

[54] **METHOD AND APPARATUS FOR
ASSEMBLING LINERS IN CONNECTORS**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 230,566, March 1,
1972.

[52] U.S. Cl. **29/629, 29/203 R, 29/203 V,**
29/235, 29/450, 29/628, 29/630 R, 29/630 A

[51] Int. Cl. **H02g 15/00**

[58] Field of Search **174/93; 29/628, 629,**
29/630 R, 203 R, 203 V, 235, 450; 53/198 R,
198 X

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Primary Examiner—Charles W. Lanham

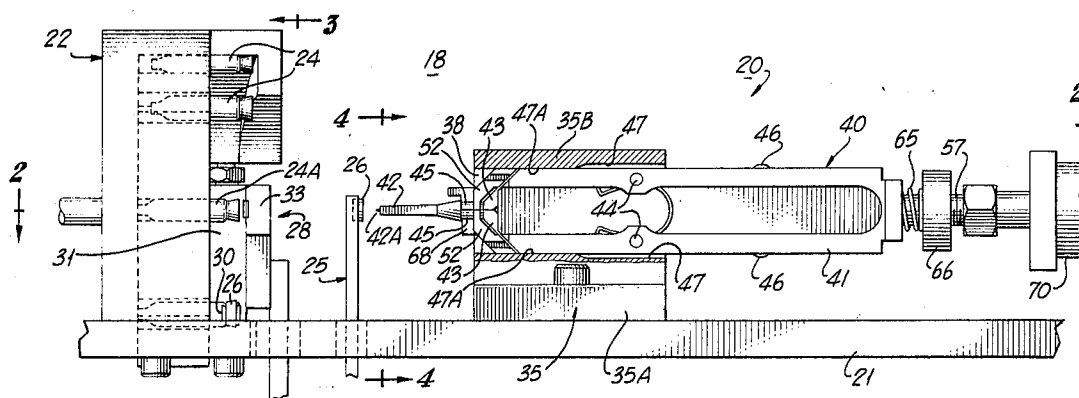
Assistant Examiner—James R. Duzan

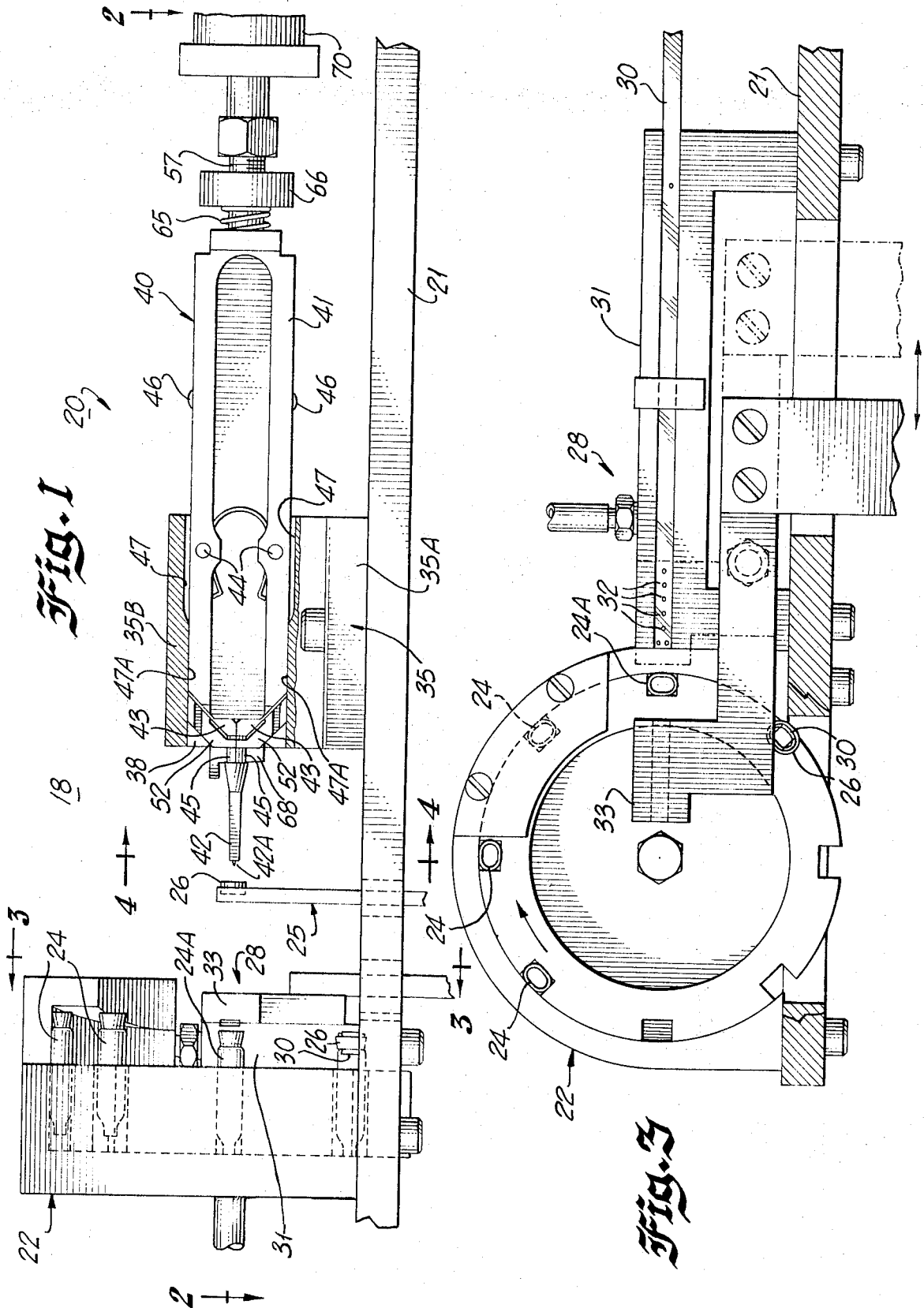
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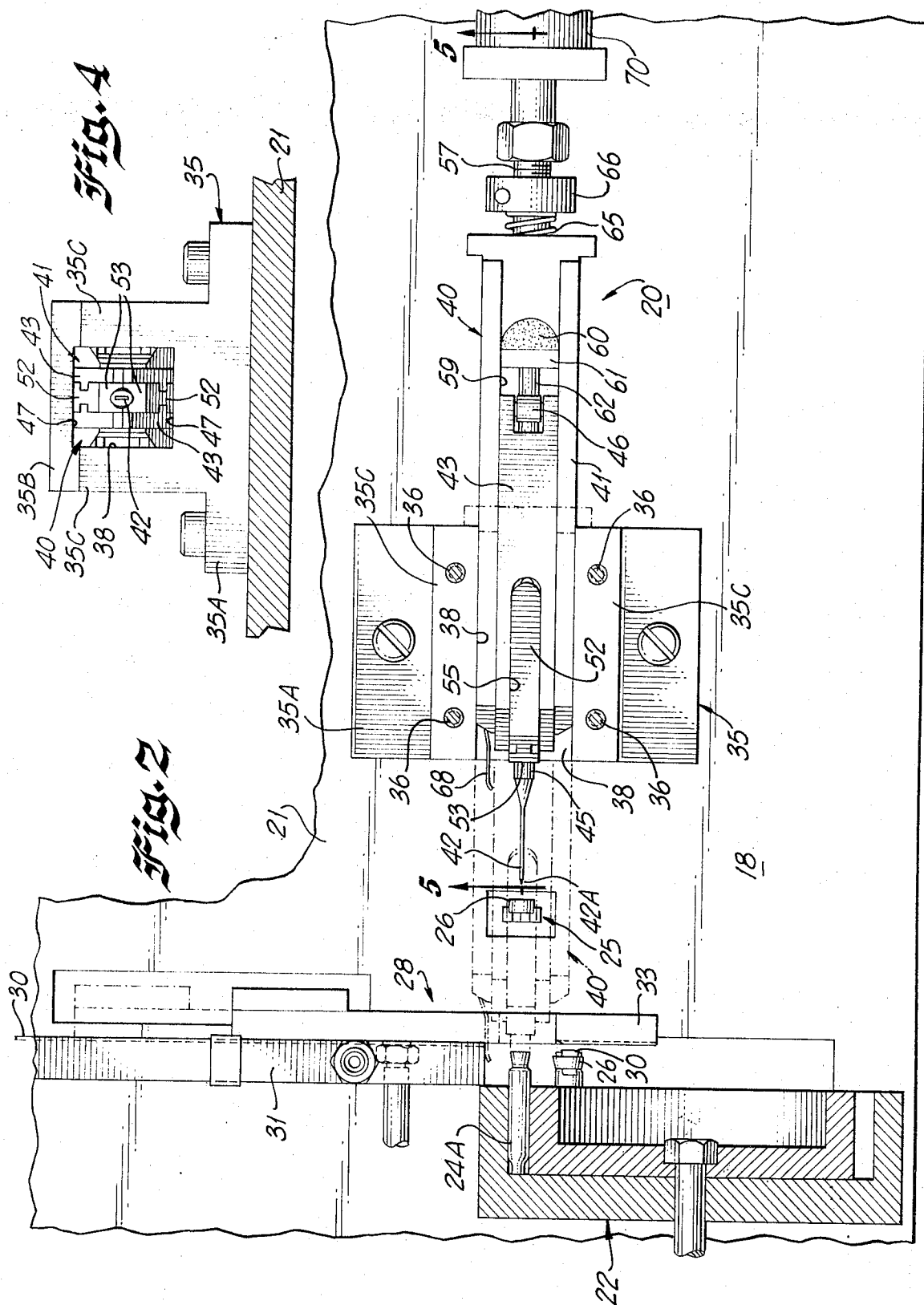
[57] **ABSTRACT**

