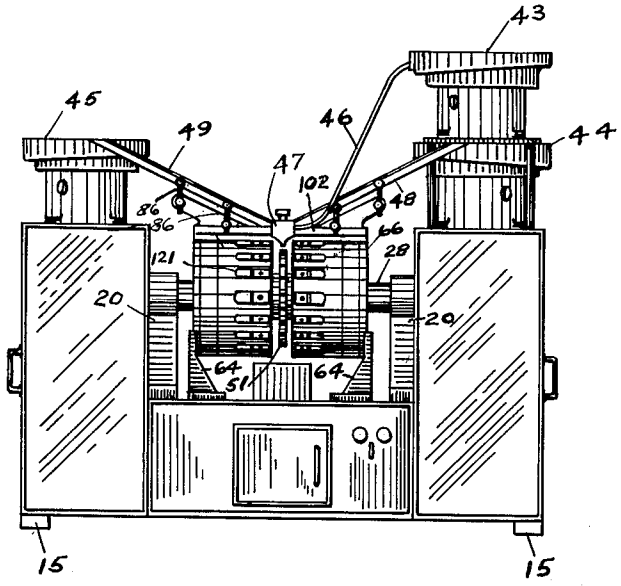


Fig 1

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CAPPING MACHINE

Filed July 29, 1960 8 Sheets-Sheet 2

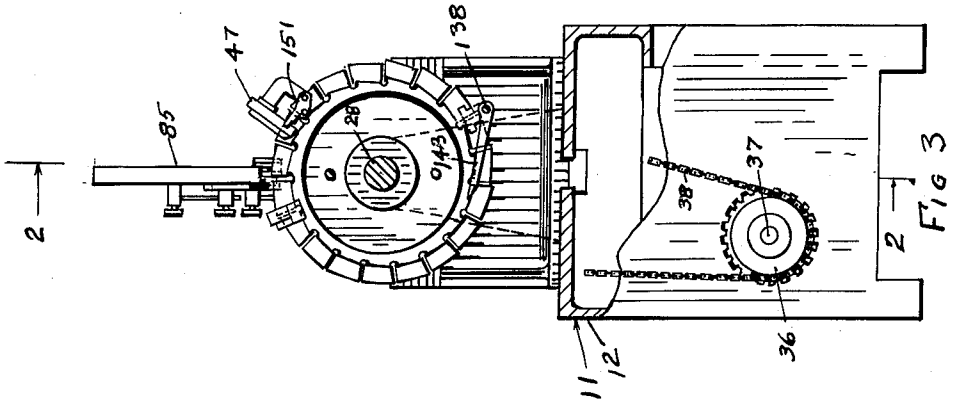


FIG 3

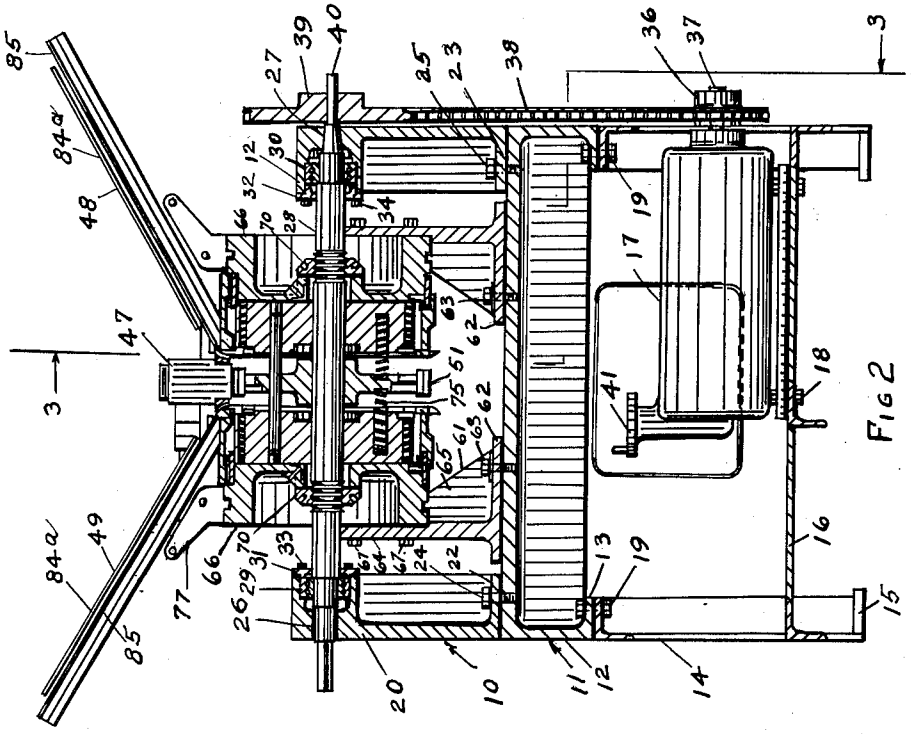


FIG 2

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CAPPING MACHINE

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FIG. 4

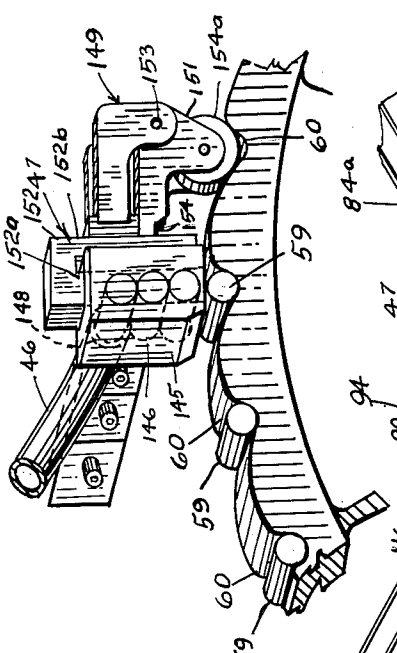
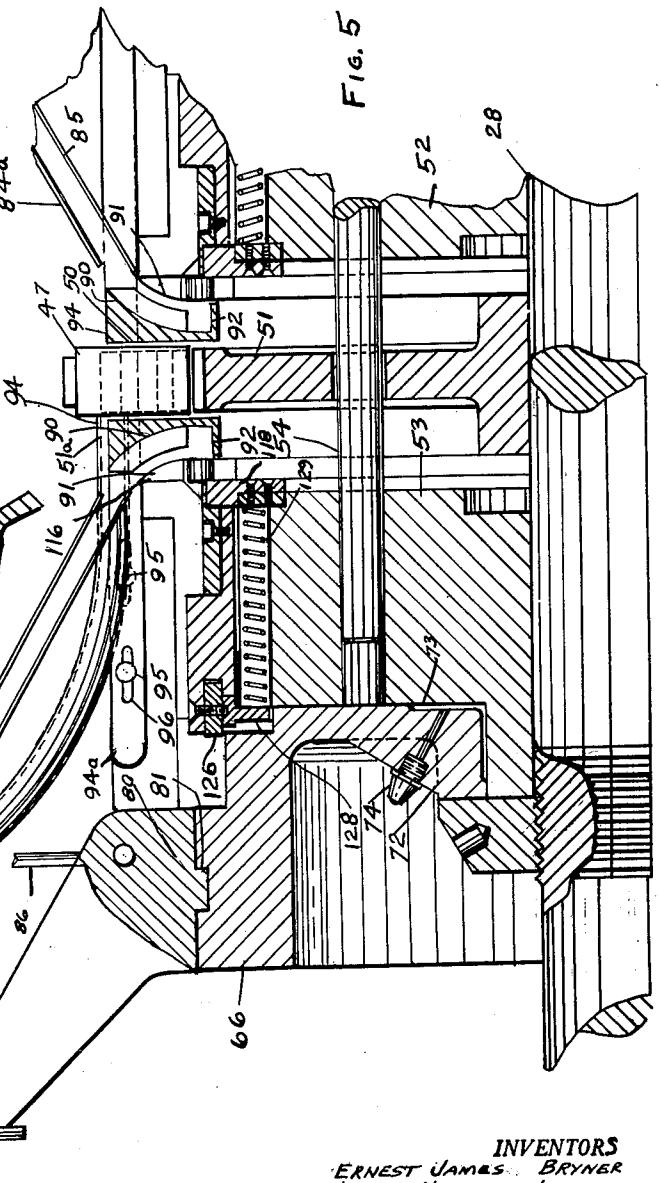


