ABSTRACT: A method and an apparatus are disclosed for the fabrication of tampon applicator tubes in which thin-walled tube blanks are supplied, without damage, by a feeder mechanism to a tube forming unit which shapes the forward end of each tube, in a sequence of operations including crimping, folding inwardly, exercising to weaken the folds to facilitate ejection of the tampon, and refolding. The tubes are resiliently carried by tube supports mounted on a first, intermittently rotatable turret and are positioned to be actuated upon substantially simultaneously by a set of dies carried by a second turret reciprocally mounted to advance and retract to and from tube engaging positions. Both outer and inner tampon applicator tubes may be formed in this manner by utilizing appropriately shaped tube supports and dies. After shaping the forward ends, the tubes are transported to a machine which applies and bonds a ring to the outer tube near the rear end thereof. Bonding is accomplished by gluing the ring to the outer surface of the tube with a suitable adhesive deposited in drops by an extrusion means.
FIG. - 35

FIG. - 33

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FIG. – 39

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APPLICATORS FOR CATAMENIAL DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

The present invention relates generally to catamenial tampon devices and more particularly to an improved method and apparatus utilized in the fabrication of applicator tubes containing such devices. The aforementioned U.S. Patent Nos. 3,204,635 and 3,358,354 disclose, respectively, an improved catamenial tampon applicator of the type utilizing an outer tube for containing the tampon and an inner, tampon-ejecting tube slidably received within the outer tube, and a method for forming the ends of these tubes. According to the aforementioned patents, the forward end of the outer tube is provided with a generally conical shape to facilitate insertion of the applicator into the vagina. The conically-shaped forward end of the outer tube comprises a plurality of dovetailed folds or pleats which provide a structure easily opened from the inside, thereby permitting the user to eject the tampon without having to exert undue pressure of force. The inner, tampon-ejecting tube includes a tampon-engageing forward end having a reduced diameter and structured similarly to the forward end of the outer tube, in that it constitutes a plurality of folded or pleated sections.

U.S. Pat. No. 3,347,234, entitled Hygienic Devices, issued Oct. 17, 1967 to Joseph A. Voss, one of the joint inventors herein, and based on application Ser. No. 387,590 filed Aug. 4, 1964, relates to an improved applicator in which a ring is secured to the outer surface of the outer tube member. The ring has a dual function, acting to both improve gripping of the applicator and to reinforce the outer tube to prevent deformation because of gripping pressure during use of the device. The ring allows relatively thin sheet material to be used for the outer tube. This facilitates the shaping of the generally conical forward end and reduces the overall, outer diameter of the applicator while retaining a relatively large internal diameter to accommodate a tampon having a large menstrual flow absorbing capacity.

One problem which arises as a result of using thin walled tubes however, is that such tubes tend to distort easily and handling techniques must be devised to prevent such distortion or deformation during fabrication of the applicator tubes. On the other hand, it is also desirable to produce the applicator tubes rapidly, on an automatic basis, to minimize fabrication costs and thereby minimize cost to the consumer. It is further desirable that the tampon applicator tubes all be uniform in appearance and dimension.

BRIEF SUMMARY OF THE INVENTION

One aspect of the present invention relates to apparatus including a tube blank feeder unit, a tube forming or shaping unit, and a ring applying and bonding unit. These cooperate to automatically fabricate, on an economical production basis, with minimal losses due to damage, a relatively thin walled, outer tampon applicator tube having a pleated, conically-shaped forward end, as disclosed in the aforementioned U.S. Pat. No. 3,204,635 and having a reinforcing and gripping ring near the rear extremity, broadly in accordance with the teachings of the aforementioned U.S. Pat. No. 3,347,234.

Broadly, the tube blank feeder unit comprises a hopper for holding a supply of tampon applicator tube blanks, the hopper having means for controlling the discharge of the tube blanks from the hopper. A tube blank orienting and feeding mechanism is positioned to receive the tube blanks from the hopper. A sensing means is further provided to sense the level of the tube blanks in the orienting and feeding mechanism, the sensing means having an output operatively connected to control the tube discharge rate from the hopper, so as to avoid damage to the tubes.

The tube blanks are automatically transported from the feeding unit to the tube forming or shaping unit. Broadly, this machine includes a first structure having tube supporting means providing therefrom and a second structure, disposed opposite the first structure, carrying tube forming dies. The structures are indexed through a series of dwell stations and reciprocated relative to one another through one cycle per dwell period so that the dies work substantially simultaneously and in sequence on the ends of the tubes, and further, in the tube supporting means. The basic process performed by this machine includes initially crimping the projecting tube end, compressing or folding the tube end into dovetailed folds or pleats, exercising the tube ends one or more times by expanding the cramped and folded end followed by a refolding operation. In the last operation, a pin, located coaxially within the die leaves a small, centrally located aperture in the forward extremity of the tube. This assures that the folds will be symmetrical about the axis of the tube and uniform in appearance and further aids in reducing the force required to eject the tampon.

The tube support means on the shaping unit forms another aspect of the invention. The rear portion of each tube blank is slidably received on a punch fixed to and projecting from the first structure. The rear extremity of each tube bears against resilient means carried by the punch so that the tube may move back over the punch during treatment by the various die means. In the case of the initial crimping or folding operation, the tube may move back a small distance and this serves to accommodate manufacturing tolerances in the overall length of the tube, increases the time of contact between the die and the tube and prevents collapse of the tube. In the folding operations, the female die, which projects from the punch, has a structure than the crimping die, forces the tube substantially all the way back over the punch against the bias of the resilient means to compress and squeeze the folded forward end of the tube against the forward end of the punch to thereby form the desired pleats.

The tubes thus formed are next transferred to a ring-applying unit which broadly includes an indexing turret having a series of projecting punches for receiving and holding the tubes. The turret is intermittently rotated or indexed through various dwell stations including a glue-applying station at which an automatically operated glue dispenser places several drops of glue on the outer surface of the tube near the rear end thereof. The turret is then indexed to a succeeding station at which a ring is placed about the tube adjacent the rear end thereof, after which the tube is unloaded at an unloading station.

According to another aspect of the invention, relating to the tube unloader device for both the tube forming unit and the ring applying and bonding machine, a motor driven paddle wheel is positioned at the respective unloading stations of the tube forming and ring applying and bonding units. The paddle wheel has a plurality of rubber jacketed paddles projecting therefrom which come into frictional engagement with the tubes during rotation of the unloader motor to propel the tubes of the tube supports, as they arrive at the unloading station.

BRIEF DESCRIPTION OF THE DRAWINGS

Other aspects of the invention, along with other objects and advantages thereof, will become apparent from a reading of the detailed description, below, in connection with the drawings in which:

FIG. 1 is a side elevation view of a tampon applicator device fabricated in accordance with the present invention;

FIG. 2 is a front elevation view of conforming device of FIG.

