United States Patent [19]

Farrar et al.

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[45] **June 5, 1973**

[54] **GUIDING APPARATUS FOR A STITCHING MACHINE**

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[52] **U.S. Cl.**.....**112/203**

[51] **Int. Cl.**.....**D05b 27/00**

[58] **Field of Search**.....112/203, 147, 47

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Primary Examiner—Patrick D. Lawson

Attorney—Cushman, Darby and Cushman

[57] **ABSTRACT**

Apparatus for guiding an edge portion of an article through a stitching machine has supports for supporting the article and sensor means such as a fluid jet and sensor interrupted by the edge of the cloth. The sensor means provides a sewing guidance signal indicative of the position of the edge of the article to be stitched and means responsive to the sewing guidance signal move one or more of the supports to guide the said edge towards the said predetermined position. Preferably the supports support a tubular article in tubular form. In cases where the edge of a tubular article after the stitching operation is displaced relative to the position the edge had before the stitching operation, there may be included seam detector means arranged to detect the beginning of the stitched edge of the tubular article and to discontinue guidance of the edge.

19 Claims, 17 Drawing Figures

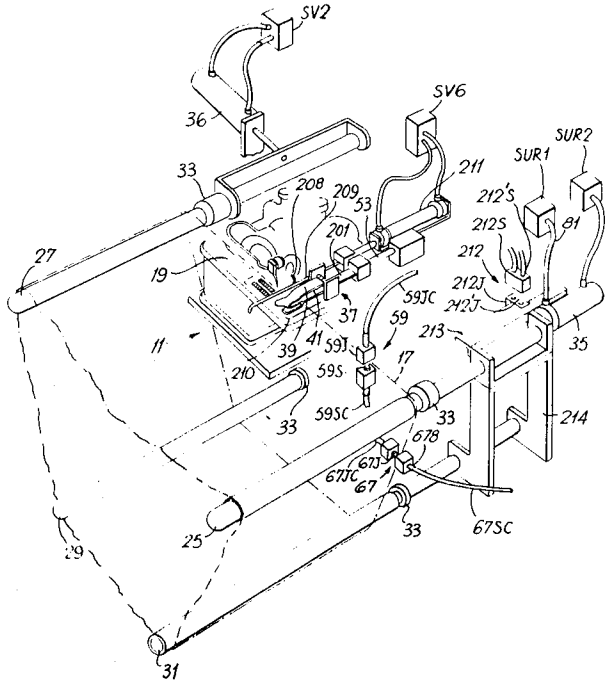


Fig. 1.

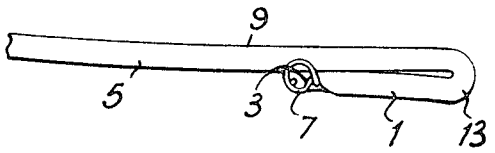


Fig. 3.

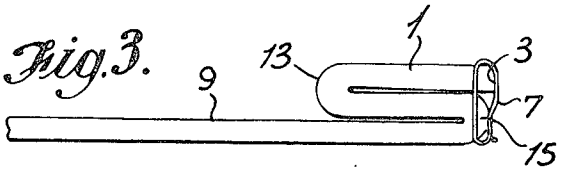


Fig. 2.

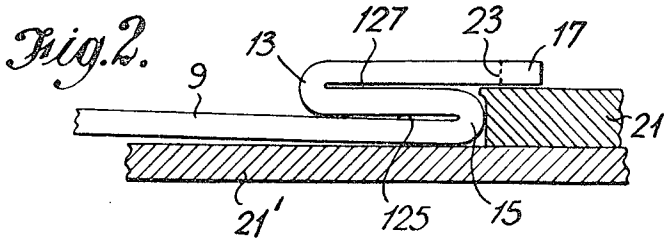
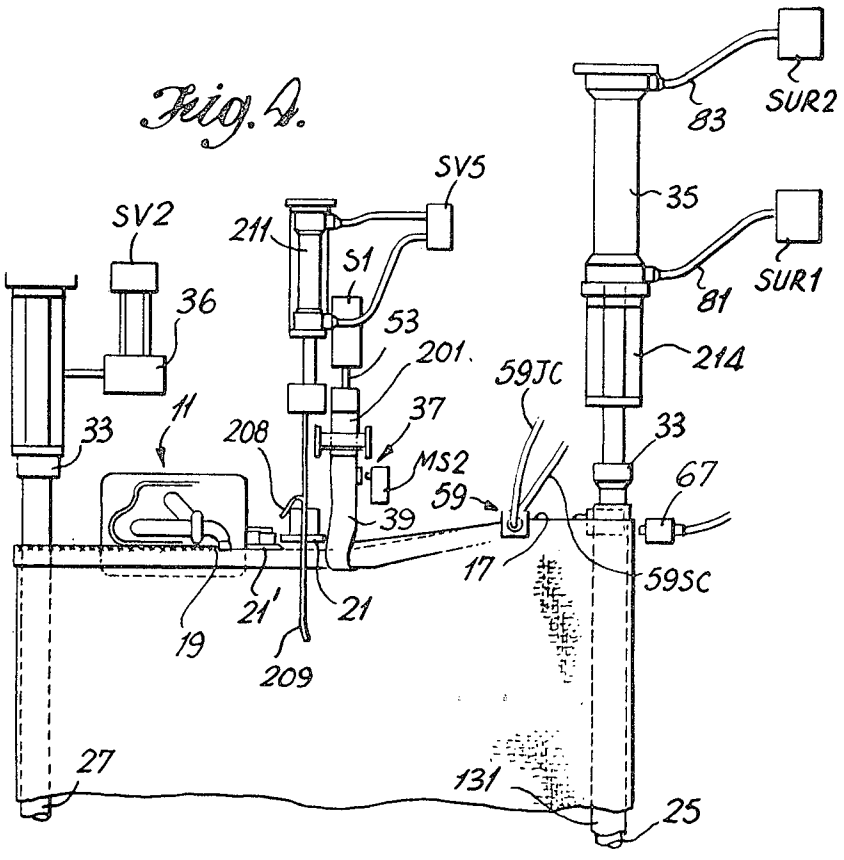


Fig. 4.



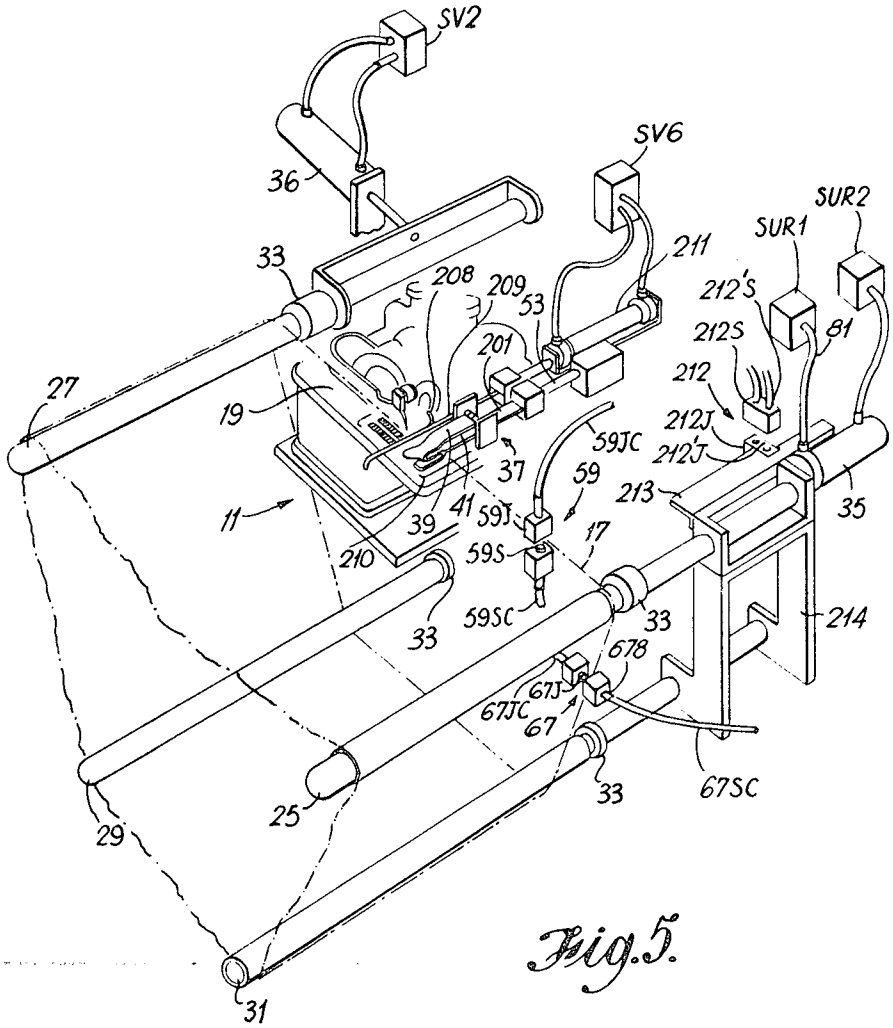

SV2
SV6
36
33
208
209
53
211
SUR1
SUR2
212'S
212S
81
201
27
19
212
212J
212'J
59JC
37
59
213
35
11
39
41
59J
17
210
59S
59SC
33
214
678
67J
67JC
67
67SC
25
29
31

Fig. 5.

Fig. 5a.

