United States Patent [19]

Barr et al.

[11] **3,785,907**

[45] **Jan. 15, 1974**

[54] **METHOD AND APPARATUS FOR AUTOMATIC ASSEMBLY OF A BELT AND ANCHOR PLATE**

[75] Inventors: **Richard S. Barr; Richard L. Groendyke,** both of Upland, Calif.

[73] Assignee: **American Safety Equipment Corporation,** New York, N.Y.

[22] Filed: **Apr. 5, 1971**

[21] Appl. No.: **130,923**

[52] U.S. Cl. **156/443,** 156/93, 156/196, 156/199, 156/200, 156/204, 156/459, 156/461, 156/538, 156/598, 156/566, 223/1, 223/49

[51] **Int. Cl.** **B31f 1/00**

[58] **Field of Search** ..... 156/66, 51–93, 156/70, 196, 199, 200–202, 273, 383, 423, 443, 459, 461, 463, 475, 476–480, 539, 543, 566; 29/243.5; 24/31, 265 BL; 223/1, 49

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Primary Examiner—Alfred L. Leavitt
Assistant Examiner—David A. Simmons
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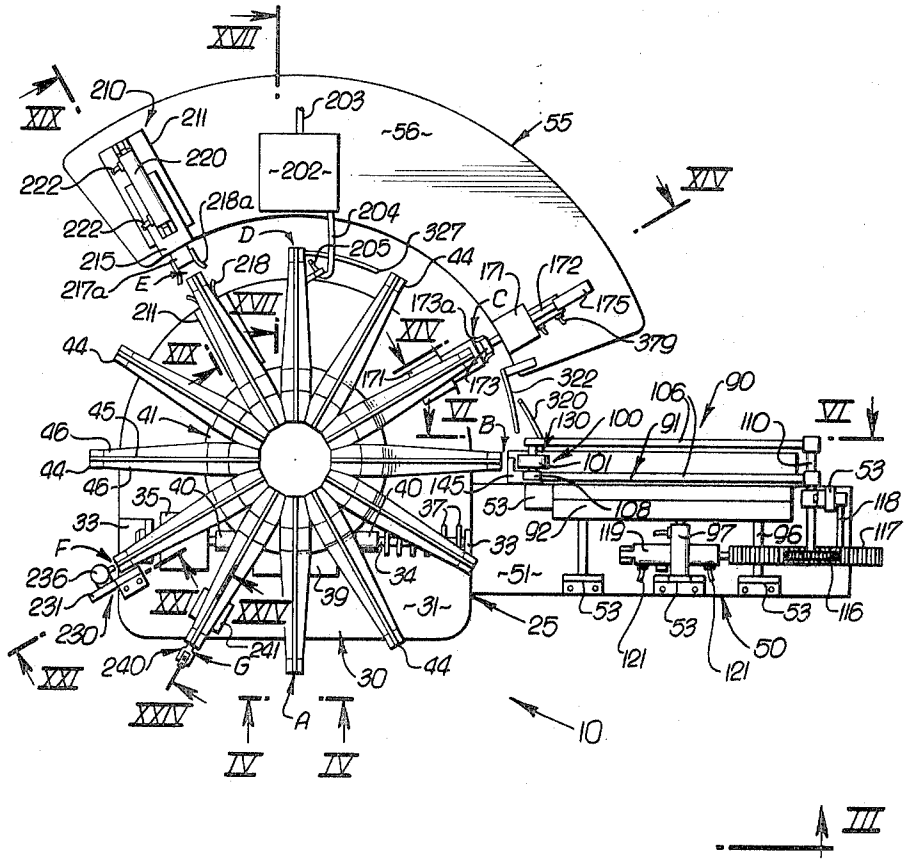
[57] **ABSTRACT**

An apparatus and method for automatic assembly and interconnection of a safety belt and an anchor plate which is attachable to a frame member of a vehicle. The apparatus and method is embodied in a system for rapid production of such assembly wherein a plurality of anchor plate carrier arms are each sequentially positioned at a plurality of stations at which an anchor plate with a belt receiving opening therein is releasably positioned on the carrier arm, a pliant bendable belt is longitudinally folded at one end and advanced into and through said anchor plate opening for only a predetermined selected distance, the longitudinally folded belt is then transversely folded about the anchor plate, the folds are symmetrically arranged and creased, and the belt is then secured in assembly with the anchor plate in the bight of the belt thus formed by adhesively bonding and sewing the opposed belt portions together. The apparatus and method automatically accomplishes the assembly of the belt and anchor plate in a rapid virtually foolproof manner while providing a safety belt anchor connection capable of meeting safety regulations and Governmental standards.

21 Claims, 34 Drawing Figures



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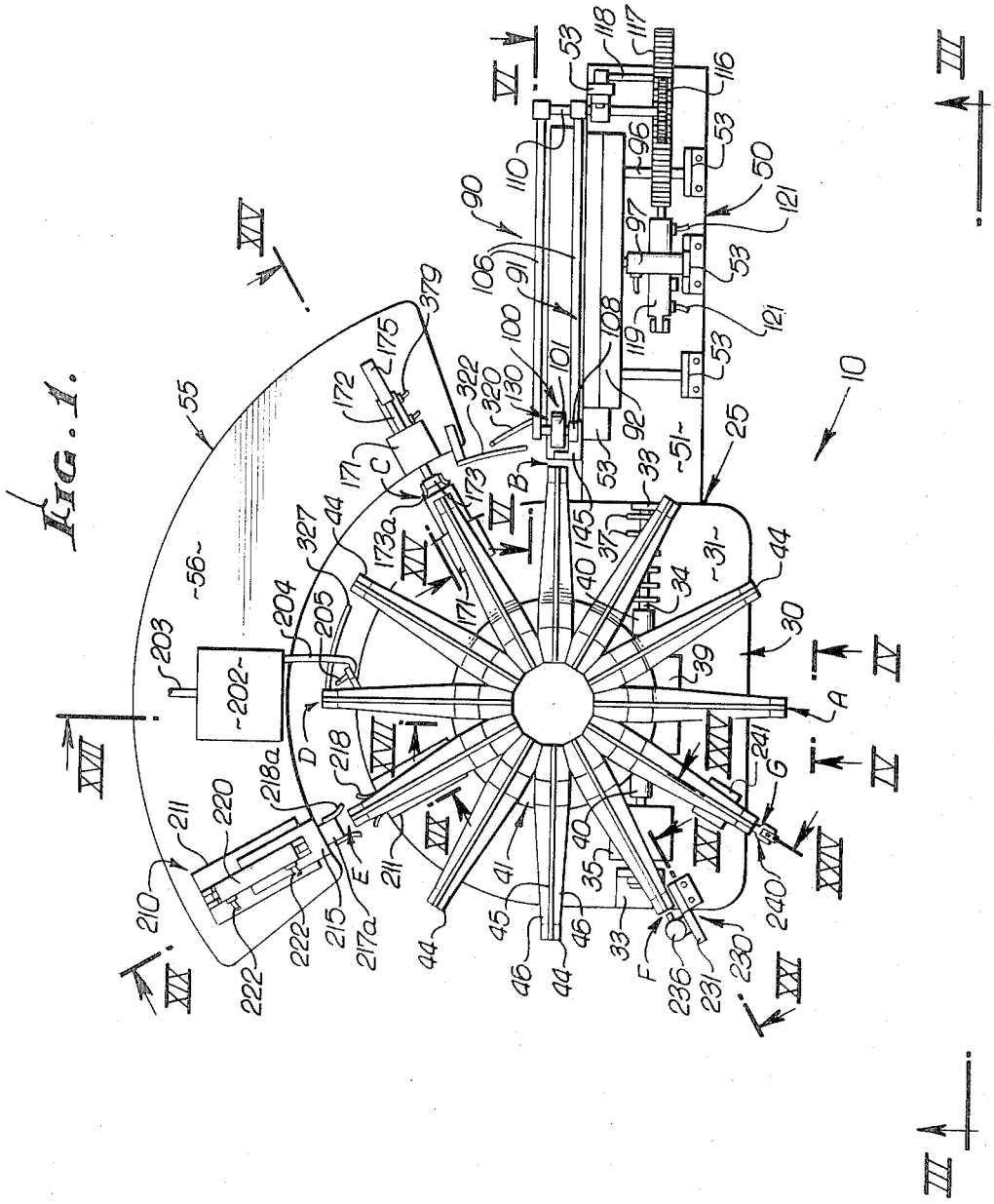

FIG. 1.

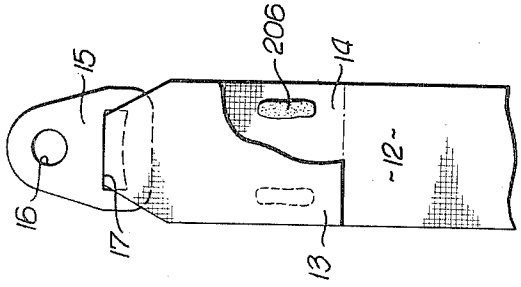

FIG. 1a.

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FIG. 2a.

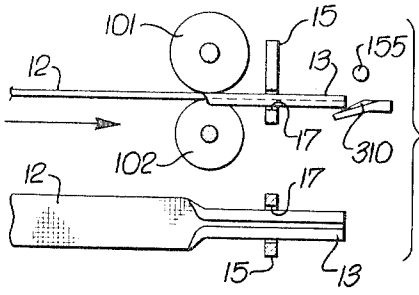

FIG. 2b.

FIG. 2c.

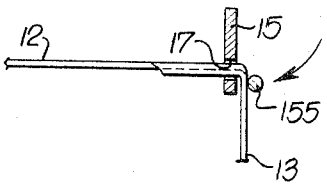

FIG. 2d.

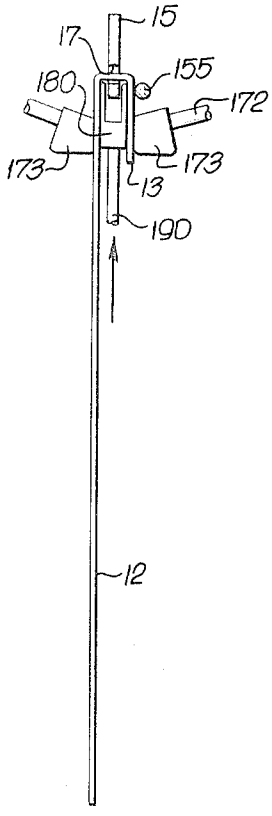

FIG. 2e.

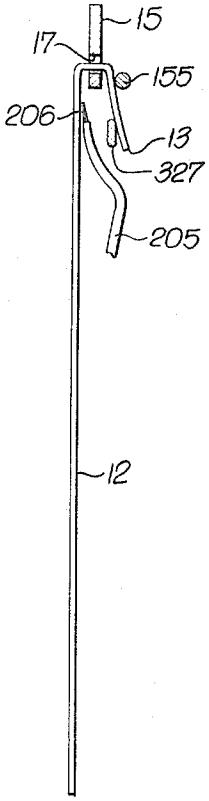

FIG. 2f.

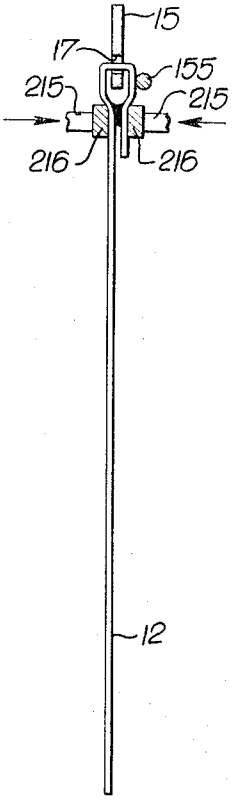

FIG. 2g.

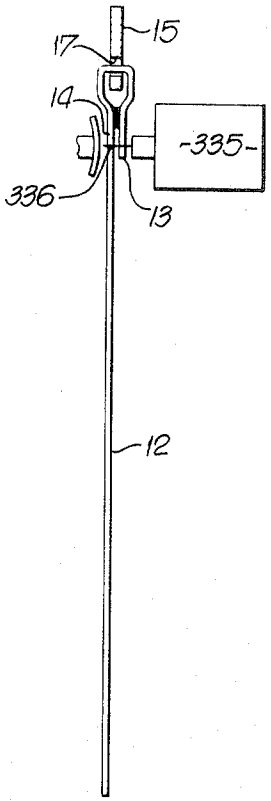

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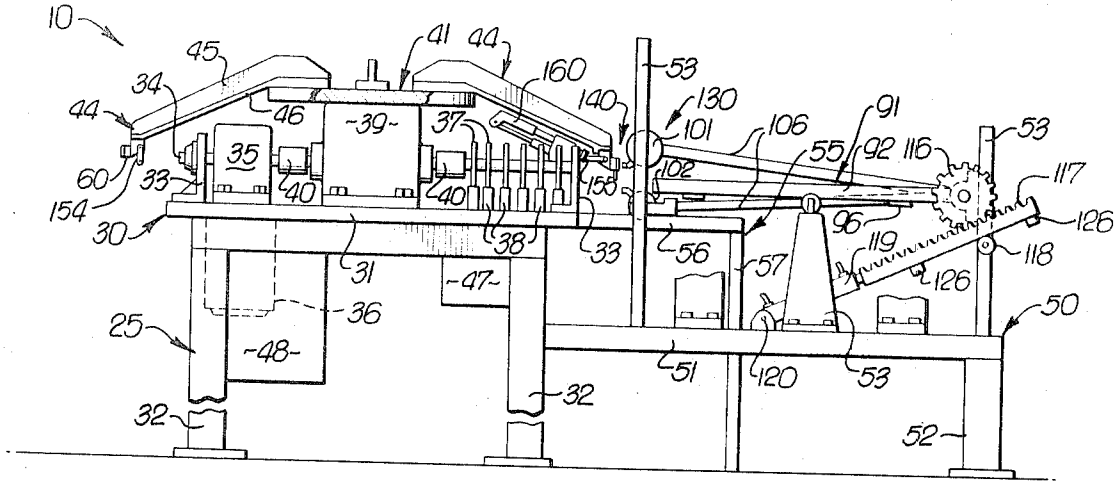
FIG. 3.