FIG. 3 is a longitudinal, sectional view of the device of FIG. 1 along with the plane 3-3;
FIG. 4 is a transverse, sectional view of the device of FIG. 1 along the plane 4–4;
FIG. 5 is an enlarged, transverse, sectional view of the device of FIG. 1 along the plane 5–5 in which the ring is glued in place;
FIG. 6 is a longitudinal, sectional view of a portion of a tube blank hopper and feeder unit in accordance with certain aspects of the invention;
FIG. 7 is a perspective view of a vibrating bowl feeder device used in connection with the apparatus of FIG. 8 for feeding tube blanks;
FIG. 10 is an enlarged, transverse, sectional view of the apparatus of FIG. 8 as taken along the plane 10–10;
FIG. 11 is a plan view, in section of a portion of the apparatus of FIG. 8 as taken along the plane 11–11;
FIG. 12 is a side elevation view, in section, of a tampon applicator tube shaping machine in accordance with certain aspects of the invention;
FIG. 13 is a transverse, sectional view of the apparatus of FIG. 12 as taken along the plane 13–13 showing an example of a turret indexing mechanism;
FIG. 14 is a transverse, sectional view of the apparatus of FIG. 12 along the plane 14–14 showing certain details of the punch turret assembly;
FIG. 15 is a side elevation view of the punch turret assembly showing aspects of the present invention including details of the punch assemblies;
FIG. 16 is a transverse, sectional view of the apparatus of FIG. 12 as taken along the plane 16–16 showing certain details of the die casting assembly;
FIG. 17 is a longitudinal, sectional view of a crimping die assembly in accordance with the invention, for forming the forward end of the tube, shown in operating relationship with a tube blank end punch carrying the tube;
FIG. 18 is a transverse, sectional view of the crimping die shown in FIG. 17 along the plane 18–18;
FIG. 19 is a side elevation view, partly in section, of a conical folding or compression die shown in operating relationship with a tube and punch;
FIG. 20 is a side elevation view of an exercising die shown in operating relationship with a tube and punch;
FIG. 21 is a side elevation view of another exercising die shown in operating relationship with a tube and punch;
FIG. 22 is a side elevation view of still another exercising die shown in operating relationship with a tube and punch;
FIG. 23 is a longitudinal, sectional view of a folding and hole-forming die shown in operating relationship with a tube and punch;
FIG. 24 is a front elevation view of a tube loading magazine assembly used in connection with the tube shaping machine;
FIG. 25 is a plan view, in section, of the assembly of FIG. 24 as taken along the plane 25–25;
FIG. 26 is a side elevation view, partly cut away, of the assembly of FIG. 24 showing also details of a tube unloading mechanism according to the invention;
FIG. 27 is a schematic representation, in section, of an air ejector device used to assist the transfer of tubes from the tube shaping unit to the ring-applying unit;
FIG. 28 is an end elevation view of the apparatus of FIG. 12 showing certain details pertaining to the electrical/pneumatic control system;
FIG. 29 is a block and schematic representation of an electrical/pneumatic system utilized in controlling the apparatus of FIG. 12;
FIG. 30 is a side elevation view, partly in section, of an alternative punch and crimping die arrangement for forming the forward ends of inner applicator tubes;
FIG. 31 is a side elevation view, partly in section, of an alternative punch and folding die arrangement used in connection with the crimping apparatus of FIG. 30 for folding and compressing the crimped, forward end of inner applicator tubes;
FIG. 32 is a side elevation view of the exterior of a ring applying and bonding machine in accordance with certain aspects of the present invention;
FIG. 33 is a transverse, sectional view of a portion of the machine of FIG. 32 along the plane 33–33;
FIG. 34 is an end elevation view of the machine of FIG. 32 including a schematic and block representation of an electromechanical circuit utilized in connection with the operation of the ring-applying and bonding machine;
FIG. 35 is a side elevation view, in section, of a portion of the machine shown in FIG. 34 along the plane 35–35;
FIG. 36 is a partial, front elevation view, partly in section, of a tube magazine and loader mechanism for use with the ring-applying machine;
FIG. 37 is a plan view, in section, of the mechanism of FIG. 36 along the plane 37–37;
FIG. 38 is a transverse, sectional view of a portion of the mechanism of FIG. 36 along the plane 38–38;
FIG. 39 is a partial, transverse sectional view of the machine of FIG. 32 as taken along the plane 39–39;
FIG. 40 is a perspective view, partly in section and partly cut away, of a ring-applying mechanism;
FIG. 41 is a partial side elevation view, partly in section, of the ring-applying mechanism of FIG. 40 in the retracted position;
FIG. 42 is a partial side elevation view, partly in section, of the ring-applying mechanism of FIG. 40 in the extended or advanced position;
FIG. 43 is an end elevation view, partly cut away, of the ring-applying machine of FIG. 32 showing the tube unloader mechanism;
FIG. 44 is a longitudinal, partial sectional view of an alternative tube exercising means shown in the retracted position, and
FIG. 45 is a longitudinal, partial sectional view of the device of FIG. 44 shown in the advanced position.

DETAILED DESCRIPTION

The apparatus of the present invention is particularly suitable for fabricating the outer and inner, thin walled tubes 10 and 12, respectively, of a tampon applicator assembly such as that depicted in FIGS. 1–5 of the drawings, and disclosed in the aforementioned U.S. Pat. Nos. 3,204,635 and 3,347,234. The applicator houses a tampon 14 contained in the forward portion of the outer tube 10 and the inside tube 12 is slidably telescoped within the outer tube 10 behind the tampon 14. The forward end of the inner tube 10 has been crimped and folded into a conical tip 16 with a small central aperture 18. The tip 16, as best shown in FIG. 4, comprises a dovetail or pleated arrangement including a series of outer folds 20 overlapping a series of inner folds 22. This structure, in combination with the thinness of the wall, facilitates ejection of the tampon as the conical end opens easily. The forward end of the inner tube 12 is crimped and folded to form a forward section 24 of reduced diameter. Like the conical tip 16 of the outer tube, the necked down section 24 consists of a series of overlapping pleats such as that depicted in FIG. 4.

To facilitate gripping of the outer tube 10 by the user, and to reinforce the tube 10, which because of its thin wall would otherwise be easily deformable, a ring 26 is bonded about the rear end of the tube. The ring 26 makes possible the use of a smooth textured exterior tube surface; it aids the user in locating the rear extremity of the outer tube and thereby provides a means for orienting the applicator to positively guide its insertion.

As shown in FIGS. 5 and 6, the outer tube 10 may comprise, by way of example, a laminated structure including an inner layer 28 of kraft paper, foil or plastic or the like, and an outer layer 32 of glazed paper, foil, or smooth polyethylene plastic film or the like. An intermediate layer 34, of paper, for example, may also be used. The inner tube 12 may be constructed,
for example, of a main lamination 36 of kraft paper enveloped in an outer layer 38 of polyethylene plastic or the like. The ring 36 may be fabricated of any suitable material such as paper, paperboard, rubber, emery board, plastic, metal, ceramic, or the like. It is dimensionally sized to slightly frictionally engage the outer surface of the tube 10, and is suitably bonded in place as will be described in detail later.

Referring to FIG. 7, the apparatus according to certain aspects of the present invention, includes generally a tube blank feeder unit 40, a tube forming unit 42 and a ring-applying unit 44. A first conduit 46 is provided for transporting cylindrical tube blanks 45 from the feeder unit 40 to the forming unit 42; the formed tubes are transferred from the forming unit 42 to the ring-applying unit 44 by means of a second conduit 48.

Referring now also to FIGS. 8-11, the feeder unit 40 comprises a frame 50 on which a tube blank hopper 52 and vibratory bowl feeder assembly 54 are supported. The hopper 52 is rigidly supported by the frame 50 and is provided with a downwardly tapering funnel section 56 at its bottom. The funnel 56 terminates at its lower extremity in a plate 58 provided with an opening 60, which opening may be square, as shown. A vibratory assembly 62 is suspended from the funnel 56 beneath the opening 60 by springs 64. The assembly 62 comprises a support plate 66 having a central opening 68, which opening is in vertical alignment with the opening 60 and may also be square, and a vibratory motor 70 is suspended from the bottom of the plate 66 by means of struts 72. The motor 70 may be of conventional construction and may, for example, be of the type including an eccentrically rotated weight to give a large displacement at a relatively low frequency.

The vibratory bowl feeder assembly 54 includes a bowl 74 mounted on a vibratory bowl 76. The assembly 54 may be a commercially available unit of the type sold, for example, by the Syntron Company, Homer City, Pa. The bowl 74 is formed with a spirally inclined track 78 which terminates at an exit opening 80 along the upper rim of the bowl 74. The vibratory bowl 76 vibrates the bowl 74 in such a manner that the cylindrical tube blanks 45, out of which the applicator tube 10 or 12 are to be formed, are induced to advance upwardly in general end-to-end relation along the spiral track 78. The bowl 74 is provided with a pair of wedges 82 and 84 for the purpose of assuring that only a single line of tube blanks 45 travel to the outlet opening 80. The wedge 82 is disposed at a height of about one tube diameter above the spiral track 78 to peel off any tube layer above the bottom layer. The wedge 84 is disposed on the track 78 so that this wedge 84 peels off all adjacent rows of tube blanks except one.