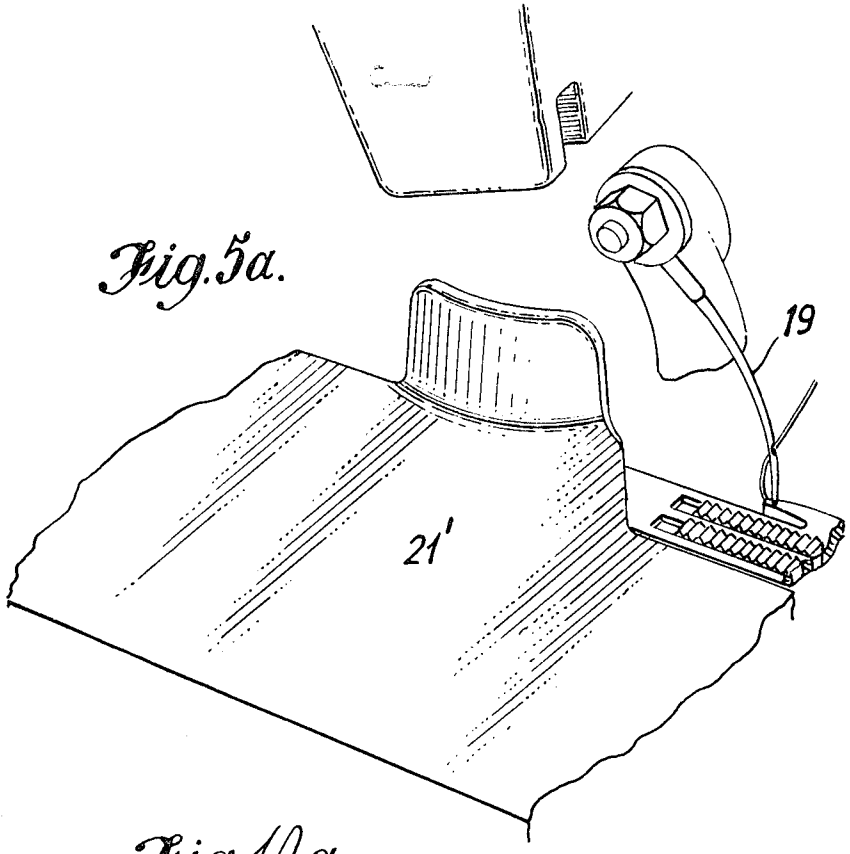


Fig. 14a.

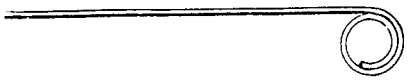
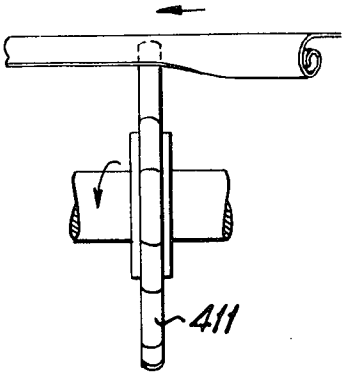


Fig. 14c.



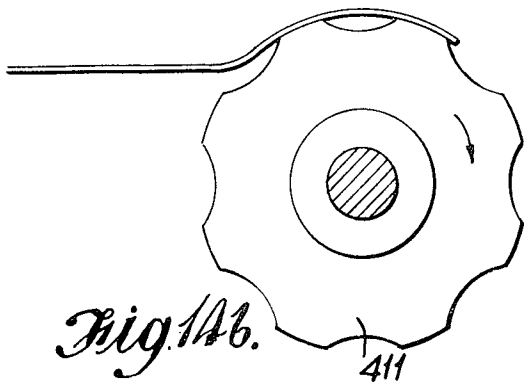
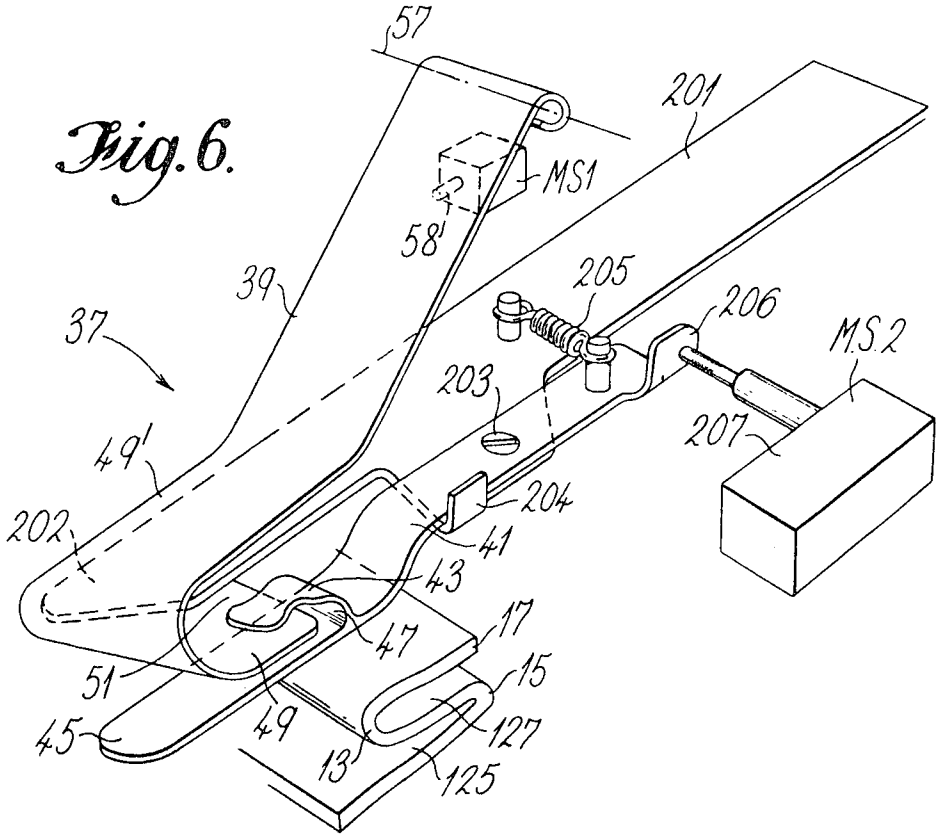


Fig. 14b.

Fig. 6.



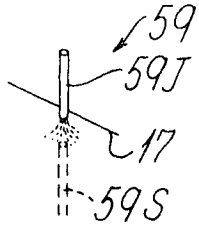


Fig. 8.

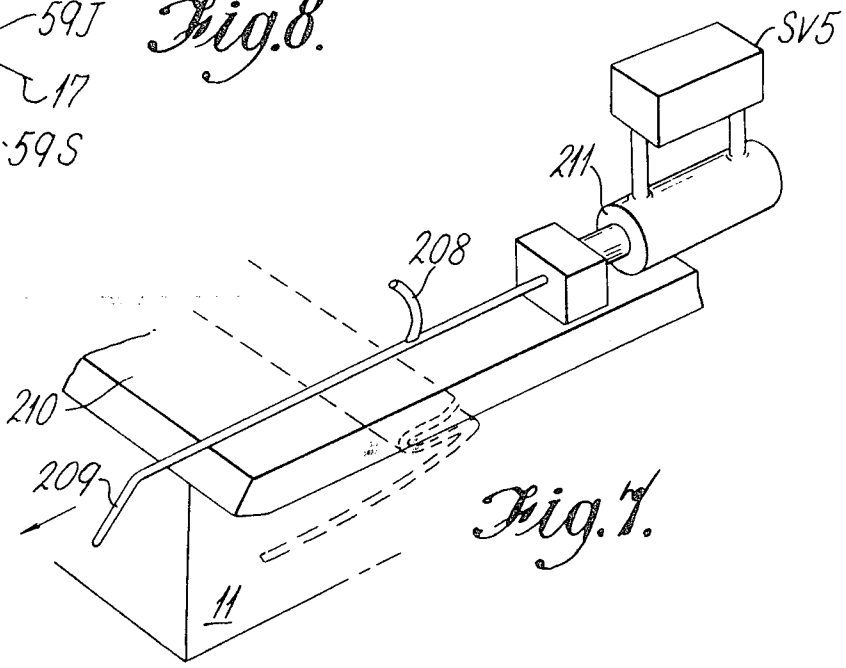


Fig. 7.

