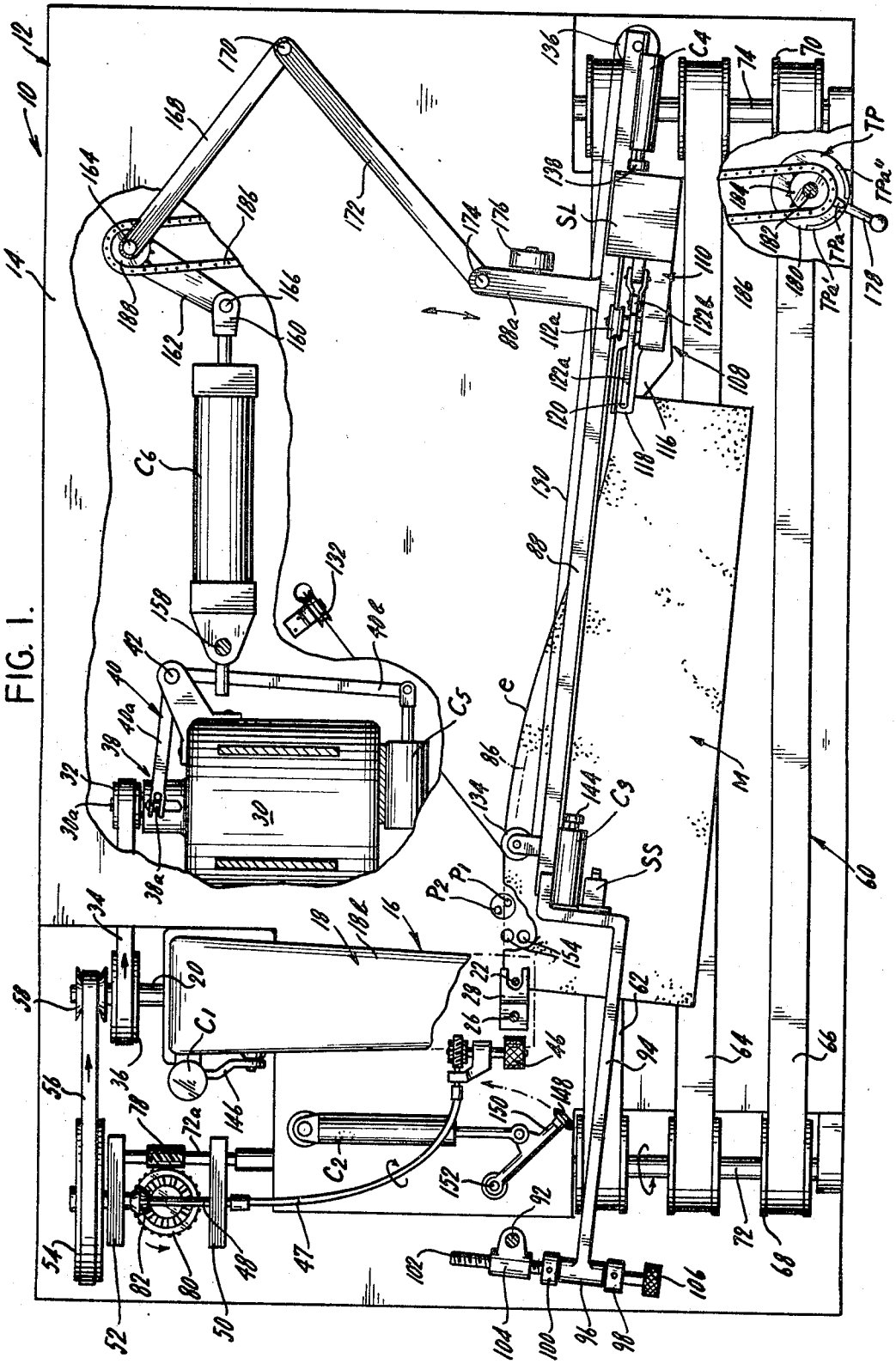
March 25, 1969 R. W. WINBERG 3,434,439

MATERIAL STITCHING AND GUIDING APPARATUS

Original Filed May 31, 1966 Sheet 1 of 4

FIG. 1.