FIG. 5



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CAPPING MACHINE

Filed July 29, 1960 8 Sheets-Sheet 4

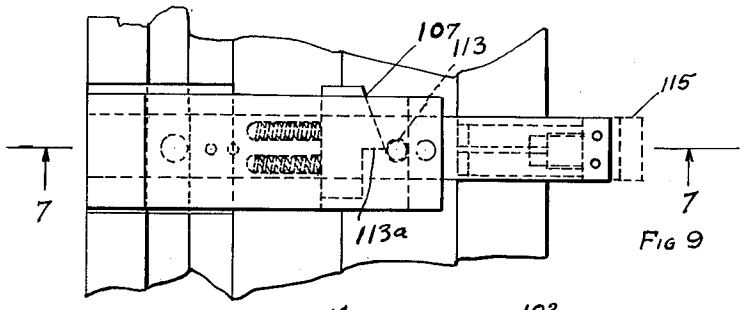


FIG 9

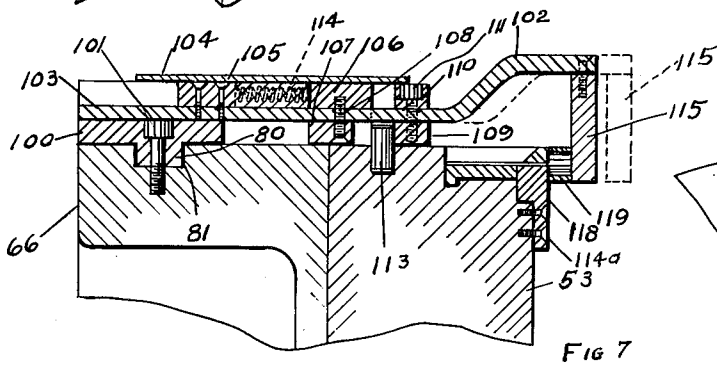


FIG 7

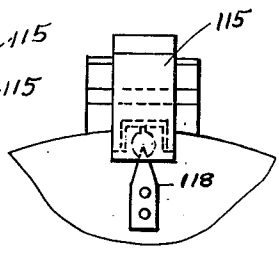


FIG 8

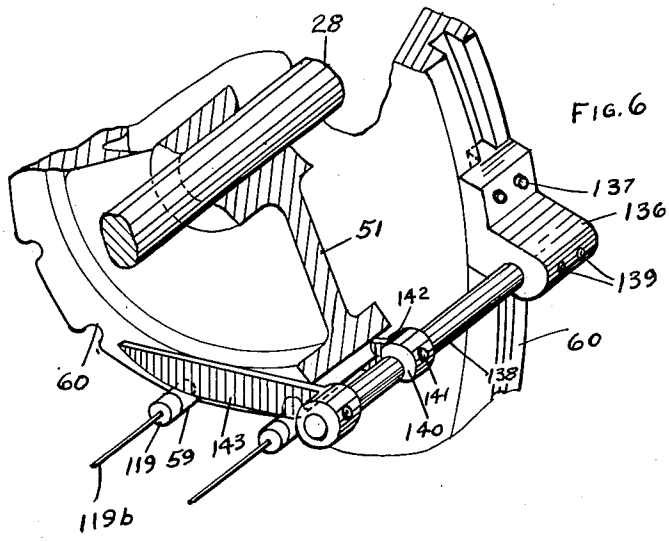


FIG. 6

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CAPPING MACHINE

Filed July 29, 1960 8 Sheets-Sheet 5

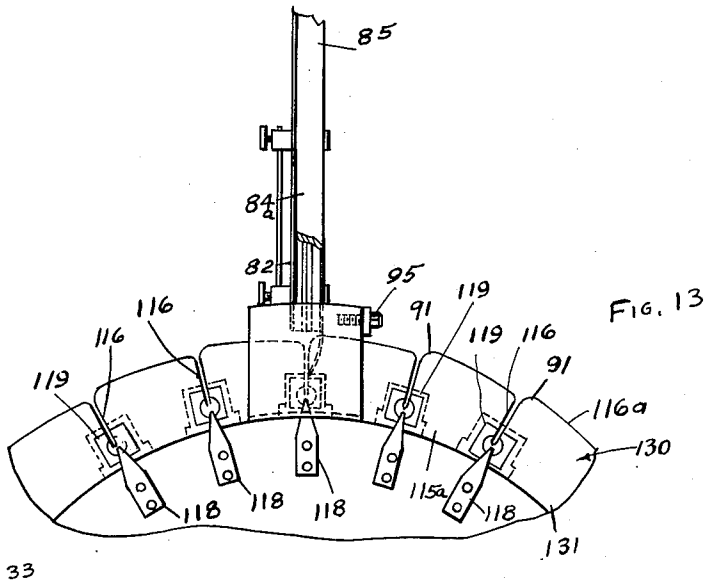


FIG. 13

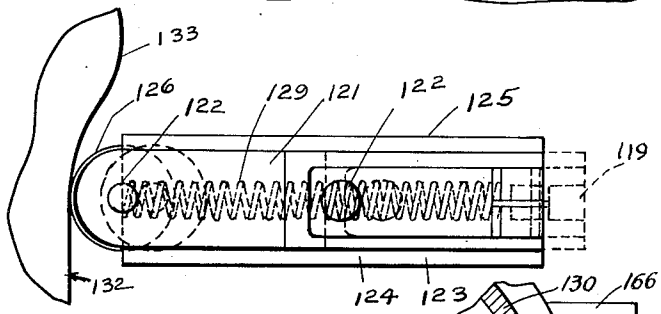


FIG. 12

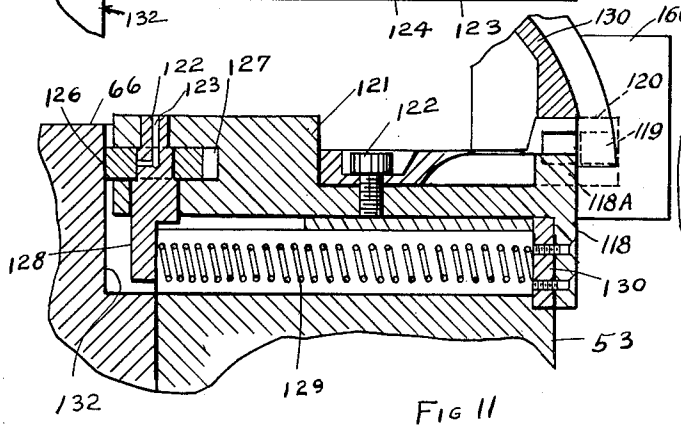


FIG 11