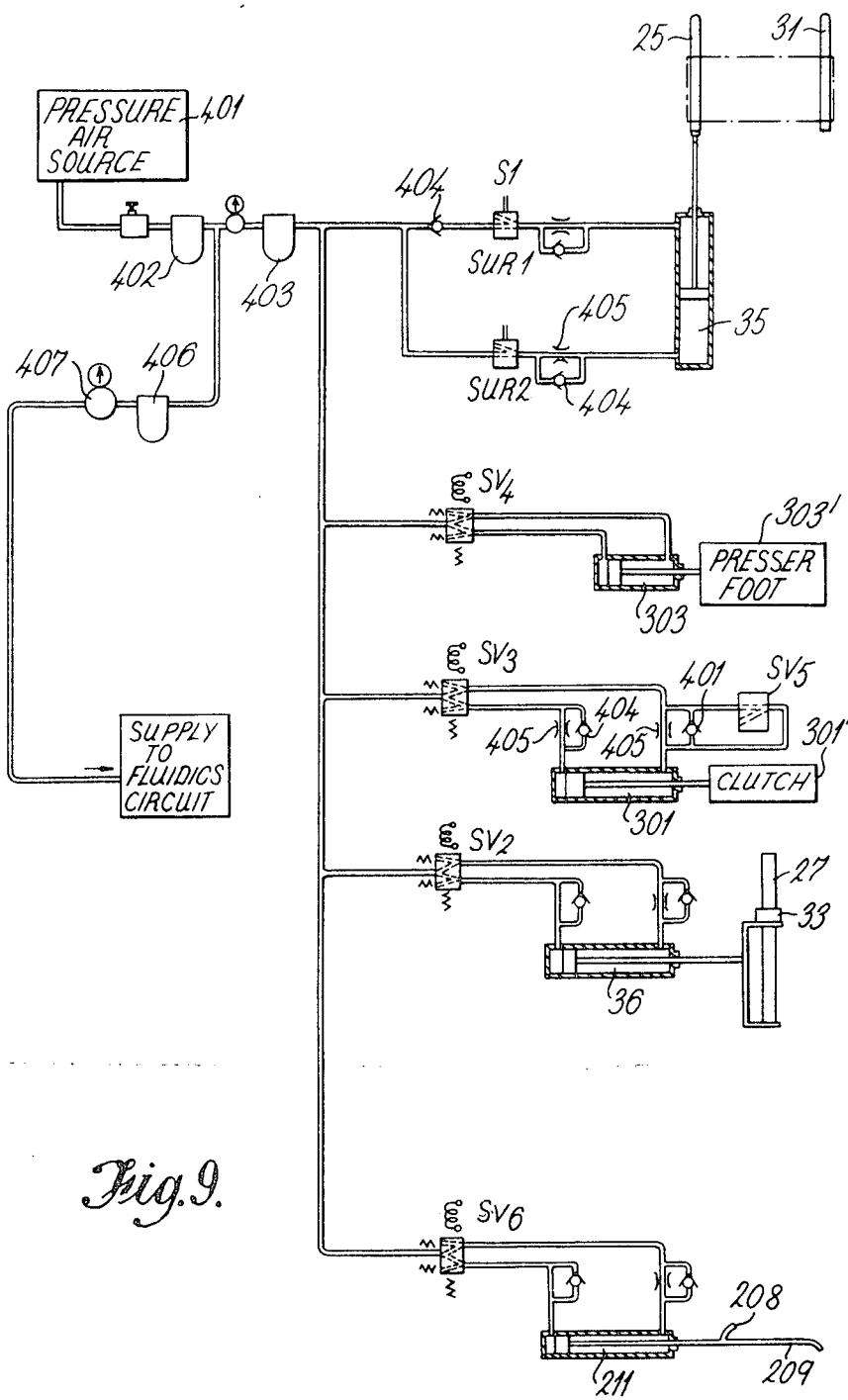

PRESSURE AIR SOURCE
401
402
403
404
S1
SUR1
405
SUR2
404
25
31
35
407
406
SUPPLY TO FLUIDICS CIRCUIT
SV4
303'
PRESSER FOOT
303
SV3
401
SV5
404
405
405
301'
CLUTCH
301
SV2
27
33
36
SV6
208
209
211

Fig. 9.

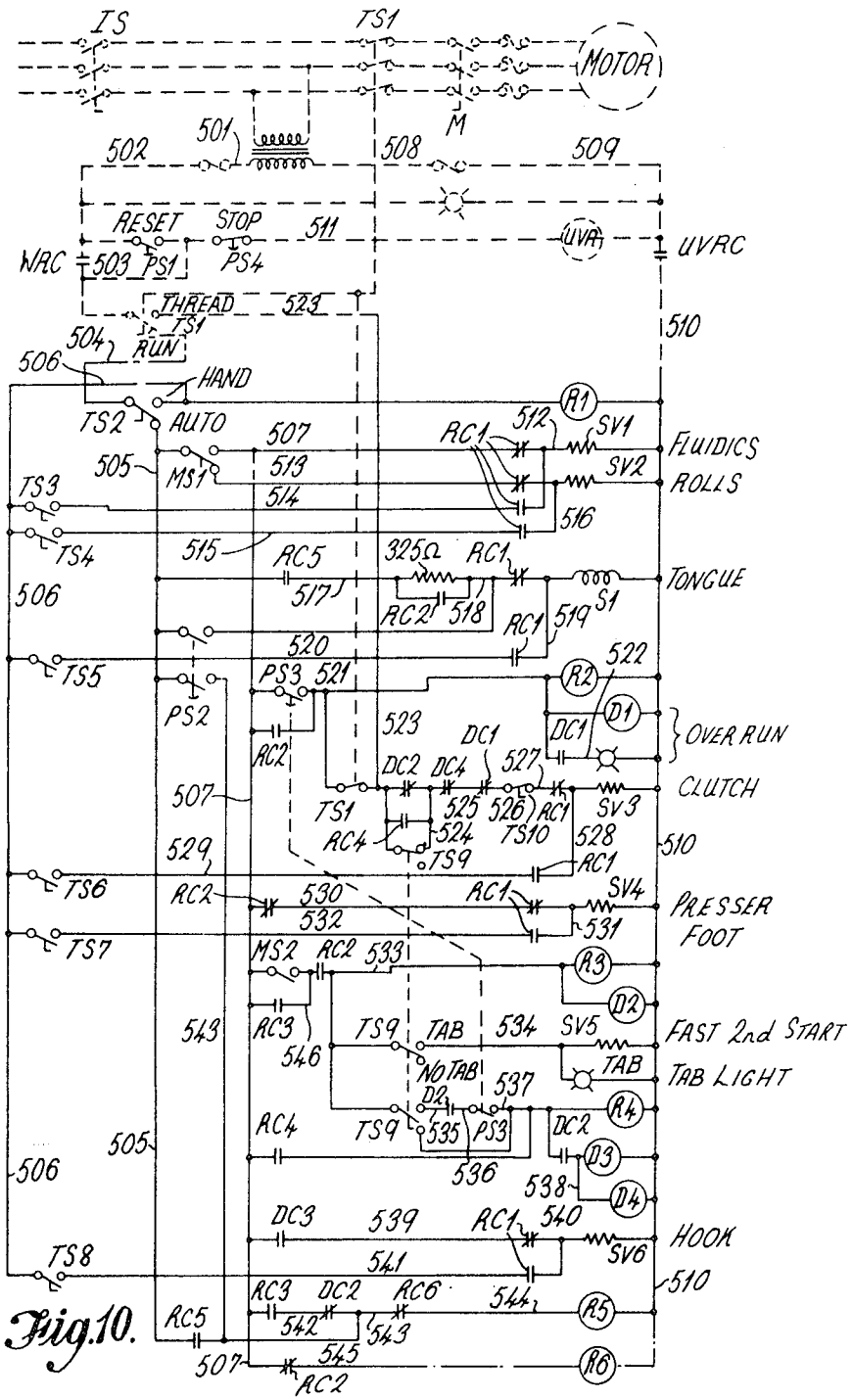

IS
TS1
MOTOR
M
501
502
508
509
RESET
STOP
511
UVR
UVRC
WRC
503
PS1
PS4
THREAD
523
TS1
504
RUN
510
506
HAND
TS2
AUTO
507
RC1
512
R1
SV1
FLUIDICS
505
MS1
513
SV2
ROLLS
TS3
514
516
TS4
515
RC5
325Ω
RC1
TONGUE
506
517
RC2
518
RC1
519
S1
520
TS5
PS3
521
522
R2
PS2
523
DC1
D1
OVER RUN
RC2
DC2
DC4
527
CLUTCH
507
TS1
525
526
RC1
SV3
RC4
524
TS10
528
510
529
TS9
RC1
TS6
RC2
530
AC1
SV4
PRESSER
532
531
FOOT
TS7
MS2
RC2
533
R3
D2
543
RC3
TS9
TAB
534
SV5
FAST 2nd START
546
NO TAB
TAB
TAB LIGHT
537
D2
R4
505
RC4
TS9
535
PS3
DC2
D3
506
536
538
D4
DC3
539
RC1
540
HOOK
TS8
541
SV6
510
RC3
DC2
RC6
544
R5
RC5
542
543
545
507
R6
RC2

Fig.10.

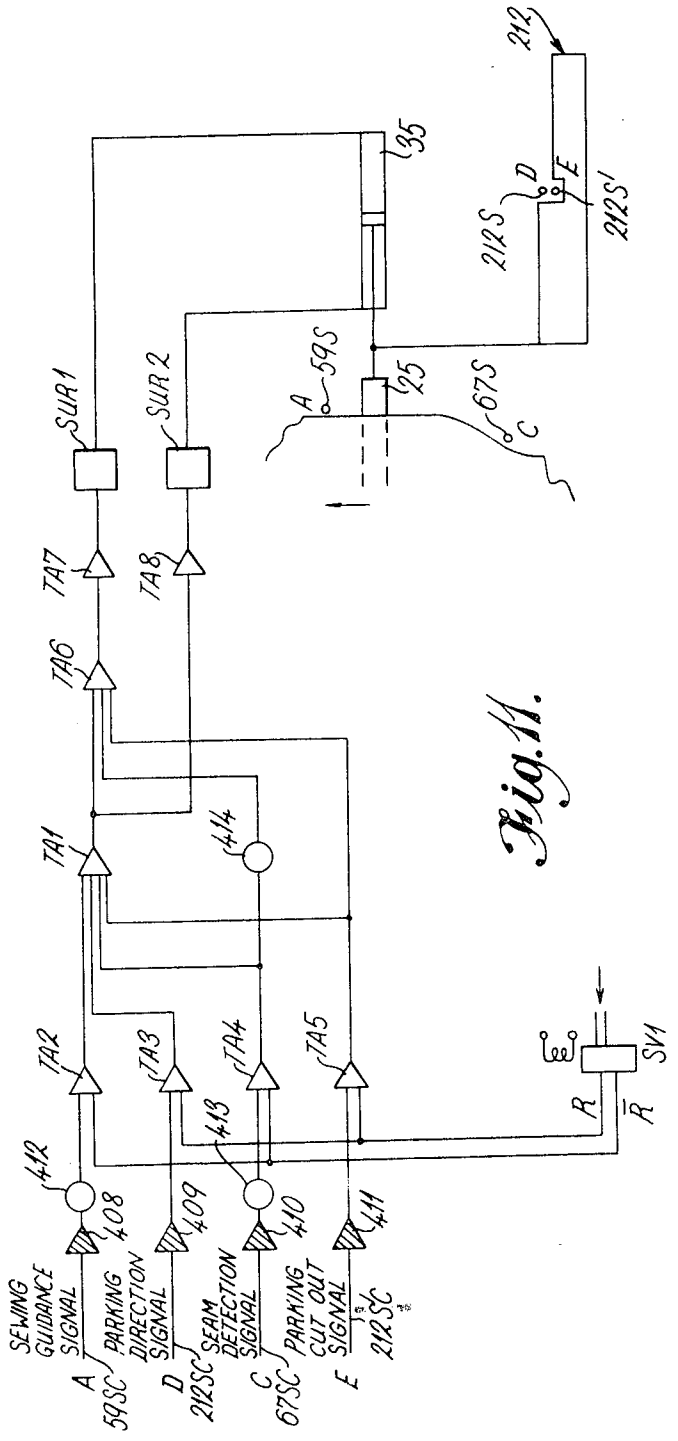

SEWING GUIDANCE SIGNAL
A
59SC
PARKING DIRECTION SIGNAL
D
212SC
SEAM DETECTION SIGNAL
C
67SC
PARKING CUT OUT SIGNAL
E
212SC
408
409
410
411
412
413
414
TA1
TA2
TA3
TA4
TA5
TA6
TA7
TA8
SUR 1
SUR 2
35
25
59S
67S
212S
212S1
212
D
E
A
C
R
R̄
SV1

Fig. 11.