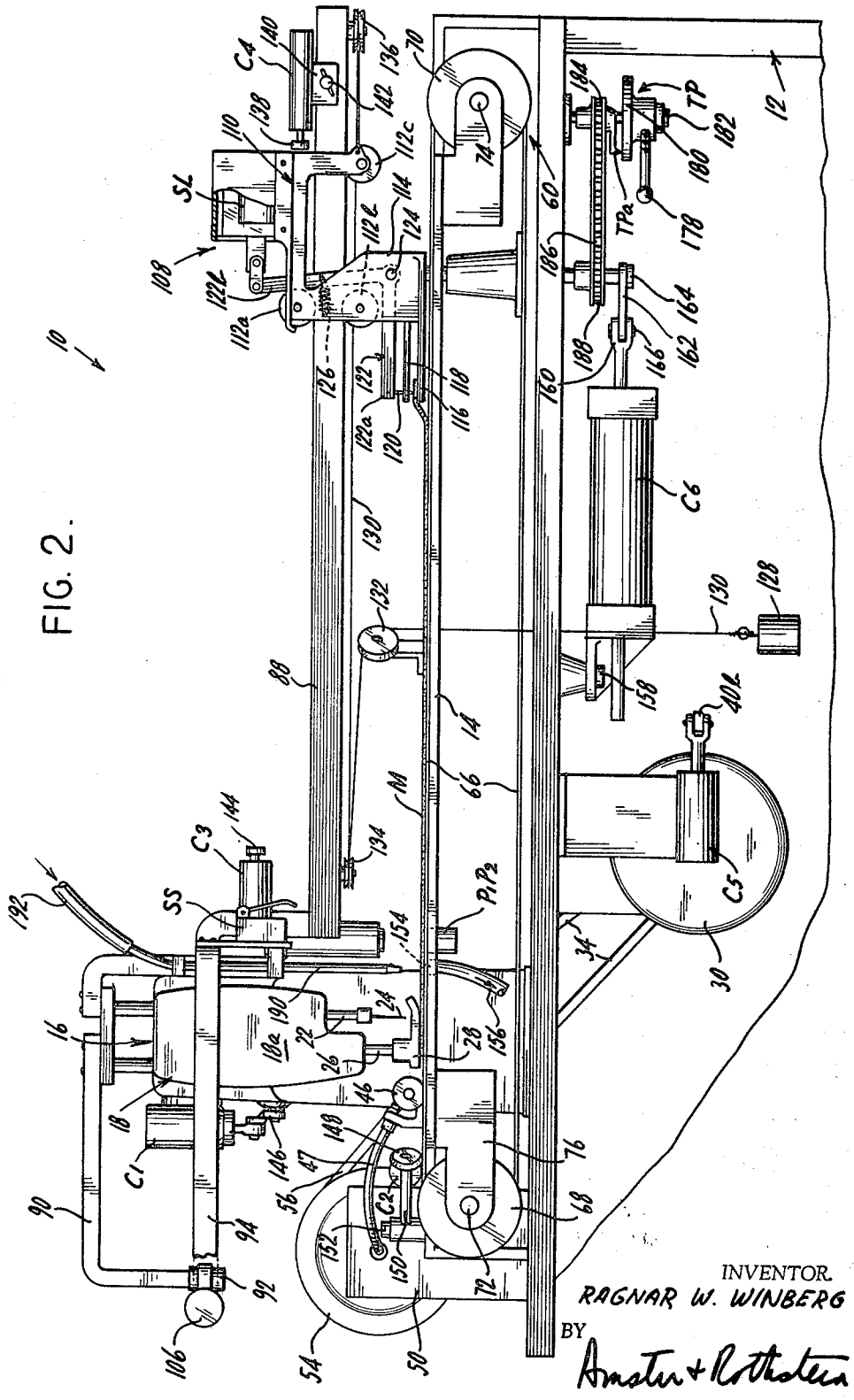


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FIG. 2.



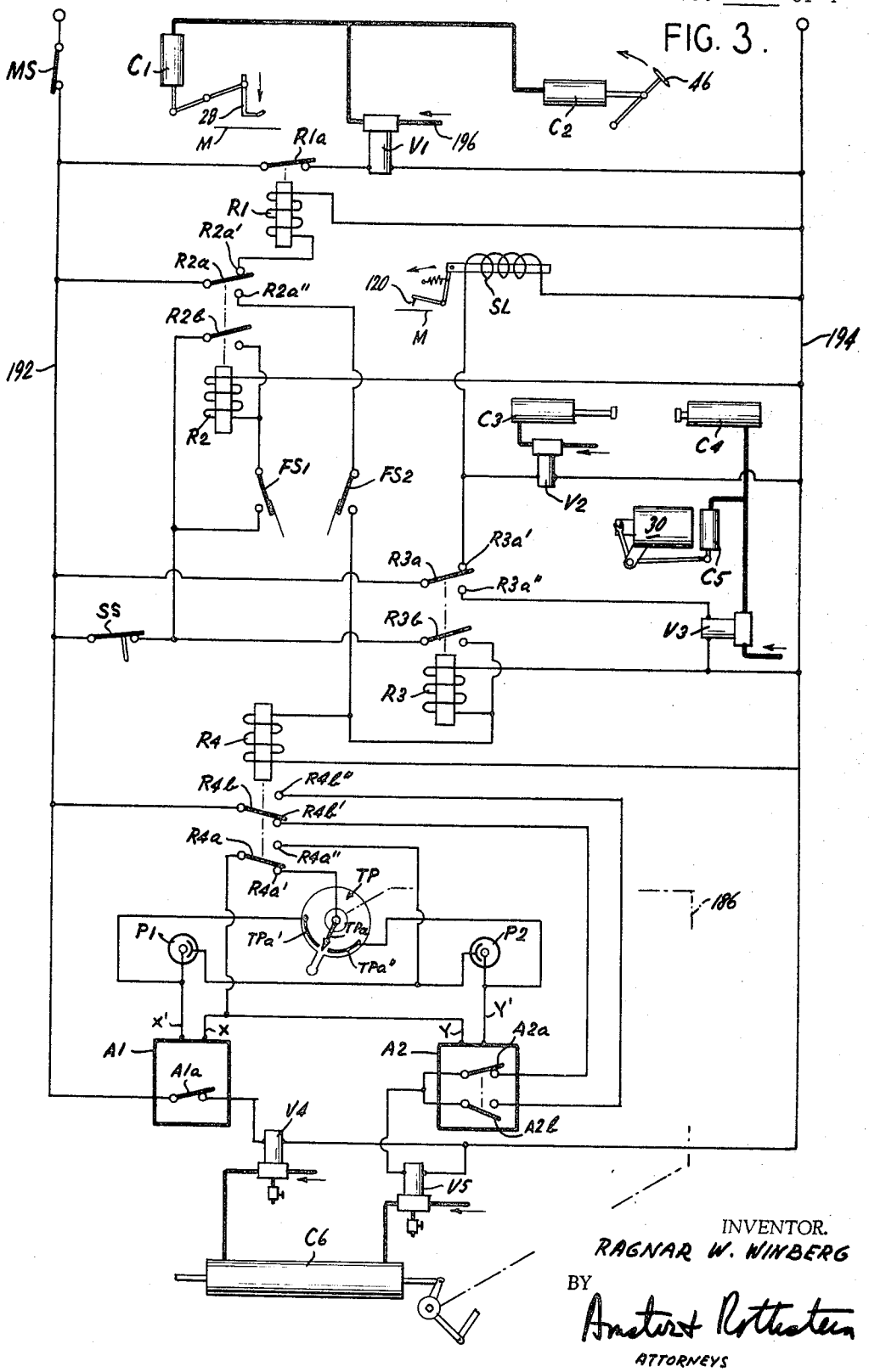
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FIG. 3.



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MATERIAL STITCHING AND GUIDING APPARATUS

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FIG. 4.