Energization of the motor 70 is controlled by means of a tube level sensing means 86. A lever 88 is pivoted on the frame 50 at the point 90 and extends downwardly into the interior of the bowl 74. The level 88 has a paddle 92 mounted on its lower end to extend to a selected depth into bowl 74. The lever 88 is connected to a switch 94 by a linkage rod 96, the switch 94 being coupled by electrical connection 97 in the electrical supply circuit of the motor 70.

In the operation of the feeder unit 40, the tube blanks 45 are first loaded into the hopper 52. The tube blanks 45 accumulate in the funnel section 56 and tend to clog the opening 60 so that the tube blanks do not pass through. The opening 60 is of sufficiently small size with respect to the dimensions of the tubes 45 that clogging will always occur. It may now be assumed that there is an insufficient supply of tube blanks 45 within the bowl 74, that is, the tube level has dropped below the selected depth to which the paddle 92 extends. The level 88 is then oriented vertically as shown in FIG. 8, and the switch 94 is actuated to energize the vibratory motor 70. The motor 70 with the plate support 66 now vibrates on the springs 64. This vibration shakes the clogged tubes loose, and they fall gently through the openings 60 and 68 and on top of the motor 70. The gentle oscillation of the motor 70 then causes the tubes 45 to fall off the motor and into the bowl 74. The presence of the tubes 45 to the selected level results in the tubes making contact with the lever 88 to move it off center to open the switch 94 and stop the motor 70. It has been found that for proper feeding of tubes there should be at least one layer of tubes on the bottom of the bowl 74 and the paddle 92 and lever 88 are so adjusted vertically as to maintain this level of tube blanks. There thus is a constant, measured supply of tubes 45 within the bowl 74, the vibratory bowl 74 in such a manner as to cause the tubes to move slowly upwardly in continuous, end-to-end fashion on the inclined track 78 until they reach the exit opening 80. As already explained, the wedges 82 and 84 function to assure that only a single row of tube blanks 45 reaches the exit opening 80; it will be apparent, however, that appropriate repositioning of the wedges would provide multiple rows of tubes which may be useful, for example, for feeding multiple tube forming units exemplified by the unit 42.

Turning now to FIGS. 12-29, a tube forming unit 42 is depicted which comprises, in general, a base 100, an intermittently rotatable turret assembly 102, a reciprocating die plate assembly 104, a tube blank loading magazine assembly 106 and a tube removal assembly 108.

The rotatable turret assembly 102 comprises a turret wheel 110 which is intermittently rotated to successive dwell stations by a motor 112 operating through a Geneva mechanism 114, best shown in FIGS. 13 and 14. The Geneva mechanism 114 includes a Geneva wheel 116 having a plurality of arc-shaped peripheral depressions 118 and radially extending slots 120 in one of its faces. A continuously rotatable driver 122 is provided with a concentric, cutaway hub 124 which rides within the depressions 118 and also carries an eccentric shaft 126 adapted to enter the slots 120 in succession to index the wheel 116. The Geneva wheel 116 is fixedly secured to the turret wheel 110 and both wheels 116 and 110 are rotatably disposed on a central shaft 128 which is fixed with respect to the base 100. The driver 112 is mounted on a jackshaft 130 which is rotatably disposed in the base 100. The shaft 130 and driver 122 are driven by means of a timing belt 142 which extends over pulleys 134 and 136 respectively driven by the motor 112 and fixed on the shaft 120.

The die plate assembly 104 comprises a generally cylindrically-shaped casting 140 which is reciprocably mounted on the central shaft 128 by means of linear ball bushings 142. An air cylinder 144 has its piston 146 connected to the casting 140 and is fixed onto the base 100. The casting 140 is provided with two symmetrically radially extending externally threaded portions 148 and 150. The base 100 has a rib portion 152 to which one end of the shaft 128 is fixed and the clevis leg 150 extends through an opening 154 in the rib portion 152. A U-shaped casting 156 is connected to the two clevis legs 148 and 150 and the piston 146 is fixed to the casting 156 so as to, in effect, connect the piston 146 to the casting 140. It is to be understood that other means, such as a rotating cam acting on a cam follower carried by the casting 140, may be used to reciprocate the casting 140.

In the example depicted in the drawings, particularly FIGS. 12, 14 and 15, the turret wheel 110 has eight substantially identical punches 160 affixed to it by nut fasteners 161. The punches 160 are equally spaced with respect to each other and symmetrically disposed in a circular pattern about the center of the shaft 128 and extend from the turret 110 parallel with the shaft 128. It will be apparent from the description which follows that virtually any number of punches may be provided, depending upon the number of processing steps to be performed. In FIG. 15, it will be noted that each of the punches 160 has a sleeve 162 slidably disposed on it. Each sleeve 162 is provided with an axially extending slot 164 which slidably receives a transverse pin 166 extending through the punch 160 to limit the axial displacement of the sleeve. The sleeve 162, at its forward end, has a radially extending flange 168 and a spring 170 is disposed between the flange 168 and a shoulder 172 on the punch for the purpose of resiliently biasing the sleeve 162 away from the turret wheel 110. The punches 160 are substantially identical in length, diameter, tip profile, etc.,
and the springs 170 and sleeves 162 are also substantially identical. In connection with the springs 170, the spring rate and mechanical performance are preferably identical.

As will hereinafter be more fully described in the example under discussion the tube blanks 45 are loaded on the punches 160 when the turret wheel 110 is at dwell station a (see FIG. 14); the forward ends of the punches are crimped at the next dwell station b; the tube ends are then folded inwardly to generally conical shapes at a station c; the tubes are next partially open at a first exercise station d; opened further at a second exercise station e; opened still further to approximate their original diameters at a third exercise station f; the tubes are then refolded into the conical shape at station g and the tip of the tube provided with a spherical profile; and a small, centrally located hole; and the tubes are lastly unloaded at position h, all of these stations being angularly displaced from each other by 45°.

Referring to FIGS. 16—23, the casting 140 is provided with axially extending dies 180, 182, 184, 186, 188 and 190. In the example being considered, these dies are spaced 45° apart, and they are mounted so as to be in axial alignment with six of the punches 160 when the turret wheel is positioned at dwell stations b, c, d, e, f and g.

As best shown in FIGS. 17 and 18, the die 180 comprises a tubular outer housing 192 having a crimp insert 194 secured by a setscrew 195, a piston 196 slidably disposed within the housing 192 and having a portion 198 extending into the insert 194. An abutment screw 200 is disposed within the outer end of the housing 192 and a compression spring 202 is interposed between the screw 200 and the piston 196. The insert 194 is provided with eight axially extending blades 204, and the piston extension 198 terminates in a segmented head 206 provided with slots 208 that receive the blades 204. The piston 196 has an end shoulder 210 that is adapted to abut against a shoulder 211 within the housing 192 so as to prevent the piston 196 from moving too far outwardly from the crimp insert 194.

The die 182 (FIG. 19) is provided with a concentric, generally conical cavity 212 within its outer end, which cavity forms the female counterpart of the conical tips of the punches 160. The die 182 is a one piece unit, having no moving parts.

The dies 184, 186 and 188 (FIGS. 20, 21 and 22, respectively) are generally similar but are of increasing diameter, the die 184 having a relatively small diameter body portion 214 with a pointed tip 216. The die 186 has a body portion 218 which is of larger diameter than the body portion 214, and has a relieved blunt tip 220. The die 188 has a body portion 222 that is larger in diameter than the body portion 218 and has a rounded tip 224.