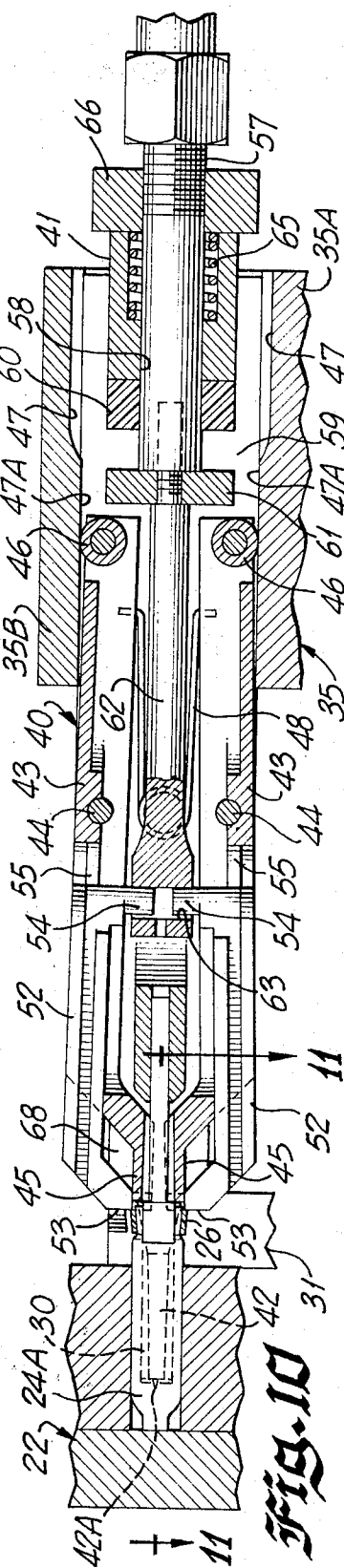
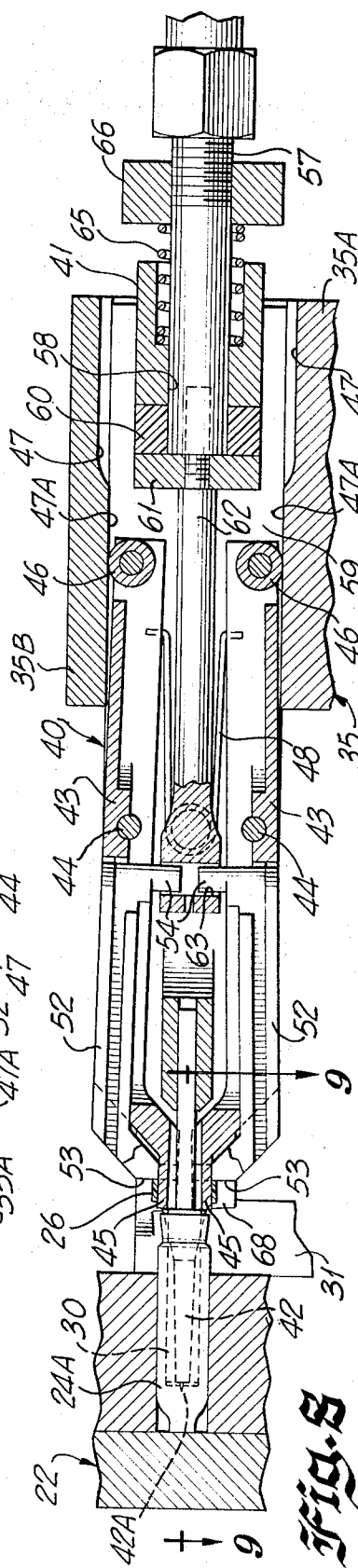
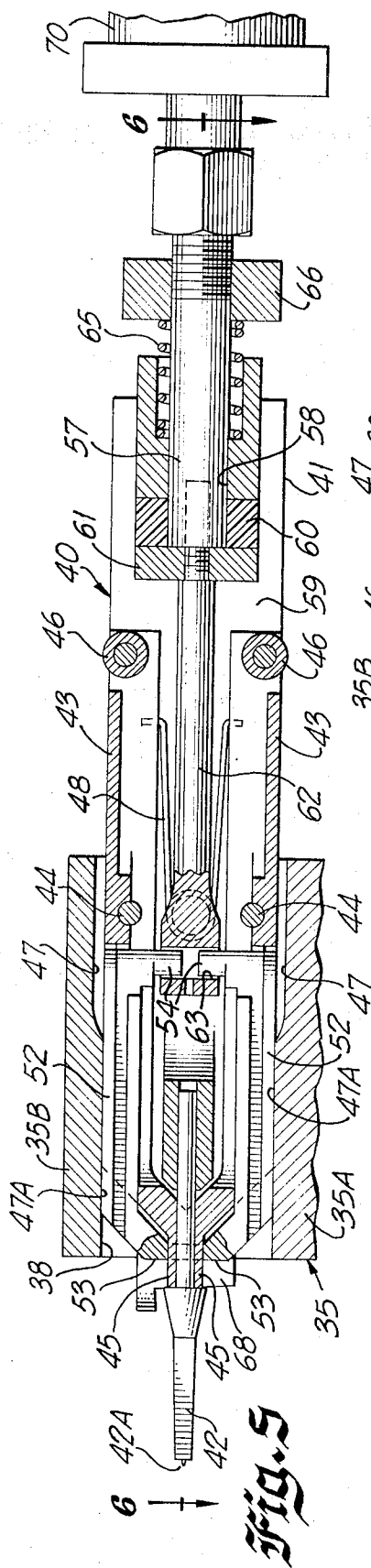
There is provided an improved method and apparatus for assembling inner liners with a connector of the type open at one end and having a plurality of inwardly extending protuberances. In accordance with the method, the liner is inserted into the connector in generally U-shape with the ends thereof projecting from the open end of the connector. An elastic band is positioned at the open end of the connector and expanded over the connector to fit over the surface of the connector. The expanded band is then moved over the folded ends of the liner onto the outer surface of the connector thereby securing the ends of the liner with the elastic band. An apparatus is provided for carrying out this method.