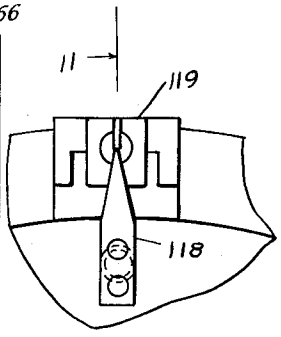


FIG 10

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CAPPING MACHINE

Filed July 29, 1960 8 Sheets-Sheet 6

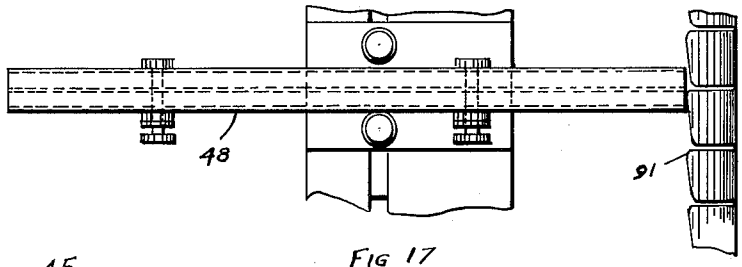


FIG 17

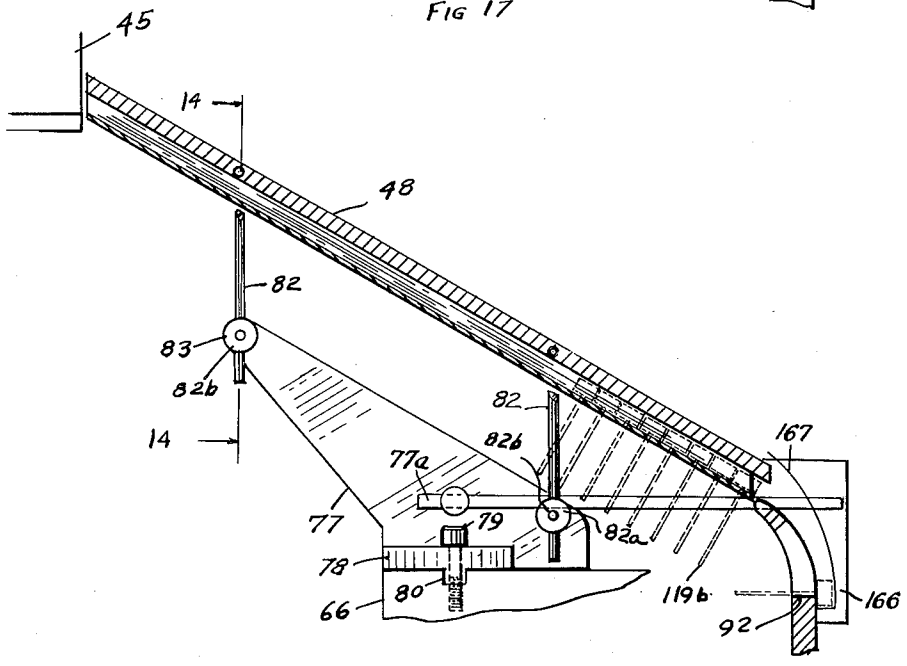


FIG 18

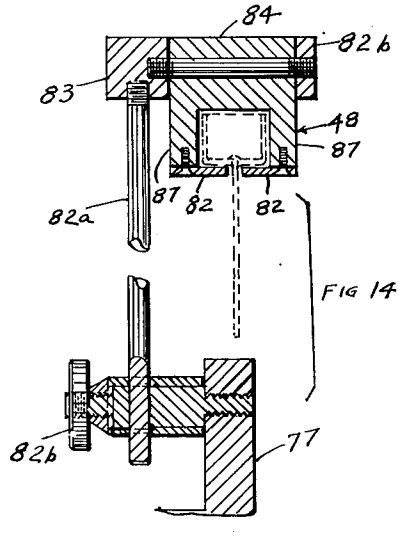


FIG 14

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CAPPING MACHINE

Filed July 29, 1960 8 Sheets-Sheet 7

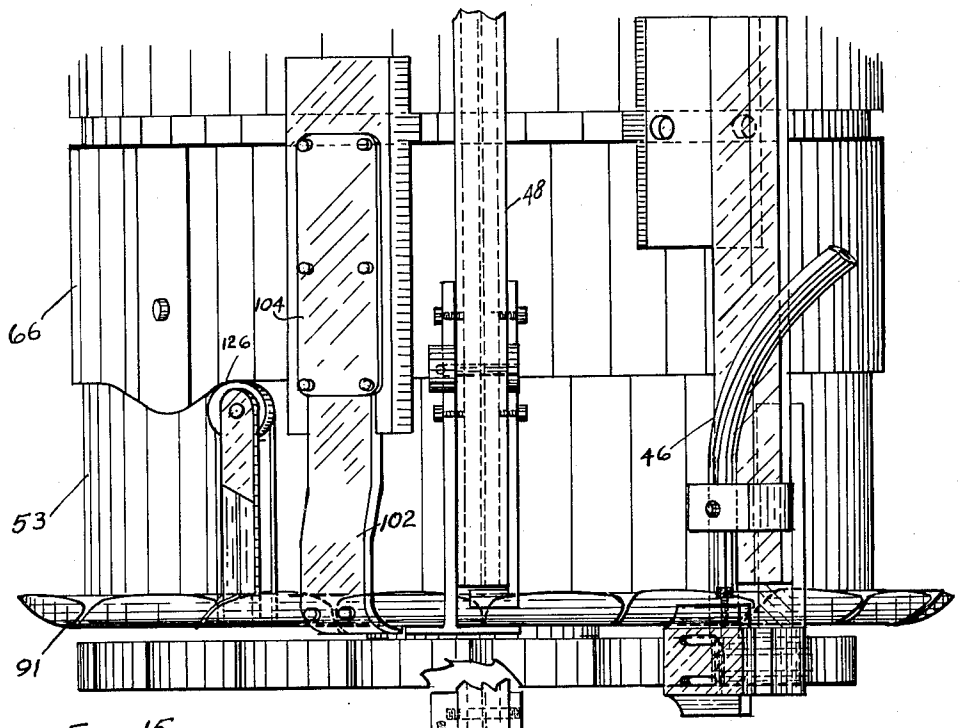


FIG 15

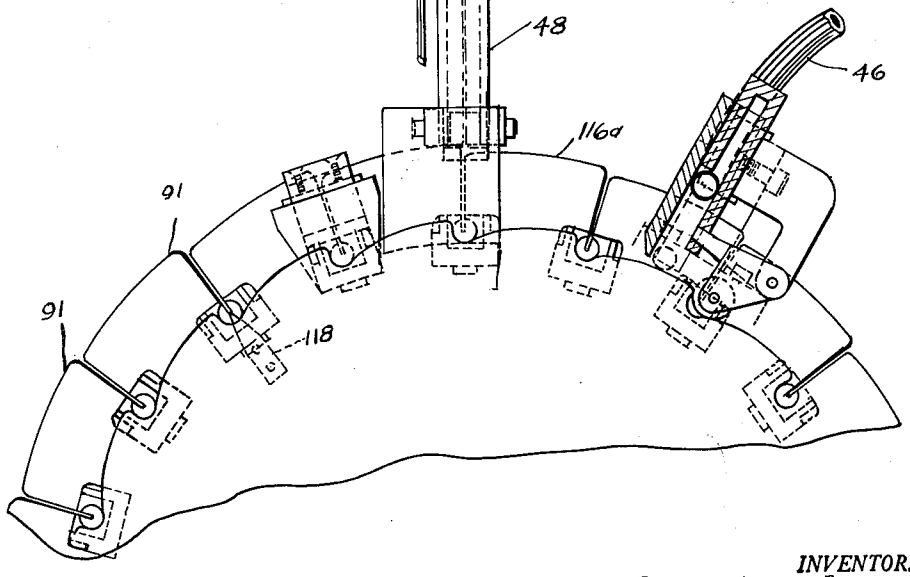


FIG 16

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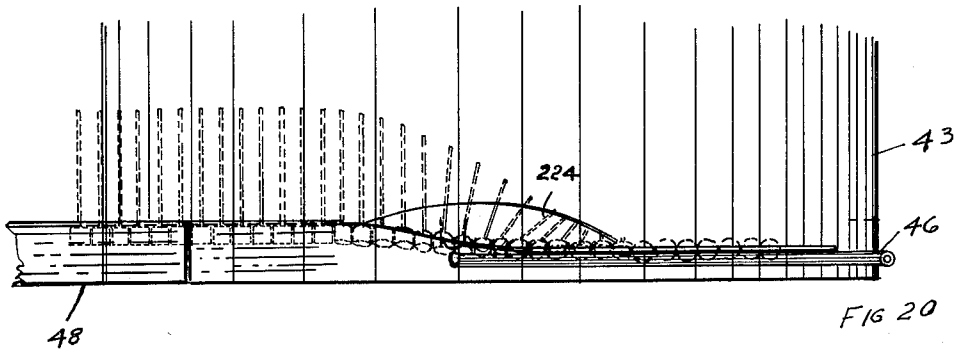