The last die 190 (FIG. 23) has in its outer end a concentric, conical cavity 226 having a rounded bottom 228. A pin 230 is disposed within an axially extending bore 232 in the die 190, the pin 230 extending through a central aperture 234 into the conical cavity 226. The pin 230 is provided with a shoulder 236, and a compression spring 238 is disposed within the bore 232 extending between the shoulder 236 and a screw 240 closing the bore 232 to bias the pin 230 toward the conical cavity 226.

Referring to FIGS. 12, 14 and 15, rollers 242, 244 and 246 may be provided for fractionally retaining the paper tubes on the punches 160 during the exercising steps at the dwell stations d, e and f. Each of the rollers 242, 244, 246 is rotatably disposed on an axle 242 carried by a block 250 which in turn is fixed to the central shaft 125. The rollers 242, 244 and 246 prevent the tubes from being pulled off the punches 160 when the exercising dies are withdrawn, as will be further explained later.

Turning to FIGS. 24—26, the tube blank loading assembly 16 comprises a rigid magazine body 252 which has a channel 254 formed therein. The channel 254 is closed by a fixed plate 256 and a longitudinally reciprocating plate 258. The magazine body 252 has an opening 260 which is connected to the exit opening 80 of the vibrating bowl feeder assembly 56 by means of the first conduit 48, preferably in the form of a Plexiglas tube. The plates 256 and 258 may also be made of a transparent material such as Plexiglas to facilitate viewing of the tube blank supply.

As will be hereinafter described in greater detail, the tube blanks 45 are fed under longitudinal pressure through the tube 46 into the channel 254 and a vertical displacement assembly 262 is provided for pushing the individual tubes 45 downwardly into the magazine channel 254. The assembly 262 comprises a displacement block 264 movably vertically for approximately the diameter of a tube 45 within the channel 254 and an air cylinder 266 for vertically moving the displacement block 264.

The channel 254 is provided with a sloping bottom 268, and a trough 270 is provided in communication with the bottom 268 to receive tubes 45 one at a time by gravity feed. The reciprocating plate 258, which extends downwardly into the trough 270, is connected directly to the reciprocable casting 140 of the die plate assembly 104 by means of a right-angle bracket 272. The trough 270 is located so that a tube 45 within the trough is in axial alignment with a punch 160 positioned in the loading station a.

The tube removal assembly 105, depicted in FIG. 26, comprises a constantly running motor 274 mounted on the base 100 and a paddle wheel 276 driven by the motor 274. Four paddles 278 of soft rubber tubing are fixed equidistantly about the periphery of the wheel 276, and the wheel 276 is so oriented that the outer extremities of paddles 278 will fractionally engage a finished tube 45a carried by a punch 160 at the unloading station h, the direction of rotation of the motor 274 being such as to move the finished tube away from the turret wheel 110. It will be noted in FIGS. 16 and 26, for example, that the casting 140 has a cutaway portion to accommodate both the loading and unloading mechanisms.

The second conduit 48, which may be in the form of a Plexiglas tube, is located in axial alignment with a punch 160 positioned at the unloading station h so that formed tubes 45a are propelled by the paddle wheel 276 into the tube 48. The tube 48 is provided with a T-fitting 280, as shown in FIG. 27, and an air hole 282 is provided through the fitting 280 and through the wall of the tube 48. The hole 282 is pointed downstream at an acute angle with respect to the longitudinal axis of the tube 48 to assist the movement of the tubes away from the tube shaping unit 42. The fitting 280 is connected to a source of air pressure by means of an air hose 284.

Turning now to FIGS. 28 and 29, air pressure to the cylinders 144 and 266 is controlled by a pair of electrical switches 290 and 292. The pulley 136 is provided with a cam 294 which is adapted to actuate each of the switches as the pulley 136 rotates. The switches 290 and 292 are a part of an electrical control circuit shown in FIG. 29 and are connected to a source of current by two electric leads 296 and 298. The switches 290 and 292 are each connected to the lead 296, and the switches 290 and 292 are respectively connected with pneumatic valves 300 and 302 which are also connected to the lead 298. An air line 304 is connected to each of the pneumatic valves 300 and 302, and the valves are respectively connected to opposite ends of the cylinder 144. The air cylinder 266 is connected to the valve 300 as shown.

In operation, the tube forming unit 42 receives tube blanks 45 through the Plexiglas tube 46 and these tube blanks are fed into the upper end of the channel 254. The tubes 45, as they travel through the tube 46 from the vibrating bowl feeder unit 40, are under axial pressure from the action of the vibratory bowl feeder assembly 54 and they do not, therefore, fall freely into the channel 254 without mechanical assistance. The assembly 262 provides this mechanical assistance and the air cylinder 266 has air pressure supplied to it, as will be hereinafter described, for each of the tubes 45 that are withdrawn from the lower end of the channel 254.

The casting 140 is reciprocated by means of the air cylinder 144, and for each forward reciprocation of the casting 140...
toward the punches 160, the loading magazine assembly 106 discharges a tube 45 onto a punch 160 in the loading station a. A tube 45 is positioned in the trough 270, and the plate 258 is retracted along with the casting 140 since it is connected to the casting. The plate 258 receives a tube 45 in a cutout portion 306 and on forward movement of the plate 258 it slides a tube 45, nested in a notch 259 in the plate 258, onto a punch 160 then in the loading station a. The tube 45 is thus pushed into a carrying position in which the sleeve 162 is at its most forward position with the rear extremity of the slot 164 bearing against the pin 166. The length of the portion of the punch 160 projecting forwardly from the flange 168 is considerably shorter than the overall length of the tube blank 45, so that in the normal carrying position, the front portion of the tube 45 extends unsupported from the front tip of the punch.

As the operation continues, each of the punches 160 will eventually have one of the tubes 45 loaded on it by means of the reciprocating plate 258 and the various dies carried by the casting 140 perform various operations substantially simultaneously on the ends of the tubes 45 at the various stations b to g, inclusive.

Referring again to FIG. 17, on the forward stroke of the casting 140 the die 180 crimps, that is, provides multiple folds in the forward end of the tube 45 at dwell station b. This crimping forces the blanks 45 individually and folds the paper wall of the tube 45 inwardly. The head 206, functioning as a stripper device, engages the forward extremity of the tube 45 as the die 180 moves over the tube, the spring 202 being thereby compressed. Upon retraction of the die 180 the head 206 under force from the spring 202, will eject the tube 45 from within the crimping die 180. It is necessary that the blades 306 be tenderly grasped by the paper folds formed in the end of the tube 45.

During the crimping operation by the die 180, the die 180 slides the tube 45 and the sleeve 162 back on the punch 160 a short distance in opposition to the action of the spring 170. It will be appreciated that the spring 162 allows compensation to be made for manufacturing tolerances in the overall length of the tubes; additionally, the resilient cushion provided by the spring 162 protects the tube from damage as a result of sudden impact upon contact by the crimping die, and increases the length of time that the die is in engagement with the tube end to assure that the crimped folds will have the required depth. The flange 168 of the sleeve 162 may be enlarged because the blades 306 are tend to be firmly grasped by the paper folds formed in the end of the tube 45.

The body portion 214 of the die 184 is relatively small in diameter compared to inside diameter of the tube 45. In one practical example, the inside diameter of the tube 45 was .578 inch and the diameter of the die body was about .250 inch. The body portion 214 is projected into the opening in the forward extremity of the cramped tube 45. At the forward extreme of the travel of the die 184, a small punch 310 remains between the pointed tip 216 and the tip of the punch 160. The front end of the tube 45 is opened slightly by the die 184.