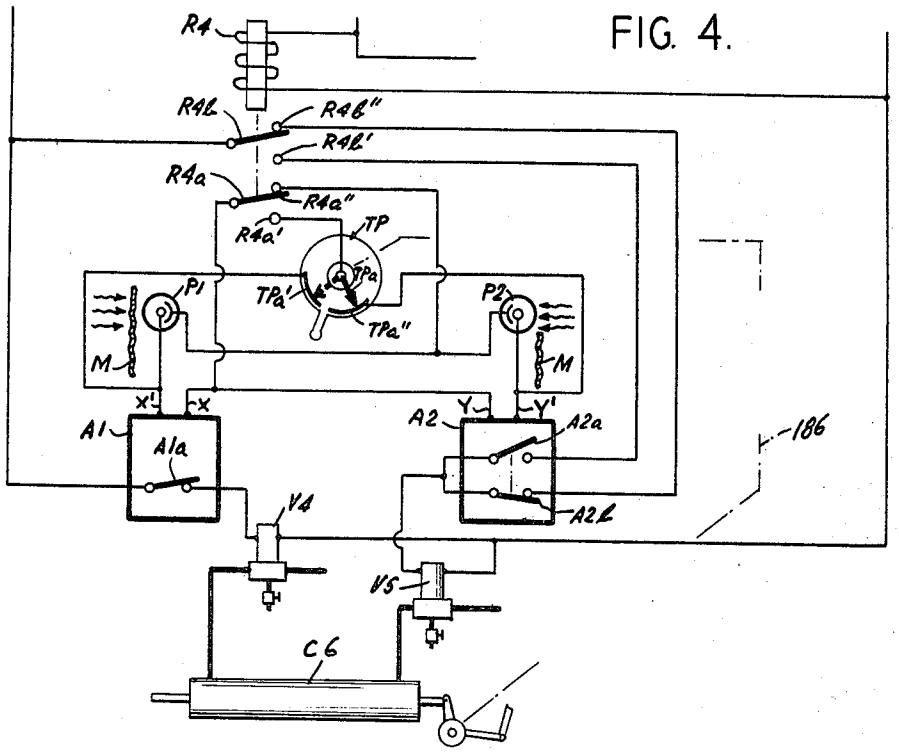
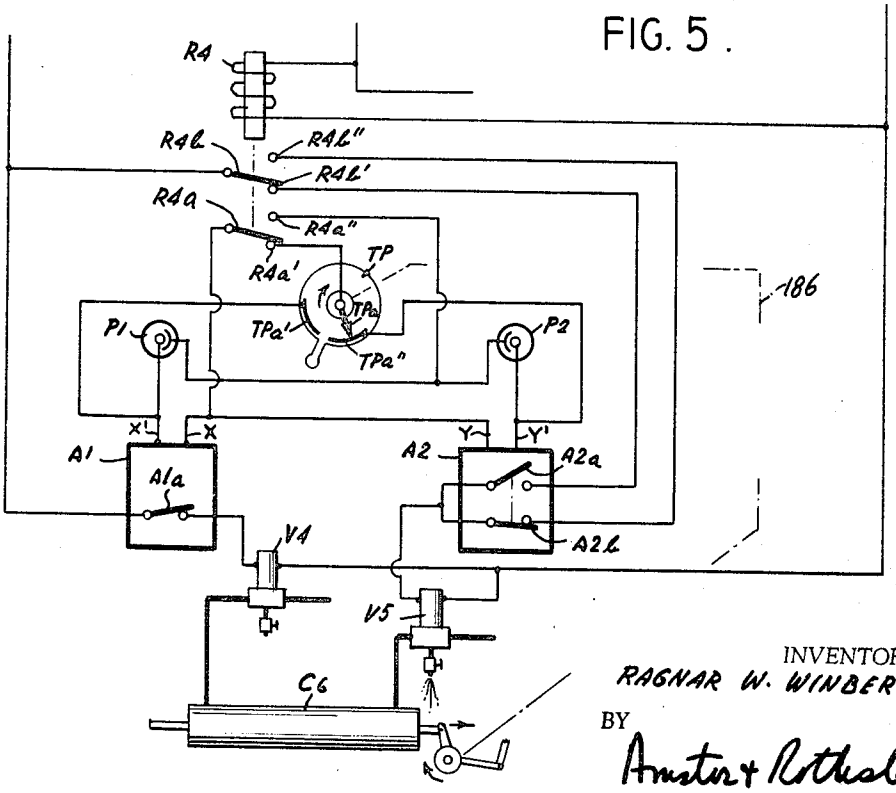


FIG. 5.



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United States Patent Office 3,434,439
Patented Mar. 25, 1969

3,434,439

MATERIAL STITCHING AND GUIDING APPARATUS

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Continuation of application Ser. No. 553,783, May 31, 1966. This application Dec. 28, 1967, Ser. No. 701,029
Int. Cl. D05b 23/00; D05c 3/02, 7/04
U.S. Cl. 112—2 23 Claims

This is a continuation of application Ser. No. 553,783, filed May 31, 1966.

The present invention relates generally to sewing apparatus, and in particular to a machine for stitching one or more plies of material along a stitch line coextensive with and spaced from the edge of a material assembly. Advantageously, the present machine finds useful application in the stitching of superposed pieces of material together along curved or contoured edges, as may be required in the manufacture of a wide variety of articles of manufacture, and in particular in men's and women's wearing apparel.

In various stages of apparel manufacture, it becomes necessary to join superposed pieces of material together along a stitch line which is spaced inwardly from the coextensive edges thereof. Usually, the machine operator matches up the superposed edges and then feeds the same through the sewing machine while continuously guiding the material to assure stitching along a line uniformly spaced from the superposed edges to provide the required selvages or margins outwardly thereof. Attempts have been made to modify conventional sewing machines to facilitate the semi-automatic or completely automatic feed of material thereto to thereby eliminate or reduce the need for an operator in constant attendance. For a wide variety of reasons, which are well understood by those skilled in this art, such equipment has found only very limited usefulness and in most instances has been confined to straight line stitching of continuous lengths of material or the stitching of large quantities of an assembly which requires the same repetitive pattern.

There exists a need for semi-automatic or automatic stitching equipment which enables the joinder of superposed plies of material along a prescribed course, whether the same be curved or straight. It would be particularly advantageous if such equipment could be useful for either short or long runs so as to be able, by relatively simple adjustment, to handle the various stitch lines which are required from day to day in a typical manufacturing operation. For example, in a garment factory, and even when confined to the stitching of a single type of garment, there are seams which, depending upon the style and size of the garment, will vary in both length and curvature. Even when merely switching from one garment to another, or from one size of garment to another, different stitching conditions are presented. For a machine of this type to acquire widespread acceptance, it is essential that the same be readily adaptable to the new conditions. Of paramount importance, is the capability of the machine to complete a stitch line which has the various desirable attributes of one stitched by a skilled machine operator.