FIG 20

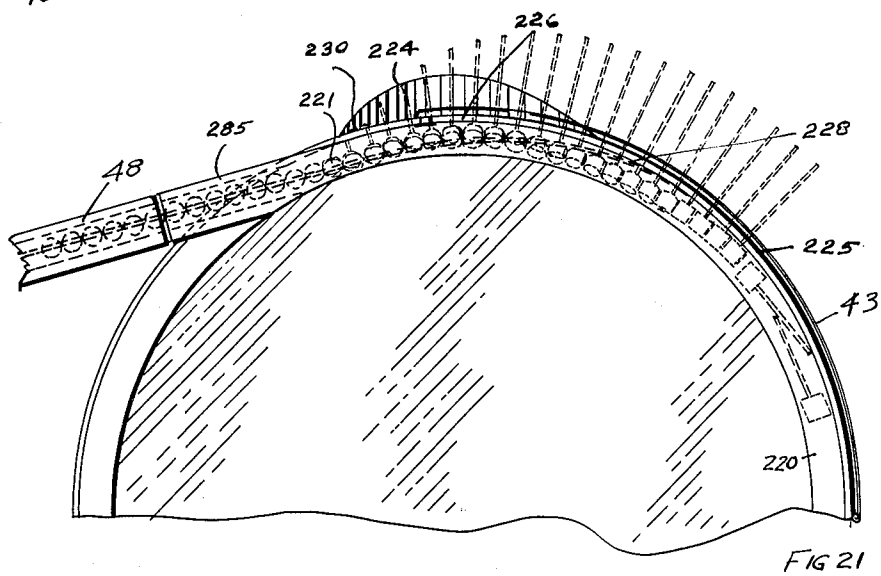


FIG 21

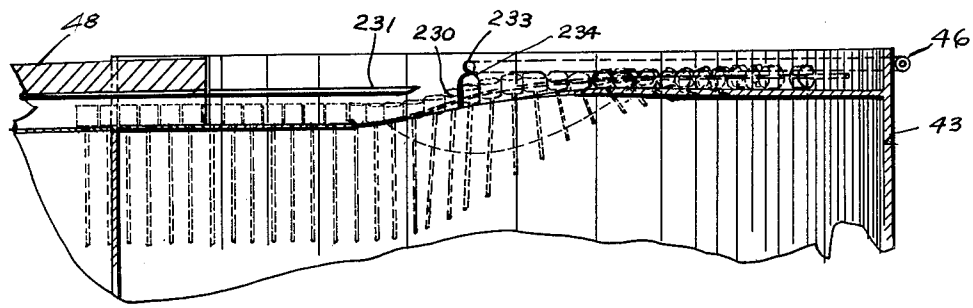


FIG 19

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United States Patent Office 3,054,167
Patented Sept. 18, 1962

3,054,167

CAPPING MACHINE

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Filed July 29, 1960, Ser. No. 46,131
22 Claims. (Cl. 29—203)

This invention relates to assembling machines and, more particularly, to machines for assembling articles of manufacture such as electrical resistors for circuit components having an elongated cylindrical or non-circular body having each of its two ends forced into a cup like cap.

Each cap may have a lead wire attached to the center of its closed end. The machine disclosed herein carries out the process of forcing the caps onto the ends of the resistor bodies. This process is known in the trade as capping. One example of resistors which may be capped by the machine disclosed herein has a film coated body with metal cups pressed over the ends to form terminals. The caps are usually octagonal or round.

While the machine disclosed herein has particular utility in capping resistors, it could be used, with possible slight modifications, for assembling various articles of manufacture in other than the electrical field where one part must be forced over another, into another, or into engagement with another.

Machines presently in existence which perform the function of the machine set forth herein operate at a relatively low production rate. These prior machines will seldom produce more than approximately fifty pieces per minute of such articles. The machine disclosed herein will produce at least three times this many cap resistors in an equal length of time.

The preferred embodiment of the machine disclosed herein, by way of example, is completely automatic. The operator is merely required to keep the feed hoppers filled with component parts to be assembled. The machine is economical to manufacture and has a very high production capacity. It is of the vertical drum or Ferris wheel type. Vibratory feeders with chutes suitably designed for transmittal of component parts for the articles from the hoppers to the machine are provided. These feeders transmit the components in regular oriented fashion. The parts handling escapement has novel construction features. The body loaders are of a quick change type which may be changed and replaced rapidly for production of various sized parts.

The centrally located body drum is pinned to the main shaft between two cap drums. The body drum has semicircular notches cut at regular intervals about its circumference into which the bodies are automatically fed for subsequent capping. From one notch or station to the next, there is a small amount of lead or change in ring radius. This change in ring radius acts as a cam which operates the forced feed in the body holder, causing body loading onto the body drum. It is positioned with its exit directly over the body wheel.

A cap drum is situated on each side of the body carrying drum. The cap drums are pinned by two seven-eighth inch diameter rods to each other and to the body wheel.

These bearing pins keep the three drums in positive register so that cap dies located on the cap drums are always aligned with the body holding notches in the body carrying drum. The cap drums are capable of being axially adjusted with relation to the body drum, sliding along the bearing pins, making it possible to assemble various lengths of resistors on the machine by adjusting spacing between the cap drums.

A cap drum is situated on each side of the body carrying drum. The cap drums as well as the body drum are keyed to the central shaft. An additional bearing pin keeps the three drums in positive register so that the cap dies are always aligned with the body holding notches. The cap drums are capable of being axially adjusted with relation to the body drum, making it possible to assemble various sizes of resistors on the machine.

The two outer moving drums cap drums carry the left and right dies for each station in a die holder. This is arranged to slide parallel to the main shaft axis. There are twenty such stations on each of the outer moving drums corresponding to the twenty body slots in the body ring. The die and die holder are arranged so as to be cammed in toward the body to effect capping. The rotation of the main shaft and drums causes the inward movement of the die holders which are each fitted with cam followers on their outer sides and are driven inwardly by a stationary cam as the drum progresses. In addition, each of the two outer moving drums is fitted with a slotted ring which forms part of the continuous escapement feeding caps into the dies. The outer moving drums, therefore, fulfill the functions of accepting one cap for each die during operation and of actually nesting the cap into the die, thus locating it, and of press fitting the cap onto the body under the force of the stationary cams.

The cams which operate the dies are spring loaded in one section (capping lobe) to allow for "overlength" travel in order to allow for adjustment for body length variation.

Each of the dies is cut on its underside to admit a "stripping finger" mounted on the moving drum and inserted up through the die. These fingers are fixed on the drum and each station has a finger. When the die moves forward to cap, this finger performs no function; however, after capping, should any cap, body, or debris of any sort remain in the die cavity, the stripping finger will cause it to be ejected as the die is drawn back over the finger by a low spot in the capping cam.