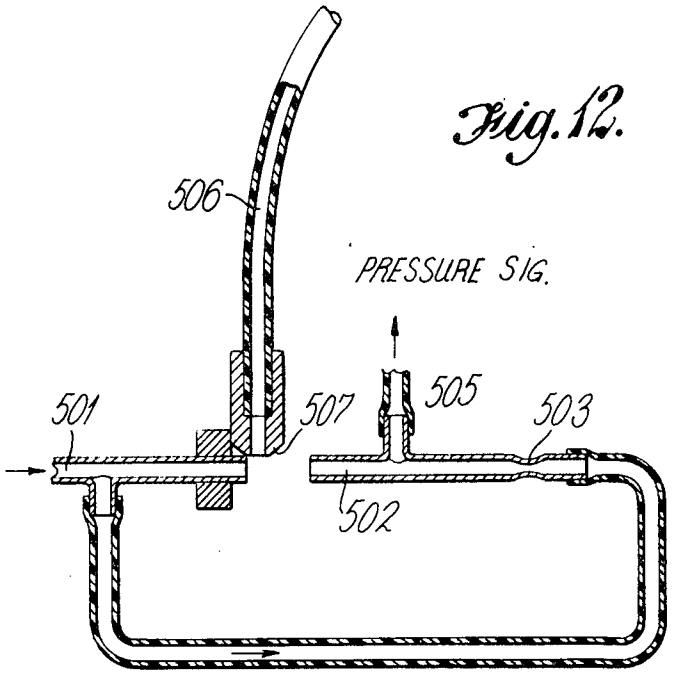

506
PRESSURE SIG.
501
507
505
503
502

Fig. 12.

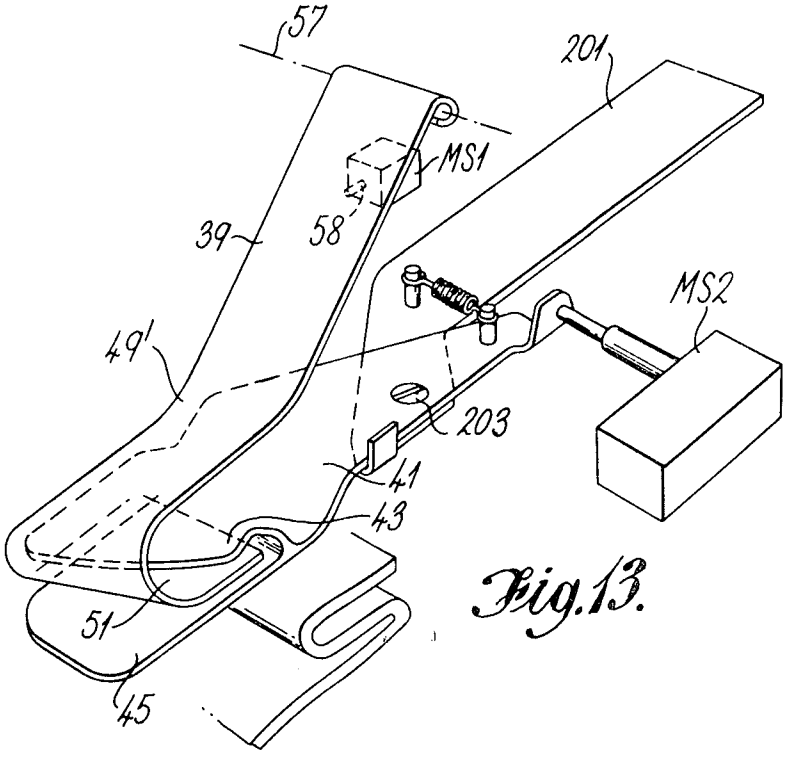

57
201
MS1
39
58
MS2
49'
203
41
43
51
45

Fig. 13.

GUIDING APPARATUS FOR A STITCHING MACHINE

The present invention relates to guiding apparatus for a stitching machine.

Overlock stitching machines are known which form a welt with a blind stitch on tubular garments, such as vests. Such machines include simple devices for assisting an operator to form the necessary folds in the edge portion of the garment in advance of, and adjacent to, the stitching machine. However, hitherto it has been essential that the operator should form the fold throughout the entire stitching operation, and inexperienced operators have found it necessary to form folds in steps with consequent intermittent operation of the machine. More experienced operators are able to form the folds continuously as the edge portion of the garment passes through their fingers on the way to the stitching machine. However, even the most skilled operators have to employ their skills to the fullest extent continuously during the stitching operation.

In another field of sewing with which the invention is concerned, multi-needle stitching machines are known for securing an elasticized tape to a garment such as underpants, to form a waistband. Whilst it has not been necessary with such machines for the operator to control the position of the tape as it enters the stitching machine, it has been necessary for the operator to control continuously the position of the edge of the garment as it approaches the stitching machine to have the tape secured thereto and to have the raw edge whipped.

It is an object of the present invention to reduce the onus on an operator of a stitching machine in the above-mentioned and other stitching operations.

In accordance with the present invention there is provided apparatus for guiding an article through a stitching machine for performing a stitching operation along an edge portion of the article, comprising supports adapted to support the article, two of the supports being so disposed that a stitching machine may be located between them with an edge portion of the article in required relationship with the stitching machine, sensor means arranged to provide a sewing guidance signal indicative of the position of the edge of the article to be stitched relative to a predetermined position required for the performance of a satisfactory stitching operation, and means responsive to the sewing guidance signal for moving at least one support to guide the said edge towards the said predetermined position.

Preferably the supports are adapted to support a tubular article in tubular form and comprise arms extending in operative positions substantially at right angles to the path of the edge portion of the article when being stitched.

Also preferably the sensor means is mounted between the stitching machine and the last support which the edge portion of the article leaves on its way to the stitching machine, and this last mentioned support is the or one of the supports which is moved to guide the edge.

In cases where the edge of the article after the stitching operation is displaced relative to the position the edge had before the stitching operation, e.g., where a welt has been formed or where a tape has been secured to the body of the article and extends beyond the edge of the body of the article, there may be included seam detector means arranged to detect the beginning of the stitched edge of the tubular article as that beginning approaches the stitching machine, and to give a seam detection signal upon such detection, and means responsive to the seam detection signal for discontinuing guidance of the edge in response to the said sewing guide signal.

The arrangement may be such that upon discontinuance of the guidance, in response to the said sewing guidance signal, the support moving means operates to put the support or supports in a fixed position for the remainder of the stitching operation. Alternatively there may be provided further sensor means for providing a further guidance signal indicative of the position of the stitched edge of the article as that edge approaches the stitching machine during the final stage of the stitching operation, and the means for discontinuing guidance of the edge in response to the said sewing guidance signal may also operate to switch the said support moving means to be responsive to the further guidance signal after detection of the stitched edge.

There is also provided in accordance with the present invention apparatus for folding the edge of a tubular article in preparation for stitching a folded welt by a stitching machine, the folding device comprising a base member, a first tongue contiguous at one end thereof with the base member and extending at the other end thereof in a plane substantially parallel to and spaced from the base member, an upper member and a second tongue contiguous at one end thereof with the upper member and extending at the other end thereof in a plane substantially parallel to and spaced from the upper member, the tongues and members having an operating position in which the first tongue extends between the upper member and the second tongue towards the conjunction thereof and the second tongue extends between the first tongue and the base member towards the conjunction thereof in such a manner as to form an S-shaped fold in the edge of the tubular article, and means responsive to detection of the beginning of the stitched edge of the tubular article for effecting movement of the first tongue away from the second tongue and upper member to allow the stitched edge of the article to pass by the folding device to a stitching machine at the end of the stitching operation.

The first tongue and the base member may be fixed relative to one another to form a first element, and the second tongue and the upper member may be fixed relative to one another to form a second element.

There may be provided an arrangement in which the second element is movable to the said operating position from an inoperative position which allows an edge portion of the article to be laid over the first element, the movement of the tongues into their operating positions being such as to carry the material of the edge portion into the required S-shaped fold.

The apparatus may include means responsive to detection of the beginning of the stitched edge of the tubular article for effecting movement of the edge of the article clear of the sewing machine after the elapse of a predetermined delay following detection of the beginning of the said stitched edge.

An embodiment of the present invention will now be described by way of example, with reference to the accompanying drawings in which:

FIG. 1 illustrates a cross-section of a folded welt formed with a blind stitch on a tubular textile article;

FIG. 2 illustrates a first stage in the formation of the welt illustrated in FIG. 1;

FIG. 3 illustrates a stage intermediate that of FIGS. 1 and 2;

FIG. 4 illustrates a plan view of apparatus embodying the present invention;

FIG. 5 illustrates a perspective view of the apparatus illustrated in FIG. 4 with the tubular textile article shown only in ghost lines so that the apparatus may more easily be seen,

FIG. 5*a* illustrates a portion of the apparatus illustrated in FIG. 5;

FIG. 6 illustrates a perspective view of a portion of the apparatus illustrated in FIGS. 4 and 5;

FIG. 7 illustrates a perspective view of another portion of the apparatus illustrated in FIGS. 4 and 5;

FIG. 8 illustrates a scrap view of a fluidic detector included in the apparatus illustrated in FIGS. 4 and 5;

FIG. 9 is a diagram of a pneumatic circuit which actuates the main moving mechanisms of the apparatus illustrated in FIGS. 4 and 5;

FIG. 10 is a diagram of an electrical control circuit which controls the timing and sequence of the operations of the apparatus illustrated in FIGS. 4 and 5;

FIG. 11 is a diagram of a fluidic circuit which applies various information signals through logic circuits to control the apparatus illustrated in FIGS. 4 and 5;

FIG. 12 shows a lint trap for use in the fluidic circuit of FIG. 11; and

FIG. 13 shows an alternative arrangement of the folding device;

FIG. 14*a* shows a curled fabric edge;

FIG. 14*b* shows an uncurling device; and

FIG. 14*c* shows another view of the uncurling device.