In copending application Ser. No. 275,297 filed on Apr. 24, 1963, now abandoned, and copending application Ser. No. 556,535 filed May 20, 1966, now Patent No. 3,322,081, the latter application being a continuation of the former and both entitled Material Stitching and Guiding Machine there is disclosed a semi-automatic sewing machine which exhibits the requisite capablities for stitching of superposed plies of material along a stitch line which stitch line closely follows the curvature of the coextensive edges of the superposed plies and is

substantially uniformly spaced therefrom. Such apparatus embodies a conveying and guiding mechanism for bodily advancing the material assembly, be it one or more plies, to a work location while continuously orienting the assembly in accordance with the contour of the edge along which the stitch line or seam is required. The conveying and guiding mechanism includes a conveyor which is arranged to underlie and engage the material and to advance the same along a feed path toward the work location. An elongated flexible cam member is arranged substantially along one side of the feed path and is adapted to be secured in a prescribed configuration relating to the contour of the edge of the material. The cam member is engaged by a cam follower which is movable therealong, with provision for engaging the material with the cam follower such that the material is steered in accordance with the prescribed configuration of the cam member to displace the material in relation to the feed path while the same is being bodily advanced toward the work location by the conveyor. The flexible cam member is reconfigured from time to time in accordance with the particular edge configuration and may be changed over by the machine operator in relatively short order and without undue difficulty. Experience with this type of equipment indicates that still greater versatility may be imparted to the equipment if it were possible to steer the cam follower or clamp by a cam member or track which did not require physical resetting each time a different set of stitching conditions were encountered. The realization of this further desirable attribute would make it a relatively simple matter for a relatively unskilled machine attendant to almost instantaneously change over from stitching conditions requiring a given length and given contour to a different length and/or different contour. Thus, it would be possible to employ the same equipment for stitching, in succession and with the relatively short change over time, a curved seam for a sleeve, a somewhat straighter and longer seam at the inside or outside of a trouser leg and the enumerable other stitching conditions which are encountered on a day to day basis in this one field. The versatility and adaptability of the present invention to automating operator-controlled and guided stitching equipment will be apparent to those skilled in the art as the instant description proceeds.

It is an object of the present invention to provide automatic sewing apparatus which realizes one or more of the aforesaid objectives. Specifically, it is within the contemplation of the present invention to provide a feeding and guiding mechanism which may be operatively arranged relative to a conventional sewing machine head and permits the stitching of one or more plies of material along a stitch line which closely follows the contour of the material edge and is in proximity thereto.

In accordance with an illustrative embodiment demonstrating objects and features of the present invention, a machine is provided for stitching material along a prescribed stitch line coextensive with and spaced inwardly from an edge thereof which comprises a support. Sewing mechanisms are mounted on the support and include the usual reciprocating needle operable at a stitching location for successively stitching the material along a prescribed stitch line. The material is arranged forwardly of the stitching location and advanced toward and through the stitching location along a normal feed path relative to the needle, as by the provision of a conveyor. Guide means are engageable with the material and operable to impart steering motion to the material as the same is advanced toward the stitching location for displacing the material from side to side relative to the normal feed path such that the material will be stitched substantially along the stitch line and in uniform spaced relation to

the adjacent material edge. The guide means includes an elongated guide rail or track projecting forwardly of the needle and a clamp movably mounted on and guided by the rail. The guide rail is mounted on the support for movement relative to the normal feed path, with the clamp being engageable with the material contiguous to the trailing end of the contoured edge when the leading end of such edge is initially positioned at the stitching location. Means are provided, preferably in the form of photocells, which are responsive to the deviations of the edge relative to the normal feed path for moving the guide rail in a direction to restore the edge to the proper oriented position for continuous stitching along the prescribed and stitch line. The guide rail is effective in response to its movement to impart a corresponding steering motion to the clamp as the latter is moved therealong and toward the stitching location to continuously orient and properly present successive edge-adjacent portions of the material in relation to the stitching mechanisms for stitching along the prescribed stitch line. In a typical illustrative machine, the elongated guide rail is rigid and is mounted on the support for pivotal movement, with the photocells constantly monitoring the position of the guide rail and pivotally adjusting the same such that the material edge contiguous to the stitching location will always be in proper relation to the needle for stitching along the prescribed stitch line.

The above brief description, as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of a presently preferred, but nonetheless illustrative embodiment in accordance with the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a plan view of a stitching machine embodying features of the present invention, shown with a typical material assembly in position for feed therethrough and with parts broken away and sectioned to reveal constructional details;

FIG. 2 is a side elevational view of the machine;

FIG. 3 is a schematic and diagrammatic representation of the controls employed in the present machine, with the controls shown in the rest condition of the machine;

FIG. 4 is a partial showing of the control shown in FIG. 3, illustrating the running condition of the machine; and,

FIG. 5 is a partial view similar to FIG. 4 likewise showing a further condition of the machine during restoration to the FIG. 3 position.

Referring now specifically to the drawings, there is shown a material guiding and stitching machine, generally designated by the reference numeral **10**, which is suitable for the stitching together of superposed plies or pieces of materials M having a curved or contoured edge *e*. Although a single ply of materials is illustrated in the drawings, it will be appreciated that this is intended to be merely representative of the various single pieces or multiple ply assemblies which may be stitched with the present apparatus. Although the sewing machine will be recognized as being a typical lock stitch sewing machine, it will likewise be appreciated that various types of commercially available sewing apparatus may be employed in accordance with the present invention. Finally, although emphasis is placed herein on automatic stitching for the garment or wearing apparel industry, it will be appreciated that the invention find application in many other fields.