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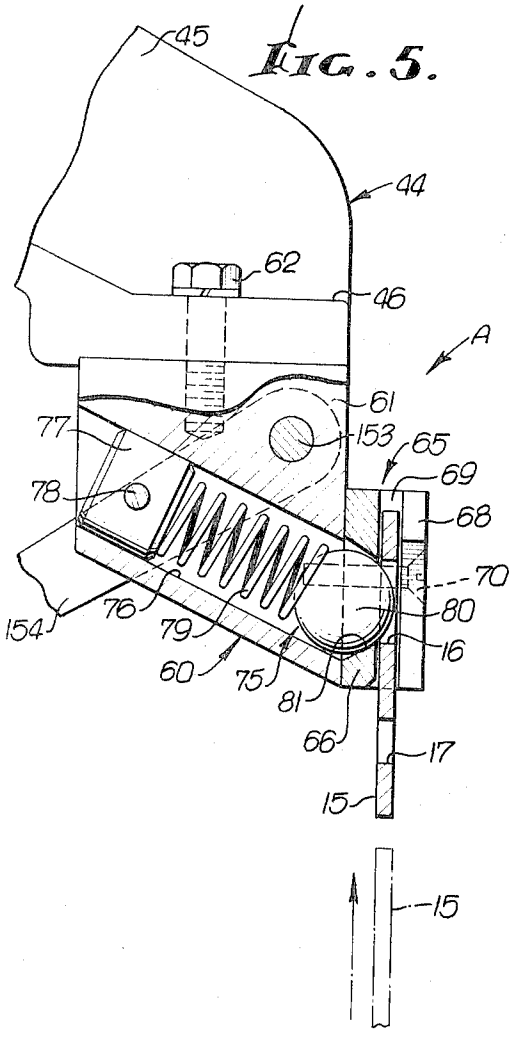

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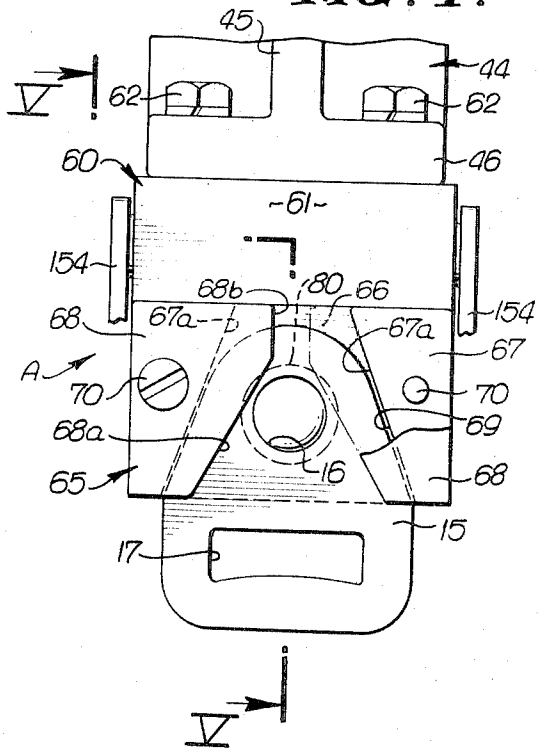

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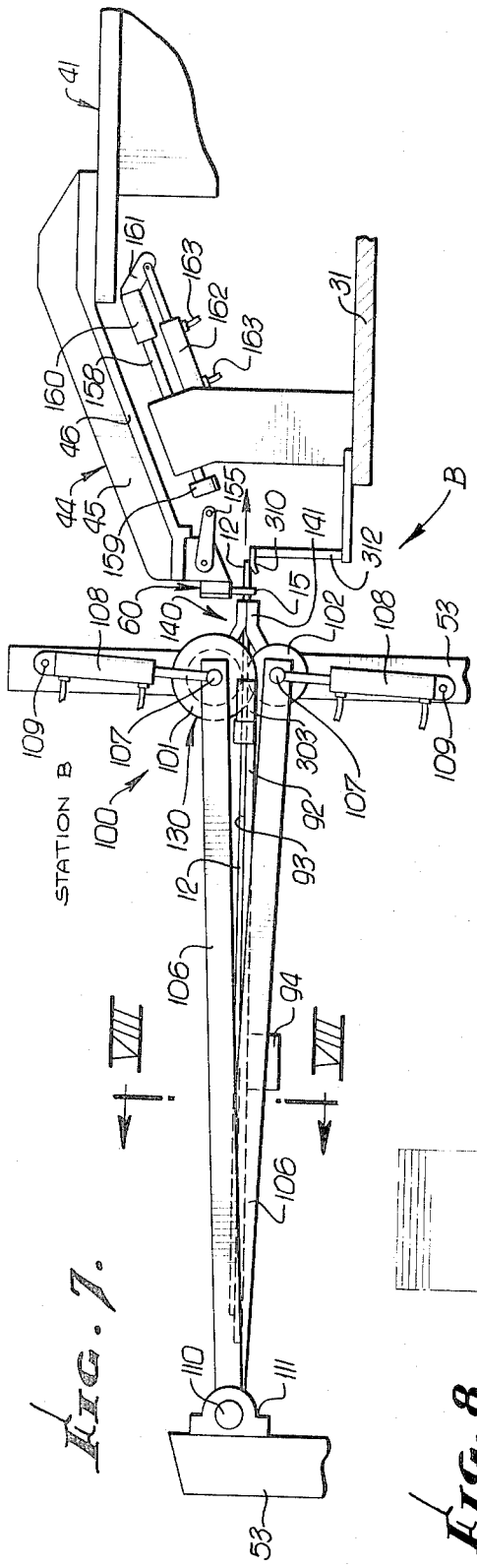

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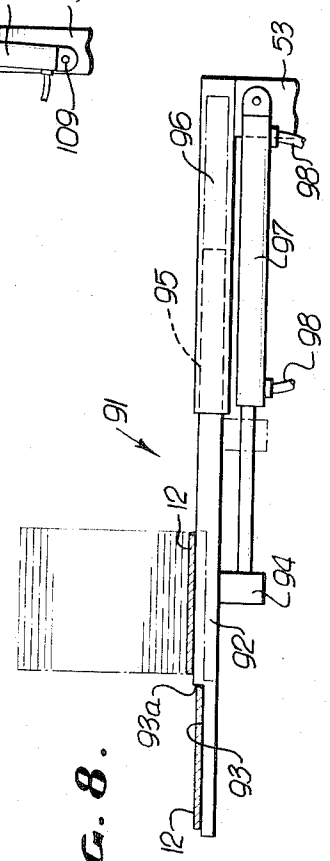

FIG. 8.

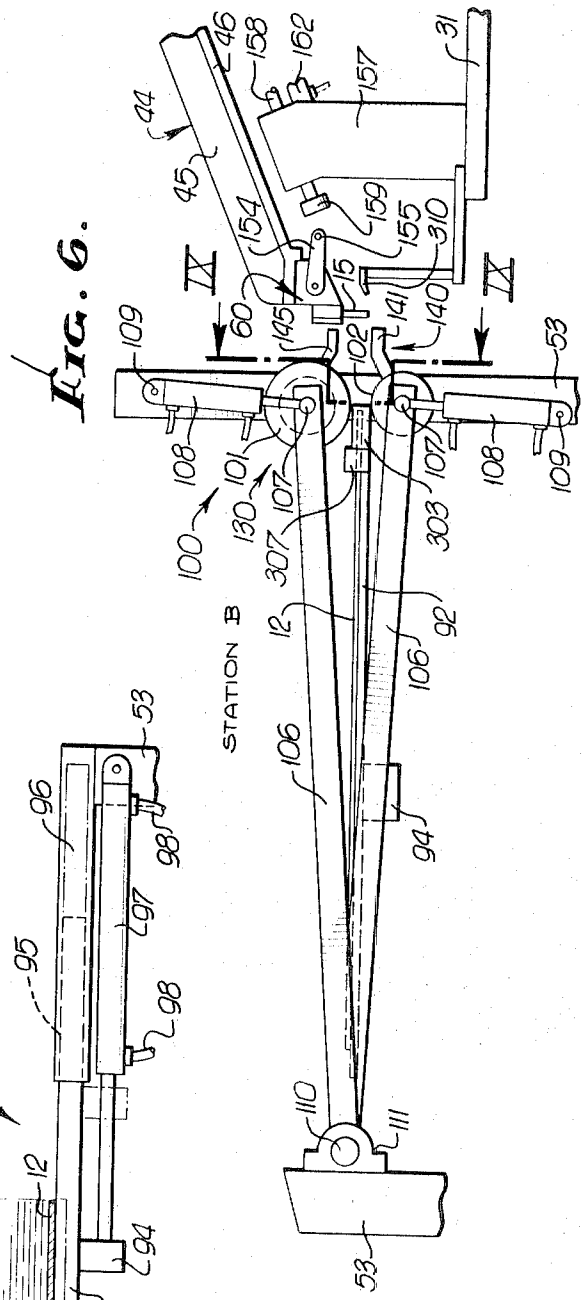

FIG. 6.

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FIG. 10.

FIG. 9.

FIG. 10b.

FIG. 11.

FIG. 13.

FIG. 12.

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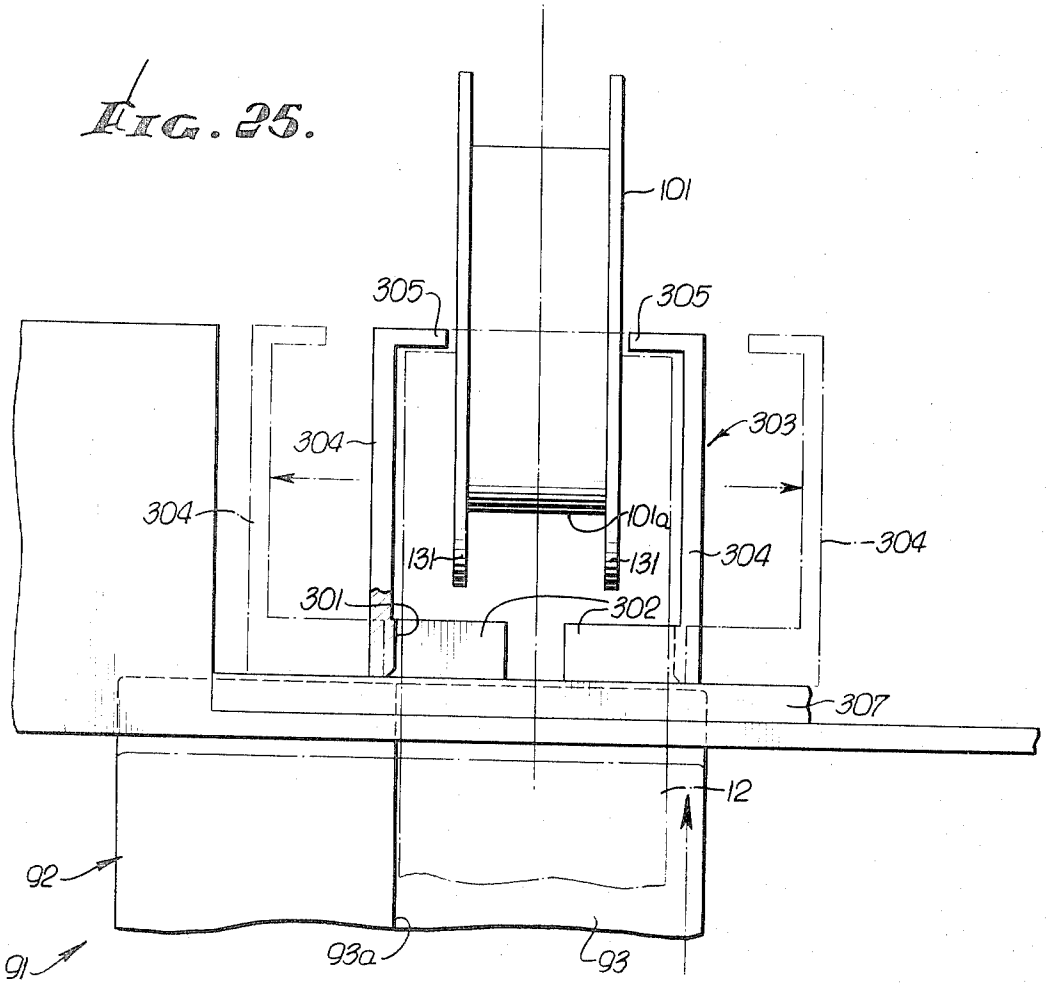
FIG. 25.