The succeeding die 186 enters the cramped end of the tube 45 and has the same action as the die 184 but, as a result of the larger diameter of the body portion 318, about .375 inch in the aforementioned practical example, the die 186 opens the tube still further as may be seen in FIG. 31. The die 186 is depicted in FIG. 32, and is inserted in a die block 244 and 246, respectively, into the forward extremity of the tube 45. The die 186 is thus almost completely back to its original form except, of course, that on retraction of the casting 140 and die 186, wall of the folds remain in the front end of the tube. Also, the forward end of the tube 45 has now been so weakened along the fold lines that the end of the tube 45 will easily fold back into the pleated configuration when engaged again by a folding die.

As noted, the purpose of the exercising operations is to weaken the conically-shaped shaped tube end to facilitate the discharge of a tampon from the final product with minimum effort. The number of exercising operations is thus dictated chiefly by the material used to form the tube. If a sufficiently weak tube paper is utilized, only one exercising operation, for example, may be required. In that case, of course, correspondingly fewer dies, punches and dwell stations are needed and, if desired, the turret wheel 116, the casting 140, and the indexing mechanism 242 and 244 and 246 and 248, may be modified accordingly. Such modification will be apparent to those ordinarily skilled in the art and are deemed to fall within the purview of the present invention.

The die 45 at the station g is treated by the die 190 as shown in FIG. 23. The die 190 is moved toward the punch 160 dwelling at station g, the pin 230 enters the tip of the tube, and the side surfaces of the conical cavity 226 compresses the conical of the tube 45 against the punch forming the end into a conical shape, with the pin 230 assuring that a small opening 18 (see FIGS. 2 and 3) remains in the tip of the finished tube 45a. One purpose of the hole 18 is to lessen the amount of pressure required to open the forward end of the tube during use of the tampon applicator. It should be noted again that the conical cavity 226 has a rounded bottom 228 so that the end of the final tube 45a is not exactly a cone. The tube 45 readily refolds on its original fold lines and the pin 230 serves as a guide to assure that the fold pattern is symmetrically about the longitudinal axis of the tube, thereby preventing lopsided bunching of the folds which tends to decrease the effort required to expel the tampon and providing a neat, concentric appearance. The action of the die 190 at the station g is substantially the same as the action of the die 182 at station c in that the die 190 squeezes the folded end of the tube 45 over the conical end of the punch 160. Just prior to the time of impact by the die 190, the pin 230 contacts the tip of the punch 160 and is forced back against the bias of the spring 238. On retraction of the die along with the casting 140, the pin 230 returns to its initial position.
The finished tube 45a, positioned on the punch 160 at the station h, is unloaded from the punch 160 by means of the rotating paddle wheel 276. As already mentioned, the paddles 278 contact the tube 45a on the punch 160 and propel it into the conveyor tube 48.

In the specific example considered, in which eight stations are used, The Geneva mechanism 114 causes the turret wheel 110 to index 45° at a time so that each of the punches 160 dwells at each of the stations a to h for a predetermined length of time. The number of stations a to h, the number of the turret wheel 110, and the duration of the dwell period of the turret wheel 110 can be varied to suit the particular type of tube to be manufactured. The switches 290 and 292 are positioned relative to one another and the cam 294 so that the casting 140 is caused to reciprocate through one complete cycle, that is, forward and back, during the dwell period of the turret wheel 110. Referring to FIG. 29, the cam 294 rotates at a constant angular velocity and during its rotation it actuates the switch 290 substantially simultaneously with the beginning of the dwell period. The cam 294, approximately one-half revolution later, actuates the switch 292 and this concurs with the end of dwell and the start of the indexing motion of the turret wheel 110. The switch 290 is connected with the solenoid valve 300 and when the switch 290 is energized, air pressure from the line 304 is supplied through the valve 300 to the rear end of the cylinder 144 so as to propel the die plate assembly 104 toward the turret 110 so as to cause the previously described interaction between the dies and the tubes 45 carried by the various punches 160. When the switch 292 is energized at the end of dwell, this causes energization of the solenoid valve 302 and air pressure is admitted to the forward end of the cylinder 144 to cause retraction of the die plate assembly 104 and the operation of the Geneva mechanism 114.

Turning now to FIGS. 32-43, and particularly FIG. 32, the ring-applying unit 44 comprises, in general, a frame 340, a rotating and indexing turret assembly 342, a loading magazine assembly 344, a tube removal assembly 346, a glue-applying unit 348, a ring-applying assembly 350 and a vibrating bowl feeder 352.

Referring to FIGS. 32-34, it will be seen that the turret assembly 342 comprises a plurality of punches 354 which are rotatably mounted within a turret wheel 356. The punches 354 are disposed at equal intervals in a circular array. Each of the punches 354 has a pulley 358 affixed to its forward end and a plurality of belts 360 extend around the arrangement of pulleys 358, so that the punches 354 are rotatable in unison. A drive motor 362 is provided for rotating the punches 354 and, as best shown in FIGS. 33 and 34, a drive belt 364 extends around most of the pulleys 358 and also around a pulley 366 fixed to the drive shaft of the motor 362.

The turret assembly 342, as shown in FIG. 35, includes also a Geneva mechanism 368 which is driven by a jackshaft 370. The Geneva mechanism 368 is similar to the Geneva mechanism 114 described in connection with the tube forming unit 42 and functions to intermittently rotate or index the turret wheel 356. The jackshaft 370 is driven by a motor 372 via pulleys 374 and 376 mounted, respectively, on the jackshaft 370 and the shaft of motor 372 and a belt 378 extending about the pulleys 374 and 376. The ring-applying unit 44 is synchronized with the tube forming unit 42 and to this end the motor 372 is preferably energized from the same source of electrical supply as the motor 112. Preferably, both of these motors are synchronous electric motors and will therefore operate at the same angular velocity as a result of being connected to the same alternating current supply source.

In the specific example shown in the drawings, the turret wheel 256 is rotated to eight different dwell stations by means of the Geneva mechanism 368. Referring momentarily to FIG. 39, these stations include a tube loading station m, an intermediate station n, a glue-applying station o, an intermediate station p, a ring-applying station f, two intermediate stations r and s and a tube unloading station t, and each of the punches 354 successively advances in and out of these stations.

The tube magazine and loading assembly 344, which slides the formed tubes 45a one after the other onto the punches 354, in sequence, at the station m, is shown in FIGS. 36-38 and comprises a magazine 380 having a vertical, elongated channel 382 therein adapted to receive the formed tubes 45a and hold them g, a vertical stack with the individual tubes being horizontal and having the tubes 45a oriented rearwardly, that is, away from the turret wheel 356. The upper end of the channel 382 communicates with the interior of the Plexiglas tube 48, the tubes 45a being pneumatically transported through the tube 48 to the upper end of the magazine 380 by virtue of the action of the air ejector means 280, 282, 284. A soft rubber cushion 284 is provided at the end of the tube 48 to absorb the impact of the tubes 45a and thereby prevent distortion or damage to the conical tube ends.

The magazine 380 has a tube outlet opening 386 which is located in axial alignment and just rearwardly of a punch 354 in the tube loading station m. A plunger 388 is movable axially with respect to the opening 386 and is provided with a trough or seat 390 extending from its forward end for receiving the tubes 45a from the channel 382. Alternatively, on the jackshaft 370 having a piston 394 connected to the plunger 388 reciprocates the plunger 388. The plunger 388 has a slot 398 cooperating with a fixed pin 391 to prevent rotation of the plunger.