The machine **10** includes a support or frame **12** having a horizontally extending feed bed or table **14** providing a large work-supporting surface. Mounted on the support **12** across one end thereof is a sewing machine, generally designated by the reference numeral **16**, which may be a typically drop-feed lock stitch sewing machine of the type manufactured by Singer Machine Company. The illustrative sewing machine **16** includes a machine

body **18** having an upstanding head section **18***a* and an elongated body section **18***b*. Extending longitudinally of the machine body **18** is its main drive shaft **20** which serves to motivate the usual sewing machine mechanisms including the vertically reciprocating needle bar **22** having the needle **24** and the associated bobbin and bobbin raceway and other known machine components. Disposed rearwardly of the needle bar **22** is the usual presser foot bar **26** which carries the presser foot **28** which coacts with a feed dog (not shown) in a usual fashion. Drive is imparted to a main drive shaft **20** from a drive motor **30** which is disposed beneath the table or feed bed **14** (see FIGS. 1 and 2). The motor output shaft **30***a* carries a driving pulley **32** which is coupled by a belt **34** to driven pulley **36** on the main drive shaft **20**. As seen in FIG. 1, the drive motor **30** is selectively coupled to and decoupled from the driving pulley **32** by clutch **38** (shown in disengaged position) which is engaged and disengaged by a double arm clutch-actuating lever **40** pivoted on the motor housing at **42** by bracket **44**. Arm **40***a* of the clutch-actuating lever **40** is bifurcated and engages a clutch actuating pin **38***a*, and arm **40***b* is connected to the piston rod of a clutch-control piston and cylinder **C5**. The clutch-control piston and cylinder **C5** is of the single acting spring-biased type. Upon the introduction of air into the cylinder, the piston rod is extended to rock the lever **40** in a direction to engage the clutch; and upon porting of the cylinder to atmosphere, the internal spring of the cylinder and piston **C5** restores the clutch **38** to its disengaged position. Further description of the clutch control and the coordination of the stitching mechanisms by the usual sewing machine parts within the body **18** is dispensed with since these are well known to those skilled in the art.

Disposed rearwardly of the presser foot **28** is a rotary puller wheel **46** which is arranged along the normal feed path of the material M through the sewing machine and directly behind the presser foot **28**. The rotary puller wheel **46** supplements the feeding action of the usual four-motion feed dog in the sewing machine which, for the present purposes, is usually insufficient to rapidly advance the material M past the stitching location afforded by the needle **24**. The puller wheel **46** is connected by an appropriate flexible coupling shaft **47** to a puller drive shaft **48** which is disposed rearwardly of the sewing apparatus and is journalled on appropriate standards **50**, **52**. The puller drive shaft **48** carries a relatively large diameter driven pulley **54** which is coupled via belt **56** to a drive pulley **58** on the sewing machine main shaft **20**. The drive pulley **58** may be of the adjustable diameter type to permit variations in the drive from the main drive shaft **20** to the rotary puller **46**. For further details of this type of rotary feeder, reference may be made to U.S. Patent No. 2,777,409 of Jan. 15, 1957 entitled Feed Means for Sewing Machines.

Extending fore and aft of the machine **10** is a conveyor **60** which includes plural side by side endless belts **62**, **64**, **66**. The upper courses of the belts **62**, **64**, **66** overlie the feed bed **14** and are arranged to underlie the material M for advancing the same along a normal feed path toward the stitching location at the sewing machine **16**. Thus, during a typical stitching interval, successive edge-adjacent portions of the material M are presented to the stitching mechanisms including the needle **24** and the presser foot **28** at the stitching location for joinder. The endless belts of the conveyor **60** are trained over aligned pairs of pulleys (i.e., pulleys **68**, **70** for belt **66**) which pulleys are secured respectively to conveyor pulley shafts **72**, **74** extending transversely of the machine. The shaft **72** is journalled on appropriate brackets (i.e., bracket **76** depending from feed bed **14**) at a location rearwardly of the sewing machine and receives drive from the motor **30** via worm **78** on shaft extension **72***a* which is coupled to worm gear **80** which in turn is driven by bevel gear **82** on shaft **48**. Thus, upon rotation being imparted

to shaft 48 for driving the puller wheel 46, corresponding rotary movement is imparted to the conveyor drive shaft 72 via gearing 82, 80, 78 to activate the conveyor 60. It will be appreciated that the variable speed pulley 58 incorporated in the coupling arrangement to the sewing machine motor 30 affords a convenient means for adjusting the rate of advance of the material M under the influence of the multiple belts 62, 64, 66 of the conveyor 60.

Overlying the feed bed or table 14 of the machine is a material-guiding assembly, generally designated by the reference numeral 84, which is engageable with the material M and is operable to impart steering motion to such material as the same is advanced toward the stitching location. By displacing the material from side to side relative to the normal feed path, it is possible to establish stitching along any requisite stitch line. A portion of a typical stitch line, designated by the numeral 86, is illustrated and is seen to be parallel to and spaced inwardly from the contoured edge *e* of the material M. The conveyor 60 serves to advance the material M along a straight line feed path appropriate for stitching along and spaced inwardly of a material edge which is parallel to the linear feed established by the conveyor. However, the material guiding assembly 84, which will now be described, serves in conjunction with the conveyor 60 to steer the material M in a manner closely simulating the guiding action imparted to the material under the influence by a machine operator when confronted with the problem of stitching along a ocntoured or curved edge *e*, yet does so on an automatic basis and to an order of accuracy and repeatability which is virtually unobtainable by a machine operator.

The material guiding assembly 84 includes an elongated straight and substantially rigid guide rail or track 88 which projects forwardly from the stitching location and is intended to overlie the table 14 and the upper courses of the plural belts of the conveyor 60. The guide rail or track 88 is mounted on the support 12 for movement relative to the normal feed path established by the plural belts of the conveyor 60. In this illustrative arrangement, the guide rail 88 is mounted for pivotal movement about a vertical pivot and in a horizontal plane generally spaced above the table 14. Specifically, appropriate bracketing 90 is secured to the machine body 18 to provide a vertical pivot in alignment with and rearwardly of the needle 24 (see FIG. 1). The guide rail 88 is suspended above the feed bed 14 for side to side swinging movement about pivot 92 by an adjustable mounting arrangement which permits the rail to be laterally adjusted relative to the vertical pivot 92, for reasons to be subsequently described. Specifically, the mounting arrangement includes an L-shaped mounting bracket 94 which is appropriately configurated at one end to provide a support for the guide rail or track 88 and is formed at its opposite end with a transverse mounting sleeve 96 which is confined between two collars 98, 100 attached to a lead screw 102. The lead screw 102 is received within an internally threaded sleeve 104 which in turn is journalled on the vertical pivot 92. The lead screw 102 is manipulated by a knurled adjustment knob 106. Accordingly, upon turning of the adjustment knob 10*y* the lead screw 102 may be threaded in and out relative to the sleeve 104 and the pivot 92 to initially adjust the starting position for the guide rail 88.