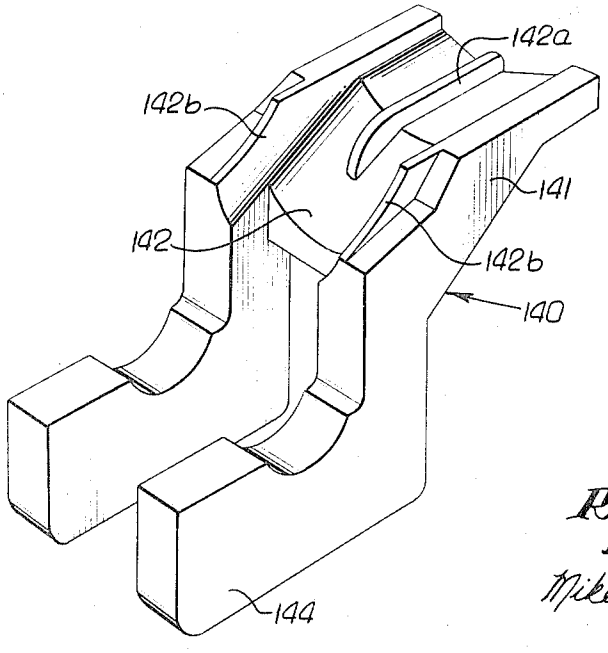


FIG. 10a.

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FIG. 14.

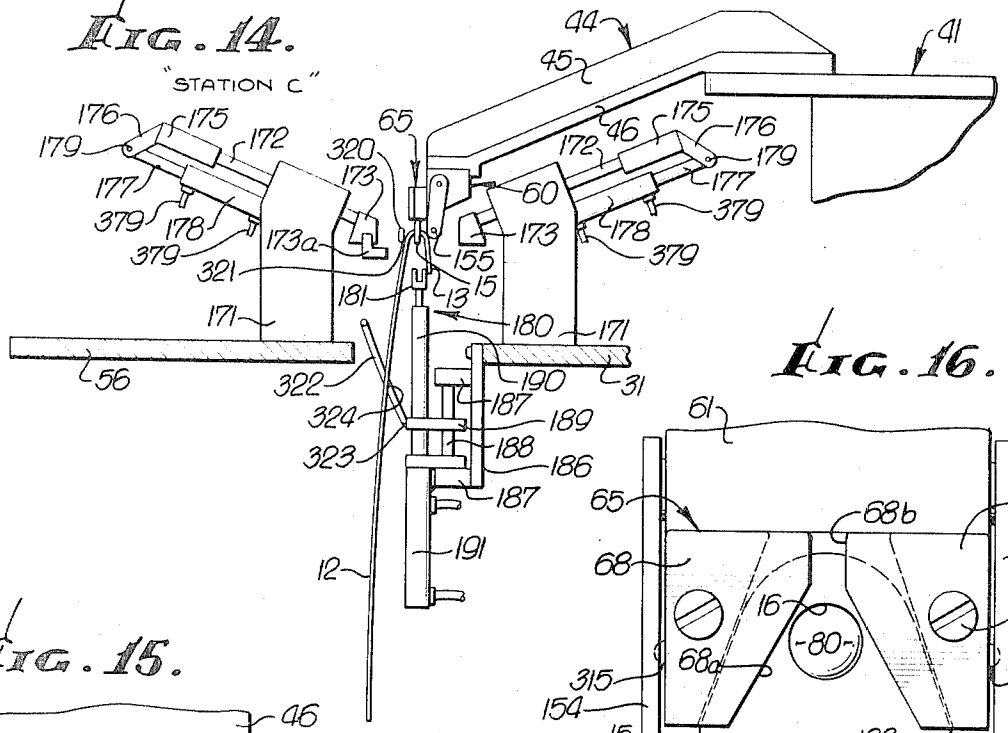
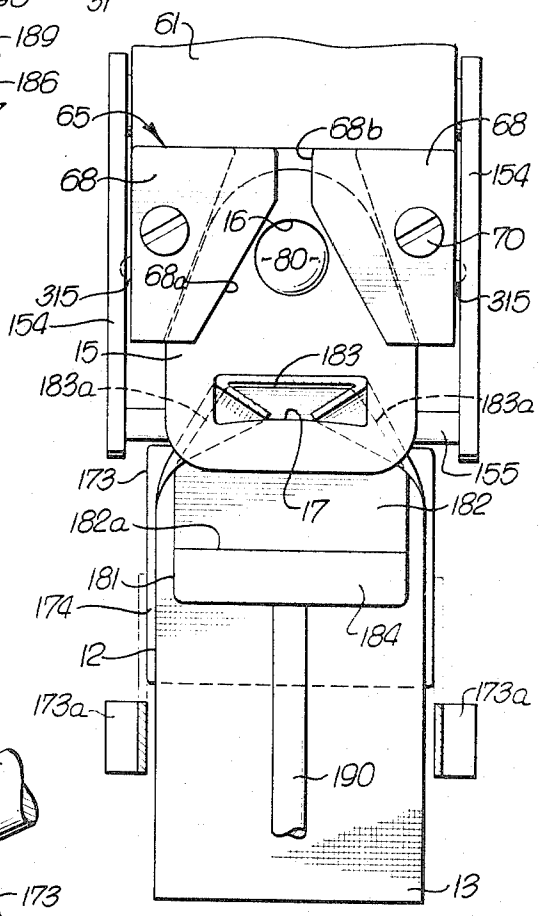


FIG. 16.



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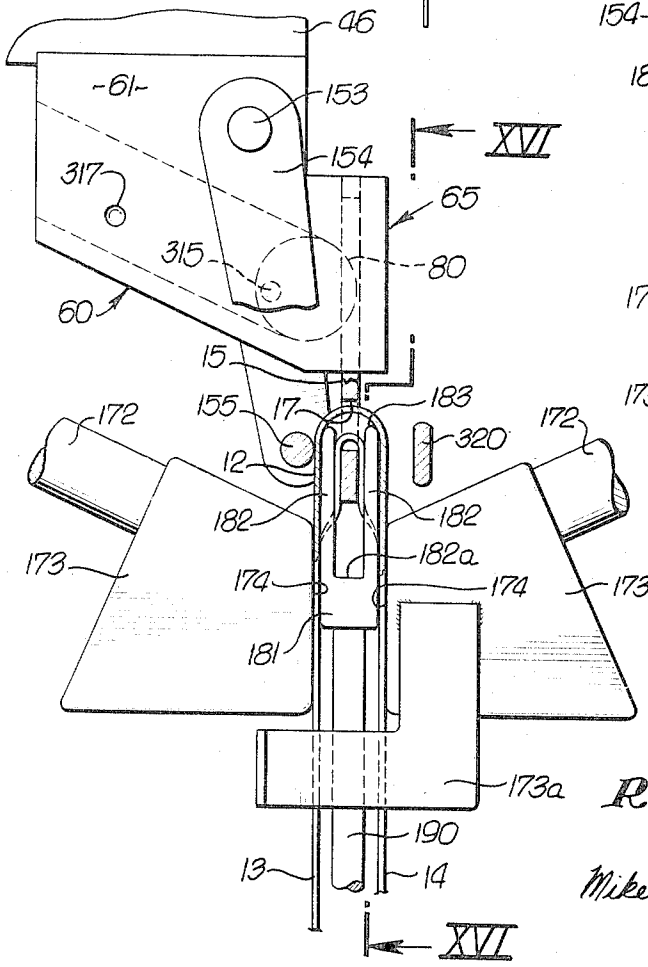

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FIG. 17.

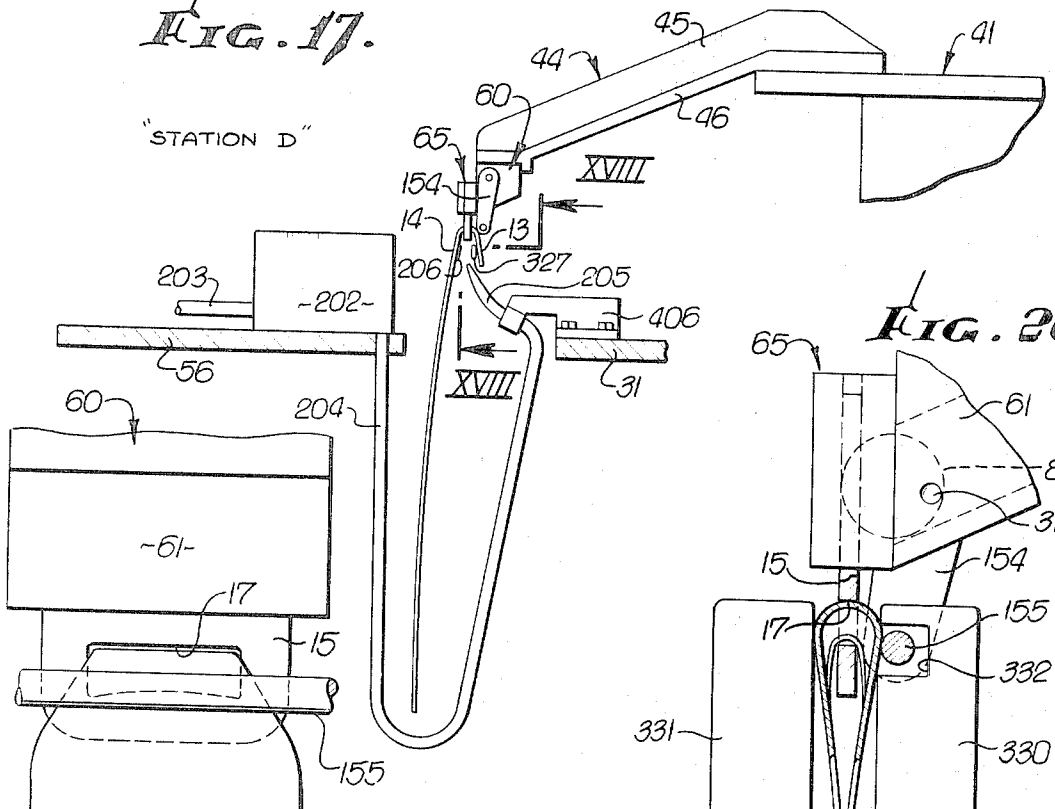

FIG. 18.

FIG. 20.

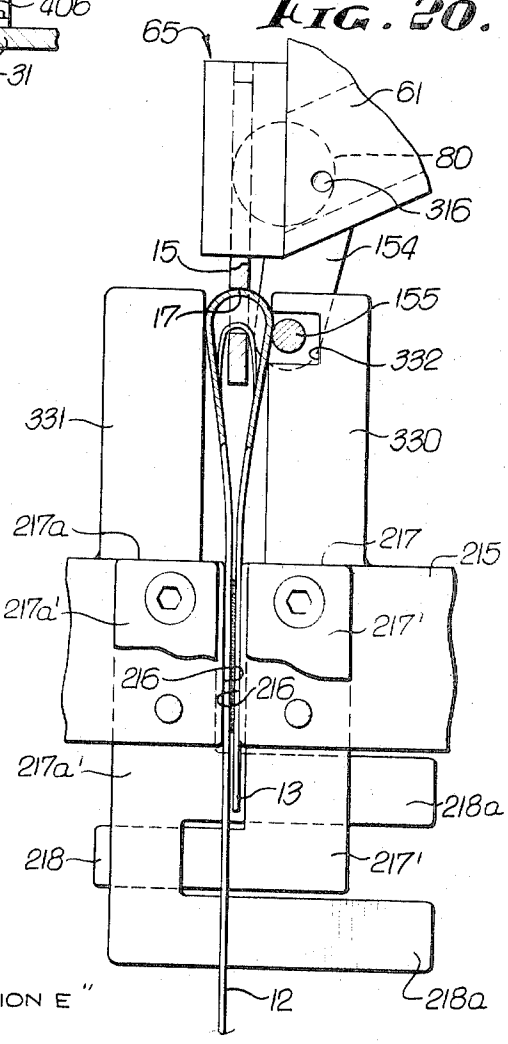

FIG. 19.