The glue-applying unit 348, depicted in detail in FIG. 39, and which operates basically as a glue dropper dispenser or extruder, includes a cylinder body 396 having a piston 390 slidably disposed rearwardly in the cylinder 392 having a piston rod 400 slidably disposed in and sealed with respect to the sides of a cylindrical bore 402 in the cylinder body 396. A return spring 404 is disposed between the enlarged piston portion 400 and a shoulder 406 at the lower end of the bore 402.
The piston 398 terminates at its lower end in a piston pin 408 which is slidably disposed in a relatively small diameter bore 412 in the cylinder body 396 provided with a laterally extending glue inlet passage 414 which is in communication with the bore 410. It should be noted that the bore 410 is of such a diameter, considering the relatively high viscosity of the glue used, that the glue will not drop from the lower end of the nozzle 412 without assistance from the piston 398, downward movement of which causes dispensation or extrusion of a droplet of glue from the nozzle. The stroke of the piston 398 may be adjusted, so as to regulate the volume of glue dispensed in each droplet, by means of a stop 416 threadedly received in the upper wall of the cylinder body 396 and having a lower extremity 418 for engaging the upper face of the piston 390. A glue reservoir 420 connected to a source of air pressure by a hose 422 is connected by a tube 424 to the inlet passage 414 so as to supply glue under slight pressure to the passage 416. Air pressure is intermittently supplied to the upper end of the bore 402, to move the piston 398, from a source of air pressure (not shown) through a tube 426, an air switch or valve 428, and a tube 430 connecting the air switch with the body 396. The air switch 426 is actuated by a mechanism to be hereinafter described. It should be noted that the nozzle 412 is positioned in the bore 410 above the piston 398 so that glue will be dropped on the portion of the tube which will carry the ring 26.

With reference now to FIGS. 32 and 40—42, the ring applying assembly 350 comprises a magazine 432 having a vertical, rectangular cross section slot 434 therein which is just slightly larger in width than the diameter of the rings 26. The slot 434 is connected to a tube 436 which turns up to the vibrating bowl feeder assembly 352. The vibrating bowl feeder assembly 352 is similar to, but smaller in size than, the vibrating bowl feeder assembly 54 described in connection with the tube blank feeder unit 40, and may also be a commercially available unit, such as that marketed by the aforementioned Synnotron Company. The vibrating bowl feeder 352 includes a spiral track bowl 438 which has ring orienting means analogous to the wedges 82 and 84, but this orienting means is so disposed with respect to the spiral track in the bowl 438 that the rings lie flat on the spiral track within the bowl 438 and travel into the upper end of the chute 436 with their axes vertical. The chute 436, for its complete length, has substantially the same thickness as the length of the rings so that, as they reach the bottom of the chute 436, they are stacked one on top of the other with their axes horizontal, as shown in FIG. 40, and enter the slot 434 in this position.

The ring applying assembly 350 comprises also a piston sleeve 440 reciprocable in a horizontal cylinder bore 442 formed in the magazine 432. The piston sleeve 440 has a longitudinal slot 444 cooperating with a pin 443 to prevent rotation of the piston sleeve. The internal diameter of the bore 444 in the sleeve 440 is just slightly greater than the external diameter of the tubes 45a. The sleeve 440 is provided with a counter bore 446 on its extreme tip which counter bore has a diameter just slightly greater than the outer diameter of the rings 26 and a length slightly greater than the outer diameter of the rings 26 and a length slightly less than the length of the rings 26. The top half of the counter bored portion of the piston sleeve 440 is cut away to provide an open portion 448 through which the rings 26 drop into the remaining lower half of the counter bored section. A forwardly tapering flat 450 is provided in the upper surface of the piston sleeve 440 at the forward extremity thereof to prevent the front, upper edge of the sleeve 440 from jamming against the next to last ring 26 (see FIG. 40).

A piston 452, slidably disposed within the sleeve 440, has a relatively small diameter, rearwardly projecting shaft 454. A compression spring 456 within a small diameter, elongated cavity in the sleeve 440 biases the piston 452. As shown in FIG. 40, the piston 452 is limited in its axial movement by a transverse pin 458 affixed to the shaft 454 and slidably received in a longitudinal slot 458 found in the wall of the sleeve 440. The purpose of the piston 452 will be hereinafter described. An air cylinder means 460 is provided for reciprocating the piston sleeve 440.

The tube removal assembly 346 (FIGS. 32 and 43) is substantially the same as the tube removal assembly 108 and comprises a motor 452 driving a paddle wheel 464, the periphery of which is tangent to the finished tubes 10 and in frictional engagement therewith during rotation to propel the tubes 10 off of the punches 354 at station 17.

Referring now to FIG. 34, the air cylinders 392 and 460 are controlled by a switch 464 and a cam 466 fixed on the pulley 374. The switch 464 has a depending actuating arm 468 riding in contact with the profiled surface of the cam 466 whereby the cam actuates the switch 464 as the pulley rotates. A solenoid air valve 470 is connected through the switch 464 with an electrical source 472. The solenoid air valve 470 is supplied with air pressure from an air line 474 and has two output pressure lines 476 and 478 connected, respectively, with the propulsion and retraction ends of the air cylinders 392 and 460.

Referring now also the FIG. 39, the air switch 428 is controlled by a cam 480 having three lobes 482, 484 and 486. The cam 480 is connected to the pulley 347 and the switch 428 is thus actuated in timed relationship with the rotation of the pulley. In the operation of the ring-applying unit 44, the punches 354 are rotated constantly by the motor 362, and the punch 354, in the tube loading station 40, has a tube 45a applied thereto from the magazine assembly 344. During each cycle, which corresponds to a revolution of the pulley 374, the switch 464 is closed by the cam 466, and the solenoid air valve 470 is thus actuated: that is, the valve 40 is of such construction that when so actuated air pressure is supplied to the pressure line 476 and air pressure is thus supplied to the air cylinder 392. A supply of formed tubes 45a is in the magazine channel 382, and the air cylinder 392 when energized advances the piston 394 forwardly and thus ejects the bottommost tube 45a onto the awaiting punch 354 which, in its loading station m, is in axial alignment with the opening 386 and the plunger 388. The plunger 388 is of substantially the same diameter as the tubes 45a and therefore the upper tubes 45a in the channel 382 are retained in their original positions until the plunger 388 retracts, at which time the next lowermost tube in the channel 382 drops into the seat 390. Retraction occurs when the cam rotates so that the tube 45a is disengaged from the original position and the solenoid air valve 470 recycles to provide air pressure in the pressure line 478 connected with the forward ends of the air cylinders 392 and 460.

The air switch 428 is actuated by each of the cam lobes 482, 484, 486 in sequence to apply drops of glue onto the base end of a tube 45a at the glue-applying station o. On each actuation of the switch 428, air pressure is supplied to the upper end of the piston 398, and the piston thus moves downwardly in the body 396 against the action of the spring 404 so as to move the piston pin 408 downwardly past the end of the inlet passage 414 and into the nozzle 412, thus ejecting a drop of glue. The cam 480 is so located on the pulley 374 and the lobes 482, 484 and 486 so spaced that the air switch 428 is actuated to eject drops of glue from the nozzle 412 onto a tube 45a while the turret wheel 356 is in its dwell condition. The cam lobes 482, 484, and 486 may be so spaced that drops of glue are applied approximately 120° apart on the tube 45a while the tube rotates.

The ring-applying assembly 350 is actuated once each cycle, along with the loading magazine assembly 344 when the solenoid air valve 470 is actuated. Air pressure is supplied both to the rear end of the air cylinder 460 and to the rear end of the cylinder 392 of the tube loading assembly 344, and the air pressure so applied to the air cylinder 460 of the ring-applying assembly 350 advances the sleeve 440. The sleeve 440 carries a ring 26 within its counter bore 446 forwardly and slides it onto the tube 45a dwelling in the ring-applying station q. The ring 26 is pushed over the complete
length of the tube 45a onto the glue previously applied by the unit 348. Air pressure is then applied to the forward end of the cylinder 460; the pressure line 478 to retract the sleeve 440 to its original position. A ring 26 above the glue joint is then applied and drops downward into the counterbored portion 446 of the sleeve 440.

The piston 452 has the function of assuring that the tube 45a is not retracted from its supporting punch 354 by frictional contact with the interior surface of the sleeve 440. As a result of the biasing action of spring 456, the piston 452 remains in contact with the top of the tube 45a during most of the retracting movement of the sleeve 440, thus firmly holding the tube 45a on the punch.