Mounted on the guide rail or track 88 is a clamp assembly 108 which includes a spring-biased clamp which is adapted to engage the trailing end of the material M along and spaced slightly inwardly of the contoured edge *e* for the coordinate guiding function with the conveyor 60. The clamp assembly 108 is seen to include a trolley or carriage 110 which includes plural rollers 112*a*, 112*b*, 112*c* engaging the upper and lower guiding surfaces of the track or rail 88. Depending from the trolley 110 is a clamp-supporting bracket 114 which carries at its lower end a horizontally extending abutment plate 116 which is adapted to be brought beneath the trailing end of the material M. Overyling the abutment plate 116 is a stripper plate 118 through which projects a clamping pin 120 which is mounted on a double arm clamp-supporting lever 122 which is pivoted on bracket 114 at 124. Arm 122*a* extends substantially horizontally over stripper plate 118 and carries the clamp pin 120 which extends through and engages the material M, while arm 122*b* extends generally upwardly and is connected to the plunger of a clamp-control solenoid SL. A spring 126 is connected to arm 122*b* and to bracket 114 to normally bias the clamp 120 into its operative or material-engaging position. Solenoid SL is effective to overcome the bias of the spring and to urge the clamp 122 to a clearance position enabling the trailing end of the material to be inserted within the clamp overlying the abutment 116 and in position for engagement by the pin at the start of a stitching interval or sequence and to be released at the end of the stitching interval.

In order to assure smooth operation of the clamp assembly 108 mounted via trolley 110 on rail 88, provision is made for counterbalancing the clamp assembly such that the pulling force exerted by the puller roller 46 and the usual feeding mechanisms in the sewing machine will permit the unimpeded feed of the material M through the sewing machine for stitching. To this end, a counterweight 128 is provided beneath the machine which is connected via cable 130 and idler pulleys 132, 134, 136 to the trolley 110 of the clamp assembly 108. By appropriate selection of the weight 128, a rather delicately balance system can be established which will respond instaneously and which will not adversely effect the material (i.e., by stretching the same) notwithstanding the mass of the clamp assembly 108.

Provision is made for propelling the clamp assembly 108 along the guide rail 88 out of an adjustable starting position toward its finishing position. Conversely, provision is made for propelling the clamp assembly 180 back to the starting position at the end of the stitching interval and after the release of the material M by the clamp pin 120. Specifically a first clamp-propelling piston and cylinder C4 is disposed behind the trolley 110, with the piston carrying an enlarged head 138 which is arranged to engage and push the trolley 110 along the track 88 toward the sewing machine 16. This piston and cylinder is adjustably mounted on the rail by the provision of a supporting shoe 140 which may be fixed to the rail by locking member 142. At the other end of the guide rail 88 forwardly of the sewing machine head 18 there is arranged a second clamp-propelling cylinder and piston C3 which has an enlarged head 144 in position to engage the trolley 110 and return the same to the starting position upon the completion of the stitching interval, as will be subsequently described.

Provision is made under the control of the machine operator for initiating a stitching interval during which the clamp assembly 108 moves from the adjusting position remote from the needle 24 to the finishing position adjacent the needle. Further means including a signaling switch SS are provided which respond to the movement of the clamp assembly 108 into the finishing position for concluding the stitching interval. These controls will be described in conjunction with the detailed description of FIGS. 3 to 5 inclusive.

The spring-biased presser foot 28 of the sewing machine normally is disposed in its operative position but is held in an elevated position for the loading of the machine prior to the initiation of the stitching interval. This is accomplished by a piston and cylinder C1 which is mounted rearwardly of the sewing machine head (see FIGS. 1 and 2), with the piston rod thereof coupled via linkage 146 to internal mechanisms on the sewing machine which, upon operation of the piston and cylinder C1, lift the presser foot 28 to the elevated loading position.

Still further, a cutter 148 is disposed rearwardly the presser foot and the puller wheel 46. The cutter 148 is

mounted on a cutter mount **150** pivoted on the bed plate at **152** and is movable at the end of a stitching interval from the retracted position illustrated in FIG. 1 to an operative position directly behind the puller wheel **46**, as indicated by the directional arrows, for severing the stitching thread which normally interconnects successive completed stitch material assemblies. The cutter **48** is moved from its normal inoperative position to the operative position under the control of the cutter-activating cylinder and piston C2 at the end of the stitching interval at which time the presser foot is raised to release the work.

Disposed forwardly of the needle **24** are a pair of spaced photocells P_1, P_2 which are mounted in a barrel rotatable about a vertical axis for positioning thereof relative to the optimum line of advance of the edge *e* relative to the stitching mechanisms. As will be described, the photocells P_1, P_2 serve to position the guide rail **88** to impart the requisite steering motion to the clamp assembly **108** during the stitching interval. Between the photocells P_1, P_2 and the needle **24** there is provided in the feed bed of the machine two ports **154** which are connected via flexible pipes **156** (see FIG. 2) to an appropriate vacuum source such that the material assembly is held down in critical location in advance of the needle **24**.

Provision is made for pivoting the guide rail **88** about its vertical pivotal mount **92** in accordance with the signals derived from the photocells P_1, P_2 during the stitching interval and for manually adjusting the position of the guide rail **88** at the start of a stitching interval. These mechanisms are coordinated into the control illustrated in FIG. 3, with the control having the capability to sense the initial adjusted position of the guide rail **88** as established by the machine operator and to restore the guide rail to such adjusted position at the end of each stitching interval. In this way, once the operator establishes the initial starting position for the guide rail for any particular stitching operation, the guide rail automatically is restored to that initial starting position. Therefore, it is merely necessary to reload the equipment at the end of each stitching interval for the next stitching operation, notwithstanding the fact that the rail has moved out of the requisite starting position during the stitching interval to impart the necessary guiding action to the material assembly. This arrangement includes a double acting rail-adjusting cylinder and piston C6 which is disposed beneath the feed bed of the machine and suspended from the support **12** thereof at pivotal mount **158**. The piston rod carries a bifurcated yoke **160** which is coupled via arm **162** to a vertical pivot shaft **164** which extends upwardly through the machine frame **12** to a location above the work-supporting surface afforded by the feed bed **14**. Arm **162** has a pivotal connection **166** to the yoke **160** on the piston rod at one end thereof, with the other end being rigidly connected to shaft **164**. Shaft **164** at its location above the feed bed carries a rigid steering arm **168** which follows the motions imparted to arm **162** under control of the cylinder and piston C6. Steering arm **168** has a pivotal connection **170** at its end remote from shaft **164** to one end of a steering link **172** which has a pivotal connection **174** at its opposite end to rail extension **88***a*. Rail extension **88***a* carries a supporting roller **176** which rides upon the work-supporting surface **14**. It will thus be appreciated that upon driving the piston toward the right in FIG. 1, steering arm **168** will be swung in a counterclockwise direction thereby swinging the guide rail **88** in the counterclockwise direction about its pivotal mount **92**. Conversely, upon driving the piston to the left in FIG. 1, clockwise motion will be imparted to the steering arm **168**, with a corresponding clockwise pivotal movement being imparted to the guide rail **88**. Air is introduced into the opposite ends of the rail-adjusting cylinder and piston C6 by the control, as will be described.