The cap dies slide in fixed housings and are actuated by a fixed drum cam through cam followers on their ends. These dies are spring returned to their load position. The spring return is reassured by a special "return" cam should the spring fail to return the die to normal position.

The cam stroke is uniform for all parts to be assembled, regardless of the length of the unit being capped.

An automatic completely mechanical means is provided for discharging the completely assembled resistor. A stripper device is provided after the normal discharge station and prior to the loading station to check for stuck or unejected assemblings and the device is provided so that it will forceably eject any part not normally ejected by gravity.

The stationary cams are mounted upon two stationary

cylindrical shaped structures which are fitted with lower extensions which reach down and are bolted to the main table surface of the machine. The inner faces of these drums bear directly against the outer faces of the cap drums. The cap drums are forced outwardly by the two compression springs which may extend from the inside of one cap drum against the body wheel and from it to the opposite cap drum. The position of these stationary drums therefore determines the separation distance of the dies at any given point in the machine since the stationary drum also provides the mount for the cams which position the slides in the cap drum. Therefore, by altering the separation distance between the outer stationary drums, the machine can be adapted to cap any particular length of resistor (within certain maximum and minimum limits). The distance between these outer drums is, in turn, controlled by the castings which support them. These castings are guided in and out axially by large keys on the castings which run in keyways on the main base. Two bolts through each casting lock them to the base plate in any position desired. The bolts are inserted through elongated slots in the castings to permit this adjustment. This axial adjustment is simplified by the use of two conical nuts on the main shaft. These nuts are brought into play only when making an adjustment in the capped length of the resistor. They are brought into tight contact with the stationary drums on each side before the bolts holding the cast supports down are loosened. After these bolts are loosened, the nuts are turned in or out by insertion of a one-half inch rod into holes provided in the nuts to bring the drums to the new required distance. The cast support mounting bolts are then drawn up tight and the nuts are backed off, thus completing the adjustment. These nuts are right and left hand so that, if forgotten during the adjustment, they would subsequently loosen themselves during normal running.

Referring to the cams which determine die slide position (cams mounted on stationary drums), one section of these cams is spring loaded so that in final seating of the cap, there is no possibility of compressing the body excessively due to insufficient length between the capping dies. This spring pressure is externally adjustable.

The machine is driven by an electric motor conveniently located beneath the machine base and, in normal operation, the motor drives the drum at a continuous constant rate. The drive is carried out through an appropriate adjustable speed belt drive, chain, sprockets, and suitable shaft and bearing arrangements. Suitable "start" and "stop" means are provided and, also, means to inch and jog the machine ahead to facilitate set-up.

The completely assembled resistors or other articles of manufacture may be discharged onto a belt conveyor or other well known conveying, storing, or packaging means most suitably adapted for the specific application on which the machine is to be used.

The escapement cover is a complex shape which is mounted stationary over the track mount and the pick-up ring to guide parts into the die mouth area. The cap seater is a device actuated by pins on the two moving drums. Each station's pin causes the plate to jump backward and push the cap into the die cavity.

In the case of both the body and cap feed, the parts are arranged in certain orientations as shown in the drawings and are tracked to the point of escapement whereupon they are held from escaping by cooperating parts of the machine. In the case of the body feed, they encounter the feed box which will meter out a part to the top of the column of bodies in the box each time one is taken out at the bottom. This is accomplished by a change in ring radius which influences the linkage as a cam as shown in the drawings. Attention is drawn to the bottom of the column of bodies where the same cam shape on the body wheel between notches also accomplishes a pre-feed or partial feed motion of each body during the travel from the previous notch to the next. It is this feature of the feed which permits it to operate at the rates cited herein and makes feeding smoother and more positive. The positive feature derives from the fact that the body, already half fed out of the box by this pre-feed motion allowed by the cammed body wheel, encounters the vertical back wall of the body notch which positively strips it from the feed box, thus making room in the column of bodies for another addition to the top of the column.

In the case of the lead feed, the ring is slotted to permit passage of the wire and cap down the slot to the die center line. This ring is also cam shaped on its periphery so that a pre-feed or camming motion of one thirty-second of an inch is provided from notch to notch for each part prior to feeding. This provides the positive feature in the case of the cap feed since the abrupt encounter of the high point of the next section of the wheel forcibly removes the cap from the track. The track is also arranged with a stop hook which will permit only one cap to escape at a time at any instant that a slot is lined up with a track mount. Further movement rotationally of the drums and, consequently, of the slot, will cause the track mouth to be sealed by the segment camming surface, thus stopping cap movements except for pre-feed camming motion. This rotation will also move the previously loaded lead away from the influence of the track stop hook and allow it to drop to the shelf or die center line.

The machine is so proportioned and designed that a neat, attractive enclosed housing may be provided for the machine and an appropriate access door for service, maintenance, and adjustment of the machine.

With the foregoing features in view, it is an object of the invention to provide an improved machine for assembling articles of manufacture which is simple in construction, economical to manufacture, and simple and efficient in operation.

Another object of the invention is to provide a machine for assembling articles of manufacture wherein the parts of the articles to be assembled are supported on a continuously rotating wheel and the assembling operation takes place as the wheel rotates to carry the article from a first position to a second position.

It is another object of this invention to provide an improved feeding mechanism for an assembly machine.

Yet another object of the invention is to provide an improved escapement and track mechanism for feeding an assembly machine.

Still another object of the invention is to provide an improved cap seating assembly and article handling device in combination with an assembly machine.

Still yet another object of this invention is to provide an assembling machine wherein a constantly rotating member on the machine having multiple stations thereon moves in uninterrupted motion in providing a high output of articles at low speed movement of the moving member.

A further object of the invention is to provide a machine which utilizes multiple stations in continuous uninterrupted motion in providing high output of articles at low machine speed.

Still a further object of the present invention is to provide a unique arrangement of feeding means for feeding a moving drum from a stationary track.

With the above and other objects in view, the present invention consists of the combination and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawings and more particularly pointed out in the appended claims, it being understood that changes may be made in the form, size, proportions, and minor details of construction without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

FIG. 1 is a front view of a machine according to the invention;

FIG. 2 is a cross sectional view of the machine taken on line 2—2 of FIG. 3;

FIG. 3 is a view partly in cross section taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged partial isometric view of the loading device for loading the body of a resistor to the body carrying drum;

FIG. 5 is an enlarged partial cross sectional view of the machine similar to FIG. 2 showing a part of the mechanism;

FIG. 6 is an enlarged partial isometric view of the machine showing the body drum and ejector mechanism;

FIG. 7 is a cross sectional view taken on line 7—7 of FIG. 9 showing the cap seater mehanism;

FIG. 8 is a side elevational view showing a part of the cap seater mechanism;

FIG. 9 is a plan view of the cap seater mechanism;

FIG. 10 is an enlarged side view of the die and die housing assemblies of the machine;

FIG. 11 is a cross sectional view of the die and die housing mechanism taken on line 11—11 of FIG. 10;

FIG. 12 is a plan view of the part of the machine shown in FIG. 11;

FIG. 13 is a side view of the cap drum and escapement cover;

FIG. 14 is a cross sectional view taken on line 14—14 of FIG. 18;

FIG. 15 is an enlarged top view of the machine showing certain parts thereof broken away;

FIG. 16 is an enlarged view of the inside edge of one of the cap drums;

FIG. 17 is an enlarged top view of one cap chute;

FIG. 18 is an enlarged side view of the cap chute showing a part of the cap drum;

FIG. 19 is an enlarged cross sectional view of the cap feed track;

FIG. 20 is a side view of the cap feed track shown in FIG. 19; and

FIG. 21 is a top view of the cap feed track.