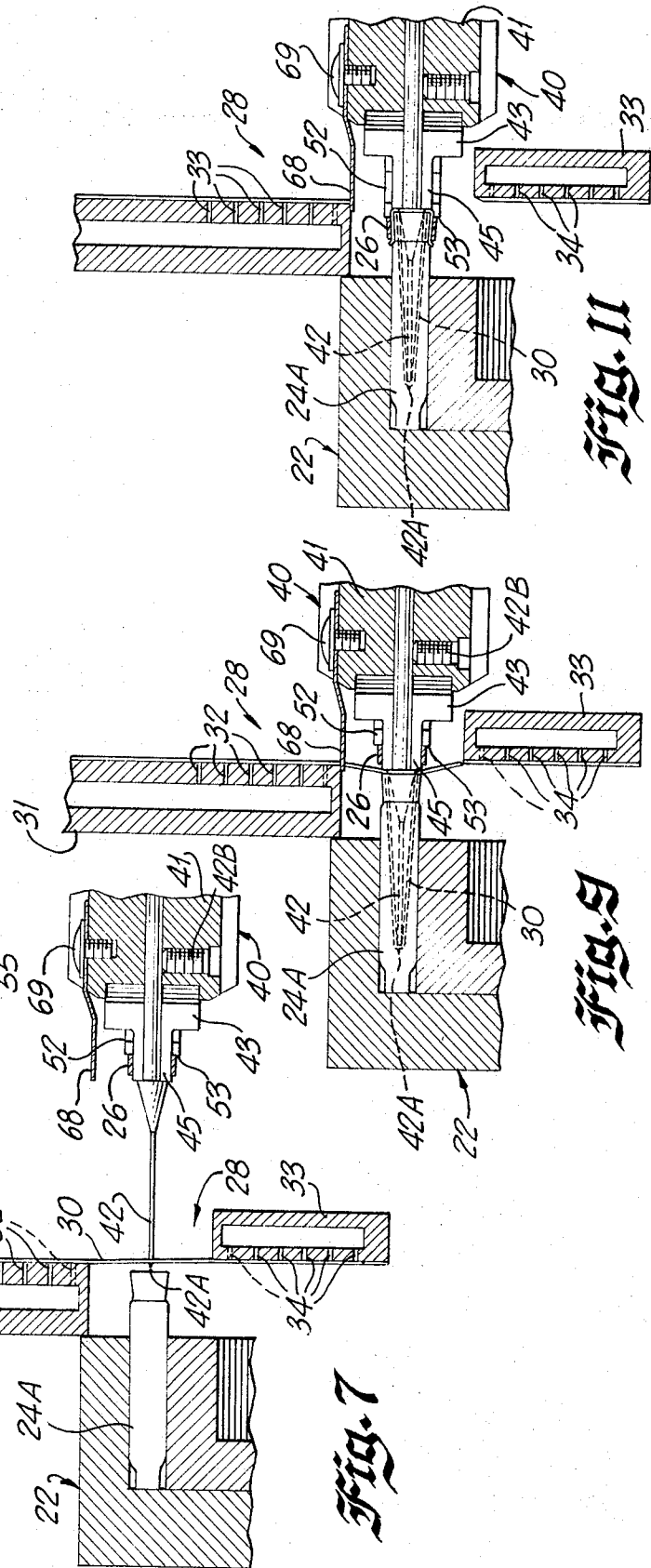
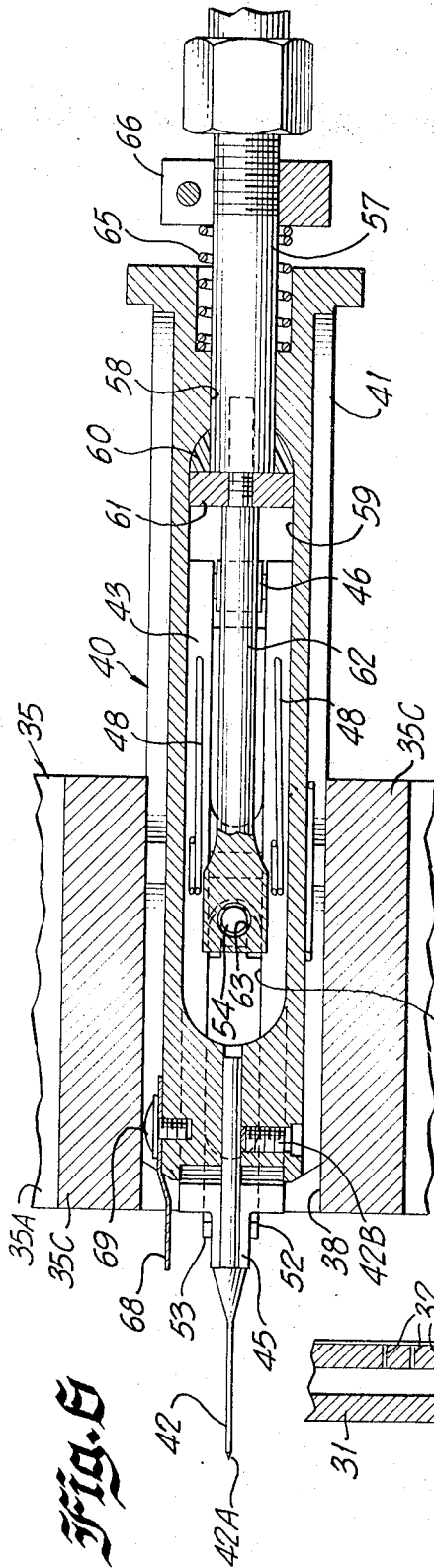
8 Claims, 12 Drawing Figures