Manual adjustment of the position of the guide track or rail **88** is accomplished by the provision of a track or rail positioner TP which is disposed at a convenient location to one side of the machine and is seen to include an adjustment handle **178** and a track position dial **180** having two arcuate conductive segments TP*a*′, TP*a*″. The dial **180** of the track positioner TP is journalled on an upstanding shaft **182**. The adjustment handle **178** is tapped through the dial **180**, and upon turning in the appropriate direction, permits the securement of the dial **180** in any adjusted position on shaft **182**. Journalled on the shaft **182** above the disc **180** is a track positioner sprocket **184** which carries a contactor TP*a* which normally is intended to maintain a neutral position between the conductor segments TP*a*′ and TP*a*″, as shown mechanically in FIG. 1 and diagrammatically in FIG. 3. However, as such times that contactor TP*a* is on one or the other of the conductive segments TP*a*′, TP*a*″ and the track positioner TP is in its operative mode, the control arrangement is such as to restore the contactor to the neutral position with the corresponding movement of the guide rail **88** to the adjusted position established in the first instance by the rotational adjustment of the dial **180** of the track positioner TP under control of the operator. Sprocket **184** is coupled via chain **186** to driving sprocket **188** on intermediate shaft **164**. Thus, the rotational movement imparted to the intermediate shaft **164** under control of the cylinder and piston C6 to achieve steering motion of the rail will be read into the track positioner TP via driving sprocket **188**, chain **186** and driven sprocket **184**.

It may be desirable to supplement the holding effect of the vacuum ports **154** by the provision of air jets directed downwardly on the material at a location overlying the vacuum ports **154**. This may be accomplished by the provision of two jet pipes **190** directed downwardly toward the ports **154** which pipes are connected via conduit **192** to an appropriate source of air under pressure (i.e., a small blower).

Turning now specifically to FIG. 3, there is shown a typical control in schematic and diagrammatic form for use in connection with the present apparatus. The various components of the machine which are integrated into this control are shown schematically to facilitate an understanding of the operation of the control. The control includes main input lines **192**, **194** which are connected to an appropriate source of power over main switch MS in line **192**. Associated with each of the several piston and cylinders are appropriate solenoid-controlled valves for connecting the respective pnuematic actuating means to a source of air under pressure for the related control functions. Specifically, solenoid control valve V1 connects the main air line **196** to both the cylinder and piston C1 for the presser foot **28** and the cylinder and piston C2 for the cutter **46**. V1 is energized over nominally closed contact R1*a* of a delay action relay R1 which has its energization coil connected across the lines over contacts R2*a*, R2*a*′ of relay R2. Relay R2 in turn has its energization coil connected across the lines of a first foot control switch FS1 and interval-end or stop switch SS. In the rest position of the equipment, presser foot **28** is held in its elevated position by activation of cylinder C1 and correspondingly the cutter **46** is held in its operative position by its cylinder C2. Upon opening of contact R1*a* in response to energization of relay R1 under control of relay R2, the presser foot **28** moves into its operative position and the cutter **46** moves into a retracted or clearance position.

Relay R2 includes contact R2*a* which transfers onto contact R2*a*″ to condition the energization circuit for relay R3 over a second foot control switch FS2. Relay R2 includes a holding contact R2*b* which is closed upon energization of the relay R2 under control of the first foot control switch FS1 to enable the machine operator to remove his foot from switch FS1 after initiating the first sequence of operations, to wit, the dropping of the presser foot **28** into the operative position and the movement of the cutter **46** away from the stitch path. Relay R3, which is energized in response to closing of the second

foot control switch FS2, includes a first contact R3*a* which is normally against contact R3*a'* but is transferred onto contact R3*a''*. In the rest position of the equipment, contact R3*a* completes an energization circuit for the solenoid SL which normally maintains the clamp pin **120** in its retracted position. Relay R3 includes holding contact R3*b* to complete a holding circuit therefore which enables the operator to remove his foot from switch FS2 after initiating this phase of the operation. Thus, after the operator has depressed foot switch FS1 to clamp the presser foot against the work load therebeneath, the operator then appropriately positions the material assembly relative to the clamp **120** and depresses foot switch FS2 to complete the clamping of the fabric. Transfer of contact R3*a* from contact R3*a'* restores the clamp-return cylinder C3 which is activated over solenoid-controlled valve V2. The establishment of the circuit over contact R3*a*, R3*a''* operates solenoid-controlled valve V3 which actuates the clutch control C5 and the clamp starting cylinder C4.

Closing of the second foot switch FS2, which signals the beginning of a stitching interval, energizes relay R4 which transfers the contacts thereof to disable the track positioner TP and establishes the required contact to place the rail-adjusting cylinder C6 under control of the photocells P_1, P_2.