Now with more particular reference to the drawings, a machine 10 which is a preferred form of construction illustrating the invention is shown for carrying out the functions and having the structure set forth herein. The rotating parts of the machine 10 include a shaft 28 rotatably supported in bearings 29 and 30. A body drum 51 is pinned to shaft 28 and cap drums 52 and 53 are slidably supported on the shaft 28. Thus, the body wheel is restrained to rotate the shaft 28. The body drum 51 and cap drums 52 and 53 are held locked together by two pins 54 which keep them in positive register and insures that caps received in the dies on the body drum will be in exact alignment with resistor bodies received in the body drum. The pin 54 extends through aligned bores in both cap drums and in the body drum and the drums may be adjusted toward and away from the body drum to set the machine for assembling resistors of different lengths. The two cap drums and the body drum are, in effect, three sections of a single drum which rotate continuously and in unison with the main shaft.

The machine which is shown by way of example has a fixed frame with a main table 11 thereon. The table 11 may be made of a single casting or it could be fabricated from steel. It has downwardly extending flanges 12 which add rigidity to the table. The lower ends of the flanges 12 are turned in at 13 and the flanges 12 are supported on legs 14 and attached thereto by bolts 19. The legs 14 have floor engaging pads 15 welded to the lower ends thereof as shown and a support structure 16 is welded to the legs 14 to add further rigidity and to provide a support for a motor and gear reducer indicated at 17 and bolted to the support by means of bolts 18.

Bearing supports 20 and 21 support the ends of the main shaft 28. They have pedestals with bases 22 and 23, respectively. The bases 22 and 23 are fixed to the main table 11 by means of bolts 24 and 25, respectively. The bearing supports 20 and 21 may be made of castings or forgings or they could be fabricated from steel or other suitable material. The bearing supports 20 and 21 are suitably bored at 26 and 27, respectively, to receive anti-friction bearings 29 and 30 which receive the shaft 28.

The bearings 29 and 30 are retained in the bores 26 and 27 by plates 31 and 32 which are in turn held in place by means of bolts 33 and 34, respectively. The main shaft 28 is driven from the motor speed reducer 17 by means of a sprocket 36 which is attached to a motor shaft 37 and drives a sprocket 39 through a chain 38. The sprocket 39 is keyed to a reduced size end 40 of the shaft 28. The speed of rotation of the shaft 37 can be varied by adjusting a crank 41. Thus, the production rate of the machine can be controlled by adjusting the crank 41.

The stationary cams which actuate the cap seater assembly and support the body loader and cap tracks are supported on cylindrical structures which are, in turn, supported on pedestals 61. These cylindrical cam supports are coextensive with the outer sides of the cap drums. The pedestals 61 which support the cam supports have bases 62 which rest on the main table 11 and are attached thereto by studs 63. The bases 62 may be provided with suitable slots receiving the studs 63 which lock the pedestals 61 after collars 70 have been properly adjusted. The pedestals 61 have upwardly extending members 64 which are reinforced by gussets 65 welded thereto. Cam supports 66 are fixed to the pedestals 61 by means of studs 67.

Spacing of the cap drums 52 and 53 on the shaft 28 is controlled by the position of the cam supports 66 which, in turn, have their positions determined by the location of the cast support bases 61 which are axially adjustable. During adjustments when the bolts holding the cast supports 61 are loosened, the position of the drums is controlled by the threaded collars or nuts 70. The cap drums may thus be adjusted to set their distance from the body drum 51 to accommodate various sized caps and bodies. The cap drums 52 and 53 are urged apart by helical coil compression springs 75 which are received in blind holes in each of the cap drums and may be passed through holes in the body drum in reaching from one cap drum to the other. A grease groove 73 is formed in the cap support 66 which receives lubricant from a grease fitting 74. This lubricant reduces friction between the supports 66 and the members 53.

Three vibratory parts feeders 43, 44, and 45 supply component parts to the machine generally in a manner familiar to those skilled in the art. The feeder 43 orients the bodies, aligns them with the tubular track, and feeds them down a chute 46 to a body loader assembly 47 in the embodiment shown.

The feeders 44 and 45 align the cup shaped caps with the open ends up and feed the caps with a wire 119*b* attached thereto downwardly into chutes 48 and 49, respectively, where they move to cap loaders 50 and 51*a*, respectively. The caps on surface 92 come to rest with their wires on the bottom of the loading surface 92 with the open end of each cap facing the resistor bodies fed into the body drum 51. As each cap is placed in the loader, it is moved into a die by the cap seater.

Resistor bodies 59 which are fed down the tubular chute 46 from the parts feeder to the body loader 47 are received in notches 69 in the outer periphery of the body loader drum. There are twenty notches in the body drum of the machine shown; however, this number can be varied within the scope of the invention.

A cap die 119 will be supported on each cap drum corresponding to each notch in the cap drum so that one cap die on each cap drum is always aligned with each body drum notch. The die or chuck 119 is a hardened part which very accurately reproduces the shape of the underside of the cup in its cavity. This shape controls the location of the cup in the capping process within ±.0005 inch (necessarily for good operation). It also functions as a tool, bucking up and supporting the fragile cup 119*b* as the body part is pressed into the cap by motion of the dies 119. It may be considered somewhat similar to a forming tool as its name implies, for although it does not form the cap, it does cause the cap to retain its form during capping. It is not a simple plunger or pusher.

A mounting pad 78 may be supported on the cam support 66. Support rods 77 are fixed to a support block and connected to a track 285 by universal joints 83.

The cross section of the track is in the form of an inverted channel with sides 87 and a web 84. Plates 82 are attached to the sides 87 and extend inwardly and define a groove. The wire leads 119*b* are attached to cup like caps. The leads slide through the groove as they move from the machine to the cap drum.

The track has been produced and tested and it overcomes the prevalent problem in the industry which is encountered when the lead part of the terminal cap is bent. This track will feed bent leads with any degree of bend up to ninety degrees and to within one-eighth inch of the underside of the cap.

The feeder 45 with the improved track disclosed in FIGS. 19, 20, and 21 has an open topped bowl with a spiral track 220 on the inner side of the bowl sides leading from the bottom of the bowl to the top and discharging to the track 285 at 221. This general type of bowl is familiar to those skilled in the art; however, the bowl disclosed herein has an improved track in combination therewith.

A fence 224 has a downwardly curving top surface 226 which begins at the upper edge of the bowl at 225. The track also reaches nearly to the top of the side at 225. Therefore, the lead wires on some of the caps swing outwardly over the top of the fence 224 and as the caps further advance and the lead wires move up the top surface of the fence 224, the caps are turned on their sides on the track with the wires extending outwardly. At this point 223, the lead wires enter a groove and move down an incline 230 to the section having a cover 231.

If the units tend to bunch up when entering the covered section, they build height just at an air stream inlet 233. The air stream inlet 233 and the notch 234 permit the overcrowded unit to tip horizontally again and be rejected back into the bowl for recirculation. Under normal uncrowded conditions, units slip in under the air stream and are fed to the cap tracks. Thus, a back pressure is possible.

A surface 90 is formed inside cap guides 94 which are fixed to the members 66 by means of fasteners 95 which are received in slots 96. By loosening the fasteners 95, the guides 94 can be adjusted laterally to accommodate various sizes of caps.

A cap seater 100 is supported on the cam supports 66 slightly ahead of the cap loader by means of studs 101 which extend through a bracket 44*a*.

The cap loader is shown in cross section in FIG. 7.