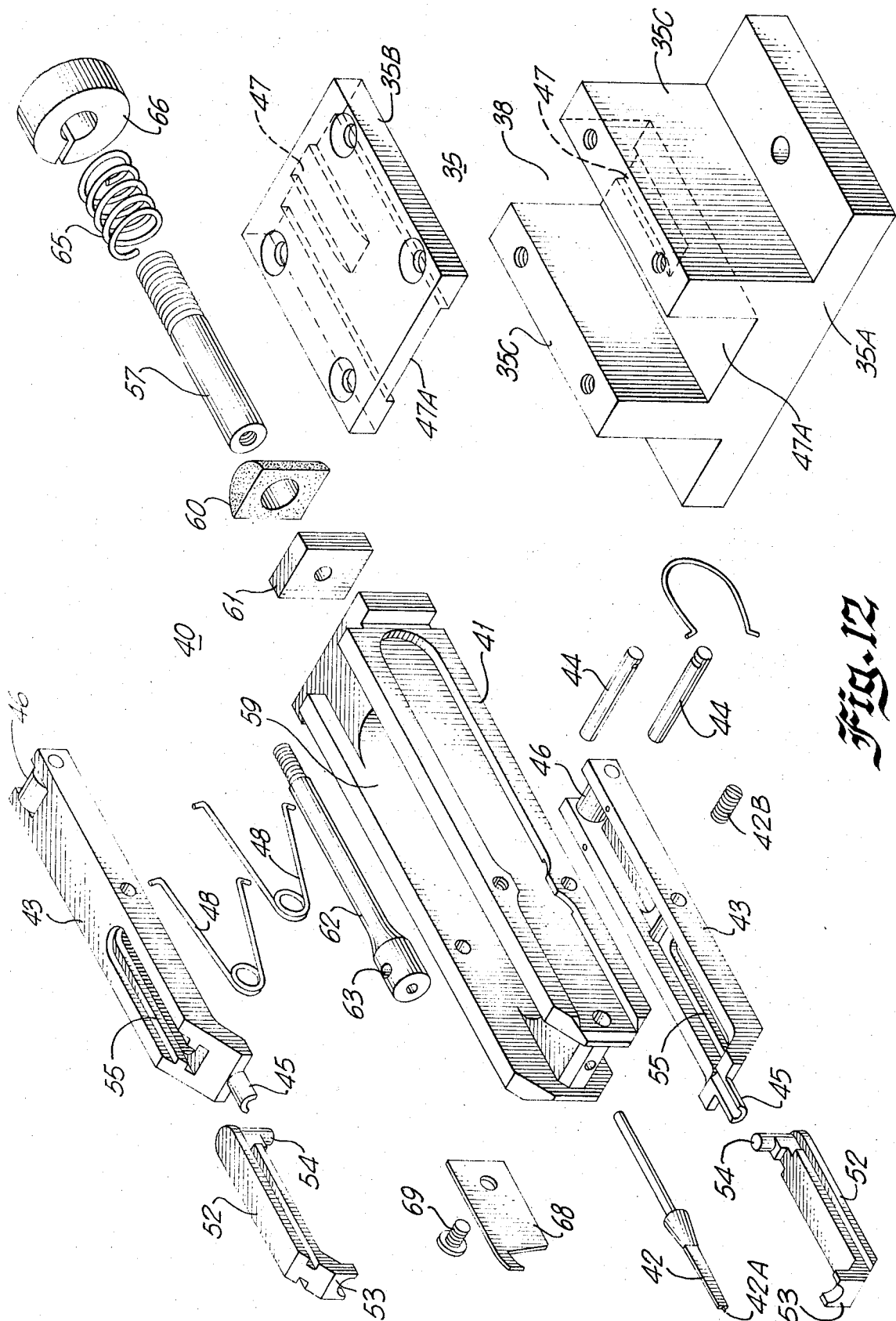


Fig. 12

METHOD AND APPARATUS FOR ASSEMBLING LINERS IN CONNECTORS

This application is a continuation-in-part of my application Ser. No. 230,566 filed Mar. 1, 1972.

This invention relates to a method and apparatus for assembling an inner liner formed of a thin strip of ribbon with a connector of the type more fully disclosed in the above mentioned application, and briefly of the type open at one end and having a plurality of inwardly extending protuberances. Such a connector is particularly useful for the assembly and joining of electrical conductors or wires and to the assembly and joining of such conductors with a solderless insulated connector without removing the insulation from the conductors.

Solderless electrical connectors as described in my above mentioned copending application are provided with a plurality of coaxially telescopically disposed sleeves including an inner sleeve of electrically conductive material and an outer jacket of electrically insulating material. The inner sleeve is provided on its inner surface with spaced apart perforations defining inwardly extending insulating piercing and wire engaging tines of protuberances. The inner sleeve is formed of relatively hard spring-like material encased within an intermediate sleeve of relatively soft material. A plurality of insulating electrical conductors or wires may be inserted within the inner sleeve positioned in the central bore thereof and having their end portions confined and embraced by the protuberances on the inner sleeve and establishing electrical contact with the metallic portion of the wires when the connector is deformed by pressure applied to the outside thereof. A crushing action is thereby exerted on the inner sleeve forcing the protuberances through the insulation on the wires and causing the protuberances to engage the metallic conducting portion of the wire with sliding or biting action. Connectors of this type are used by the millions and automatic machinery has been provided for feeding and deforming the connectors in an assembly operation. However difficulty had been experienced in that upon insertion of the wires into the inner sleeve, the wires may hang up on the inwardly projected protuberances, and although an operator may play the wires free of the protuberances during assembly thereof, there is no assurance that the wires have bottomed, or been fully received within the connector, and moreover such playing of the wires pass the protuberances is time consuming.