The unloading assembly 346 functions to unload the finalized tubes 10 at the station 5 in a manner already described. Any suitable receptacle may be provided for receiving the tubes 10 so unloaded from the puncher 354. A pneumatic tube 458, similar to the tube 48 can, for example, be utilized.

The intermediate dwell station 9 has no particular function; however, the station 5 provides so that the glue may dry slightly on the base ends of the tube 45a after being applied thereon by the glue-applying unit 348 and prior to receiving a ring 26. The rings 26 are applied at the station 9, as described above, and the intermediate dwell assembly 462 serves to allow further drying of the glue after the rings 26 have been applied onto the tubes prior to unloading at the station 5. As an alternative to using the exercising dies as exemplified by one or more of the dies 184, 186 and 188, a single station exercise system may be substituted in which each of the punches 160 is replaced by a punch assembly 490, as shown in FIGS. 44 and 45. With this embodiment, the dies 24 and 25 are exercised after crimping by opening or expanding the crimped forward end from the inside rather than by insertion of one or more dies from the outside.

Each of the punch assemblies 490 comprises a tube 492 with a thread portion extending through and fixed to the turret wheel 110 by nut 494. The tube 492 has a boss 496 drawn into contact with the front face of the turret wheel 110 by tightening the nut 494. The outer diameter of the portion of tube 492 extending forwardly of boss 496 is the same as the outer diameter of the punches 160 for receiving tube blanks 45. A stem 498 is reciprocably disposed in the tube 492 and has an enlarged, generally conically shaped head 500 on its front end which has essentially the same outer diameter as that of the head 500 matches in profile the front end of each of the punches 160 and is adapted to fit against the forward edge of the tube 492. A spring 502 is provided between the rear end of the tube 492 and a snap ring 504 disposed in a slot adjacent the rear end of the stem 498 to bias the head 500 against the front edge of the tube 492.

A sleeve 506, like the sleeve 162, having a forwardly positioned, radially extending flange 508, is slidably disposed on the tube, and a spring 510 is provided between the flange 508 and the boss 496. The sleeve 506 and the spring 510 have the same function as the sleeve has preferably the 162 and spring 170, in the first embodiment, already discussed, and the sleeve has preferably the same limited movement on the tube 492 by virtue of a pin 513 held transversely by the tube 492 and riding in an axially oriented slot 514 (shown in broken lines) provided in the sleeve 506.

A turret indexing mechanism providing six dwell stations may be used with the single exercise station under discussion but the eight station device already described can also be employed. In that case, each of the punch assemblies 490 is adapted to be operative in the station 9 of the turret wheel 110, and at this station the roller 244 is adapted to contact the tube 45 and hold it in place on the tube 492.

An air cylinder 516 having a plunger 518 is fixed to the base of the machine and disposed behind the turret wheel 110. The plunger 518 is in axial alignment with the stem 490 of the punch assembly 490 positioned at the station 9. One end of the air cylinder 516 is connected to the solenoid valve 302 and the other end of the air cylinder 516 is connected to the solenoid valve 300, it being understood that the cylinders 144 and 266 remain connected to the solenoid valves 300 and 302 as shown in FIG. 18.

In operation, the punch assemblies 490 have the same function as the punches 160 and cooperate in the same manner with the dies 180, 182 and 190, respectively, at the stations 9, 10 and 11, as has been previously described. glue-applying.

The forward stroke of the stem 498 for opening the crimped forward end of the tube 45 is accomplished by the air cylinder 515 which is energized by the valve 300 to advance the stem to the position shown in FIG. 45 in which the enlarged head 500 is disposed within the crimped portion of the tube 45 to penetrate and unfold that portion. At the same time, the valve 300 energizes the cylinder 144 for the purpose of advancing the die plate casting 140 and the cylinder 266 for the purpose of displacing a tube blank 45 downwardly into the magazine channel 254. As previously described, the foregoing occurs at the beginning of the dwell portion of the cycle. At the completion of the dwell period, the switch 292 is actuated so as to energize the solenoid valve 302, to admit air under pressure to the other ends of the cylinders 144, 266 and 516 to simultaneously retract the casting 140, the solenoid assembly 262 and the plunger 518, respectively, the retraction of the last element permitting the return of the stem 498 to its initial position (FIG. 44) by the action of the spring 502.

Although particular apparatus and methods have been described to illustrate various manners in which tampon applicator tubes can be fabricated, it will be appreciated that the present invention is not limited to such particular illustrations and descriptions, and modifications, alterations, and equivalent arrangements will suggest themselves to persons skilled in the art. For example, it will be obvious that, with the adoption of appropriate tube feeding and removal mechanisms, a tube forming unit such as the unit 42 may be oriented vertically with the reciprocating casting 140 positioned above the turret wheel 110, or vice versa.

Further, it will be obvious that the tube forming unit and the ring-applying and bonding unit may be combined into a single apparatus. To this end, the turret wheels 110 and 356 may be replaced by turret means having a sufficient number of stations to preform the tube shaping, ring-applying and bonding operations. These stations would include tube blank loading, applying, ring applying, tube end crimping, folding, exercising, refolding and unloading. If three successive exercising operations are necessary, a total of 10 dwell stations would be provided.

Accordingly any and all modifications, alterations, and equivalent arrangements which fall within the scope of the following claims should be considered to be part of the present invention.

We claim:

1. In an apparatus for automatically fabricating tampon applicator tubes, said tubes each having a forward end and a rear end, a machine for shaping the forward end of the tubes comprising:
   a first movable member;
   a plurality of elongated tube support means attached to said first movable member and projecting therefrom, said tube support means being shaped to slidably receive said tubes in axial fashion with the forward portion of said tubes projecting from the forward end of said tube support means and including resilient means adapted to be engaged by the rear ends of the tubes;
   means coupled to the first movably member for intermittently rotating said member through successive operational dwell stations between tube loading and unloading stations;
   a second movable member;
   a plurality of tube shaping elements attached to said second movable member and projecting therefrom in axial alignment with the tube support means to engage the forward ends of the tubes during dwell of the first movable
member, said tubes being adapted to slide rearwardly on the support means against the bias of the resilient means as a result of the engagement of the tube ends of the shaping elements to the length of the tube, or to fluctuating tolerances in the overall length of the tubes and to cushion the contact of said tube shaping elements against the forward ends of the tubes; and

means coupled to the second movable member for reciprocating the second member toward and away from the first movable member between tube engaging and dis-engaging positions, respectively, in timed relation with the intermittent rotation of the first member.

2. A machine, as defined in claim 1, in which:
   the first movable member comprises a rotatable turret;
   the indexing means comprises a Geneva movement driven by a continuously rotating motor means;
   the reciprocating means includes a piston coupled to the second movable member, a cylinder enclosing said piston and connected through valve means to a pressurized source of fluid; and
   said machine further including a cam connected to rotate with the Geneva movement motor drive means, and operatively associated with switch means to actuate the valve means.

3. A machine as defined in claim 1 in which the reciprocating means includes a cam rotated in timed relation with the indexing means, and a follower fixed to the second movable member and biased into continuous contact with the profiled surface of the cam.