An arm 102 is slidably supported in the space between a top surface 103 of the seater 100 and a bottom surface 104 on a member 105. Spacer blocks 106 and a cam 107 are attached to the arm 102 by means of a stud 108 and blocks 109 and 110 are attached thereto by means of a stud 111. A space between each cam 107 and each block 109 is provided through which the outer ends of pins 113 pass. The inner ends of the pins 113 are received in peripherally spaced holes in the cap drums 52 and 53. Two springs 114 are in engagement with the member 105 and one side of the cam 107 so that the arm 102 is constantly urged to the dotted line position shown. One of the pins 113 is supported in fixed alignment with each cap die in each cap drum. Each time a cap loading die approaches the chutes 48 and 49, a pin 113 will move along the cam 107 and move the arm 102 to the full line position shown, allowing a cap to be seated in the die. As the cap drum advances, the pins 113 will pass an end 113*a* of the cam 107 and the springs 114 will return the arm 102. The cap will be forced into the cap loading die as indicated in FIG. 7. As the next pin 113 approaches the cam 107, it too will engage the cam 107 and urge the arm 102 to the full line position to receive the next cap.

The cap dies 119 each have a cavity 117 in their bodies of a suitable size to receive a cap. Spaced stripper fingers are arranged on the underside of each die 119 and attached to the cap drums adjacent the outer periphery thereof by means of screws 114*a*. The dies 119 have inwardly facing die members with the cavities 117 therein. The cavities 117 have a slot 131*a* in the upper periphery which is aligned with a slot 116 in the pick-up rings through which the wires attached to the resistors may enter as the cap enters the die. The cap dies 119 are received in the cavities 117 of a pick-up ring 131. Stripping fingers 118 are fixed to the cap drums. A slot 118*a* is cut on the underside of each die 119 to admit the stripping fingers 118. When the die moves forward to cap, the finger performs no function; however, after capping, if any cap, body, or debris of any sort remains in the die cavity 117, the stripping finger 118 will cause it to be ejected as the die is drawn back over the finger 118 by a low spot in the capping cam.

The outside periphery of the ring 131 is made up of segments inwardly inclined between the slots 116. As each enlarged end 91 of a surface 116*a* passes the ends of chutes 84*a* and 85 to bring a slot 116 under a wire of a cap, one cap will enter the slot 116 to allow the cap to move to the surface 92.

As the cap dies 119 move down the chutes 84*a* and 85, they are urged into the respective dies by the cap seater arm 102 which retracts each time a die passes it.

Rollers 126 are received in slots 127 in members 121 and are rotatably supported therein by means of axles 122 which have a grease groove 123 therein. The axles 122 extend outwardly and overlie the ends of the cap loading drums 52 and 53 at 128 to form a support for the inner ends of springs 129. The springs 129 abut against the members 128 (die slide rollers) at one end and against ring 130 at the other end. A ring 130, in turn, is fastened to each of the cap drums 52 and 53. The guard 166 is fixed to the support 77 by means of rods 77*a* and the guard 166 has the curved surface 167 which is generally concentric to the outer curved surface on members 130 so that the caps can slide down freely between the curved surface 167 and the outer curved surface on members 130.

The cam support 66 has a cam 132 on its inner side on which the wheel or roller 126 runs so that as the cap drum rotates, the wheel 126 will follow the contour of the cam 132 and cause the cap die to move inwardly and force the caps onto the bodies as the cam climbs a contour 133 of the cam 132. A low spot in the cam 132 causes the die to retract after the die has moved in to cap the resistor.

When the capped resistor bodies reach the bottom part of the path of travel of the drums, they are removed from the notches 60 in the body loading drum by gravity. The ejecting mechanism is made up of a bracket 136 which is fixed to the cam support 66 by means of studs 170 and has an arm 138 supported thereon by means of set screws 139. If any one of the resistor bodies 59 is not removed from the body ring, the resistor body will encounter arms 142 and 143 and be forceably ejected.

The body loader is made up of a body guide 145 which

has a vertically extending slot **146** therein. The slot **146** is open at the bottom. A hole **148** in the side of the body guide **145** is connected to the body chute **46** and allows the resistor bodies from the chute **46** to enter the body guide **145**.

An escapement mechanism **149** is provided to regulate the feed of the bodies **59** from the chute **46** to the drum **51**. The escapement mechanism is made up of a U-shaped slide **152**, one leg **152***a* of which extends into the slot **146** and rests in front of the discharge end of the chute **46** when a roller **154** has dropped into a notch **60**. The other leg **152***b* of the slide **152** slidably engages one outside surface of the body guide **145**.

The member **149** is attached to the leg **152***b* and a bell crank **151** is swingably attached to the mechanism **149** at **153**. A roller follower **154***a* is attached to a second leg of the bell crank **151** and a detent **154** is attached to the third leg. The detent **154** is used to operate the up and down motion of the slide **152**. The function of the slide **152** is to break the axial compressive force which is transmitted through the column of parts in the feed tube and to thus defeat the tendency of the topmost piece to arch across the slot which would cause clogging of the feed. One piece at a time is fed as each notch comes up since only when a slot is encountered is there clearance for a part to leave the chute.

The foregoing specification sets forth the invention in its preferred practical forms but the structure shown is capable of modification within a range of equivalents without departing from the invention which is to be understood is broadly novel as is commensurate with the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An assembly machine comprising a first drum and a second drum supported on a shaft and restrained to rotate therewith, means to drive said shaft, spaced means on the periphery of said first drum to support a first part of an assembly, spaced means on said second drum to receive second parts of said assembly, said spaced means on said second drum comprising cap dies axially slidably supported in slots in the outer periphery of said second drum, springs urging said cap dies away from said first drum, a cam fixed to said machine, and means on the outer end of said cap dies engaging said cam as said drums rotate, forcing said cap dies toward said first drum, thereby forcing said first part and said second parts together.

2. A machine for assembling articles of manufacture by applying a cap to each end of a body comprising a first rotatable drum member on said machine, first circumferentially spaced support means on the peirphery of said first rotatable member to receive said bodies, a second rotatable drum member on said machine rotatable about a common axis with said first rotatable member, second circumferentially spaced support means on said second rotatable drum member axially spaced from said first support means and from each other for receiving said caps, means to feed said caps to said second rotatable member and said bodies to said first rotatable member, cam means disposed around the axis of rotation of said rotatable members to force said caps on said bodies as said rotatable members rotate continuously, and means to discharge said articles from said machine.

3. The machine recited in claim 1 wherein said means on said first drum to support a first part comprises spaced notches in the periphery of said first drum, said notches extending generally parallel to the axis of rotation of said drums.

4. A machine for forcing cup shaped caps onto the ends of bodies comprising a first drum, a second drum, and a third drum all disposed on a shaft and restrained to rotate with said shaft, spaced means on the periphery of said first drum to hold said bodies, means to drive said shaft, circumferentially spaced die means on said second and said third drums to hold said caps with the open end of each said cap in alignment with an end of one of said bodies, cam means on said machine adjacent said second and said third drums, and follower means on said second and said third drums adjacent each said die means engaging said cam means and forcing said caps over the ends of said bodies as said shaft rotates.

5. The machine recited in claim 1 wherein said cap dies each have an opening therein facing said first drum and feeder means is provided to force said second parts into said openings in said dies.

6. The machine recited in claim 5 wherein said means to force said second parts into said openings comprises a feed member having a surface generally flush with a part of a said cap die when said cap die passes through a predetermined position, means to feed said second parts to said surface, and a cap seater actuated by means on said drums extending between said first drum and said second drum, forcing said second parts into a said die each time a die passes said surface.

7. The machine recited in claim 1 wherein said drums are adjustable on said shaft toward and away from each other to accommodate various sizes of first and second parts.