The embodiment of the invention illustrated in FIGS. 4 to 11 is suitable for forming a folded welt with a blind stitch on a tubular textile article, such as at the lower, hip end of a man's vest.

A blind stitch welt is illustrated in FIG. 1 and consists in known manner of a folded-back portion 1 of the cloth, the free edge 3 of which is both whipped and secured to the main portion 5 of the article by overlock stitching which is blind. That is to say that the threads of the stitches 7 do not extend on to the outer surface 9 of the garment. Such a welt may be formed by an overlock stitching machine which is conventional.

Referring to FIGS. 4, 5 and 9, an overlock stitching machine is shown at 11, and the remaining apparatus comprises apparatus embodying the invention for guiding a tubular article through the stitching machine. The stitching machine 11 includes an electric quick stop drive motor (not shown) which is brought into and taken out of driving relationship with the various parts of the machine by a clutch 301' operated by a double-acting pneumatic ram 301 controlled by a solenoid valve SV3. The stitching machine also includes a presser foot 303' moved between operative and inoperative positions by a double-acting pneumatic ram 303 controlled by a solenoid valve SV4.

Referring to FIGS. 4 and 5, and FIGS. 2 and 3, the marginal portion of the garment is fed to the overlock stitching machine 11 with two folds 13 and 15 formed therein, and with the raw edge 17 of the garment beyond the fold 15. As the thus folded garment approaches the needle 19 (see FIGS. 4 and 5) of the stitching machine 11, the fold 15 runs against a welt guide 21 which serves to position the fold 15 relative to the needle 19. Between the welt guide 21 and the needle 19 there is a reciprocating knife 21' which cuts the cloth at a position illustrated by the broken line 23 in FIG. 2 so that the edge 3 shown in FIG. 3, produced by the cutting, has a predetermined relationship with the fold 15 and so that any irregularity in the edge 17 is lost.

The garment is presented to the stitching machine 11 in the folded form illustrated in FIG. 2 by the mechanical apparatus illustrated in FIGS. 4 to 8 which is controlled by pneumatic electrical and fluidic circuits shown respectively in FIGS. 9, 10 and 11. Considering firstly the general structure of the apparatus as shown in FIGS. 4 to 8 four rollers 25, 27, 29 and 31 have axes which are substantially normal to a plane containing the direction of feeding motion of the stitching machine feed dogs, and the direction of reciprocating motion of the needle of the stitching machine. The rollers 25, 27, 29, and 31 are mounted for rotation in bearings 33, and constitute supports adapted to support in tubular form the article to be stitched. The rollers 27 and 29 are axially fixed but the rollers 25, 31 are movable in the axial direction by a double acting pneumatic ram 35. The roller 27 can be moved transversely of its axis of rotation between a first, running position (illustrated in FIG. 5) and a second, loading position, by means of a double-acting pneumatic ram 36 which is under the control of a solenoid valve SV2. When the roller 27 is in its loading position the length of the path around the four rollers 25, 27, 29 and 31 is less than that when it is in its running position, thereby making it easier to place a tubular article over the four rollers.

In the embodiment of the invention specifically described above and illustrated in the drawings, the two rollers 25 and 31 are arranged to be movable axially to position the edge of the cloth correctly. It will be realized that only one roller, or more than two rollers, may be moved axially in other embodiments.

Between the roller 25 and the stitching machine 11 there is provided a folding device 37 shown in FIG. 6, which consists of first, second and third elements indicated at 41, 39 and 201 respectively. The first element 41 has a first tongue 43, and a base member 45 which are joined at a smoothly contoured throat 47. The third element 201 has a third tongue 202 which lies in the same plane as the first tongue 43 of the element 41. The first element 41 is pivotally mounted on the third element 201 at a bearing 203 the axis of which is at right angles to the planes in which lies the tongues 43 and 202. The third element 201 carries a stop 204. The first element 41 is biased into engagement with the stop 204 by a spring 205. The tongue 43 moves only a small distance towards the tongue 202 on the element 201 against the restraining force of the spring 205, and when this happens a tab 206 on the element 41 moves against the operator of a switch MS2 and causes the switch to close. The second element 39 overlies the lower elements 201, 41 and has an upper member 49' and a second returned tongue 49, the tip of which, in the operative position (illustrated in FIG. 6) is disposed adjacent but spaced from the throat 47 so as to perform the folding operation which forms the fold 15. The tip of the tongue 43 of the first element 41 and the free end 202 of the third element 201 are both disposed in the same plane adjacent but spaced from an arcuate portion 51 of the second element where the tongue 49

merges with the upper member 49' of the element 39. The tongues 43 and 202 form the fold 13.

Referring again to FIG. 5, the third element 201 is mounted on the armature 53 of a solenoid S1 which serves to move the lower element assembly of a third and first elements 201 and 41 between a forward operative position, as illustrated in FIG. 6 and a retracted position. The lower element assembly 201 and 41 is held in the operative position by a spring (not illustrated). When the solenoid is energized the assembly 201, 41 is rapidly withdrawn by the solenoid S1, and is returned to the operative position by the spring when the solenoid S1 is de-energized.

Referring to FIG. 6, the upper, second element 39 is mounted for swinging movement about an axis 57 between a lowered, operative position, illustrated in FIG. 6, and a raised, inoperative position. When in the lowered, operative position, the element 39 contacts the operator 58 of a microswitch MS1 thereby holding the switch MS1 closed.

Referring to FIGS. 7 and 5, a hook 208 is mounted on a rod 209 between the folding device 37 and the stitching machine 11. The purpose of the hook 208 is to remove the edge of the article from the stitching machine 11 at the end of the stitching operation. The axis of the rod 209 is parallel to the plane of the article and at right angles to the folded edge of the article. The rod 209 is placed on the bed 210 of the overlock stitching machine 11 so that the article will pass over it into the stitching machine 11. The rod 209 is slidable axially between its inoperative position with the hook 208 clear of the edge of the article, as shown in FIG. 7, and an operative position wherein the hook 208 is moved leftwards (as seen in FIG. 7) thus engaging the edge of the article and carrying the edge of the article to the left (as seen in FIG. 7). The rod 209 is mounted on the piston rod of a double-acting pneumatic ram 211 which serves to move the hook 208 between the retracted inoperative position, as illustrated in FIG. 7, and the extended, operative position. The double-acting ram 211 is controlled by a solenoid valve SV6.

There will now be described with reference to FIGS. 4, 5 and 8, sensor means arranged to provide a sewing guidance signal indicative of the position of the edge of the article to be stitched. A detector 59 is mounted between the roller 25 and the folding device 37. The detector 59 comprises an air jet 59J supplied with relative high pressure air through a conduit 59JC and directed at a sensor 59S. The air pressure may for example be 4–5 p.s.i. and is high relative to the pressure of the fluidic control circuit (to be described hereinafter) which may be at a pressure of about 10 inches of water. Signals from the senor 59S are carried along a conduit 59SC. The jet 59J and sensor 59S are disposed at opposite sides of the path of the cloth between the roller 25 and the folding device 37, and a line between the jet 59J and its sensor 59S intersects the line required to be followed by the edge 17 of the cloth.

In operation, as will be described in more detail hereinafter, the edge of the cloth is moved towards the detector 59 when the signal along the conduit 59SC indicates that the sensor 59S is not obscured by the cloth, and the cloth is moved away from the detector 59 when the sensor 59S is obscured by the cloth. Thus the edge of the cloth is arranged to hunt about the required position for sewing, and it is found that in practice the guidance provided by this hunting gives easily sufficient accuracy. The system has the advantage of simplicity over an arrangement with two detectors and a dead space, but such an arrangement may be used if necessary.

Referring to FIG. 5, a further detector 67 constituting seam detector means is provided between the rollers 31 and 25 and comprises an air jet 67J and a sensor 67S. This detector 67 has the purpose of detecting the beginning of the stitched edge of the article as it approaches the stitching machine 11 towards the end of the stitching operation. The jet 67J is supplied with high pressure air through a conduit 67JC and the output signal is carried through a conduit 67SC.

Referring to FIG. 5, a two jet detector 212 is mounted on the main frame of the machine and has for its purpose the detection of the position of a guide blade 213 which moves with the rollers 25 and 31, so as to control the parking of the rollers at a suitable position at the end of the stitching operation. The detector 212 comprises jets 212J and 212'J and sensors 212S and 212'S. The jets 212J and 212'J are supplied with high pressure air, and the signals from the sensors 212S and 212'S are carried by conduits 212SC and 212'SC (shown in FIG. 11 but not in FIG. 5). The detector 212 gives signals indicative of the position of a blade 213 which is mounted on the movable carriage 214 which carries the rollers 25, 31.

Reference is now made to FIG. 9, 10 and 11 which illustrate schematically the control circuits of the pneumatic system, the electrical system and the fluidic system respectively. The various functions of the apparatus, other than the stitching machine, are powered by pneumatic rams which are controlled by electrically operated pneumatic valves and fluidically operated pneumatic valves known as step up relays. The solenoid valves are controlled by the electrical system and the step up relays are controlled by the fluidics system. In general, the pneumatic system powers the apparatus, the fluidic system provides detection and logic functions, and the electrical system controls timing and sequence of operations.

Referring to FIG. 9, the various pneumatic devices have been described with reference to other diagrams, with the exception of the high pressure air source 401 and associated system. The source 401 supplies high pressure air through a filter 402 and oiler 403 to the rams 35, 303, 301, 36, and 211, through step up relays SUR1, and SUR2 and solenoid valves SV4, SV3, SV2 and SV6 respectively. The ram circuits include flow regulator and restrictor devices 404 and 405, in known manner to regularize flow. A filter 406 and low pressure regulator 407 are fed from the high pressure supply and provide the low pressure supply to the fluidics circuit.