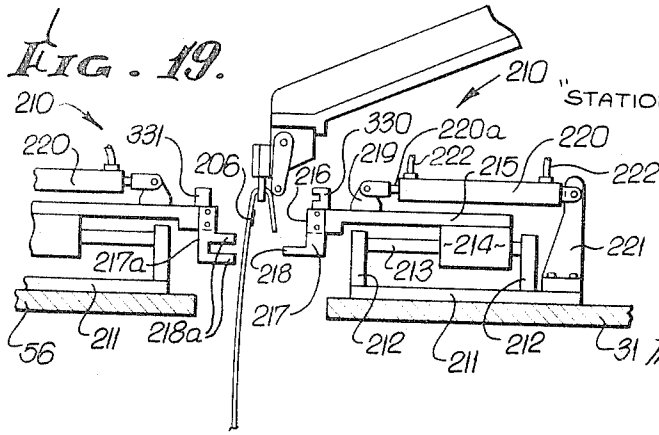

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FIG. 21.

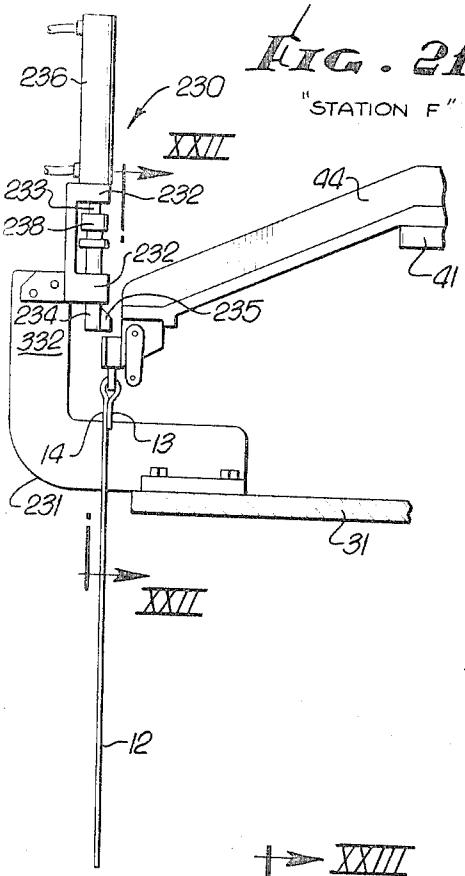


FIG. 24.

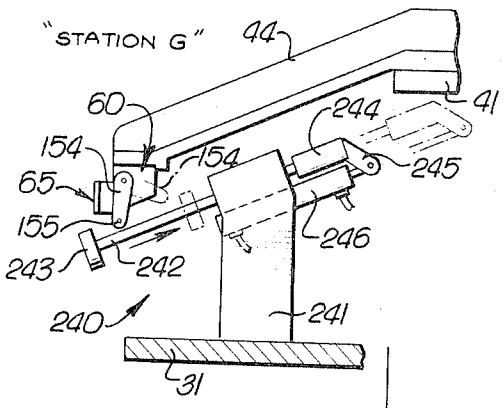
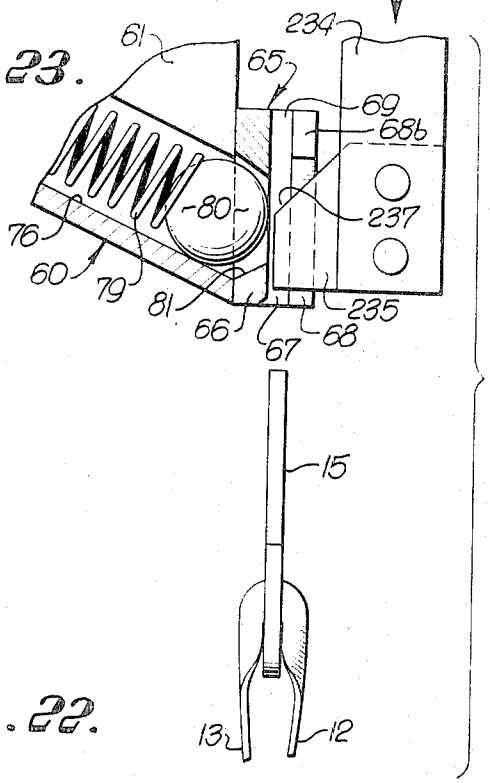


FIG. 23.



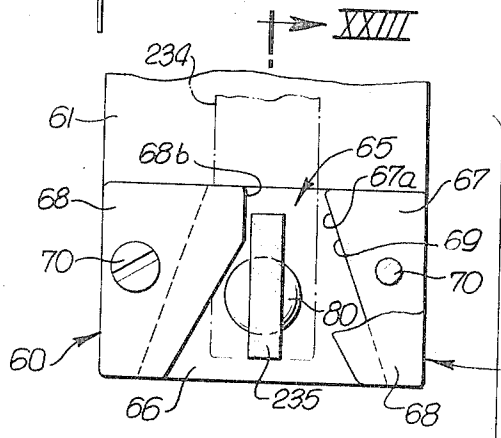
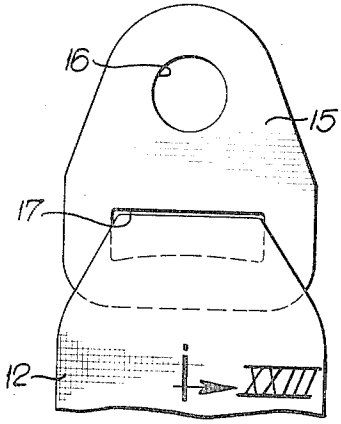


FIG. 22.



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METHOD AND APPARATUS FOR AUTOMATIC ASSEMBLY OF A BELT AND ANCHOR PLATE

BACKGROUND OF THE INVENTION

Current federal safety regulations require as original equipment on all new automobiles the provision of six seat belt assemblies and two shoulder belt assemblies. These requirements necessarily entail the attachment in some manner of one end of each of 16 safety belts to the automobile structure. The prior proposed customary method of attachment of such belt end portions to an anchor plate having a slot therein was to longitudinally hand fold one end portion of the belt to reduce the width of the belt to permit hand insertion of the folded end through the transverse slot in the anchor plate, to then transversely hand fold the belt portion over the anchor plate to form a bight in the belt, and then to secure the end portion of the belt to the remaining portion of the belt by several different well known methods. The anchor plate may then be connected by a bolt to the automobile chassis to secure one end of the belt on the vehicle.

Heretofore the inserting, folding, and securing of the belt to the anchor plate have been performed by hand. When only two belt assemblies were required per automobile, that is, four belt end portions to be anchored, hand methods were adequate for production of the number of belts required to originally equip automobiles. When the number of seat belt assemblies required per car increased from two to six and two shoulder belt assemblies were additionally required, hand methods of performing the operations above mentioned became too slow to meet production requirements and become costly, expensive and uneconomical. A need was created for performing the assembly operations of connecting a belt to an anchor plate and preferably the assembly operations were to be readily adaptable to automation and to the design and construction of a machine for automatically performing such operations without or with a minimum of manual assistance.

In addition, prior manual assembly of seat belt end portions with anchor plates required extremely close supervision and inspection to assure that the final belt and anchor plate assembly met the necessary standards of strength, resistance to disassembly, and the absence of frayed, scored, or partially cut belt fibers or filaments at the connection which would tend to reduce the safety margin allowed for such connections when placed under impact tension loading. The safety belt anchor plate connection must be adequate to withstand maximum test loading without separation of the belt from the anchor or without damage to the interconnection.

BRIEF DESCRIPTION OF THE INVENTION

The present invention, therefore, relates to an automatic method and apparatus for interconnecting and securing a safety belt to an anchor plate, and more particularly to a novel method and apparatus for inserting one end of a belt through an aperture in an anchor plate and firmly securing the belt portions in assembly with the anchor plate to withstand loading stresses to which the belt and anchor connection may be exposed under selected severe crash conditions.

It is, therefore, a primary object of the present invention to provide a novel method and apparatus for automatically assembling and securing one end of a safety belt to an anchor plate having a belt receiving aperture therein.

An object of the present invention is to disclose and provide a novel method including a sequence of steps by which a safety belt end portion may be rapidly assembled with an anchor plate in such a manner that the belt end portion may be attached to the plate without damaging or reducing the tensile strength characteristics of the belt.

Another object of the present invention is to disclose and provide a novel method of attaching a seat belt to an anchor plate.

Still another object of the present invention is to disclose an apparatus and method for interconnecting an end of a seat belt with an anchor plate wherein the end portion of the seat belt is rendered a degree of stiffness by longitudinally folding margins thereof for insertion as by pushing into the anchor plate aperture.

A further object of the present invention is to disclose and provide an apparatus and method for assembling an anchor plate and an end portion of a seat belt wherein means are provided for assuring symmetrical folding of belt portions about the anchor plate.

A still further object of the present invention is to disclose and provide an apparatus and method as stated above wherein means are provided for maintaining and holding a belt portion in selected aligned relationship with the anchor plate.

A still further object of the present invention is to disclose and provide an apparatus and method for interconnecting a safety belt with an anchor plate wherein a belt end portion is temporarily adhesively secured to an opposed standing belt portion to hold the anchor plate in assembly therewith until the belt portions are permanently secured as by stitching.

The invention generally contemplates an apparatus and method for assembling a pliant belt with an anchor plate having an opening smaller than the width of the belt. The apparatus and method includes means for longitudinally folding an end portion of a belt to pass the folded belt portion into and through said opening for a predetermined distance. Means are provided for transversely folding the belt end portion an adjacent remaining belt portion about the anchor plate to position the surfaces of the belt portions in opposed relation, and means for securing the belt portions, first temporarily by adhesive, and then permanently by stitching. The apparatus and method includes means for relatively rapidly passing a belt and an anchor plate from station to station to provide a releasable anchor plate belt assembly capable of being readily handled without disassembly thereof until the interconnection is permanently secured as by suitable means such as stitching.

Various other objects and advantages of the present invention will be readily apparent from the drawings in which an exemplary embodiment of the invention is shown.

IN THE DRAWINGS:

FIG. 1 is a top plan view of an apparatus embodying this invention for assembling the belt and anchor plate shown in FIG. 1*a*;

FIG. 1*a* is a fragmentary plan view of an anchor end of a seat belt assembly made by the apparatus and method of this invention;

FIGS. 2*a*–2*g*, inclusive, schematically illustrate the method of assembly of the belt end portion with an anchor plate; FIG. 2*a* showing advancement of a belt along a path, FIG. 2*b* underfolding of the leading belt end portion, threading into an anchor plate aperture, and spreading of the folded portion at the belt end, FIG. 2*c* transverse bending of the belt end portion passed through the anchor plate, FIG. 2*d* pressing and creasing the transversely folded belt end about the anchor plate, FIG. 2*e* application of adhesive to the belt, FIG. 2*f* clamping pressure being applied to the belt end and standing portions to temporarily secure the same, and FIG. 2*g* sewing of the belt end and standing portions in permanent relation;

FIG. 3 is a side elevational view taken from the plane indicated by line III—III of FIG. 1, a portion of the head being cut away for clarity;

FIG. 4 is an enlarged partial side elevational view taken of a plate mounting station and along the plane indicated by line IV—IV of FIG. 1 showing anchor plate releasable mounting means on the end of a carrier arm;

FIG. 5 is a fragmentary cross-sectional view taken at the plate mounting station along the stepped planes V—V of FIG. 4;

FIG. 6 is a fragmentary elevational view of a belt inserting station, the view being taken in the vertical plane indicated by line VI—VI of FIG. 1 and with the belt feeding means in open position;

FIG. 7 is a view similar to FIG. 6 and shows the belt feeding means in closed position;

FIG. 8 is a fragmentary sectional view taken along the plane indicated by line VIII—VIII of FIG. 7 showing shuttle means in the belt feeding means in extended feeding position;

FIG. 9 is a fragmentary cross-sectional view taken along the plane IX—IX of FIG. 6 showing upper and lower drive wheels of the longitudinal folding means in open position;

FIG. 10 is an enlarged fragmentary sectional view of the belt feeding means, the section being taken in a vertical plane longitudinally bisecting the folding means which is in closed position;

FIG. 10*a* is a perspective view of further longitudinal folding means attachable to said lower drive wheel support;

FIG. 10*b* is a fragmentary perspective view of belt end unfolding means or spreader shown in FIG. 10;

FIG. 11 is a transverse sectional view taken in the plane indicated by line XI—XI of FIG. 10;

FIG. 12 is a fragmentary transverse sectional view taken in the plane indicated by line XII—XII of FIG. 10;

FIG. 13 is a fragmentary sectional view in the plane indicated by line XIII—XIII of FIG. 10;

FIG. 14 is a fragmentary elevational view of the belt transverse folding station taken in the vertical plane indicated by line XIV—XIV of FIG. 1 and also showing crease-forming means;

FIG. 15 is an enlarged elevational view of a portion of FIG. 14 with the folding jaws and crease-forming means in closed position;

FIG. 16 is a fragmentary sectional view taken in the plane indicated by line XVI—XVI of FIG. 15;

FIG. 17 is a fragmentary elevational view taken at the adhesive applying station and along the plane indicated by line XVII—XVII of FIG. 1;

FIG. 18 is an enlarged fragmentary view taken in the planes indicated by the line XVIII—XVIII of FIG. 17 showing the adhesive pattern on the belt;

FIG. 19 is a fragmentary elevational view taken in the plane indicated by line XIX—XIX of FIG. 1 showing the belt clamping means in open position;

FIG. 20 is an enlarged fragmentary elevational view of FIG. 19 showing the belt clamping means in closed position;

FIG. 21 is a fragmentary elevational view at the anchor plate release station and taken along the plane indicated by the line XXI—XXI of FIG. 1;

FIG. 22 is an enlarged fragmentary exploded elevational view taken along the plane indicated by line XXII—XXII of FIG. 21 showing the release position of the mounting means;

FIG. 23 is a fragmentary cross-sectional view taken along the plane indicated by the line XXIII—XXIII of FIG. 22;

FIG. 24 is a fragmentary elevational view taken at the repositioning station and along the plane indicated by line XXIV—XXIV of FIG. 1 showing presetting of parts on the carrier arm prior to commencing a new cycle; and

FIG. 25 is an enlarged fragmentary top view of a belt end positioning means for locating a belt end with respect to the belt feed wheels.