8. A machine for connecting a first member and a second member together by axial movement of one said member relative to the other comprising a first generally cylindrical drum for supporting said first member, a second generally cylindrical drum for supporting said second member, said drums being supported on said machine and restrained to rotate about a common axis, means to drive said first drum and said second drum at the same rate, peripherally spaced means on said drums for supporting said first member and said second member in alignment with each other, said means on said drums remaining continually in alignment with each other during rotation of said drums, means on said second drum to move said first member toward said second member whereby said first member is connected to said second member, and a fixed cam means on said machine, said cam means being positioned adjacent an end of said second drum to actuate said means on said second drum.

9. An assembly machine comprising a first and a second drum, a shaft, said first and second drums being supported on said shaft and restrained to rotate together and with said shaft all at the same speed, said first drum having peripherally spaced notches in the surface thereof for receiving elongated members, die members axially slidably supported on the periphery of said second drum, said die members having cavities therein facing said notches in said first drum, loading means for loading cup shaped caps into said cavities as said drums rotate, said loading means comprising means to deposit said caps between said drums and means to force said caps into said cavities, a cam fixed to said machine positioned at the end of said second drum, and follower members on said die members engaging said cam, forcing said die members toward said first drum whereby said caps are forced over the ends of said elongated members.

10. The machine recited in claim 9 wherein said loading means comprises a track having an inverted channel therein terminating adjacent said second drum, said track having a slot through the bottom thereof extending from one end of said track to the other, each said die member having a slot communicating with said cavity therein, a feeding means for feeding said caps into said channel, said channel being adapted to receive caps having a wire attached to the bottom and extending therefrom, said wire extending through said slot in said track, said slot in each said die member passing under said slot in said track as said drums rotate whereby a said wire moves into said die slot each time a die member passes said track.

11. The machine recited in claim 10 wherein said feeding means comprises a ring fixed to said second drum, said ring has openings between said die members and said first

drum, a slot communicates with each said opening and the periphery of said ring, and an enlarged portion on the periphery of said ring adjacent each said slot urges said caps out of said feeding means.

12. The machine recited in claim 11 wherein each said die member has a slot intersecting the cavity thereof, and a stripping finger is fixed to said second drum and extends through said slot, said die member forcing a cap therein against said finger each time each said die member passes a particular place on said cam.

13. The machine recited in claim 1 wherein stripping fingers are attached to said second rotatable member, each said finger having an end extending through an axially disposed slot in a said die, said die moving outwardly from said second rotatable member relative to said stripping finger after each said body is capped whereby a cap remaining in said chuck after capping will be ejected from said die.

14. The machine recited in claim 4 wherein said die means comprises hollow members each having an open end facing said first drum, chute means to supply said caps to said machine, means to direct said caps to said chuck means, and seater means for urging said caps into said die means.

15. The machine recited in claim 14 wherein said seater means comprises a plate supported on said machine, means on said second drum to move said plate toward said second drum each time a said die means approaches said seater means, and spring means urging said plate away from said second drum each time a said die means moves away from said seater means.

16. The machine recited in claim 4 wherein said means to move said caps into engagement with said first parts comprises means slidably supporting said die means on said second drum, cam means on said machine engaging each said slidable means as it rotates with said second drum away from said feeding means urging said die means toward said first drum, and spring means urging said die means away from said first drum.

17. A machine for assembling articles having elongated bodies to cup shaped parts comprising a first drum having spaced notches on the periphery thereof for receiving said bodies, a second drum fixed to rotate with said first drum, means to rotate said drums at a constant rate about a common axis, spaced dies on said second drum to receive said cup shaped parts, means to feed said bodies and said cup shaped parts to said drums, said means to feed said bodies comprising a tubular chute, a body loader on said machine above said drums, said body loader having an upwardly extending slot therein for receiving said bodies, said chute terminating in said slot, said slot being open at each end, the bottom end overlying a part of the periphery of said first drum and communicating intermittently with said notches, and escapement means on said body loader allowing one said body to move into one said notch in said first drum each time a said notch moves thereunder, said escapement means having a roller engaging another said notch each time a said notch is under said slot, said roller moving out of each said notch as said first drum rotates, forcing a said body into a said notch each time a said notch moves away from said body loader.

18. The machine recited in claim 17 wherein said means to feed said cup shaped parts comprises an annular member having spaced, radially extending notches in the periphery thereof, the outer periphery of said annular member between each said radial notch being contoured to form a cam surface, a chute for said cup shaped parts, each said cam surface moving past the outlet from said chute for said cup shaped parts and each removing a cup shaped part therefrom.

19. The machine recited in claim 18 wherein said annular member has spaced openings one disposed below each said second notch, one said notch communicating with each said opening and a said die disposed on said drum with a part receiving opening aligned with each said opening in said annular member.

20. In combination, a machine for capping elongated bodies with caps comprising two drums rotatable about a common axis, means on said drums adjacent the periphery thereof to support said bodies, means to feed said caps to said body support, said feeding means comprising a vibratory feeder having a bowl with an open top, a spiral track on the inside periphery of the side wall of said bowl leading from the bottom thereof to the top, means on said bowl to align said caps on said track with the same part of each cap up, a covered chute communicating with said feeding means to receive said caps from said track, means to cause excess said caps to fall from said track back into said feeder, said last mentioned means comprising a fence having a notch therein for receiving said caps, a notch in said fence extending upwardly therein for receiving a part of each said excess cap which moves on top of another said cap on said track adjacent said chute, and a source of compressed air directed toward said notch for forcing said excess caps from said track whereby the caps are prevented from bunching.

21. A machine for assembling articles of manufacture comprising a drum made up of two outer spaced wheels and an inner spaced wheel supported on a single shaft on said machine and locked together for rotation thereon, means to drive said drum continuously at a constant rate, a spring urging said outer wheels outwardly away from said inner wheel, cam supports fixed to said machine and engaging said outer wheels limiting the outward movement thereof, spaced notches on the outer periphery of said inner wheel for receiving article bodies, body loader means for feeding said bodies to said notches, said body loader means comprising a vertical slot in said body loader means communicating with a chute from a feeder, a member in said slot overlying said bodies, a bell crank connected to said body and to said overlying member, a wheel on said bell crank engaging a notch on said wheel each time a said notch moves under said body loader means whereby a said body is forced into said notch each time a said notch moves under said body loader means, spaced dies in said outer wheels each having an open cavity facing one of said notches, a pick-up ring on the side of each said outer wheel, each said pick-up ring having openings, one said opening registering with a cavity in each said die, radially extending slots in said ring, one slot connecting each said opening with the outer periphery of said wheel, said dies being axially slidable on said wheels, spring means urging said dies away from said inner wheel, a cap seater arm slidably supported on said machine, a plate member on said arm, cam means on each said outer wheel urging said arm toward said inner wheel each time a said die approaches said body loader means, spring means adapted to urge said arm and a cap engaged by said plate member into one said die each time a die with a cap in front thereof moves away from said cap arm, and stripping fingers attached to said outer wheels, each said stripping finger extending through a stripping groove in the underside of one said die, an end of a said stripping finger extending into each said die through said stripping groove, each said die sliding over a said finger end after each said body is capped whereby a cap remaining in a said die will be ejected.

22. An assembly machine comprising a first and a second drum, a shaft, said first and second drums being supported on said shaft and restrained to rotate together and with said shaft all at the same speed, said first drum having peripherally spaced notches in the surface thereof for receiving elongated members, die members axially slidably supported on the periphery of said second drum, said die members having cavities therein facing said notches in said first drum, loading means for loading cup shaped caps into said cavities as said drums rotate, said loading

means comprising means to deposit said caps between said drums and means to force said caps into said cavities, a cam fixed to said machine, follower members on said die members engaging said cam, forcing said die members toward said first drum whereby said caps are forced over the ends of said elongated members, a third drum disposed on said shaft on the side of said first drum opposite said second drum, said third drum being substantially identical to said second drum, and a second cam disposed adjacent said third drum.

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