The operation of the apparatus will now be described from different aspects with regard to the mechanical apparatus, and with regard to different control systems.

Firstly the sequence of operations will be described simply from the point of view of the operator in the following steps, with the reference mainly to FIGS. 4, 5 and 6.

1. The operator loads the article on to the supports 25, 31, 27 and 29 and enters guides (now shown) which lead the edge portion between the jets and sensors of the two detectors 59 and 67 so as to cover both jets.

2. The operator lays the edge portion of the material on top of tongues 202 and 43 and drops second element 39 into position. The tongues 202 and 43 then

move to the operating position overlying the tongue **49** and form the required S-shaped fold. At the same time the apparatus moves the roller **27** to its receiving position and lifts the presser foot of the sewing machine **11**, and the fluidic system switches on to sewing guidance.

3. The operator places the material under the presser foot and pulls through the sewing machine **11** sufficient material to allow the folding device **37** to form the required fold.

4. The operator then starts the machine, drops the presser foot and starts to stitch.

5. The machine runs until the beginning of the stitched edge or seal approaching the roller **25** uncovers the seam detector jet **67** due to the offset position of the stitched edge relative to the unstitched edge. This switches off the sewing guidance system and locks the rollers **25** and **31** in the position then obtaining.

6. Stitching continues until the start of the sewn seam catches the hinged tongue **43** of folding device **37.** This movement closes the switch MS2 which:

i. energizes the solenoid S1 to extract the tongues **43**;

ii. starts a timing relay to operate the hook **208** at a later stage after the stitching is complete, allowing a slight overlap of stitching; and

iii. starts a timer to stop the sewing machine at a predetermined time after operation of the hook **208.** This limits the length of chain sewn after the fabric is pushed off the line of sewing.

7. Finally the operator lifts the second element **39** of the folding device **37** which via the action of MS1 causes the roller **27** to move to the loading position, and the rollers **31** and **25** to park.

Where it is required to sew onto the welt a visible tab giving information as to the maker, size or the like, the sequence may be modified by operating **T89.** Upon the detection of the beginning of the seam by the tripping of the pivotted element **41,** a timer is started which after a delay stops the machine with the completed seam under the presser foot. The tab is then inserted in front of the presser foot and the sewing machine is restarted to stitch on for about 2 inches in so doing stitching the tab onto the seam and then the action of a timing device causes the hook **208** to eject the garment.

With reference in particular to FIG. **11,** there will now be described the fluidic system which controls axial movement of the rollers **25** and **31** to effect sewing guidance and parking of the rollers. Four signals A, D, C and E pass along the four conduits **59SC, 212SC, 67SC** and **212'SC** respectively and consist of the sewing guidance signal from detector **59,** the parking direction signal from detector **212,** the seam detection signal from detector **67** and the parking cut out signal from detector **212.** A fifth signal R is derived from the solenoid valve SV1 which gives a fluidic signal **1** when the upper element **39** of the folding device **37** is down in its operative position. The complement of R, $\bar{R}$ is also provided by the valve SV1. The unshaded triangles in the Figure represent turbulence amplifier devices having NOR functions. The shaded triangles represent lint trap devices having a NOT function and these devices are described hereinafter. The fluidic circuit is so arranged that in the presence of signals to both the step up relays SUR1 and SUR2, high pressure air is admitted to both ends of the ram **35** and its piston is held positively stationary. To move the ram **35** one way, the signal is removed from the appropriate **1** step up relay to admit pressure at the appropriate end of the ram **35.**

The conduits **59SC, 212SC, 67SC** and **212'SC** feed the signals A, D, C and E respectively into lint traps **408** to **411** which have for their function the removal from the fluidic signals of any pieces of lint which may have been picked up from the sensors and which must be prevented from reaching subsequent fluidic devices. The operation and construction of these lint traps will be described hereinafter with reference to FIG. **12.** The inversion of signals A, D, C and E then pass respectively to turbulence amplifier **TA2, TA3, TA4** and **TA5,** which also receive from the solenoid valve SV1 signals $\bar{R}$, R, $\bar{R}$ and R respectively. Between the lint traps **408** and **410** and their respective turbulence amplifier TA2 and TA4 are included two short delay elements **412** and **413** for smoothing the sewing guidance signal and seam detection signal obtained when the garment is made of perforated or eyelet type material that is material having an openwork effect produced by transferring sinker loops to two adjacent needles.

The outputs of all four amplifiers **TA2, TA3, TA4** and **TA5** are applied to a further turbulence amplifier **TA1,** the output of which is applied to turbulence amplifier **TA6** together with the output of the amplifier **TA5** and the output of the amplifier **TA4** after the latter has been delayed in a delay element **414.** The output of the amplifiers **TA1** and **TA6** are then inverted in further turbulence amplifiers **TA7** and **TA8** respectively and fed to the step up relays **SUR1** and **SUR2.**

The operation of the fluidic circuit of FIG. **11** is as follows. When the operator lowers the upper element **39** of the folding device **37,** the signal R ensures that the outputs of the amplifiers TA3 and TA5 are zero but allows the effect of the sewing guidance signal A and seam detection signal C to pass to the amplifier **TA1.** So long as the seam detection signal C is zero, the sewing guidance signal A controls the output of the amplifier **TA1,** and, depending on whether the signal A is a 1 or 0, opens one or other of the step up relays SUR1 and SUR2 to move the rollers 2S in the appropriate direction. As has been said, the action of the sewing guidance signal A is to cause the edge of the article to hunt about the required position.

As soon as the sensor **67S** detects the beginning of the stitched seam, the signal C becomes a 1 and inhibits the sewing guidance signal A at the amplifier **TA1.** The signal C also locks the step up relays SUR1 and SUR2 in their last position before inhibition of the sewing guidance signal A.

At the end of the stitching operation, the operator raises the element **39.** The solenoid valve SV1 produces a signal $\bar{R} = 1$ which inhibits the sewing guidance signal A and the seam detection signal C and allows the parking direction signal D to control the movement of the roller **25** by way of the amplifiers **TA1, TA6, TA7** and **TA8** and the relays **SUR1** and **SUR2.** This continues until the parking cut-out signal E inhibits the parking direction signal at TA1 and locks the roller **25** in the parked position by opening both step up relays SUR1 and SUR2.

Thus the amplifier TA1 can have directed to it either the signal A for sewing guidance or the signal D for parking direction control. Also similarly, the amplifier TA1 can be turned off by the signal C near the end of the sewing sequence or by the signal E when the parking position is reached. The signal C and E both stop the guidance by turning off not only the amplifier TA1 but also the amplifier TA6. When the signal C is used

to stop the sewing guidance, it turns off the amplifier TA1 and also, via the small delay 44, turns off the amplifier TA6 thus preventing any tendency of the system to kick to the left, should it be travelling leftwards at the time the signal C arrives.

During sewing guidance by the signal A the amplifiers TA1 and TA6 provide output and complement for the step up relays SU1 and SU2 and the system is caused to hunt as the edge of the fabric chops signal A.

The lint trap which has been referred to with regard to FIG. 11 is illustrated in FIG. 12. A first polyvinyl chloride tube 601 passes a continuous stream of air to a receiver tube 602, across a gap of about a half inch. The tube 601 also passes air through a constricting element 603 direct to the tube 602, the air passing through a further tube 604. An output pressure signal is taken along a polyvinychloride tube from an outlet 605 positioned between the mouth of the receiver tube 602 and the restrictor 603. Adjacent the jet of the tube 601 is positioned a control jet 607 leading from an inlet tube 606 of polythene along which is passed the fluidic signal from which lint is to be removed. In the absence of a signal along the conduit 606, a signal in terms of a precalibrated pressure is taken from the outlet 605. In the presence of a signal at the jet 607, the flow from the tube 601 to 602 is disturbed and the pressure at the outlet 605 falls giving a 0 output signal. Due to the general turbulence at the jet 607, any lint in the conduit 606 is dispersed.

There will now be described the operation of the electrical circuit of FIG. 10 which controls the timing and sequence of operations of the guiding apparatus and the stitching machine. In the circuit diagram, the different contacts of each relay, such as the relay for example, are indicated by the same reference letter and numeral RC5. The most significant leads in the circuit are referenced by reference numerals such as 505 and 517, and a particular set of the contacts of a relay (such as the contacts of the relay R5) are indicated by reference to the lead on either side of that set of contacts.

Considering the sequence from the starting position in which the machine is entirely switched off, the isolator IS is first closed followed by the closure of the motor switch M. The reset switch PS1 is then closed to energize the under voltage relay UVR which closes the contacts UVRC between lines 502 and 503, and the contacts UVRC between the lines 509 and 510. A switch TS1 the function of which will be described later is set to the run position and a switch TS2 the function of which will be described later is set to the auto position.

However once the relay R1 is de-energized, all the outputs of the electrical circuit are connected to the solenoid valves SV1, SV2, SV3, SV4, SV5, SV6 and the solenoid S1, which are isolated from the turn switches TS3, TS4, TS5, TS6, TS7 and TS8 respectively.

The next step is to close the switch PS2 which energizes the solenoid S1 which controls the folding device 37, and the relay R5, which maintains the solenoid S1 in the energized state by means of the contacts RC5 between the lines 505 and 517. The contacts of the relay R5 between the lines 505 nd 543 maintain the relay R5 closed and thus the tongue 43 of the folding device 37 is moved into the retracted position and held there. This will occur automatically after the first full sequence of stitching has occurred and thereafter.

At this stage the machine is standing with

a. the roller 27 in the loading position,
b. the motor M running,
c. the clutch 301 disengaged,
d. the presser foot down,
e. the fluidic system of FIG. 11 holding the support rollers in the parked position,
f. the folder 39 in the up position, and
g. the element 201 carrying the tongue 43 in the withdrawn position.