The apparatus and method of the present invention will be described with respect to an exemplary safety belt generally indicated at 12 which may be made of suitable high tensile strength nylon filament material or the like to form a webbing which is pliant and flexible both longitudinally a laterally. Such belt webbing generally is relatively long with respect to width and thickness of the belt. The width and thickness may be varied according to body restraint and strength requirements for which the belt is intended. The present invention is directed to automatic assembly of a connector member, such as a metal anchor plate generally indicated at 15 with a belt end portion of such a safety belt so as to provide a secure, failure-proof connection between the belt and anchor plate.

In the exemplary method of automatically assembling a safety belt end portion with an anchor plate, reference is first made to FIGS. 2*a* to 2*g* in which the several steps to perform such an automatic assembly are schematically sequentially shown. It will be understood that belt stock may be supplied in the form of precut belt lengths arranged in stacked parallel relation or may be in the form of a coil or reel of belt stock which may be uncoiled and fed through a cutting means for cutting the coiled stock to preselected belt length. In the present example, belts are shown already precut to selected length.

As shown in the schematic figure, a precut belt length 12 is advanced in a direction along its longitudinal axis. As it is advanced, the leading end portion 13 is fed into a longitudinal belt folding means which downwardly folds edge margins of the belt, the margins having approximately a width of one-quarter of the belt width. The longitudinal edge margins are folded and tucked underneath the central longitudinal portion of the belt, reducing the belt width by approximately one-half, and providing a top belt layer and a bottom belt layer having a longitudinal joint at approximately the center line of the belt.

The under-folded belt end portion may be readily guided and inserted into an aperture or slot in anchor plate 15 as the entire belt advances along its unidirectional path. The anchor plate 15 is releasably positioned and held on an anchor plate carrier arm or member with the plate aperture exposed. A selected length of the leading folded belt portion passes through the anchor plate aperture 17 and upon moving away from the back face of the anchor plate, the leading portion is caused to partially longitudinally unfold, which unfolding is assisted by the natural resilient memory of the belt material. At the same time, downwardly hanging disposition of the leading belt end portion (FIG. 2*c*) may be assisted by a suitable opposed belt contacting and holding member (later described). The standing or remaining portion of the belt on the infeed side of the plate 15 is then released by the longitudinal folding means to permit the standing belt portion to be guided into downward hanging position from the anchor plate (FIG. 2*d*). In this position the end portion of the belt is transversely folded over the anchor plate with the standing belt portion and the end portion lying in generally opposed or overlying relation. To form the folded belt about the anchor plate to occupy minimum space and to symmetrically connect the belt to the anchor plate, a belt fold line form means is inserted between the standing and belt end portions on opposite sides of the anchor plate so that the underfolded longitudinal margins just below the aperture are diagonally flared outwardly at a selected angle to provide maximum belt width at a location at approximately above the bottom edge of the anchor plate. External pressure shoes (later described) cooperate with the fold line form means for pressing the belt to hold the diagonal fold lines.

When the belt end portion and adjacent standing portion of the belt have been uniformly diagonally folded and transversely formed about the anchor plate, adhesive or bonding material is deposited (FIG. 2*e*) on the standing belt portion at an area opposite the belt end portion. Immediately after such deposit, clamping means (FIG. 2*f*) move into pressure engagement with opposite sides of the belt loop adjacent the anchor plate and at the adhesive area to clamp and hold the material together while the adhesive begins to set. Sufficient setting time is provided so that when the belt and anchor plate is advanced to a position for release of the anchor plate-belt assembly, the belt end portion will be temporarily firmly secured to the standing belt portion. The anchor plate-belt assembly is then released, the assembly being held by the adhesive between the standing belt portion and end portion. This initially assembled belt and anchor plate may then be transferred to a sewing station (FIG. 2*g*) where the overlapped belt portions are sewn by a suitable sewing machine in well-known manner. After the sewing operation is complete the assembled anchor plate and belt may then be advanced to a stacking station or other suitable storage location for further processing or handling.

In the present embodiment, the anchor plate 15 may be of suitable generally triangular configuration in which aperture or slot 17 is provided adjacent the base portion of the triangle and an opening or hole 16 is provided in the central portion of the triangular shape. Other suitable anchor plate shapes may be employed provided a selected relation between anchor bolt hole 16 and belt receiving slot 17 is correlated, with the several operations of the automatic assembling operation as described hereafter.

Generally speaking, apparatus 10 includes a frame structure 25 provided with a central table 30 supporting centrally thereof an indexing head means 41 rotatable about a vertical axis. At one side of table 30 and supported on frame structure 25 is a belt feed table 50 and adjacent thereto and to the periphery of the indexing head means 41 is an auxiliary station table 55. The table 50 and 55 together with indexing head means 41 define a plurality of stations at certain of which automatic operations are performed, such operations being described after first describing in more detail the relationship of the tables and the head means.

In FIGS. 1 and 3, the central table 30 on frame structure 25 includes a main top plate 31 of generally semicircular plan supported by a plurality of suitable legs 32. On a portion of top plate 31 lying below a diameter of the semicircular portion of the plate are spaced aligned upstanding brackets 33 for supporting a transverse horizontal shaft 34 which extends therebetween. The left end portion of shaft 34 may be associated with a gear box 35 which is suitably coupled to a motor 36 below top plate 31. At the right end of shaft 34 may be mounted a series of control or operating cams 37 which upon rotation, actuate a plurality of respective switches 38 carried by top plate 31 in cooperable relation with the cams 37. Between gear box 35 and cams 37 is provided a shaft indexing gear means 39 having couplings 40 on opposite sides thereof connecting shaft 34 to the gear means 39 in suitable manner. The arrangement of gear means 39, couplings 40 and shaft 34 may also include means responsive to excessive or overloading of shaft 34 in torque for stopping the operation of apparatus 10.

Indexing head means 41 is suitably coupled to gear means 39, and may include a selected number of radially extending uniformly circumferentially spaced arms 44 each arm serving as an anchor plate carrier or support member. Arms 44 may each include a vertical web 45 and horizontally extending flanges 46 to provide desired rigidity. Each arm 44 may be inclined downwardly from the indexing head means 41 to a plane spaced above tabletop 30 a selected distance for performance of the assembly operations.

Electrical control means 47 may be carried on one of the legs 32 beneath table top 30, said electrical switch arrangement to control the operation of motor 36 and cam actuated switches 38. The switches 38 operated by the cams 37 open and close electrically actuated pneumatic valves of a pneumatic operating and control system including suitable pressure air tubes, relays, rams and the like which are well known and which have been omitted for the purposes of brevity and clarity. A pneumatic switch box 48 may be mounted on one of the legs 32 to house various parts of the pneumatic operating system.

Feed table 50 supported on an extension of the frame structure 25 extends sidewardly from the non-semicircular portion of the table 30. Feed table 50 includes a top plate 51 supported by a plurality of legs 52 and may be provided with a plurality of upstanding spaced vertical supports 53 for supporting belt feeding equipment as later described.

Auxiliary station table 55 of frame structure 25 is suitably spaced from and generally located behind cen-

tral table **30**. Table **55** may include a curved or arcuate shaped top plate **56** supported by legs **57** at the same height as the main top plate **31** of central table **30**.

Generally, in operation of indexing head means **41**, a switch in electrical switch box **47** is closed and a pneumatic system is filled with pressurized air from a suitable pressure air source. Motor **36** is energized to rotate both the cams **37** on shaft **34** and to drive the head gear box means **39**. The gear box means **39** rotates the indexing head **41** to incrementally rotate carrier arms **44** approximately one-twelfth of a circle, to stop rotation thereof at selected stations, to hold the arms **44** stationary for a selected dwell period before turning the arms another one-twelfth segment of a circle. The rotation and dwell cycle moves each anchor plate carrier arm **44** around plate **31** in 12 incremental equal steps with each arm **44** moving to the position the preceding arm **44** occupied while the following arm **44** moves to the position formerly occupied by an arm **44**.

During the selected dwell period when arms **44** are stationary, the cams **37**, which are synchronized with the dwell periods, operate various anchor plate and belt handling means at the different stations. While the exemplary apparatus is provided with 12 arms **44** and 12 dwell positions, in the present embodiment, only seven positions are of primary significance. These significant positions, called stations, are: an anchor plate mounting station at A (FIG. **1**); a belt feeding and inserting station at B; a transverse belt folding station at C; an adhesive applying station at D; a belt clamping station at E; a plate releasing station at F; and, a transverse folding mechanism repositioning station at G. At each of these stations, equipment is mounted on top plates **31, 51** and **56** to automatically perform the functions of the belt assembly apparatus **10**. The equipment and automatic means at each station will be described in connection with the successive movement of an individual anchor plate carrier arm from station to station around apparatus **10**.

Anchor Plate Mounting Station A

Initially, a selected carrier arm **44** is located at a start position or anchor plate mounting station A where anchor plate **15** is releasably attached to the end extremity of carrier arm **44** by an anchor plate mounting means **60**.

A supply of anchor plates **15** may be carried in a suitable magazine (not shown) from which plates **15** may be fed one at a time in timed sequence with the positioning of an arm **44** at station A. Each anchor plate **15** may be carried by suitable automatically operable jaws for aligned advancement upwardly to mounting means **60** (FIGS. **4** and **5**) and with hole **16** therein exposed and disposed adjacent the top of plate **15**. Anchor plates **15** may also be readily manually fed to mounting means **60** as will be apparent from the following description.

Plate mounting means **60** includes a block element **61** bolted at **62** underneath and to flange **46** of arm **44**. On the front face of block **61** is located positioning means **65** for holding plate **15** on block **61** with plate aperture **17** exposed or uncovered and horizontally disposed. Positioning means **65** includes a ported base plate **66** and a pair of spaced side plates **67** having inner converging edge walls **67***a* corresponding in inclination to the angular shape of the anchor plate **15** to restrain sideward movement of anchor plate **15**. A pair of outer retention plates **68** on side plates **67** have inner converging edges **68***a* defining with side plates **67** and plate **66** converging channels **69** for reception of edge margins of plate **15**. Inner edges **68***a* merge into parallel spaced edges **68***b* which define a front facing and upwardly and downwardly opening slot for release of the anchor plate **15** as hereafter described. Countersunk machine screws **70** may extend through the several plates **66, 67,** and **68** and into tapped holes in block **61** for securement thereof.

Mounting means **60** also includes detent means **75** for releasably holding plate **15** in position in channels **69**. The detent means includes a downwardly and outwardly inclined radial bore **76** in block **61** having a closure plug **77** at its inner end secured by a pin **78**. Plug **77** provides a seat for the inner end of a coil spring **79**, the other end of spring **79** being seated against a ball **80** retained in bore **76** by a spherical seal **81** formed in the ported base plate **66**. Base plate **66** provides a ball port from which a selected spherical segment of the ball may protrude into holding engagement with hole **16** of anchor plate **15** when an anchor plate is moved upwardly into channels **69**. The biased ball **80** is readily retractable by pressure movement by anchor plate **15** vertically in channels **69**; the ball **80** snapping into hole **16** to hold plate **15** from dropping out of the holding means. In such position, the elongated aperture **17** in anchor plate **15** is located below block **61** and suitable space is provided in front of and behind the anchor plate **15** for manipulation of belt **12** as later described.

Upon completion of the upward insertion and snapping into place of anchor plate **15** in holding means **16** at station A, arm **44** with mounting means **60** and anchor plate **15** carried thereby are rotated successively through two inoperative arm positions to a fourth operative arm position at which is located a belt feeding station B.

Belt Feeding Station B

The belt feeding means **90** of this invention includes a shuttle means **91** (FIGS. **1** and **3**) for transferring a belt from a supply thereof to a path for longitudinal feeding of the belt, a longitudinal feeding means **100** for advancing a belt in the direction of its axis, a first folding means **130** associated with feed means **100**, and a second folding means **140** for completing under folding of longitudinal margins of the belt.