My above mentioned copending application advantageously overcomes this difficulty by providing an inner lining within the inner sleeve of the connector for guiding wires pass the protuberances. Deformation of the inner sleeve by pressure applied to the outside of the connector forces the protuberances through the lining and through the insulation of the wires so as to engage a metallic portion of the wires to make electrical contact therewith. As therein disclosed the inner lining may be formed of a strip of ribbon film of any suitable materials such as of thermoplastic resin, for example, polypropylene or polyester, vinyl resins and the like. One suitable strip has been found to be a film of polypropylene 0.001 inches thick and 0.170 inches wide. When such a film is folded through the open end of the connector in a generally U-shape, the edges of the ribbon film will generally overlap forming a substantially closed receptacle for receiving and guiding the wires

pass the protuberances of the sleeve. In accordance with the present invention the ends of the film strip are secured to the open end of the connector by bringing the ends of the film strip out of the connector, folding them over the open edge of the connector, and securing them in place by an elastic band.

Accordingly an object of the present invention is the provision of a new and improved method for assembling an electrical connector.

Another object of the present invention is the provision of a new and improved apparatus for assembling an electrical connector.

Still another object of the present invention is the provision of a new and improved method for inserting inner liners into an electrical connector of the type open at one end and having a plurality of inwardly extending protuberances.

Still another object of the present invention is the provision of a new and improved apparatus for assembling an inner liner within a connector of the type open at one end and having a plurality of inwardly extending protuberances.

In accordance with these and other objects there is provided an improved method of assembling an inner liner formed of a thin strip of ribbon with a connector of the type open at one end and having a plurality of inwardly extending protuberances. The liner is first inserted into the connector in generally U-shape with the ends thereof projecting from the open end of the connector. An elastic band is positioned at the open end of the connector and the band is expanded to fit over the surface of the connector. The expanded elastic band is then pushed over the end of the connector folding the open projecting ends of the liner over the ends of the connector thereby securing the ends of the liner with the elastic band.

In accordance with another feature of the present invention there is provided an improved apparatus for assembling an inner liner formed of a thin strip of ribbon with a connector of the type open at one end and having a plurality of inwardly extending protuberances. There is provided means for inserting the liner into the connector in generally U-shape with the ends thereof projecting from the open end of the connector. Means are provided for positioning an elastic band at the open end of the connector and expanding the band to fit over the outer surface of the connector. Means are then provided for pushing the expanded band over the folded ends of the liner thereby securing the ends of the liner with the elastic band.

The invention will be more clearly understood from the following detailed description when read in connection with the accompanying drawings in which:

FIG. 1 fragmentarily illustrates a machine work station including a machine work head for carrying out the present invention;

FIG. 2 is a plan sectional view of the machine work station of FIG. 1, illustrated at line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view of the machine work station of FIG. 1, illustrated as taken at line 3—3 of FIG. 1;

FIG. 4 is a fragmentary elevational view of the machine work station of FIG. 1, taken along line 4—4 of FIG. 1;

FIG. 5 is an elevational view of the work head of FIG. 1 illustrated in one step of its cycle of operation, and taken at line 5—5 of FIG. 2;

FIG. 6 is a plan view of the work head of FIG. 5, taken along line 5—5 of FIG. 6;

FIG. 7 is a fragmentary view of the work station of FIG. 1, illustrating the work head in another step in its cycle of operation;

FIG. 8 is a fragmentary view of the work station of FIG. 1, illustrating the head thereof in another step of its cycle of operation;

FIG. 9 is a detail view illustrating the operation of the head of FIG. 8, taken along line 9—9 of FIG. 8;

FIG. 10 is an elevational view of the work head of FIG. 1, illustrated in yet another step of its cycle of operation.

FIG. 11 is a detail view illustrating the work head of FIG. 10, taken along line 11—11 of FIG. 10; and

FIG. 12 is an exploded isometric view of the work head of FIG. 1.

Referring now to the drawings, and particularly to the machine work station illustrated in FIGS. 1 through 3, there is fragmentarily illustrated a machine work station of an assembly machine 18 for assembling liners in connectors according to the present method and apparatus, and including a work head 20 supported on a frame 21 of the assembly machine 18 and including a connector conveyor 22 for supplying and aligning connectors 24 with the work head 20. A band conveyor 25 supplies elastic bands 26 to the work station. A tape dispensing system 28 provides a strip of ribbon film 30 to the work station.