The article is next loaded on to the rollers 27, 25, 31 and 29, and the second element 39 of the folding device 37 is dropped in position, thus closing the microswitch MS1. This energizes the solenoid valve SV1 thus changing the fluidic circuit from parking to guidance operation. The solenoid valve SV2 is de-energized and moves the roller 27 to the running position. The line 507 becomes live and the relay R6 is energized by way of the lines 507 and 545. The relay contacts RC6 of the relay R6 between the lines 543 and 544 open and de-energize the relay R5. The relay contacts RC5 between lines 505 and 543 and the relay contacts RC5 between the lines 505 and 517 both open so that the relay R5 stays de-energized and the solenoid S1 is de-energized. The elements 201 of the folding device 37 moves to the left in FIG. 6 to its operative position into engagement with the upper element 39 and the fabric of the article. The solenoid valve SV4 is energized by way of the lines 507, 530 and 531 and raises the presser foot. The operator pulls the material of the article through the folding device 37 until a satisfactory start to the welt is formed and this is placed under the presser foot.

The next stage is for the operator to close the switch PS3 which energizes the relay R2. The relay contacts RC2 between the lines 507 and 521 maintain the relay R2 energized, and the relay contacts RC2 between the lines 507 and 530 open and de-energize the solenoid valve SV4 thus dropping the presser foot. The relay contacts RC2 between the lines 517 and 518 close and short out the resistor 825. The relay contacts RC2 between the lines 546 and 533 close and gate the relay R3 etc. The relay contacts RC2 between the lines 507 and 545 open and de-energize the relay R6 and the relay contacts RC6 between the lines 543 and 544 close and gate the relay R5. The solenoid valve SV3 is energized by way of the lines 521, 523, 524, 525, 526, 527 and 528.

At the same time a delay device D1 is energized and begins timing. This timer is set to a period a little longer than the machine takes to complete the seam on the largest garment size to be used, and it is normally de-energized before it times out. If however a bad seam is made it usually does not trip the microswitch MS2 operated by the pivotted tongue 43, and the machine would continue stitching until there was a fabric pile-up under the needle. To prevent this the delay device D1 is arranged so that at the end of its time delay the delay contacts DC1 between the lines 525 and 526 open to de-energize the solenoid valve SV3 and thus to stop the machine.

At this stage the motor clutch is engaged and the machine begins stitching the seam. This continues until the stitched seam engages the tongue 43 which closes the microswitch MS2. (After this point two alternative sequences can be followed, and there will firstly be described the sequence in which the machine has been set to stitch a welt without the introduction of an informa-

tion tab, and that the turn switch TS9 has been set in the "no tab" position.)

When the microswitch MS2 is closed by the engagement of the beginning part of the seam with tongue 43, the relay R3 is energized. The relay contacts RC3 between the lines 507 and 542 close and energize the relay R5. The relay contacts RC5 between the lines 505 and 517 close and energize the solenoid S1 thus making the element 201 carrying the tongues 43 and 202 withdrawn to the right in FIG. 6. The relay contacts RC3 between the lines 507 and 546 close and maintain the relay R3 in the energized position, and the relay contacts RC5 between the lines 505 and 543 close and maintain the relay R5 in the energized condition. The relay R4 is energized and maintains itself energized by way of the contacts RC4 between the lines 507 and 537. The relay R4 is superfluous to the "no tab" sequence but it is important when the tab sequence is used as will be described hereinafter. The delay device D2 is energized and begins timing.

After a small delay the delay device D2 comes to the end of its predetermined delay and opens the contacts DC2 between the lines 523 and 524. However the contacts DC2 between the lines 523 and 524 are inoperative as they are shunted by the turn switch TS9. The contacts DC2 between the lines 537 and 538 close and energize the delay devices D3 and D4 both of which begin timing. The contacts DC2 between the lines 542 and 543 open and isolate the line 507.

After a small delay the delay device D3 comes to the end of its delay interval and closes the contacts DC3 between the lines 507 and 539 which in turn energize the solenoid valve SV6 which makes the hook 208 move to the left in FIG. 7 to eject the fabric from under the presser foot.

After a further delay the delay device D4 comes to the end of its delay interval, and opens the contacts DC4 between the lines 524 and 525 which de-energize the solenoid valve SV3 so that the machine stops stitching.

The operator next lifts the upper element 39 of the folding device 37 to remove the article. The lifting of the upper element 39 opens the microswitch MS1 which de-energizes the line 507 and hence de-energizes the elements SV1, R2, D1, SV4, R3, D2, R4, D3, D4, SV6. The solenoid valve SV4 is already de-energized by means of the relay contacts RC2 between the lines 507 and 530 and remains so. The relay R6 is already de-energized by way of the relay contacts RC2 between the lines 507 and 545 and remains so.

At this stage

a. the fluidic system reverts to the parking state

b. the elements 201 of the folding device 37 remain withdrawn by the relay R5,

c. the clutch remains disengaged,

d. the presser foot remains down,

e. the hook 208 remains in the right-hand position in FIG. 7, and

f. the solenoid valve SV2 is energized so that the roller 27 moves to the loading position.

The sequence is thus complete and ready for another operation.

There will now be described the alternative sequence which occurs when it is desired to make a seam with a tab sewn into the seam. The sequence differs from the original sequence at that stage when the seam engages the pivotted tongue 43 and switches the microswitch MS2. When it is desired to use the tab sequence, the machine is first set up as above but with the turn switch TS9 turned to the tab position. The contacts TS9 between the lines 523 and 524 open and make the delay of device D2 between the lines 523 and 524 and the relay contacts RC4 between the lines 523 and 524 operative. The switch contacts TS9 between the lines 533 and 534 close and gate the solenoid valve SV5 and the tab light TAB' is energized. The contacts TS9 between the lines 533 and 537 open and the contacts TS9 between the lines 533 and 535 close which causes gating of the relay R4.

When the microswitch MS2 is operated by engagement of the stitched seam by the pivotted tongue 43, the relay R3 is energized so that the relay contacts RC3 between the lines 507 and 542 close and energize the relay R5. The relay contacts RC5 between the lines 505 and 517 close and energize the solenoid S1 thus making the element 201 of the folding device 37 move to the right in FIG. 6, and withdraw. The relay contacts RC3 between the lines 507 and 546 next close and maintain the relay R3 energized, and the relay contacts RC5 between the lines 505 and 543 close and maintain the relay R5 energized. The solenoid valve SV5 is energized and by-passes an air regulator that normally gives a slow start to the clutch engagement. The tab light between the lines 534 and 510 is illuminated. The delay device D2 is energized and begins timing.

After a small delay the delay device D2 comes to the end of its delay interval and the delay contacts DC2 between the lines 523 and 524 open and de-energize the solenoid valve SV3 thus stopping the machine. The delay contacts DC2 between the lines 535 and 536 close and gate the switch contacts of PS3 between the lines 536 and 537. The delay contacts DC2 between the lines 537 and 538 close and gate the delay devices D3 and D4.

At this stage the machine has stopped with the welt under the presser foot and the tab light TAB' lit to show that the machine is ready for a tab to be inserted. The tab is placed on the seam just in front of the presser foot.

The operator next presses the switch PS3 and so closes the switch contacts PSC3 between the lines 507 and 521. These are already shunted by the relay contacts RC2 between the lines 507 and 521. The switch contacts PSC3 between the lines 536 and 537 close and energize the relay R4, the delay device D3 and the delay device D4. The relay contacts RC4 between the lines 507 and 537 close and maintain in the energized state the relays R4, D3 and D4. The relay contacts RC4 between the lines 523 and 524 close and re-energize the solenoid valve SV3 so that the machine begins stitching and the tab is carried under the presser foot and is stitched to the seam.

After a small time interval the delay device D3 comes to the end of its delay interval and the contacts DC3 between the lines 537 and 539 close and energize the solenoid valve SV6. This causes the ejector hook 209 to eject the article from the stitching machine.

After a further delay the delay device D4 come to the end of its delay interval, and the sequence of the machine continues as in the previous no tab sequence.

In the event of a thread breakage, the switch TS1 is set to the thread position. The motor is discontinued and stops and the contacts of the switch TS1 between the lines 503 and 504 open and isolate the lines 504,

505, 506, 507 and so on, thus preventing any of the sequence from carrying out. The contacts TS1 between the lines 503 and 523 close and energize the solenoid valve SV3 thus engaging the motor clutch and enabling the machine to be turned over by hand. The contacts TS1 between lines 521 and 523 open and isolate the relay R2 and so on. It is to be noted that the solenoid valve SV2 is de-energized so that the rolls will move to the operative position to give access to the machine. Also the solenoid valve SV4 is de-energized so that the presser foot will remain down, this being a more convenient position for threading up.

Contacts on the switch TS10 can be operated whilst the machine is running, and act to de-energize the solenoid valve SV3 thus disengaging the clutch and stopping the machine. This enables the seam to be inspected and/or guidance checked at any time. Under normal conditions of course it is not used.

A turn switch TS2 can be operated to isolate the logic circuits of FIG. 11. This energizes the relay R1 enabling the outputs to be operated independently by the turn switches TS3, 4, 5, 7 and 8. These are for a mechanic's use and are not normally used.

It is to be noted that the relay contacts RC3 between the lines 521 and 546 open when the microswitch MS2 is properly switched and prevent any further timing by the delay device D1. Thus, providing the microswitch MS2 operates, the delay device contacts DC1 between the lines 525 and 526 cannot thereafter stop the machine.

When using the tab sequence described above, the solenoid valve SV5 is energized prior to the second start of the stitching machine. This valve by-passes the flow regulator shown in the pneumatic circuit of FIG. 9 which controls the speed of engagement of the sewing machine motor clutch. This enables the second start to be fast so that the delay devices D3 and D4 will not trip out before the tab has been stitched on the seam.

Reference will now be made to two modifications to the apparatus illustrated in FIGS. 13 and 14. In FIG. 13 there is shown an alternative form of the tongue 43 carried by the element 201 of the folding device 37. This tongue extends across to the position occupied previously by the stationary tongue 202 which is dispensed with. Otherwise the operation is the same as for the folding device shown in FIG. 6.