Shuttle means **91** (FIG. **8**) for transporting each belt **12** to feeding means **100** may include an elongated shuttle plate **92** supported on feed table **50**. Shuttle plate **92** reciprocates beneath a magazine of stacked precut belts (not shown) to select the lowermost belt from the belt stack and to advance the selected belt transversely of the belt axis to the longitudinal feeding means **100**. For this purpose shuttle plate **92** has a belt receiving surface **93** defined by a longitudinal shoulder **93***a*, the belt receiving surface being positionable beneath the stacked belts. The shuttle plate **92** is guided in its reciprocal movement by parallel guide bars **95** extending from the back of plate **92** and slidably received in shuttle guide members **96** mounted on two of the vertical supports **53** on feed table **50**. Reciprocal movement of the shuttle plate is provided by a pneumatic double acting cylinder and piston ram means **97** having air hoses **98** connected at opposite ends of the cylinder, the ram means **97** being supported by a vertical support **53** on the feed table. The free end of the ram piston rod

may be connected to plate 92 by a depending bracket 94. Thus the shuttle plate 92 is reciprocally movable between a belt pickup position beneath a stack of belts as shown in phantom lines in FIG. 8 to the belt advancement or feed position shown in solid lines in FIG. 8 to transfer belts from the supply magazine to the longitudinal feeding means 100.

Feeding means 100 advances each belt 12 along a path in the direction of the longitudinal axis of the belt and toward the aperture 17 of the plate 15 positioned at station B. In this example, shuttle means 91 positions the leading end of belt 12 in longitudinal alignment with a laterally expandable or widened belt guide opening 301 (FIG. 25) provided by base portions 302 of belt end positioning and stop finger means 303. Extending from each portion 302 is a forwardly projecting finger 304 having an inturned stop 305 at its end against which the leading corner edges of a belt abut outboardly of wheel 101 to determine the longitudinal advancement of the belt for later engagement by top and bottom wheels 101 and 102 of the feed means. Belt 12 may be advanced to stop 305 by hand or by a suitable drive means (not shown) moved into engagement with the top of a belt 12 while supported by shuttle plate 92 through opening 301 into abuttment with stop 305.

Finger means 303 are slidably carried by a member 307 extending across the path of belt 12. Air actuated means (not shown) are provided for operation of finger means 303 in timed sequence with the several steps performed at station B. The finger means 303 are in normally closed position during belt feeding and are expanded or spread apart to release the standing portion of the belt as later described.

Feeding means 100 includes vertically separable upper and lower belt folding and advancing wheels 101 and 102 respectively. Each wheel may be rotatably carried on an axle 107 mounted at one end of an elongated tubular member 106, each tubular member 106 being typically supported at their opposite end about a common axis provided by pivot pin 110 carried in a mounting block 111 secured in a suitable manner to a rear vertical support 53 of feed table 50 at approximately the same height as the end of anchor plate carrier arm 44.

Means for vertically moving each wheel 101 and 102 towards and away from the other may comprise a double-acting cylinder and piston means 108 having a pivotal connection to axle 107 of the respective wheel and pivotally mounted at 109 from a support 53 of feed table 50. In wheel separated open position shuttle means 91 moves in a horizontal plane in spaced relation to wheels 101 and 102 and a belt 12 is advanced through opening 301 to position a belt end against guide and stop fingers 303 and at the bite of the wheels 101 and 102 when the wheels are moved toward each other to engage the belt end portion for advancement of the belt. It should be noted that the longitudinal axis of the belt as it is held on the belt supporting surface of the shuttle lies at right angles to the axis of the wheels and that the shoulder 93, opening 301, and finger means 303 maintain the belt end portion in this relationship so that the belt is accurately advanced with respect to the initial folding action of the belt which is performed by the wheels as described hereafter.

Means for advancing belt 12 a preselected distance by the drive wheels 101 and 102 may be provided by a gear 116 (FIG. 1) carried on an extension of pivot shaft 110, gear 116 having its teeth engaged with the teeth of a rack bar 117. Bar 117 is carried on an idler roller 118 adjacent gear 116, the other end of said rack bar being suitably connected with the piston rod of a double-acting cylinder and piston means 119 pivotally mounted at its opposite end at 120. Pressure air hoses 121 are connected at opposite ends of the cylinder means for reciprocation of the rack bar. Rotation of gear 116 by rack bar 117 turns pivot shaft 110 which may be connected by suitable gear means such as bevel gears and gear shafts through each tubular member 106 to the axles 107 of the wheels 101 and 102 for selective rotation of the wheels. The gearing and the driving forces imparted to wheels 101 and 102 are arranged to rotate wheels 101 and 102 in opposite directions when in closed position with a belt end portion between the bite of the wheels and to advance the belt a selected distance which is a portion of the length of the belt.

Means for adjusting the length of the belt portion advanced between wheels 101 and 102 may comprise adjustable stops 126 carried on rack bar 117 for engagement with a suitable fixed stop such as idler wheel 118. It will be readily apparent that other adjustable stop means may be used to positively limit longitudinal travel of rack bar 117 thereby limiting the amount of rotation imparted to drive wheels 101 and 102 and the distance belt 12 is advanced.

At station B belt 12 is folded, pushed and threaded through slot 17 in the anchor plate. Since the normal width of belt 12 is much greater than the largest dimension of slot 17, the leading end portion of belt 12 is folded longitudinally into underlying or infolded relation with the center longitudinal belt portion to provide a width which will permit the passage of the folded belt end portion through the slot 17, the folded portions tending to stiffen the belt end portion whereby the longitudinally folded belt end portion may be inserted through slot 17 as by pushing with wheels 101, 102.

The first longitudinal folding means 130 is provided by the cross-sectional configuration of the peripheral portions of the wheels 101 and 102. In this example (FIGS. 9 and 10) upper wheel 101 is provided with a circumferential channel defined by radially outwardly directed spaced annular walls 131. The width of the circumferential portion of wheel 102 is less than the spacing between the annular walls 131 of wheel 101 by an amount approximately twice the thickness of a belt. Circumferential belt engaging surfaces 101*a* and 102*a* may be knurled or roughened to provide frictional grasping of the belt.

Upon positioning of a belt 12 with its end edge against finger stops 305, wheel 102 is raised to its uppermost position with surface 102*a* contacting the end edge margin of the belt adjacent stops 305. Top wheel 101 is lowered with walls 131 pushing corner edge margins of belt 12 downwardly over the circumferential edges of wheel 102 to begin the longitudinal folding of the belt end portion. It should be noted that by first raising wheel 102 to support the end edge margin of belt 12 from beneath the belt, the succeeding downward movement of wheel 101 then acts upon a belt end portion which is laterally held and vertically supported so as to maintain an aligned position with the longitudinal path of the belt. When the wheels are vertically moved together with the belt end thus positioned in the bite of wheels 101, 102, edge margins of the belt as they are bent over the circumferential edges of wheel

102 provide an inverted U cross section as shown in FIG. 11.

Further infolding of the longitudinal edge margins of belt 12 is provided by second folding means 140 immediately after the initially folded belt exits from the bite of the wheels 101 and 102 as the belt is advanced by the wheels. As best seen in FIGS. 10 and 12 the leading inverted U section end of a belt 12 is advanced against a closely adjacent folding and guide block or shoe 141. Block 141 is provided with an upwardly inclined selectively transversely curved concave surface 142 for engagement with the depending longitudinal edge margins of the belt end for folding said margins upwardly and underneath the central portion of the belt. During such under and upwardly folding operation a top guide plate 145 provides a bottom surface 146 against which the top surface of the belt may slide and be held against vertical movement which might place the belt end out of alignment with the aperture 17. Top guide plate 145 and bottom guide block 141 define a transverse opening 147 through which the underfolded belt end portion passes for insertion into a slot 17.

Means for limiting lateral slippage or displacement of the partially folded belt end portion and to assure symmetrical longitudinal infolds may comprise an upstanding longitudinal rib 142*a* at the longitudinal center line of the surface 142 and having its front edge inclined upwardly from surface 142 starting at a point spaced from the front edge of surface 142. Rib 142*a* extends to the back face of block 141 and has a top edge spaced from surface 146 of the top guide member a sufficient distance to pass the web material. To further facilitate lateral guiding, guide block 141 includes front side walls 142*b* which limit lateral movement of the belt.

Both bottom guide block 141 and top guide plate 145 include extensions 144 which may be connected in suitable manner to the ends of tubular members 106 adjacent the wheel shafts 107. Thus when the wheels are moved together to engage a belt end portion for advancement thereof, the bottom guide block and then the top guide plate are moved into operative relationship to further fold and guide the belt end portion toward the anchor plate. The end of the belt emerging from the exit opening 147 defined by the plate and block is directly aligned with the slot 17 and since the exit opening is closely adjacent thereto as shown in FIG. 10, the infolded shape of the longitudinally folded belt provides rigidity to maintain the belt end portion in an aligned path for insertion into and through slot 17. As the folded end portion emerges from plate opening 17, it advances to a plow shaped surface 310 formed on a generally rectangular member 311 carried by a vertical bar 312 secured at its lower end to top plate 31. Surface 310 sidewardly and upwardly diverges from a longitudinal front central ridge line 313 and serves to contact the leading end edge margin of the folded belt to cause unfolding of the belt end portion which has passed a selected distance through opening 17. This unfolding is preparatory to securement of the belt end portion to the opposed standing portion as later described.

After a selected length of the belt end portion is passed through anchor plate slot 17, rotation of wheels 101 and 102 are stopped and retain engagement with the belt to hold the belt against longitudinal slippage during initial downwardly folding of the belt end portion about the anchor plate, such downward folding also occurring initially at station B.

Means for downwardly folding the free belt end portion about anchor plate 15 may comprise a horizontally disposed belt holding bar 155 pivotally hung from carrier block 61 by a pair of hangers 154 pivotally supported at their upper ends on a pin 153. Hangers 154 are shown in vertical position in FIG. 10 and are normally positioned in approximately horizontal position (FIG. 6) wherein the holding bar 155 lies inwardly of carrier block 61. In such normally retracted position bar 155 is proximate to a cylindrical head 159 carried on an inclined shaft 158 slidably mounted in a stand 157 carried by main plate 31 of the central table 30. The upper end of shaft 158 carries an enlarged stop member 160 provided with a downwardly inclined fixed arm 161 having a pivotal connection at its free end to a piston rod of a fluid pressure cylinder means 162. Cylinder means 162 is double acting and is provided with fluid pressure lines 163 at opposite ends thereof.

Thus in timed sequence with the dwell of carrier arm 44 at station B the fluid pressure cylinder means 162 may be actuated to advance the head 159 against the holding bar 155 to cause bar 155 to swing forward from its detent held rear position into pressure engagement with the upper surface of the folded belt end portion 13 at the anchor plate 15 (FIG. 10). Such pressure contact while belt 12 is being held against longitudinal slippage by wheels 101 and 102 prevents displacement of belt 12 in the aperture 17 of the anchor plate, and initiates downward folding of free belt end portion 13 about anchor plate 15. In such downward folding the longitudinal folds which extend beyond bar 155 are permitted to further expand so that the resiliency of the belt material continues unfolding of the infolded longitudinal margins of the belt end portion.

Holding bar 155 is maintained in pressure contact with the folded belt opposite the anchor plate below aperture 17 by detent means 315 carried by each hanger 154 between its ends and cooperable with a bottom detent recess 316 provided in the opposed surface of carrier block 61. A top detent recess 317 holds bar 155 in upper retracted position as later described. The clamping pressure of bar 155 against the folded belt at the back of anchor plate 15 positively positions and holds the belt and anchor plate in temporary assembly and assists in keeping the desired aligned relationship of the belt end portion, anchor plate, and belt standing portion as further operations are performed since the long belt standing portion may drag and cause displacement of the belt with respect to aperture 17. In addition, it may be desirable to assembly anchor plates with belts which have been connected to a buckle at the opposite end of the belt; the exemplary pressure holding of the belt and plate by bar 155 will prevent displacement of the belt with respect to the plate which might occur because of the additional hanging weight of the belt and buckle.

Upon completion of the initial folding operation described above, wheels 101 and 102 may be separated to release the belt 12. Finger means 303 are simultaneously spaced apart, and the standing portion of the belt is dropped by return of the shuttle plate 92 to the stack of belts. As the arm 44 is then moved toward the next station C, the anchor plate 15 pulls belt 12 and the standing portion of the belt 12 hangs from the anchor

plate as best shown in FIG. 14, the belt end portion 13 being held against plate 15 by bar 155 during such movement to station C.

During the approach of the belt to station C, the free hanging standing portion of the belt is guided by a top guide member 320 which bears against the outer belt surface opposite plate 15 as at 321 to maintain the outer folded belt material at the plate. A bottom guide rod 322 which curves downwardly to a point 323 beneath station C may bear against inner surfaces of the belt as at 324 to prevent lower portions of the belt from swinging inwardly too far and out of a desired path or annular work zone generally defined by the circumferential edge of the central work table 31.