The connectors 24 may be of the type more fully described and illustrated in my above mentioned copending patent application, and briefly may include a plurality of coaxially telescopically disposed sleeves including an inner sleeve of relatively hard spring-like electrically conductive material, an intermediate sleeve of soft deformable material, and an outer jacket of suitable electrically insulating material. The inner sleeve is constructed of hard spring-like electrically conductive material such as spring tempered phosphor bronze and is provided on its inner surface with a plurality of in-turned perforations which provide protuberances or tines. These protuberances may be spaced on the inner sleeve in any suitable manner and, in my above mentioned patent application, the resulting protuberances define a plurality of curved upstanding knife-like edges which may be made to engage metallic conductor portions of wires with a sliding, biting action to provide a good electrical contact therewith. The outer jacket is formed of a suitable electrically insulating material, such as, a heat shrinkable thermoplastic material, and is heat shrunk at one end during the heat curing process of the jacket to form a slightly inwardly tapered reduced neck. The inner lining in the completed connector may be formed of any suitable material, such as polyethylene which, in the above mentioned parent application, in a particular embodiment was 0.001 inches thick and 0.170 inches wide. The upper loose ends of the strip is secured to the open end of the connector by the elastic bands 26 secured over the outer folded edges of the tape on the outside of the reduced neck of the connector.

The connector conveyor 22 may be of any suitable type wherein the connectors 24 are supplied one at a time in alignment with the work head 20. As herein illustrated connector 24A is held by the connector conveyor 22 at the desired work position. Similarly the band conveyor 25 may be of any suitable type wherein

the bands 26 are supplied one at a time to the work station of the assembly machine aligned with the work head 20. The tape dispensing system 28 is of the type which will supply the very thin ribbon film 30 to the work station, and in the illustrated embodiment, as best illustrated in FIGS. 3, 7, and 9, includes a stationary vacuum plate 31 having a plurality of vacuum ports 32 for holding the ribbon film 30. A movable vacuum plate 33 is sequentially movable back and forth across the work area of the work station for picking up the end of the ribbon film 30, and includes a plurality of vacuum ports 34 for gripping the thin ribbon film. In operation the movable vacuum plate 33 will move to the right, as viewed in FIG. 3, until the ports 34 thereof overlies the end of the ribbon film. The vacuum is then transferred from the stationary vacuum plate 31 to the movable vacuum plate 33 and the movable vacuum plate 33 is then returned to the left, to the position illustrated in FIG. 3, so that the ribbon film 30 overlies the end of the connector 24A as illustrated in FIG. 7. Selective drawing and release of the vacuum as between the vacuum plates 31 and 33 provides for the step-by-step advance of the ribbon film 30 in response to the cycling of the work head 20.

The work head 20, best illustrated in FIG. 12, includes a stationary or frame portion 35 including a lower portion 35A and a cap portion 35B secured together in any suitable manner as with screws 36, FIG. 4. The lower portion 35A of the frame portion 35 includes a pair of upstanding webs 35C which, together with the cap portion 35B, define a generally rectangular guide opening 38 for supporting and guiding a movable head assembly 40. The head assembly 40 includes a carriage 41 having a forwardly projecting pusher blade 42 terminating with a pin type point 42A. The pusher blade is fixed to the carriage 41 by a set screw 42B. The carriage 41 is thereby adapted for sliding travel toward and away from the connector 24A; the movement of the carriage 41 may be effected in any suitable manner, such as by a fluid cylinder fragmentarily illustrated at 70.

Mounted on the carriage 41 for oscillating or rocking movement thereon is a pair of spreader jaws 43 pivotally mounted to the carriage 41 by suitable pivot pins 44. The forward end of the spreader jaws 43 terminates in a band engaging and spreading projection 45 and the opposite or rearward end of each spreader jaw 43 carries a cam follower or roller 46. The cam rollers 46 are adapted to engage along confronting cam tracks 47 terminating in confronting lobe portions 47A of the frame portion 35. Torsion springs 48 bias the spreader jaws 43 in scissor-like fashion to bias the band engaging projections 45 toward each other and the rollers 46 apart from each other.

For pushing an expanded ring off the band engaging projections 45, there is provided a pair of pusher jaws 52 each slidably mounted on a respective one of the spreader jaws 43 and including a forward pusher section 53 shaped to conform to the band engaging portion 45 of the spreader jaws 43, and additionally including an inwardly extending projection 54 extending through a groove 55 in the respective spreader jaw 43.

Control of the carriage 41 is through a control shaft arrangement including a pusher shaft 57 extending through an aperture 58 in the carriage 41 opening into a central recess or groove 59 in the carriage 41. A spreader shaft 62 extends within the groove 59 axially

from the pusher shaft 57. A bearing member 60 and lock member 61 serve to align and position the pusher shaft and spreader shaft 62 within the groove 59. The forward end of the spreader shaft 62 is provided with a through aperture 63 receiving the inwardly extending projections 54 of the pusher jaws 52 for controlling the sliding movement of the jaws 52 relative to the spreader jaws 43. A compression spring 65 interposed between the rear of the carriage 41 and a lock 66 secured on the pusher shaft 57 tends to bias the pusher shaft 57, spreader shaft 62 and pusher jaws 52 rearwardly.

A cutter blade 68 is secured to the carriage 41 in any suitable manner as by the screw 69 and tends to sever the strip of ribbon film 30 at a predetermined length.

The operation of the liner apparatus briefly is as follows. The ribbon film is advanced by the vacuum plates 31 and 33. Specifically with reference to FIG. 3 the movable vacuum plate 34 moves to the right, to the position illustrated in phantom, and the end of the ribbon film 30 is picked up by the vacuum in the vacuum ports 34 of the movable vacuum plate 33. The movable vacuum plate 33 then moves to the left, to the position illustrated in solid in FIG. 3, drawing the end of the ribbon film 30 across the open end of the connector 24A. The travel of the movable vacuum plate 33 is selected to provide a proper length of ribbon past the center of the connector 24A, such that as the carriage 41 along with the pusher blade 42 locks into the ribbon to carry the ribbon into the connector 24, as illustrated in the steps of FIGS. 7 and 9, the cutter blade 68 will engage against the edge of the stationary vacuum plate 31, as illustrated in FIG. 9, and sever the ribbon film.