In FIG. 14 there is shown an uncurling device for use with knitted material such as eyelet material. It is found with knitted material that an edge of a garment in tension tends to curl as shown in FIG. 14A. The edge portion of the garment must be uncurled before it passes through the sensors of the guiding apparatus, and this is achieved by a toothed wheel shown in FIG. 14B. The toothed wheel 411 rotates about an axis parallel to the direction of travel of the edge portion of the article, and rotates in such a direction that the teeth brush the edge of the article to the uncurled position shown in FIG. 14B. An end view of the wheel is shown in FIG. 14C.

An embodiment of the invention has been described above which is suitable for forming a welt on a tubular garment. Amongst other uses of apparatus in accordance with the present invention, is stitching a tape, for example an elasticized tape, to a tubular garment. In such an arrangement a multi-needle stitching machine is employed. Folding means, such as the device 37, are not required because the elasticized tape covers and extends beyond the raw edge of the cloth and the raw edge is whipped and secured to the tape by stitches. The tape is supplied from a reel to the stitching machine and its position as it passes through the stitching machine is accurately controlled by appropriate positioning of the reel of tape. The raw edge of the article to which the tape is to be stitched does have to be controlled, and is, for the major portion of the stitching operation, under the control of a detector such as the detector 59 which influences the axial position of the roller which the article last leaves on its way to the stitching machine or influences the axial position of that roller and the preceding one. However, in this embodiment the detector 67 is placed at the opposite side of the detector 59 (i.e., on the side furthest from the bulk of the article) because the edge of the tape extends beyond the raw unstitched edge. This is distinct from the embodiment described above with reference to the drawings wherein the edge of the formed welt is displaced backwardly away from the position where the raw edge would be had the welt not been formed. Therefore, the detector 67 is employed to sense the leading edge of the tape.

Fluidic elements are described above as the control elements. Evidently other forms of control elements may be used. For instance the detectors may be photoelectric devices and the fluidic control circuit (FIG. 11) could be dispensed with in favor of an electropneumatic arrangement or an electro hydraulic arrangement or wall attachment devices could be used instead of turbulence amplifiers.

We claim:

1. Apparatus for folding the edge of a tubular article in preparation for stitching a folded welt by a sewing machine head around the edge of said tubular article, the folding device comprising a base member, a first tongue contiguous at one end thereof with the base member and extending at the other end thereof in a plane substantially parallel to and spaced from the base member, an upper member, a second tongue contiguous at one end thereof with the upper member and extending at the other end thereof in a plane substantially parallel to and spaced from the upper member, the tongues and members having an operating position in which the first tongue extends between the upper member and the second tongue towards the conjunction thereof and the second tongue extends between the first tongue and the base member towards the conjunction thereof in such a manner as to form an S-shaped fold in the edge of the tubular article, and means responsive to detection of the beginning of the stitched edge of the tubular article for effecting movement of the first tongue away from the second tongue and upper member to allow the previously stitched edge of the article to pass by the folding device at the end of the stitching operation.

2. Apparatus according to claim 1 in which the first tongue and the base member are fixed relative to one another and form a first element.

3. Apparatus according to claim 2 in which the second tongue and the upper member are fixed relative to one another and form a second element.

4. Apparatus according to claim 3 in which the second element is movable to the said operating position from an inoperative position which allow an edge portion of the article to be laid over the first element the movement of the tongues into their operating positions

being such as to carry the material of the edge portion into the required S-shaped fold.

5. Apparatus according to claim 1 in which the means for effecting movement of the first tongue comprises pivot means allowing the first tongue to pivot on a third element about an axis generally perpendicular to the plane of the first tongue upon contact of the first tongue with the beginning of said stitched edge.

6. Apparatus according to claim 5 in which the means for effecting movement of the first tongue comprises switch means arranged to be actuated by pivotal movement of the first tongue on the third element and means for moving the third element upon actuation of the switch means to withdraw the first tongue from between the second tongue and the upper member.

7. Apparatus according to claim 6 in which the third element has a third tongue extending in the same plane and same direction as the first tongue but spaced therefrom.

8. Sewing machine apparatus comprising:

a sewing machine head for performing along the edge of a tubular article a stitching operation in which the edge of said tubular article is displaced relative to the position the edge had before said stitching operation;

support means adapted to present said tubular article to said sewing machine head in a position for said article to be stitched by said sewing machine head, said support means being adapted to support said tubular article in tubular configuration with said support means extending within said tubular article;

sensor means arranged to provide a sewing guidance signal indicative of the position of said edge of said article to be stitched, and

control means responsive to said sewing guidance signal for urging said article to be stitched and said sewing machine head towards a predetermined relationship required for the performance of a satisfactory stitching operation;

seam detector means arranged to detect the beginning of the stitched edge of the tubular article as that beginning returns towards the sewing machine head, and arranged to give a seam detection signal upon such detection; and

means responsive to the seam detection signal for discontinuing the guidance of the edge in response to the said sewing guidance signal.

9. Apparatus according to claim 8 in which upon discontinuance of said guidance in response to said sewing guidance signal, said control means operates to put said article and said sewing machine head in a fixed relationship for the remainder of said stitching operation.

10. Sewing machine apparatus comprising:

a sewing machine head for performing a stitching operation along the edge of a tubular article;

support means adapted to present said tubular article to said sewing machine head in a position for said article t o be stitched by said sewing machine head, said support means being adapted to support said tubular article in tubular configuration with said support means extending within said tubular article;

sensor means arranged to provide a sewing guidance signal indicative of the position of said edge of said article to be stitched;

control means responsive to said sewing guidance signal for urging said article to be stitched and said sewing machine head towards a predetermined relationship required for the performance of a satisfactory stitching operation; and

a device for folding the edge of said tubular article in preparation for stitching a folded welt by said sewing machine head around said edge of tubular article, said folding device comprising a base member, a first tongue contiguous at one end thereof with said base member and extending at the other end thereof in a plane substantially parallel to and spaced from said base member, an upper member, a second tongue contiguous at one end thereof with said upper member and extending at the other end thereof in a plane substantially parallel to and spaced from said upper member, said tongues and members having an operating position in which said first tongue extends between said upper member and said second tongue towards the conjunction thereof, and said second tongue extends between said first tongue and said base member towards the conjunction thereof, in such a manner as to form an S-shaped fold in said edge of said tubular article, and means responsive to detection of the beginning of the stitched edge of the tubular article for effecting movement of said first tongue away from said second tongue to allow the stitched edge of the article to pass by said folding device at the end of said stitching operation.

11. Sewing machine apparatus comprising:

a sewing machine head for performing a stitching operation along the edge of a tubular article;

support means adapted to present said tubular article to said sewing machine head in a position for said article to be stitched by said sewing machine head, said support means being adapted to support said tubular article in tubular configuration with said support means extending, within said tubular article;

sensor means arranged to provide a sewing guidance signal for urging said article to be stitched and said sewing machine head towards a predetermined relationship required for the performance of a satisfactory stitching operation; and

means responsive to detection of the beginning of said stitched edge of said tubular article as that beginning returns towards said sewing machine head, said responsive means being arranged to effect movement of said edge of said article clear of said sewing machine head after the elapse of a predetermined delay following detection of said beginning of said stitched edge.

12. Sewing machine apparatus comprising:

a sewing machine head for performing a stitching operation along the edge of a tubular article;

support means adapted to present said tubular article to said sewing machine head in a position for said article to be stitched by said sewing machine head, said support means being adapted to support said tubular article in tubular configuration with said support means extending within said tubular article;

sensor means arranged to provide a sewing guidance signal indicative of the position of an edge of said article to be stitched, said sensor means comprising fluidic sensor means in which the presence or absence of an output signal is determined by interrup-

tion of a stream of gas by said edge portion of said article; and

control means responsive to said sewing guidance signal for effecting relative movement between at least part of said support means and said sewing machine head, said relative movement urging said article to be stitched and said sewing machine head towards a predetermined relationship required for the performance of a satisfactory stitching operation.

13. Sewing machine apparatus comprising:

a sewing machine head for performing a stitching operation along the edge of a tubular article;

support means adapted to present said tubular article to said sewing machine head in a position for said article to be stitched by said sewing machine head, said support means being adapted to support said tubular article in tubular configuration with said support means extending within said tubular article;

sensor means arranged to provide a sewing guidance signal indicative of the position of an edge of said article to be stitched; and

control means responsive to said sewing guidance signal for effecting relative movement between at least part of said support means and said sewing machine head, said relative movement urging said article to be stitched and said sewing machine head towards a predetermined relationship required for the performance of a satisfactory stitching operation.

14. Apparatus according to claim **13**, comprising a main frame to which said sewing machine head and said support means are coupled, said coupling being such that in operation said sewing machine head is fixedly coupled to said main frame, and at least part of said support means is movable coupled to said main frame to allow movement under the control of said control means.

15. Apparatus according to claim **13**, in which said support means comprises a plurality of spaced apart supports, and including loading means which comprises means for effecting movement of at least one support towards another support to facilitate loading a tubular article onto said supports.

16. Sewing maching apparatus comprising:

a sewing machine head for performing a stitching operation along the edge of a tubular article;

support means adapted to present said tubular article to said sewing machine head in a position for said article to be stitched by said sewing machine head, said support means being adapted to support said tubular article in tubular configuration with said support means extending within said tubular article;

sensor means arranged to provide a sewing guidance signal indicative of the position of an edge of said article to be stitched, and

control means responsive to said sewing guidance signal for urging said article to be stitched and said sewing machine head towards a predetermined relationship required for the performance of a satisfactory stitching operation.

17. Apparatus according to claim **16** in which said support means comprises a plurality of arms spaced apart in a non-linear configuration and extending in operative positions substantially at right angles to the path of said edge portion of said article when being stitched, and the control means is arranged to urge said article and said sewing machine head towards said required relationship by effecting relative movement between at least one of said arms and said sewing machine head.

18. Apparatus according to claim **17** in which at least one of said arms is cantilevered.

19. Apparatus according to claim **17**, in which each arm carries roller means arranged to allow transverse movement of said tubular article across said arm during said stitching operation.

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