Transverse Folding Station C

Further transverse folding at belt 12 about anchor plate 15 is shown in FIGS. 14–16. At station C crease or fold forming means coact with pressure folding means so that the folding and partial unfolding of the belt portion threaded through the anchor plate 15 and the standing portion of the belt will be in registration and longitudinal alignment.

Means for pressing the opposed belt portions at the anchor plate may include opposed and aligned pressure heads or jaws 173 on opposite sides of anchor plate 15 and the belt carried thereby when positioned at station C. Each pressure jaw 173 includes a flat vertical pressure face 174, which is advanced and retracted toward and from the folded belt by a rod 172 axially guided for reciprocal movement in a stand 171. The opposite end of rod 172 carries an enlarged head 175 connected by a fixed downwardly inclined arm 176 to a piston rod 177 of a pressure fluid cylinder and piston means 178, the piston rod 177 having a pivotal connection at 179 to the end of arm 176. Fluid pressure cylinder means 178 may be of double acting type and is provided with fluid pressure lines 179.

The belt end portion 13 which has been inserted through the anchor plate will normally be at least approximately vertically aligned with the anchor plate because of the aligned relationship of the belt inserting and feeding means. The standing portion of the belt 12 is pulled from the prior station by movement of head 42 to the next station so that the standing portion may not be precisely vertically registered with the inserted end portion 13 of the belt. To properly align the end portion 13 and the standing portion of belt 12 with the anchor plate, the jaw 173 supported from the stand 171 on the table top 56 may be provided with belt aligning guide plates 173*a* which may be slightly outwardly diverging so as to accommodate a misaligned standing portion of belt 12 and to urge the misaligned portion into vertical alignment and registration with the anchor plate and end portion 13. Thus in operation pressure jaw 173 with the belt aligning side plates is first advanced into pressure aligning contact with the belt standing portion and then the opposed pressure jaw 173 is moved into pressure contact with the belt end portion below the holding bar 155. It should be noted in FIG. 15 that the top portions of the opposed pressure faces 174 are disposed in closed or pressure holding position approximately just below the lower edge portion of the anchor plate and thus at the lower portion of the creases being formed. The pressure holding contact of the pressure faces 174 against the belt and the lateral confinement of the belt between guide plates 173*a* serves to closely contain the belt portions during the crease or fold forming operation.

Crease forming means 180 may comprise a yoke 181 carried on the end of a fluid actuated rod 190 connected with a cylinder and piston means 191 of double acting type having pressure fluid inlet lines 192 at opposite ends of the cylinder means. The cylinder means 191 may be suitably supported from a depending bracket 186 carried by an edge portion of plate 31, said bracket 186 including outwardly directed horizontal supports 187 and a vertically disposed shaft 188 upon which is slidably mounted a guide member 189 connected to rod 190 for accurately guiding reciprocal vertical movement of the crease forming yoke 181.

Yoke 181 includes a lower body portion 184 connected to rod 190 and a pair of transversely spaced ears 182 forming therebetween a slot 182a for reception of the lower portion of the anchor plate 15 and internal fold portions of the belt below slot 17. As best seen in FIG. 16, the configuration of each ear 182 includes a top edge 183 having a length approximately the width of the inner dimension of the folded belt portion lying in the slot 17. Top edge 183 forms with peripheral beveled or inclined edges 183*a* obtuse angles which are selected to form the ultimate taper or diagonal of the folded belt portion at slot 17. The width of body 184 may be slightly less than belt 12. Thus, the peripheral edges 183 and 183*a* on each ear 182 provide a creasing form which may be extended upwardly into the area opposite slot 17 in anchor plate 15 and between the central portion and longitudinal marginal portions of the belt so that a crease or fold will be accurately and uniformly provided in the folded belt portions on opposite sides of anchor plate 15.

After the pressure belt holding faces 174 are in position, the yoke 181 is raised into the fold forming top position wherein ears 182 project into the space between the central longitudinal belt portion and the infolded belt portions which extend downwardly and outwardly from the aperture 17 in anchor plate 15. The external containment of the transversely folded belt resists the internal pressure of the yoke 182 so that the diagonal folds are uniformly made in accordance with the edges 183, 183*a* of the ears 182. As shown in FIG. 15, holding bar 155 which has pressure engagement against the folds opposite the anchor plate portion below aperture 17 is spaced a sufficient distance from plate 15 so that the ear 182 can be passed over the internal diagonal folds and the external belt portion.

The pressure heads 173 and the crease forming yoke means 181 are then retracted as controlled by the cam system described earlier. When retraction of both is completed, arm 44 moves through a sixth position to a seventh position as viewed in FIG. 2 where an adhesive applying station D is provided.

Adhesive Applying Station D

As best seen in FIGS. 1 and 17, as the belt and anchor plate approach station D, a curved belt guide bar 327 engages the lower inner surface of belt end portion 13 to slidably displace portion 13 inboardly and to open the space between the belt end portions 13 and 14 to facilitate application of adhesive to the inner surface of belt portion 14.

Means for securing the belt portions 13 and 14 together by adhesive may include an adhesive or glue depositing means comprising a supply source of adhesive such as receptacle 202 filled with a selected quantity of

suitable adhesive. The adhesive may be kept at a selected temperature by heating means associated therewith (not shown). The receptacle **202** may be closed pressure vessel to which pressure air fed by an air supply hose **203** may be used to transport the adhesive material through a supply hose **204** to a suitable nozzle **205** positioned at station D a distance below anchor plate **15.** The nozzle is upwardly inclined to direct and to apply by ejection a pair of generally parallel spaced short bands of deposited adhesive material on the inner surface of belt portion **14** at a height opposite belt end portion **13.** Suitable adhesive metering means may be employed so that a preselected quantity of adhesive is ejected or shot from the nozzle to provide adequate bands of adhesive **206** on the belt.

Nozzle **205** may be suitably supported from main table **31** by a bracket **206** having an adjustable clamp means at its end for engagement with nozzle **205** to properly position the nozzle discharge port with respect to the belt surface. It is understood that various means may be used to apply the adhesive to the inner surface of belt **14,** the pressure supplied adhesive ejected through nozzle **205** being exemplary thereof.

The ejection of adhesive at station D is preferably controlled by the presence of a belt **12** on the carrier arm, such presence being sensed by suitable sensing means (not shown) at station D. An example of a well known sensing means for this purpose is an air jet beam which is interrupted by the belt in proper position with respect to the nozzle. Photoelectric sensing devices may also be suitable for this purpose. In the absence of a belt on a carrier arm, the jet air beam would not be broken and the nozzle would be inoperative to eject the adhesive material.

Upon deposit of the adhesive as desired, arm **44** carrying the belt **12** is moved to the next position where a belt clamping or holding station E is provided. It should be noticed that a relatively fast drying adhesive may be used so that a desired tacky condition is provided when arm **44** and anchor plate and belt reach the next station.

Belt Clamping Station E

At belt clamping station E, means **210** are provided for holding the belt portions **13** and **14** under pressure engagement until the adhesive material sets at least sufficiently to prevent separation of the belt portions upon departure from station E.

Upon entering station E, the belt end portions **13** and **14** may still be in slightly open diverging relation in the application of adhesive to the belt and transport of the belt to the belt clamping station some misalignment of the belt portions may occur. At station E a pair of essentially identical clamping means are provided on opposite sides of the belt portions. For purposes of brevity, like reference numerals will be applied to like parts of both clamping means.

Clamping means **210** may include a support plate **211** carried by main table **31** or by a plate **56** on the accessory table **55.** Each base **211** carries radially spaced upstanding members **212** between which extend a slide member **213** for slidably mounting a carrier **214.** Each carrier **214** includes an upper forwardly extending support arm **215** which extends beyond outboard upstanding member **212** into proximate position with one side of the belt **12.** At the end of each arm **215** is provided a flat pressure or clamping surface **216** for pressure engagement with the adjacent surfaces of the belt portions.

On opposite side faces of the end of each arm **215** may be mounted belt aligning and guide means for cooperable interleaving or intermeshing engagement with guide means on the opposed clamping means to positively align in registration the belt portions. In this example, guide means **217** at the right of belt **12** (FIG. **19**) includes a pair of depending side plates **217***a* secured as by screws to opposite side faces of arm **215.** At the guide means **217** on the right the plates **217***a* include a single set of forwardly projecting lower fingers **218.** At the clamping means **210** on the left, the side plates **217***a* include vertically spaced sets forwardly extending fingers **218***a* which receive therebetween the set of single fingers **218** on the opposed clamping means. Each of the fingers **218** and **218***a* is flared outwardly and away from the planar zone of the belt **12** so that in the event of misalignment of the belt portions **13** and **14** the outwardly flared fingers **218, 218***a* would engage and guide the misaligned belt portion into proper vertical registration with the other opposed belt portion.

In addition to pressure surfaces **216,** each arm **215** may be provided with adjustably mounted pressure blocks **330, 331** to bear against the belt portions above pressure surfaces **216** in the event it is desired to press or crease the diagonal folds at the anchor plate. Block **330** is provided with a transverse recess **332** for reception of bar **155** during the clamping operation. Blocks **330, 331** may be spring biased to exert a selected pressure force against the belt portions or may be adjustably fixed to arms **215** to just touch the belt portions and thus serve to further contain the belt portions during the clamping operation.

In operation, belt end portion **13** is in substantial alignment with the anchor plate because of the holding pressure of bar **155.** Clamp means **210** on the right (FIG. **19**) may be first advanced into the belt clamping zone and then clamp means **210** on the left may be advanced so that the set of guide fingers **217***a* and **218***a* are interleaved and guide the standing belt portion **14** into aligned registration with belt portion **13** and anchor plate **15.** The pressure faces **216** clamp the belt portions at the adhesive applied area for a selected time interval as determined by the cam means so that the belt portions will be adhesively held together until permanently secured as by sewing. In closed clamping pressure engagement shown in FIG. **20** the intermeshing of the fingers **218** illustrates the lateral engagement of the inner surfaces of the fingers with the side edges of the belt portions immediately below the adhesive bands which are held under clamping pressure by the pressure face **216.**

Means for actuating the pressure or clamping arm carriers **214** may comprise fluid pressure cylinder means **220** of double acting type having one end pivotally mounted to an upstanding standard **221** secured to table **31.** At the opposite end of cylinder means **220** a piston rod **220***a* is pivotally connected at its outer end to a bracket **219** secured to the arm **215.** The axis of the cylinder means **220** lies approximately parallel to the slide **213** and upon actuation of the cylinder means **220** by introduction of pressure fluid through hoses **222** the piston rod **220***a* will advance or retract the carrier **214** on the slide **213** so as to move the pressure faces into pressure engagement with the belt. Clamping pres-

sure may be maintained for a suitable time so as to permit the adhesive to set and firmly bond the belt portions together.

On completion of the clamping operation the arm 44 is then moved through two more positions of the rotating head (which provide additional setting time for the adhesive) to an eleventh position where anchor plate release station F is located.

Anchor Plate Release Station F

Means for releasing the assembled anchor plate and belt 12 from the arm 44 is illustrated in FIGS. 21–23 inclusive.

In FIG. 21 arm 44 carries belt 12 in assembled relationship with the anchor plate and with the belt firmly held in such assembly by the adhesive bonding of belt portions 13 and 14. At station F release means 230 may comprise an upright angle bracket 231 which crosses the circular path of the end of carrier arms 44 and which may be secured at one end to table top 31. The upright leg 332 of the angle arm carries a fluid pressure cylinder means 236 with its axis vertically disposed. Below cylinder means 236 are provided vertically spaced guide members 232 for a slide member having a bottom head 234 provided with a protruding striking finger 235 facing arm 44. Slide member is connected to the end of piston rod 233 by a suitable coupling 238. Strike finger 235 is vertically aligned with opening or slot 68*b* provided on the mounting means 61 when mounting means 61 is positioned at station F.

Upon actuation of fluid pressure means 236 after strike finger 235 moves through the slot 68b and its lower face engages the top edge of anchor plate 15. Anchor plate 15 is thus driven downwardly, the edges of the port 16 which were interlocked with the protrusion of ball 80 are forced against the ball to cause the ball to be pushed into bore 76 and away from the ball seat 81 so that the upper body portion of anchor plate 15 may slide past ball 80. As the strike finger progresses further downwardly it positively ejects anchor plate 15 with the belt assembled therewith and normally holds ball 80 in retracted position in port 76. In the event the downward displacement of the strike finger passes ball 80, the upper edge of strike finger 235 is inclined or tapered as at 237 so that upon the return upward movement of the strike finger, the strike finger may readily retract the ball 80 to permit passage of finger 235.

In the description of the plate release station F given above the assembled belts and anchor plates held by adhesive may be collected for transport to a sewing station at another area or each assembly may be transported separately upon suitable conveyor means to such a sewing station. It will be understood that various types of sewing heads and sewing means may be utilized to accomplish the sewing of the belt end portion 13 to the standing portion in well known manner.

As indicated in schematic sketch FIG. 2*g*, a modification of the method is shown wherein another station may be provided for sewing the belt portions together while being carried on arm 45. In FIG. 2*g* is exemplarily illustrated an anchor plate with the adhesively held belt end portion in assembly therewith, the assembly being positioned opposite a sewing head 335 provided with a needle 336 to sew a suitable stitch in a selected pattern to secure end portion 13 to standing portion 14. Opposite needle 241 is a suitable sewing foot in order to accomplish the desired stitching.

It will be understood that the sewing station (FIG. 2*g*) may occur prior to the release station as described above so that when the belt and anchor are released, a permanent assembly has been completed.

Reset Station G

After the assembled anchor plate and belt is released from the mounting means 60, the carrier arm 44 moves to a twelfth position (FIG. 24) where the mounting means 60 and the belt holder bar 155 may be preconditioned for the reception of another anchor plate and the commencement of another belt and anchor plate assembly cycle.

In FIG. 24 the reset means 240 includes an upwardly extending hook member, in this example a disc 243 carried on the outer end of a reciprocal piston rod 242 guided through a stand 241 and having an enlarged head 244 connected by a link 245 to one end of a piston rod of the fluid pressure cylinder means 246. Stand 241 may be located on table top 31. The reciprocal path of movement of disc 243 is at a selected angle so that in projected position disc 243 lies radially outwardly of the depending hangers 154 and holding bar 155. Upon retraction of disc 243, the disc engages holding bar 155 and returns the bar to its uppermost detent held position as indicated in dotted lines in FIG. 24.

Upon completion of the operation at station G, it will be apparent that holding bar 155 is retracted to a non-interference position with respect to the insertion of another belt end portion in an anchor plate in the succeeding cycle. Also, the mounting means 60 is clear and is ready to receive a next anchor plate in the manner as described previously. Movement of the carrier arm to the first position commences a second cycle for that carrier arm.

In the exemplary embodiment of this invention a rotatable head with 12 carrier arms is illustrated, it being understood that the number of arms may be increased or decreased depending upon the production steps to be performed and the time interval required for certain operations. For example, the invention contemplates that the securing means illustrated as initially including adhesive means, may include other temporary securing means such as temporary clamp means or temporary staple means.

It will be understood that in the manufacture of safety belts a fabric or webbing is required to have specified strength and breaking characteristics, and that to achieve such characteristics the fabric, while being pliant and bendable, includes a memory characteristic which may make handling of the belt fabric difficult. It therefore should be noted that the automatic folding, threading, and unfolding of the belt end portion is accomplished with belt fabric having such characteristics and that the resulting assembly meets standards and specifications with respect to the connection of a belt to a connector member or anchor plate and is acceptable in appearance because of the precise registration and alignment of the edges of the belt portions. Longitudinal folding of margins of the belt end portion are uniform and symmetrical with respect to the longitudinal axis of the belt and the margins are maintained in such symmetrical uniform relationship while the belt end portion is inserted through the opening in the anchor plate. It should also be noted that initial transverse folding of the longitudinally folded belt portion about the anchor plate occurs when the holding bar 155

moves ito contact with the top surface of the belt and holds the belt in initial folded position against the lower portion of the anchor plate. Such holding relationship is maintained throughout many of the succeeding operational steps of the method so that the initial folded relationship of the belt end portion with the anchor plate is continued and is virtually undistrubed. The longer standing belt portion may be cocked or misaligned with respect to the anchor plate as it is passed into and through certain of the succeeding stations. Because of its length the standing belt portion is more readily adapted to be brought into proper alignment with the anchor plate and belt end portion.

It will be understood of course that various modifications and changes may be made in the shape of the anchor plate, the size and width of the safety belt to be attached, the plate holding means, the belt folding means, and the apparatus and method of moving an anchor plate and belt portion into interconnection along a selected path. All changes and modifications coming within the scope of the appended claims are embraced thereby.

We claim:

1. In an apparatus for interconnecting an elongated pliant belt and an anchor plate having an opening to receive said belt, the combination of:
- means for positioning said anchor plate with said opening exposed;
- a supply source for said pliant belt;
- means for moving from said supply source a belt with one end portion of uniform width with longitudinal edges normal to said plate and in alignment with said opening;
- means for folding said one end portion of said belt along longitudinally directed fold lines to provide upper and lower belt layers with said edges in proximity;
- said belt moving means passing said longitudinally folded end portion a selected distance through said opening to position said end portion on one side of said plate and the remaining belt portion on the other side of said plate with upper and lower belt layers retained in said opening;
- means for transversely folding upper and lower belt layers about said anchor plate and unfolding the belt portions on opposite sides of said plate for positioning said belt portions in opposed relation;
- and means securing said portions together.

2. In an apparatus as stated in claim 1, wherein said belt folding means longitudinally folds said belt end portion into said belt layers before said end portion enters said opening.

3. In an apparatus as stated in claim 1 including
- means for limiting lateral displacement of infolded edge margins.

4. In an apparatus as stated in claim 1 including
- means for holding said belt portion passed through said opening in folded relation against said anchor plate.

5. In an apparatus as stated in claim 1 wherein said means for moving said belt include
- a pair of belt drive wheels having their bite located in the path of advancement of a belt;
- and means for positioning the leading edge of said belt at said bite of said drive wheels.

6. In an apparatus for interconnecting an elongated belt and an anchor plate having an opening to recieve said belt, the combination of:
- means for positioning said anchor plate with said opening exposed;
- a supply source for said pliant belt;
- means for moving from said supply source a belt with one end portion normal to said plate and in alignment with said opening;
- means for folding said one end portion of said belt along longitudinally directed fold lines;
- said belt moving means passing said end portion a selected distance through said opening to position said end portion on one side of said plate and the remaining belt portion on the other side of said plate;
- means for transversely folding said belt about said anchor plate for positioning said belt portions in opposed relation;
- means for securing said portions together; and
- means including a biased member for releasably positioning said anchor plate with said opening exposed.

7. In an apparatus as stated in claim 6 including
- means to eject said anchor plate from said releasable positioning means.

8. In an apparatus for interconnecting an elongated belt and an anchor plate having an opening to receive said belt, the combination of:
- means for positioning said anchor plate with said opening exposed;
- a supply source for said pliant belt;
- means for moving from said supply source a belt with one end portion normal to said plate and in alignment with said opening;
- means for folding said one end portion of said belt along longitudinally directed fold lines;
- said belt moving means passing said one portion a selected distance through said opening to position said end portion on one side of said plate and the remaining belt portion on the other side of said plate;
- means for transversely folding said belt about said anchor plate for positioning said belt portions in opposed relation;
- means for securing said portions together;
- means for holding said belt portions in folded relation about said anchor plate;
- and means for releasably retaining said holding means for said end belt portion.

9. In an apparatus for interconnecting an elongated pliant belt and an anchor plate having an opening to receive said belt, the combination of:
- means for positioning said anchor plate with said opening exposed;
- a supply source for said pliant belt;
- means for moving from said supply source a belt with one end portion normal to said plate and in alignment with said opening;
- means for folding said one end portion of said belt along longitudinally directed fold lines;
- said belt moving means passing said longitudinally folded end portion a selected distance through said opening to position said end portion on one side of said plate and the remaining belt portion on the other side of said plate;

means for transversely folding said belt about said anchor plate for positioning said belt portions in opposed relation;
means for securing said portions together;
said opening in said anchor plate having a maximum dimension less than the width of said pliant belt;
means for guiding longitudinally folded edge margins of said belt end portion into said opening;
said means for transversely folding of said pliant belt including
pressure applying means on opposite sides of said plate for pressing said belt portions toward each other;
and means movable between said pressure applying means and between said folded portions of said belt for uniformly folding and creasing said belt at said anchor plate.

10. In an apparatus for interconnecting an elongated pliant belt and an anchor plate having an opening to receive said belt, the combination of:
means for positioning said anchor plate with said opening exposed;
a supply source for said pliant belt;
means for moving from said supply source a belt with one end portion normal to said plate and in alignment with said opening;
means for folding said one end portion of said belt along longitudinally directed fold lines;
said belt moving means passing said longitudinally folded end portion a selected distance through said opening to position said end portion on one side of said plate and the remaining belt portion on the other side of said plate;
means for transversely folding upper and lower belt about said anchor plate for positioning said belt portions in opposed relation;
means for securing said portions together;
said opening in said anchor plate having a maximum dimension less than the width of said pliant belt;
means for guiding longitudinally folded edge margins of said belt end portion into said opening;
and means for applying adhesive to one of said belt portions for temporarily securing said belt portions together.

11. In an apparatus as stated in claim **10** including
clamp means for pressing said belt portions together after said adhesive is applied to one of said belt portions.

12. In an apparatus for interconnecting an elongated belt and an anchor plate having an opening to receive said belt, the combination of:
means for positioning said anchor plate with said opening exposed;
a supply source for said pliant belt;
means for moving from said supply source a belt with one end portion normal to said plate and in alignment with said opening;
means for folding said one end portion of said belt along longitudinally directed fold lines;
said belt moving means passing said one portion a selected distance through said opening to position said end portion on one side of said plate and the remaining belt portion on the other side of said plate;
means for transversely folding said belt about said anchor plate for positioning said belt portions in opposed relation;
means for securing said portions together;
means for holding said belt portions in folded relation about said anchor plate;
and means for resetting said belt portion holding means for a succeeding operational cycle.

13. In an apparatus for interconnecting an elongated flexible pliant member and a rigid anchor member therefor having a through opening to receive said pliant member, the combination of:
means for releasably positioning said anchor member with said opening normal to the advancement of the pliant member;
means for reducing by longitudinally folding the width of said end portion of said pliant member and for increasing stiffness thereof to facilitate passage through said opening;
means for moving one member relative to and normal to the other member for passing through said opening a selected length of said folded pliant member whereby an end portion and a remaining portion of said pliant member lie on opposite sides of said anchor member and a folded portion lies in said opening;
means for transversely folding at least one of said end and remaining portions into opposed relation with respect to the other portion;
and means for securing said portions about said anchor member.

14. In an apparatus as stated in claim **13** including
means for holding said end portion in folded relation about said anchor member.

15. In an apparatus for assembling a pliant belt with a connector member having an opening to receive a portion of said belt, the belt portion having longitudinal edges, the combination of:
means for holding the connector member in a selected position;
means for positioning said belt portion adjacent to said connector member and at an angle to the connector member for threading longitudinally the belt portion through said opening;
means for folding the belt portion along longitudinally directed lines with said edges in proximity before pushing said belt portion into said opening;
means for applying a force to said belt portion longitudinally thereof to push one end of said belt portion through said opening to assemble said belt portion with said connector member;
means for transversely folding said belt portion into overlying relation to form a loop of said longitudinally folded end portion with said longitudinal edges in proximity in said opening and with said connector member assembled therewith;
and means to secure said overlying belt portion to retain said connector member in assembled relation with said loop.

16. In an apparatus as claimed in claim **15** wherein said means to secure said belt portions includes a sewing means.

17. In an apparatus as claimed in claim **15** including

means for temporarily holding said belt portion in such overlying relation prior to actuation of said securing means.

18. In an apparatus as claimed in claim **15** wherein said means for transverse folding of said belt portion includes

a projectible and retractable member on one side of said connector member engagable with that part of the belt portion passed through said opening for folding the belt portion against an edge of the opening in said connector member.

19. In an apparatus as stated in claim **15** wherein said longitudinal folding means includes a set of wheels having cooperable circumferential edges forming a channel section in said belt portion to longitudinally partially fold edge margins of said belt portion;

said longitudinal folding means including guide means to receive said partially folded longitudinal edge margins on the belt portion and to fold said edge margins into close spaced relation with the adjacent belt portion.

20. In an apparatus as stated in claim **15** wherein said longitudinal folding means includes

guide means to receive said folded longitudinal edge margins on said belt portion and to fold said edge margins into close spaced relation with the adjacent belt portion.

21. In an apparatus for assembling a belt with a connector member having an opening to receive a portion of said belt, the combination of:

means for holding the connector member in a selected position;

means for positioning said belt portion adjacent to said connector member and at an angle to the connector member for threading longitudinally the belt portion through said opening;

means for folding the belt portion along longitudinally directed lines with said edges in proximity before pushing said belt portion into said opening;

means for applying a force to said belt portion longitudinally thereof to push one end of said belt portion through said opening to assemble said belt portion with said connector member;

means for transversely folding said belt portion into overlying relation to form a loop of said end portion with said connector member assembled therewith;

and means to secure said overlying belt portion to retain said connector member in assembled relation with said loop;

said longitudinal folding means including a set of wheels having cooperable circumferential edges forming a channel section in said belt portion to longitudinally fold edge margins of said belt portion,

and guide means to receive said partially folded longitudinal edge margins on said belt portion and to fold said edge margins into close spaced relation with the adjacent belt portion;

said guide means including a guide member connected with each wheel of said set of wheels;

and means for moving said set of wheels and guide members toward and away from each other.

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