4. In an apparatus for automatically fabricating tampon applicator tubes, said tubes having a forward end and a rear end, a machine for shaping the forward end of the tubes comprising:
   a base;
   a first turret, mounted on the base for rotation about an axis; an array of substantially identical, spaced, elongated tube support means projecting from the turret parallel to the axis, each support means comprising:
   a punch for receiving a tube and having a rear end fixedly secured to the turret and a forward end provided with a shape conforming to the final tube end shape, a sleeve mounted on the punch, the sleeve being axially slidable along the punch between limits and having a radially projecting flange at its forward extremity adapted to be engaged by the tampon applicator tube held by the punch, the length of the portion of said punch extending forwardly of the shoulder being shorter than the length of the tube to be processed, and a resilient means interposed between the flange and the turret for biasing the sleeve away from the turret; means coupled to the first turret for rotationally indexing said turret to successive dwell stations, said stations being equal in number to the number of support means; a second turret mounted on the base for reciprocation toward and from the first turret in a direction parallel to the axis; means coupled to the second turret for reciprocating said turret in timed relation with the indexing of the first turret;
   a number of elongated tube shaping and processing elements fixedly mounted on and projecting from the second turret toward the first turret parallel to the axis and adapted to substantially simultaneously act upon the forward ends of the tubes held by the support means, each said element being in axial alignment with one of the tube support means during dwell of the first turret, said elements including at least:
   a crimping die for forming a plurality of folds in the forward portion of the applicator tubes, and
   a compression die, conforming to the final shape of the forward end of the tube, for pressing the forward end of each tube against the forward end of the punch to fold the forward ends of the tubes inwardly.

5. Apparatus, as defined in claim 4, which includes abutment means fixed with respect to the base and adapted to be engaged by the flanges of the sleeves to limit rearward motion thereof during the tube crimping operation.

6. A machine, as defined in claim 4, in which:
   the forward ends of said punches and the compression die means having matched, generally conical shapes;
   the tube shaping and processing elements further include at least one male exercising die adapted to unfold the crimped tube end after compression thereof to weaken said tube end, and a second female compression die means for recompressing the tube end after the exercising operation; and
   the machine further including means attached to the base for frictionally engaging the outer surface of the tubes during the exercising operation to prevent said tubes from being drawn off the punches by the exercising dies upon retraction of the second turret.

7. A machine, as defined in claim 7, in which:
   the forward ends of the punches and the compression die means have matched, generally conical shapes;
   the tube shaping and processing elements further include a plurality of male exercising dies having progressively larger diameters for progressively unfolding the crimped tube ends to thereby weaken the folds in the tube end, and a second compression die for recompressing the tube ends after the exercising operation, the second compression die including an axially disposed, resiliently biased pin for extending into the forward end of the tube to form a central hole in the shaped forward end of said tube; and
   said machine further including means attached to the base for frictionally engaging the outer surface of the tubes during the exercising operation to prevent the tubes from being drawn off the punches by the exercising dies upon retraction of the second turret.

8. A machine, as defined in claim 4, in which the front ends of said punches and the interior of said compression die have matched, generally necked down shapes.

9. A machine, as defined in claim 4, in which the means for reciprocating the second turret includes an axially disposed cylinder affixed to the base, a piston slidably received within the cylinder and attached to the second turret, valve means operatively associated with said indexing means to alternately connect opposite ends of the cylinder to a fluid pressure source to advance and retract the piston and second turret during each dwell period.

10. A machine, as defined in claim 4, in which:
   each punch includes an outer, axially extending tubular portion secured to said first turret, stem means slidably disposed within the bore of said tubular member;
   the machine further including means for moving said stem means forward a sufficient distance to penetrate and unfold the forward, crimped end of said tube; and
   means for holding the applicator tubes to restrain the tubes against being pushed off the punch by the stem means during the exercising operation.

11. A machine, as defined in claim 10, in which the means for moving said stem means includes:
   a cylinder means disposed parallel to the axis and positioned to be in successive, coaxial alignment with the stem means during dwell;
   a piston in the cylinder with a forwardly extending plunger adapted to engage the rear end of said stem means; and
   valve means coupled to a source of fluid pressure and connected to admit pressurized fluid alternately into opposite ends of said cylinder, said valve means being energized in timed relation with said first turret indexing means to advance and retract the piston during each dwell period.

12. A machine, as defined in claim 4, which includes:
   a magazine for holding a supply of applicator tube blanks, a tube feed element in alignment with successive tube support means during dwell, said feed element being secured to the second turret to reciprocate therewith and load tubes in succession from the magazine onto the tube support means at a loading station; and
means for removing a shaped tube from the tube support means during each dwell period at an unloading station, the removing means including a motor driven, rotatably wheel with radially extending resilient paddles for frictionally engaging the tubes during rotation in a direction to move the tube off the tube support means.

13. A machine, as defined in claim 12, in which: the shaped tubes are unloaded into a conduit for transferring the tubes for further processing; the machine further including: air ejector means connected to the conduit for assisting the movement of said tubes away from the unloading station, said air ejector means including means for directing a jet of air into the conduit in the downstream direction.

14. In an apparatus for shaping the forward ends of tubes, said tubes including rear extremities, the combination comprising:

a turret;

a plurality of tube support means carried by said turret, each said tube support means including:
an elongated punch fixed at one end to said turret and projecting therefrom;
sleeve means disposed about said punch and slidable along said punch, a portion of said punch projecting forwardly from the forward extremity of said sleeve means, said portion being adapted to slidably receive one of said tubes,
means for limiting the displacement of said sleeve means relative to said punch, and
means interposed between said sleeve means and said turret for resiliently biasing said sleeve means away from said turret, said rear extremity of said sleeve bearing against said sleeve means;
means carrying tube shaping elements for engaging the forward ends of said tubes to thereby shape said tube ends; and
means for intermittently moving said turret and said means carrying said tube shaping elements relative to one another in timed relation to bring said forward ends of said tubes, said tubes thereby moving rearwardly against the bias of said resilient biasing means to compensate for manufacturing tolerances in the overall length of said tubes and to cushion the contact of said tube shaping elements against the forward ends of said tubes.

15. A combination, as defined in claim 14 in which:
said punch is provided with a longitudinally extending bore;
the combination further including an elongated stem slidably disposed in said bore for axial movement, said stem including an enlarged head projecting from the forward end of said punch and having an outer diameter substantially equal to the outer diameter of said punch; and a spring interposed between the rear end of said punch and the rear extremity of the stem to bias said head rearwardly into engagement with the forward extremity of said punch.

16. In an apparatus for shaping the forward ends of tubes, said tubes having rear extremities, the combination including:
a first member having an axis;
a plurality of die means affixed to and projecting from said first member parallel to said axis treating said tube ends in sequence, said die means including:
a tube end crimping die forming a series of longitudinally extending folds in said tube end,
a first female folding die, having a cavity conforming generally to the final shape of the tube,
die means shaped to penetrate said tube end and unfold said tube end,
a second female folding die having a cavity conforming generally to the final shape of the tube and including centrally located means forming an axially disposed aperture in the forward end of said tube, and
a second member positioned opposite said first member coaxially therewith;
means for intermittently moving said first and second members relative to one another in timed relation to bring said die means into successive engagement with the forward ends of said tubes; and
a plurality of support means projecting from said second member for holding said tubes, said support means including resilient means engaged by said rear extremities of said tubes and permitting said tubes to move rearwardly against the bias thereof during treatment of said forward ends of said tubes by said die means to compensate for manufacturing tolerances in the overall length of said tubes and to cushion the contact of said die means against said forward ends of said tubes.

17. Apparatus, as defined in claim 16, in which said penetrating die means includes a plurality of generally cylindrical male dies having progressively larger diameters and provided with a generally conical tip portion.
United States Patent Office
Certificate of Correction

Patent No. 3,568,577 Dated March 9, 1971

Inventor(s): Joseph A. Voss et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page -2-

ring-applying"; line 11, "515" should read --516--; line 43 "preform" should read --perform--; line 45, before "applying (first occurrence) insert --glue--; line 49, after "According insert a comma (--,--); line 67, "movably" should read --movable-- Column 17, line 3, "of" (third occurrence) should read --by-- line 11, after "respectively" insert a comma (__,__). Column 18, line 71, "alignment" should read --alignment--. Column line 3, "rotatably" should read --rotatable--.

Signed and sealed this 21st day of December 1971.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR. ROBERT GOTTSCHALK
Attesting Officer Acting Commissioner of Patents