Once the ribbon film 30 has been moved across the open end of the connector 24A, forward movement of the carriage 41 within the frame portion 35 of the work head 20 will first engage a band 26 in the band conveyor 25, from the position illustrated in FIG. 1. Movement of the carriage 41 will position the band 26 onto the band engaging projections 45 of the spreader jaws 43, as illustrated in FIGS. 5 and 6.

Forward movement of the carriage 41 will also bring the pin point 42A of the pusher blade 42 into engagement with the ribbon film across the connector 24A, the point thereof piercing the ribbon film to locate the ribbon film and to provide a secure engagement of the pusher blade with the film without slippage or retracting of the film, as best illustrated in FIG. 7. Continued forward travel of the carriage 41 will insert the ribbon film 30 into the connector 24A, as illustrated in FIGS. 8 and 9. As previously described, the cutter blade 68 will be effective to sever the ribbon film 30 at the proper length as determined by the travel of the carriage 41.

During the initial forward movement of the carriage 41, the rollers 46 are riding in the recessed or grooved portion of the cam track 47, so that the spreader jaws move forwardly toward the connector 24A without opening. However continued forward movement of the carriage 41 will position the rollers 46 onto the lobe portions 47A of the cam track 47, spreading the spreader jaws 43, as illustrated in FIGS. 8 and 9. During this movement of the carriage 41, the compression spring 65 is sufficient to move the carriage and associated pusher and spreader shafts as a unit. However the forward end of the spreader jaws 43 will come to bear against the open edge portion of the connector

24A and further forward movement of the spreader jaws 43 is inhibited.

Continued forward movement of the pusher shaft 57 will override the bias of the compression spring 65, as illustrated in FIG. 10, thus sliding the pusher jaws 52 forwardly and pushing the expanded ring 26 off of the band engaging projection 45 of the spreader jaws 43 and onto the outer surface of the connector 24A, as best illustrated in FIG. 11. The ring 26 will engage against the inwardly tapering end portion at the open end of the connector thus providing a secure elastic interlock between the band 26 and the connector 24, and further preventing ready disassembly of the band from the connector. Finally the pusher shaft 57 and associated carriage 41 will be withdrawn through engagement of the bearing member 60 and lock member 61 against the end of the groove 59.

Although the present invention has been shown and described with reference to a single embodiment of the method and apparatus thereof, it is to be understood that various changes and modifications may be made without departing from the spirit of the invention and it is intended by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An improved method of assembling an inner lining formed of a thin strip of ribbon with a connector of the type open at one end and having a plurality of inwardly extending protuberances, said method including the step of inserting the lining in general U-shape with the ends thereof projecting from the open end of the connector, folding the open projecting ends of said lining over the ends of the connector along the outer surface thereof, and securing the ends of the lining with an elastic band.

2. A method of assembling an inner liner formed of a thin strip of ribbon with a connector of the type open at one end and having a plurality of inwardly extending protuberances, said method including the steps of inserting the liner into the connector in generally U-shape with the ends thereof projecting from the open end of the connector; positioning an elastic band at the open end of the connector and expanding the band to fit over the outer surface of the connector, and folding the open projecting ends of the liner over the ends of the connector and moving the band over the folded ends of the liner thereby securing the ends of the liner with the elastic band.

3. The method as set forth in claim 2 wherein the inserting step includes positioning a liner across the open end of said connector, engaging said liner at its center with a blade, and driving said blade and liner into said connector.

4. The method as set forth in claim 3 wherein said engaging step includes piercing said liner with a needle-like point on said blade to prevent slippage during the insertion procedure.

5. The method as set forth in claim 3 wherein said positioning step includes supporting the free end of a continuous supply of a thin strip of ribbon by a vacuum support, gripping such free end of the supply of ribbon with a movable vacuum gripper across the open end of a connector so as to position a length of ribbon strip for forming a liner across the open end of a connector.

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6. The method as set forth in claim 5 wherein simultaneously with said inserting step there is providing cutting of the liner from the continuous supply of thin strip of ribbon at proper length.

7. The method as set forth in claim 2 wherein the positioning of the elastic band is between the projecting open ends of the liner, and the moving step comprises pushing the expanded band into the end of the connector simultaneously folding the open projecting ends of the liner.

8. An apparatus for assembling an inner liner formed of a thin strip of ribbon with a connector of the type open at one end and having a plurality of inwardly ex-

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tending protuberances, said apparatus including:

means for inserting the liner into the connector in generally U-shape with the ends thereof projecting from the open end of the connector;

means for positioning an elastic band at the open end of the connector and expanding the band to fit over the outer surface of the connector; and

means for folding the open projecting ends of the liner over the ends of the connector and means for pushing the band over the folded ends of the liner thereby securing the ends of the liner with the elastic band.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,781,985 Dated January 1, 1974

Inventor(s) JOHN L. YONKERS

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

Column 1, line 5, after "1972", insert -- which is a continuation of my application Serial No. 114,954 filed February 12, 1971, now abandoned. -- .

Signed and sealed this 30th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents