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Austin et al.

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[54] **SLIDING CLASP FASTENER STRINGERS**

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[52] **U.S. Cl.** **66/86,** 112/265, 112/105

[51] **Int. Cl.** **D04b 23/00**

[58] **Field of Search** .....112/105, 265; 24/205.1 C, 205.13 C, 24/205.16 C; 66/83–86, 1

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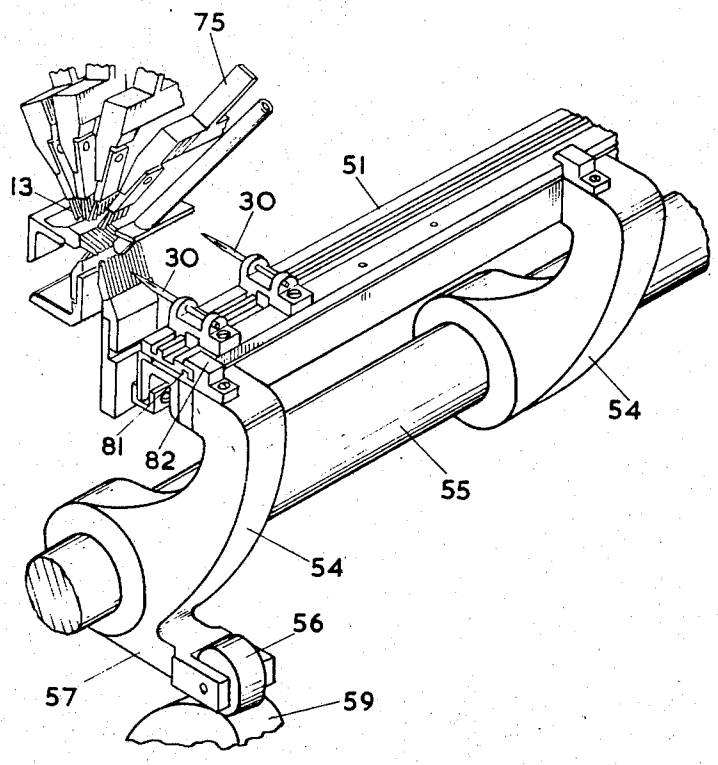
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[57] **ABSTRACT**

A slide fastener stringer comprising a knitted tape and a series of coupling elements secured thereto during knitting by an auxiliary sewing thread.

9 Claims, 9 Drawing Figures



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SHEET 1 OF 7

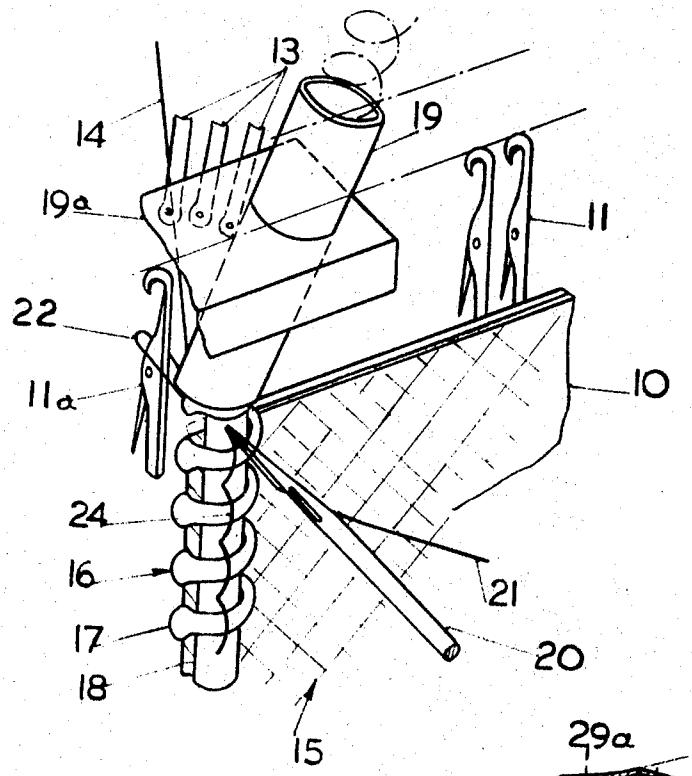


FIG. 1.

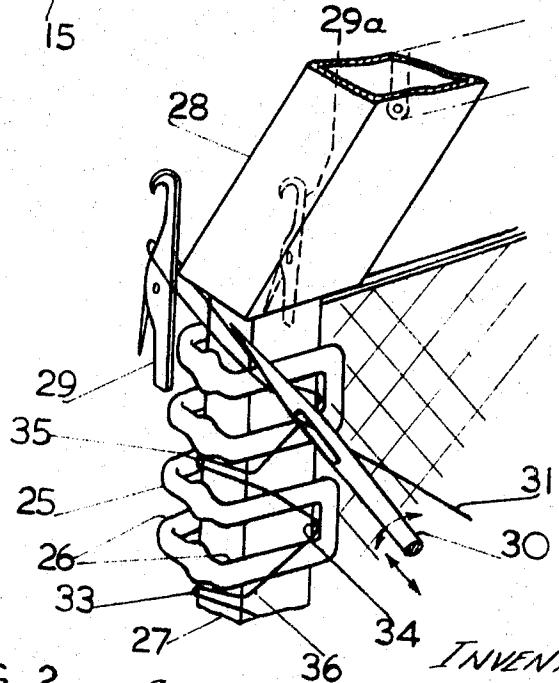


FIG. 2.

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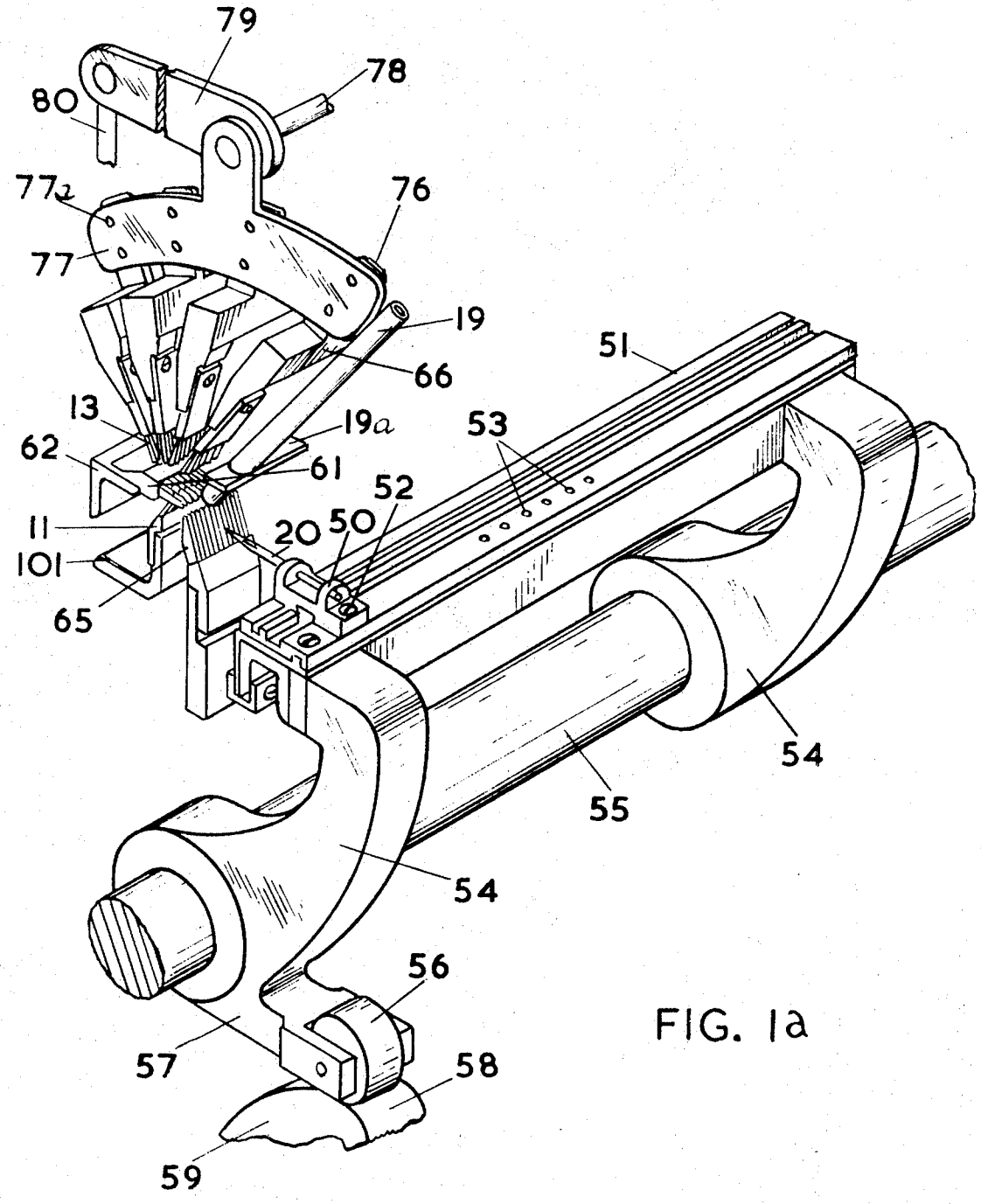

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FIG. 1a

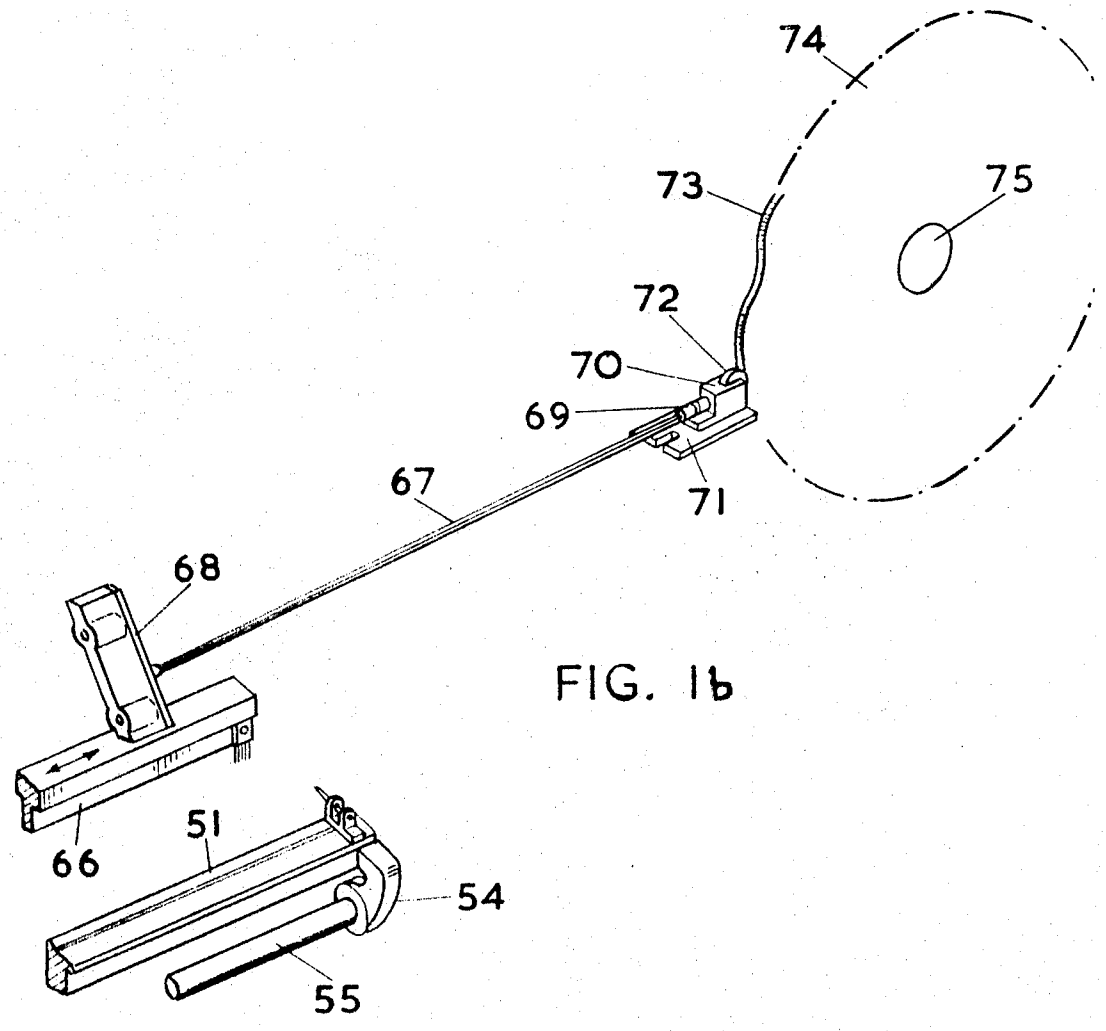


FIG. 1b

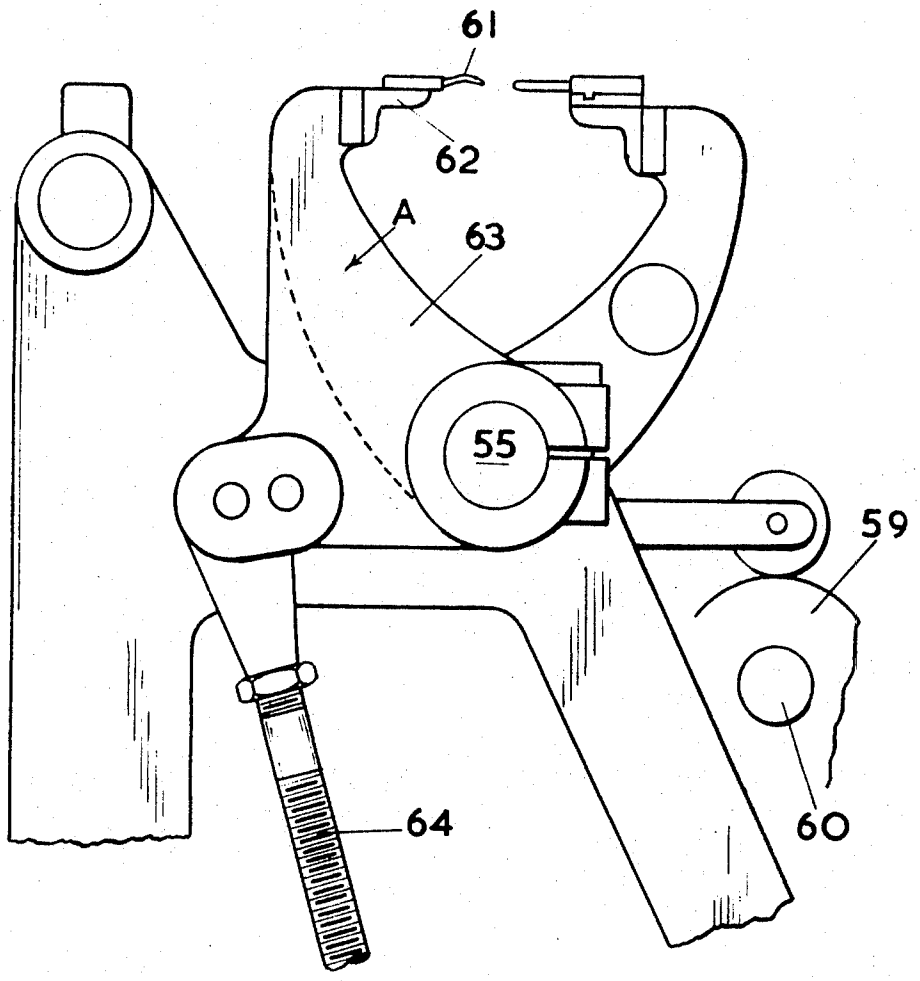


FIG. 1c

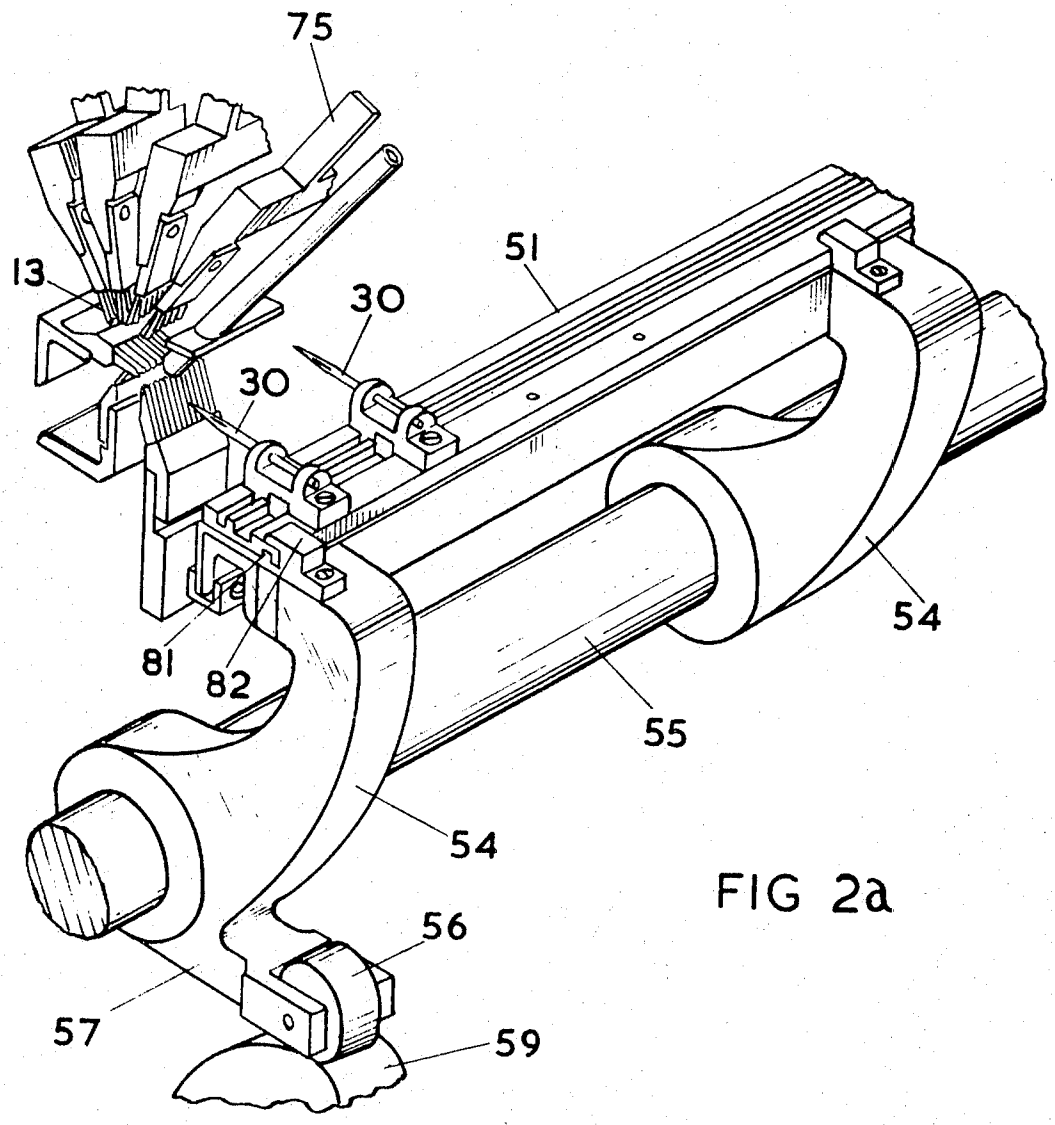


FIG 2a

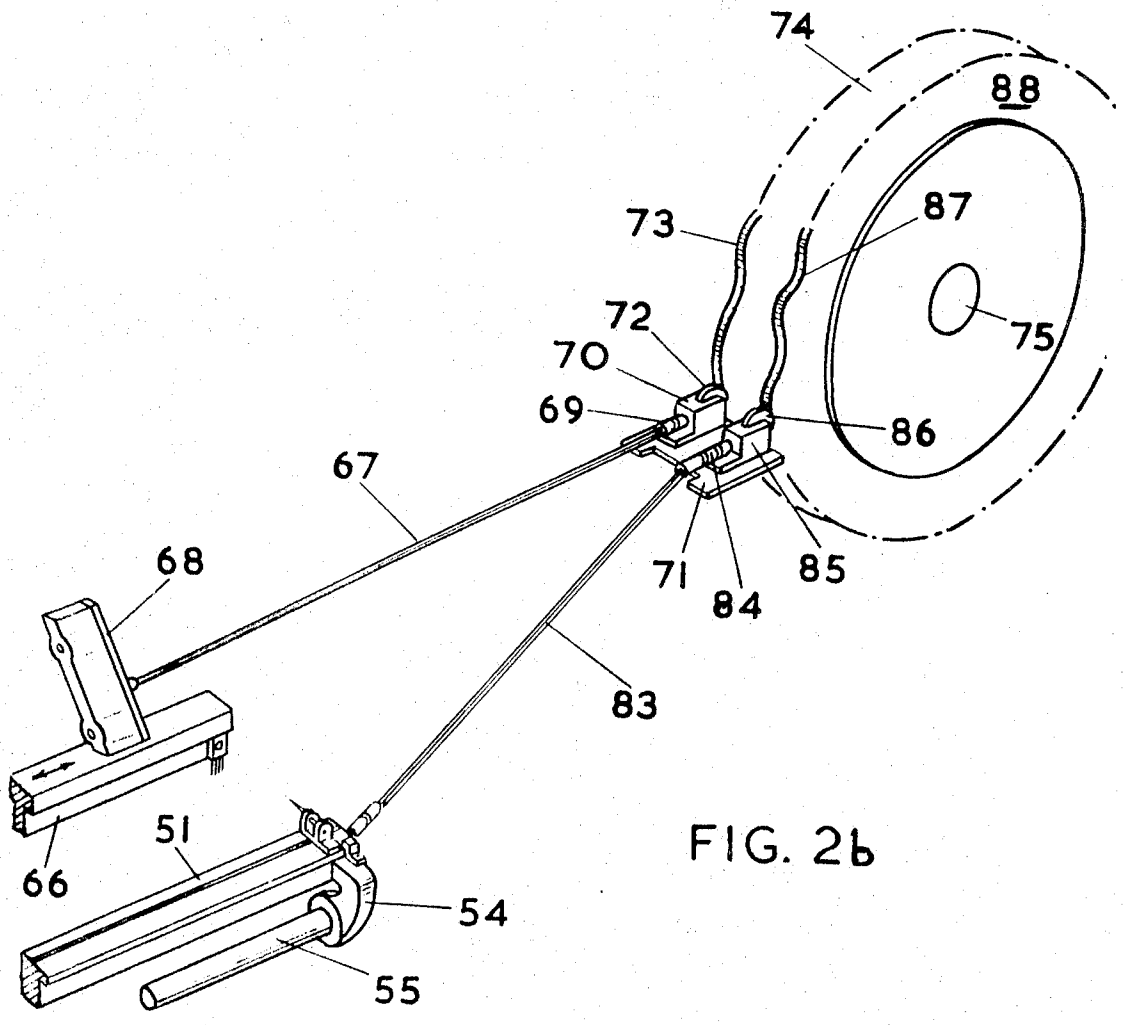


FIG. 2b

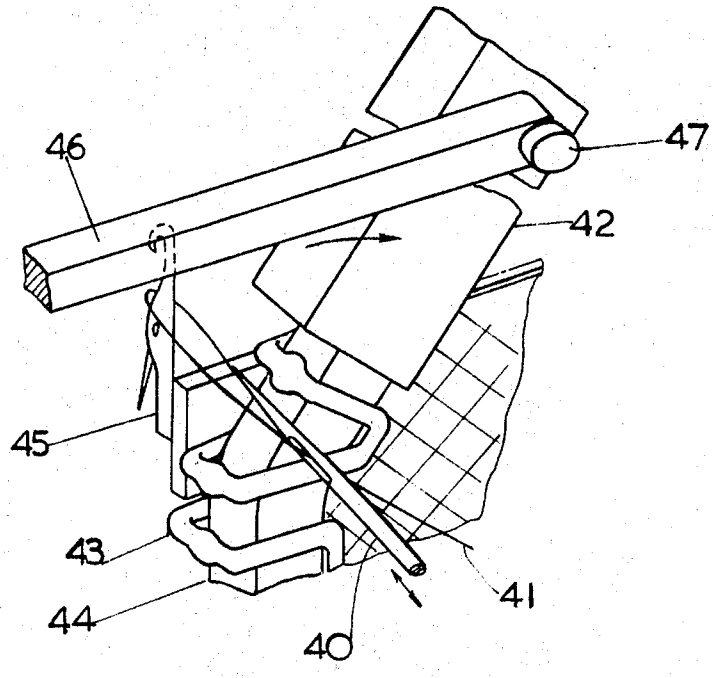


FIG. 3.

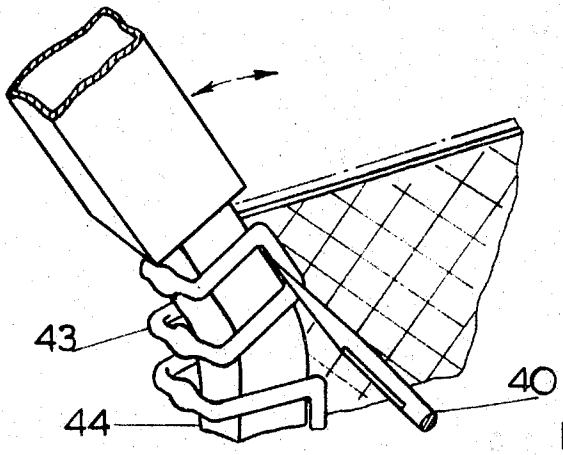


FIG. 4.

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SLIDING CLASP FASTENER STRINGERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to sliding clasp fastener stringers and to methods and machines for their manufacture.

2. Description of the Prior Art

A sliding clasp fastener comprises two stringers, each stringer comprising a series of coupling elements secured to a carrier tape. It is now well known to provide a series of interconnected coupling elements formed from a length of plastics filament which is either wound in a coil shape, or is formed into a meander configuration which is folded along its centerline into U-shape. A fastener having a coil-shape element construction will be referred to hereinafter as "coil fastener construction" and one having U-shaped elements will be referred to hereinafter as "meander fastener construction". Other forms of interconnected coupling elements have been proposed wherein the elements are produced by notching a tube of plastics material or by molding a series of elements having interconnecting portions formed integrally with the elements.

SUMMARY OF THE INVENTION

According to the present invention, a method of making a sliding clasp fastener stringer comprises warp-knitting a carrier tape and, during the knitting, locating a series of interconnected coupling elements at one face of the tape and adjacent a longitudinal edge of the tape as it is knitted, passing a binding thread by reciprocating movement of a sewing needle between adjacent coupling elements of the series to form a stitch loop at the other face of the knitted tape beyond the hooked end of a knitting needle employed in knitting the tape, and moving the hook of the knitting needle through the stitch loop so that the hook engages the loop and interlinks the loop with a yarn of the knitted tape.

The sewing needle may move in the lapping sense of the yarn guides of the machine when the sewing needle is at the front of the machine and between its reciprocating movements to effect a zig-zag pattern of binding thread on the face of the coupling elements remote from the tape and two series of laterally spaced stitch loops on the other face of the tape, one series being engaged by a first knitting needle and the second series being engaged by a second knitting needle. Twin sewing needles may be employed to feed two binding threads to form two series of stitch loops extending longitudinally of the elements the loops of each series being engaged by a respective one of two knitting needles. Preferably each of the twin needles is also caused to move in the lapping sense of the yarn guides of the machine when the sewing needle is at the front of the machine and between its reciprocating movements.

The series of coupling elements may be of known coil or meander fastener construction and may comprise a cord or braid disposed between arms of the coupling elements to minimise slipping of the binding thread across the elements. In the case of the single sewing needle not having a swinging movement, the needle may penetrate the cord or braid. In the cases of the single needle having a swinging motion, or of the twin needles, the needle or needles may penetrate the cord or braid, or may pass either side of the cord or braid.

Instead of or in addition to the cord or braid, the coupling elements may have notches or depressions in their outer surfaces to prevent slipping of the binding thread across the elements.

The series of coupling elements is conveniently guided through a tubular guide to its position adjacent an edge of the tape being knitted.

The invention also includes a warp-knitting machine for making a sliding clasp fastener stringer, the machine having a knitting zone and comprising a row of knitting needles for knitting a carrier tape of the stringer, a plurality of guide bars each carrying yarn guides, a tubular guide having a lower end

disposed to guide a series of interconnected coupling elements to a predetermined position in the knitting zone adjacent one end of the row of knitting needles, a sewing needle disposed at the front of the machine and means for reciprocating the sewing needle through a plane containing the row of knitting needles in a position beneath the tubular guide whereby during use the sewing needle passes a binding thread from the front to the rear of the machine, said thread passing around coupling elements being guided from the lower end of the tube, the needle coacting with at least one of the knitting needles to knit the binding thread into the tape and secure the elements thereto.

The tubular guide is preferably supported in a fixed position relative to the plane of movement of the knitting machine.

Means may also be provided for moving the sewing needle in directions in the lapping sense of the yarn guides when the needle is at the front of the machine so that the needle acts to form stitch loops of binding thread on at least two different knitting needles of the machine.

Two sewing needles may be provided to feed two binding threads to two knitting needles.

The invention also includes a fastener stringer when made by a method or with a machine so defined above.

BRIEF DESCRIPTION OF THE DRAWINGS

Three embodiments of the invention and modifications thereof will now be described by way of example only and with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a first fastener stringer construction being made on a warp-knitting machine and illustrating the first embodiment;

FIG. 1*a* is an isometric view of part of a practical machine according to the first embodiment;

FIG. 1*b* is an isometric view of other parts of the machine, and

FIG. 1*c* is an end view of part of the machine;

FIG. 2 is a perspective view of a second fastener stringer construction being made on a knitting machine, illustrating a second embodiment, and

FIG. 2*a* is an isometric view of part of a practical machine according to the second embodiment;

FIG. 2*b* is a view similar to FIG. 2*a* of further parts of the machine, and

FIGS. 3 and 4 are perspective views of a stringer construction being made on a warp-knitting machine and illustrating a third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The first embodiment will now be described initially with regard to FIG. 1 which shows diagrammatically, parts of a three guide bar warp-knitting machine are represented as follows: numeral **10** designates a trickplate in which is slidably mounted a row of latch needles **11**. Yarn guides **13** movable in known controlled manner with respect to the latch needles by a plurality of guide bars as will be described. Each guide bar carries yarn guides **13** through which yarns **14** are fed to be knitted into a carrier tape **15** at a knitting zone of the machine.

In a first embodiment (FIG. 1) which relates to a machine for making coil fastener construction, a series of coupling elements **16** in the form of a coil of plastics filament having a series of longitudinally aligned coupling heads **17**, and surrounding an inner textile cord **18** is fed downwardly with the cord through a tubular guide **19** as for example, by a ratchet operated toothed wheel as will be described. The tubular guide **19** is fixedly mounted in a bar **19***a* secured between end frames of the machine. The lower end of the guide **19** is located at a predetermined position adjacent a longitudinal edge of the tape **15** at the knitting zone and the guide is inclined forwardly of the machine to permit the lapping movements of three series of yarn guides **13** between the needles **11** and the guide.

A sewing needle **20** is disposed at the front of the machine and perpendicularly to the general plane of the tape **15**.

Operating means as will be described, working in synchronism with the operation of needles **11** and guides **13**, are provided to pass the needle in a reciprocating manner below the tubular guide **19** and through the plane of the needles **11**. The sewing needle **20** passes through the cord **18** to feed a binding thread **21** through the cord and between adjacent coupling elements **16**.

In operation, when the latch needles **11** are in the lowermost position, the sewing needle **20** is advanced through the cord **18**. As the needle **20** is withdrawn, the frictional grip effected on the thread **21** by the cord **18** enables a stitch loop **22** to be formed above a latch needle **11***a* at the rear of the tape. The timing of the latch needles **11***a* and sewing needle **20** are so arranged that as the latch needles rise, needle **11***a* is inserted through the loop **22**. One of the yarns **14** is then lapped across the needle **11***a* and subsequent lowering of this needle links the loop **22** into the knitted tape **15**.

As the series of coupling elements are fed with the progressively formed tape, the needle **20** is synchronously moved between successive pairs of coupling elements **16** so that a series of loops **24** of thread **21** is formed over the series of coupling elements on the side remote from the knitted tape **15**.

Considering now a practical form of the machine in more detail, reference is made to FIGS. **1***a* through **1***c*. In the machine a plurality of sewing needles **20** are located in needle holders **50** which are spaced-apart along a needle bar **51** extending along the front of the machine, the holders **50** being located by screws **52** in holes **53** in the needle bar. Only one holder **50** is shown in FIG. **1***a* for clarity. The needle bar **51** is mounted along its length at intervals upon levers **54** which are pivotally mounted upon a shaft **55** secured to the machine frame. A motion of the needles along substantially rectilinear but slight arcuate paths between the tubular guides **19** and adjacent coupling elements **16**, as described with regard to FIG. **1**, is produced by pivoting of the levers **54** in a controlled manner. This controlled movement is provided by a cam follower **56** on an arm **57** of each lever **54**, the cam follower being in engagement with a peripheral cam surface **58** of a cam **59** which itself is secured to a shaft **60** (FIG. **1***c*) which is drivable in synchronism with the rest of the machine. FIGS. **1***a* and **1***c* also show material holding blades **61** which are disposed on an L-shaped bracket **62** extending along the machine at the back of the needles **11**. The material holding blades **61** are moved as in normal manner for knitting machinery by a lever **63** to which the bracket **62** is secured, the lever being pivotally mounted upon the shaft **55** and pivotally movable by an actuating rod **64** which is moved in synchronism with the movement of the needles **11**. The movement of the holding blades **61** is thus synchronized with that of the needles **11** so that the blades **61** occupy the position shown in FIGS. **1***a* and **1***c* during movement of the needles **11** between them whereby knitted tape material is held down and is not forced upwards by the needles themselves. The levers **63** are moved in an anti-clockwise direction as shown by arrow 'A' in FIG. **1***c* and out of the path of the needles **11** when the needles **11** move downwardly after a knitting operation to enable the last course of knitted material to pass beneath the blades **41** in preparation for the next holding operation.

A plurality of needle guides **65** are of conventional construction and operate in the normal manner for knitting machinery.

The yarn guides **13** are mounted upon four guide bars **66** which extend horizontally across the machine and hold groups of guides **13** for guiding the yarns **14**, one group for each tape. In FIG. **1***a* one group of guides is shown. The guide bars **66** are movable in horizontal manner as shown in FIG. **1***b* by a drive rod **67** which is connected at one end to a block **68** mounted on the guide bar and is secured at the other end to a block **68** mounted on the guide bar and is secured at the other end to a short rod **69** movable axially in a housing bracket **70** mounted on part of the machine frame **71**. Each guide bar **66** is urged in conventional manner in knitting machinery towards the right by spring loading so that a cam follower **72** on the end of short rod **69** engages the peripheral cam surface **73** of a cam **74** secured to a drive shaft **75** which is rotatably mounted and drivable in the machine frame. Movement of each guide bar **66** by the cam **74** provides the lapping movement of the yarn guides **13** attached to that guide bar in the normal way for knitting machinery so as to perform knitting operations in conjunction with the independent lapping movement of the other guide bars. At intervals each guide bar **66** is mounted by a bracket **76** to an arcuate arm **77** which is pivotally mounted for swinging movement in a vertical plane upon a horizontal shaft **78** which extends from side-to-side of the machine. Each bracket **76** is connected to the arm **77** by pins **77***a* upon which the bracket **76** is slidable. Movement of the arm **77** in its vertical plane provides simultaneous swinging movement of the guide bars **66** and thus of the yarn guides **13** in a conventional manner for knitting machinery to move the yarns **14** between positions at the front and rear of the knitting needles. This movement is provided by a crank **79** and a connecting rod **80** with one end of the crank being secured to the shaft **78**.

The machine described with reference to FIGS. **1***a*, *b* and *c* attaches the coupling elements **16** to the tape during knitting in the same way as has been described for the basic construction with reference to FIG. **1**. The knitting operation for each tape is performed in conventional manner by swinging movement of the yarn guides **13** by movement of the crank **79** so as to pivot the arms **77** upon the shaft **78**, and also by lapping movement of the guides caused by horizontal movement of the guide bars **66** controlled by the cam **74** as described above. With the latch needles **11** at their lowermost position after knitting one course of each tape, the sewing needles **20** are reciprocated forwardly and rearwardly of the machine by operation of the lever **54** upon the shaft **55** by the cam **59**. Each needle **20** moves through a cord **18** to form a stitch loop **22** above a respective latch needle **11** so that as the needle bar **101** with the latch needles **11** rise, the appropriate needles are inserted through the loops **22**. With subsequent lapping of the yarns **14** and lowering of the latch needles, the loops **22** are knitted into the tape **15**.

In a second embodiment (FIG. **2**) relating to a machine for making meander fastener construction, a stringer being made on the machine comprises a series of coupling elements **25**, the arms **26** of each coupling element being mounted astride a braid **27**. The series of elements **25**, together with the braid, are fed downwardly through a suitably shaped stationary inclined tubular guide **28** to the knitting zone. A sewing needle **30** has an operating means to pass the needle in its axial direction beneath the tubular guide and also as will be described to swing the needle in a horizontal lapping sense of the yarn guides of the machine when the needle is at the front of the machine so that the needle may pass alternately at either side of the braid **27**. The needle **30** may penetrate the sides of the braid to provide a frictional holding means for a binding thread **31** fed by the needle to effect a stitch loop. Alternatively, if the needle **30** does not penetrate the braid **27**, felt pads (not shown) may be provided at each side of the braid to frictionally engage the thread **31**.

Another means of frictionally holding the thread **31** is to provide resilient fingers between which the needle **30** passes. By means of the horizontal swinging movement of the needle **30**, the thread **31** is looped alternately around latch needles **29** and **29***a* to be interlinked with loops of the knitted tape **15**.

For example, referring to FIG. **2**, the thread **31** is looped into an edge of the knitted tape as at position **33** which is one of a plurality of spaced positions in a first series of loops at one side of the braid. The thread passes to the front of the structure and progresses angularly across an arm of a coupling element to be looped into the tape at position **34** which is one of a plurality of spaced positions in a second series of loops at the other side of the braid. The thread **31** returns to the front of the structure, progressing angularly across an arm of the next successive coupling element and is looped in at the edge of the tape at position **35**. Thus, by virtue of the horizontal swinging

movement of the sewing needle **30**, the auxiliary thread **31** assumes a zig-zag arrangement of stitching **36** at the face of the series and forms two series of stitch loops. The needle **30** cooperates with two knitting needles **29**, **29***a* as with the needle **11***a* in the first embodiment, so that the two series of loops are held by needles **29**, **29***a* and knitted into the tape.

A practical machine for performing the second embodiment is described with reference to FIGS. **2***a* and **2***b*, most parts of which operate in a similar manner to those described in the first embodiment with reference to FIGS. **1***a* through **1***c*, and like parts bear like reference numerals. In the second embodiment, however, the needle bar **51** is slidably mounted between a lower slideway **81** and upper guides **82** so as to be movable horizontally across the front of the machine to effect movement of the sewing needles **30** in the lapping sense of the yarn guides.

Sliding movement of the needle bar **51** is effected by means of a drive shaft **83** which is secured at one end to the needle bar and at its other end carries a short shaft **84** slidable within a housing **85**. A cam follower **86** on the end of the shaft **84** lies in engagement with a peripheral cam surface **87** of a cam **88** secured to the drive shaft **75**. The needle bar **51** is spring loaded towards the right as viewed in FIGS. **2***a* and **2***b* so that the cam follower **86** always engages the cam surface **87**.

In a third embodiment (FIGS. **3** and **4**), the stringer construction produced is the same as that produced by the machine of the second embodiment (FIG. **2**) employing a horizontally swinging sewing needle. However, in this third embodiment a sewing needle **40** is moved solely in a reciprocating manner as in the first embodiment. The zig-zag arrangement of binding thread **41** is effected by oscillating a tubular guide **42**, through which a series of coupling elements **43** and its braid **44** is fed, in a plane substantially parallel to that of the knitting needles **45**. Oscillation of the tubular guide **42** is obtained by the actuation of a connecting rod **46** pivotally connected at its one end to one face of the guide **42** by pin **47** and connected at its other end to a rotatably driven crankshaft (not shown) geared to the main drive of the knitting machine. The tubular guide oscillates about a position lying on the longitudinal axis of the braid **44** and below the sewing needle **40**. The angle through which the tubular guide **42** oscillates is sufficient to locate the braid **44** alternately on each side of the path of movement of the sewing needle **40** at each reciprocation of the needle. The resultant pattern of the binding thread **41** is thus similar to that illustrated in FIG. **2** of the drawings.

In any of the above embodiments, the series of coupling elements may be varied so that in the first embodiment (FIG. **1**) for instance, the series of coil-type coupling elements **16** may be replaced by a series of meander type coupling elements **25** as employed in the second embodiment (FIG. **2**). Further, in any embodiment the series of coupling elements may be employed without an internal cord or braid.

Whereas the above embodiments have been described in relation to machines employing latch-type knitting needles, the invention may also be performed with machines using bearded-type or compound-type needles.

We claim:

1. A method of making a sliding clasp fastener stringer comprising warp-knitting a carrier tape and, during knitting, locating a series of interconnected coupling elements at one face of the tape and adjacent a longitudinal edge of the tape as it is knitted, passing a binding thread by reciprocating movement of a sewing needle between adjacent coupling elements of the series to form a stitch loop at the other face of the knitted tape beyond the hooked end of a knitting needle employed in knitting the tape, and moving the hook of the knitting needle through the stitch loop so that the hook engages the loop and interlinks the loop with a yarn of the knitted tape.

2. A method according to claim **1** wherein the sewing needle is caused to move in the lapping sense of the yarn guides of the machine when the sewing needle is at the front of the machine and between its reciprocating movements to effect a zig-zag pattern of binding thread on the face of the coupling elements remote from the tape and two series of laterally spaced stitch loops on the other face of the tape, one series being engaged by a first knitting needle and the second series being engaged by a second knitting needle.

3. A method according to claim **1** wherein the series of coupling elements is of coil fastener construction.

4. A method according to claim **1** wherein the series of coupling elements is of meander fastener construction.

5. A method according to claim **1** wherein a cord or braid is disposed between arms of the coupling elements and extends longitudinally of the series of elements.

6. A method according to claim **1** wherein the series of coupling elements is guided through a tubular guide to its position adjacent an edge of the tape being knitted.

7. A warp-knitting machine for making a sliding clasp fastener stringer, the machine having a knitting zone and comprising a row of knitting needles for knitting a carrier tape of the stringer, a plurality of guide bars each carrying yarn guides, a tubular guide having a lower end disposed to guide a series of interconnected coupling elements to a predetermined position in the knitting zone adjacent one end of the row of knitting needles, a sewing needle disposed at the front of the machine and means for reciprocating the sewing needle through a plane containing the row of knitting needles in a position beneath the tubular guide whereby during use the sewing needle passes a binding thread from the front to the rear of the machine, said thread passing around coupling elements being guided from the lower end of the tube, the needle coacting with at least one of the knitting needles to knit the binding thread into the tape and secure the elements thereto.

8. A machine according to claim **7** wherein the tubular guide is supported in a fixed position relative to the plane of movement of the knitting needles.

9. A machine according to claim **7** wherein means are provided for moving the sewing needle in directions in the lapping sense of the yarn guides when the needle is at the front of the machine so that the needle acts to form stitch loops of binding thread on at least two different knitting needles of the machine.

* * * * *