Turning now to the track selector TP, as previously described the adjustable dial **180** has two conductive segments TP*a'*, TP*a''* which are engaged by contactor or slider TP*a*, with the movement of the contactor being linked to the movement of the guide track **88**. Contactor TP*a* is normally connected over contact R4*a*, R4*a'* of relay R4 to line X of relay A1 having normally closed contact A1*a*. The photocell P_1 is seen connected to relay A1 at line X' and is connected to line X over contact R4*a''* of relay R4. Thus, in the illustrated position, relay A1 is under control of the contactor TP*a* of the track positioner TP. Upon transfer of contact R4*a* against contact R4*a''* in response to energization of the relay R4, the track positioner TP is disabled and the photocell P_1 serves as the input to relay A1. When contactor TP*a* is on conductive segment TP*a'*, line X and X' are connected to each other to activate relay A'. However, upon transfer of contact R4*a* into engagement with contact R4*a''*, photocell P_1 takes over and when exposed to light completes a circuit across lines X, X' to activate relay A1. In a similar fashion, relay A2 is under control of the track positioner TP via segment TP*a''* and photocell P_2. Relay A2 includes a first contact A2*a* which is normally closed and establishes an energization circuit for solenoid-controlled valve V5 over contactor R4*b'* or relay R4. Relay A2 further includes contact A2*b* which is normally open and upon energization of the relay establishes a secondary energization circuit for solenoid-controlled valve V5 over contact 44*b*, R4*b''* of relay R4, the latter being energized to disable the track positioner TP. In the illustrated position, track positioner TP establishes a circuit across lines Y, Y' at such time as contactor TP*a* is on conductive segment TP*a''* to disrupt the energization circuit for solenoid-controlled valve V5 and thereby bleed off port the corresponding right side of the rail-adjusting cylinder and piston C6. By way of summary, when the track positioner TP is in control (relay R4 deenergized), the rail-adjusting cylinder and piston C6 is appropriately ported to atmosphere and activated by solenoid-controlled valves V4, V5 to restore the contactor TP*a* to the neutral position illustrated in FIG. 3. This may be appreciated by reference to FIG. 5 wherein a typical position of contactor TP*a* on segment TP*a''* is illustrated, it being noted that the relay R4 is not energized such that the track positioner TP is in control of the rail-adjusting cylinder and piston C6. For this illustrated condition, a circuit is established to cross the lines Y, Y' transferring the contacts of relay A2 to disrupt the energization circuit for solenoid-controlled valve V5 over open contact A2*a*. Closing of contract A2*b* has no effect since relay F4 has not been energized. Energization of solenoid-controlled valve V5 bleeds the right end of the cylinder C6. Input is imparted to the left end of cylinder C6 via solenoid-controlled valve V4 which is energized over closed contact A1*a*. Accordingly, the rail-adjusting cylinder and piston C6 is activated until such time as the contactor TP*a*, which is ganged to the linkage associated with the guide rail **88**, assumes the neutral position illustrated in FIG. 3 whereupon the connection across the energizing contacts of relay A2 is opened and the relay restores to the illustrated position in FIG. 3.

In FIG. 4, there is shown a typical running condition for the apparatus wherein relay R4 has been energized to transfer its contact R4*a*, R4*b* such that the relays A1, A2 are placed under direct control of the photocells P_1, P_2. For the illustrated condition, it will be noted that fabric is removed from photocell P_2 thereby signalling relay A2 to activate the contacts thereof which is effective to establish an energization circuit for solenoid-controlled valve V5 over contacts R4*b*, R4*b''*. Since fabric overlies photocell P_1, contact A1*a* remains closed and solenoid-controlled valve V4 remains energized. For all practical intents and purpose, the rail-actuating piston and cylinder C6 signals that the operation is proceeding properly and that guide track **88** does not have to be displaced (see the condition illustrated in FIG. 1 wherein photocell P_1 is covered by the material M while photocell P_2 is exposed signalling the proper feed of the particular assembly M to the stitching location). At such time as photocell P_1 is exposed to light, indicating that the edge *e* has gone too far to the left off of the stitching path (when viewed from the right in FIG. 1), relay A1 is activated to open contact A1*a* which energizes solenoid-controlled valve V4 to port the corresponding side of the cylinder C6 to atmosphere, with the other side being connected to air under pressure. This obviously brings about a corresponding restoration of the edge *e* of the material M to the proper feeding position relative to the needle **24**. If the material shifts to far to the right blocking both photocells P_1, P_2, relay A2 transfers to interrupt the energization circuit for solenoid-controlled valve V5. With the continued application of pressure over solenoid-controlled valve V4 to the opposite side of the cylinder C6, the corresponding correction is imparted to the guide track **88** until such time as the edge is restored to the proper position for stitching.

A typical sequence of operation will now be described in detail to facilitate a more thorough understanding of the present invention:

At the start of the operation, the operator places the material M onto the feed bed of the machine overlying the conveyor **60** and places the leading end of the assembly beneath the presser foot **28**. The presser foot is elevated to its inoperative position under control of cylinder C1 and the cutter **46** is along the stitch line having just cut the previous fabric assembly. The operator then adjusts the clamp assembly **108** along the guide track **88** to a position wherein the clamp pin **120** is engaged with the trailing end of the contoured edge *e*. Based upon a modest amount of experience, the operator will determine whether or not the lateral position of the guide track **88** should be adjusted relative to the stitching location by turning knob **106** to assure that the material M will not have to make too radical an excursion as it is fed through the sewing machine **16**. Thereupon, the operator depresses foot control FS1 which actuates relay R2 which in turn deenergizes relay R1. Energization of relay R2 under the momentary control of the foot switch FS1 completes a holding circuit. Deenergization of relay R1 allows the presser foot **28** to move against the work to clamp the same and retracts the cutter disc **46** from the stitch path until the end of the machine cycle. Thereupon, the operator depresses foot switch FS2 which activates relay R3. Transfer of contact R3*a* causes clamp pin

120 to engage the trailing end of the work in response to deenergization of its solenoid SL and to also activate solenoid-controlled valve V3 which engages the clutch associated with the sewing machine motor 30 and activates the clamp-propelling cylinder and piston C4 to overcome the inertia of the system and start the clamp assembly 108 down the guide track 88. The presser foot 24 and rotary puller 46 are effective to advance the work through the stitching location, with the trailing end thereof being steered under control of the guide rail 88 and the photocell controls P_1, P_2 as previously described. The closing of foot switch FS2 energizes relay R4 which transfers its contacts to disable the track positioner TP and places the rail-adjusting cylinder and piston C6 under direct control of the photocells P_1, P_2 for the continuous monitoring of the position of the edge *e* of the material M, as previously described in conjunction with FIG. 4. Periodically, one side or the other of the cylinder C6 is ported to atmosphere, with the other side being connected under pressure to establish new adjusted positions for the guide track 88 as the edge *e* of the material is constantly monitored in advance of the stitching location. At the end of the run, the clamp assembly 108 contacts the stop switch SS which disrupts the holding circuit for relay R3 by opening the holding circuit established over contact R3*b*. Transfer of relay R3 to the position illustrated in FIG. 3 disrupts the energization circuit for solenoid-controlled valve V3 which releases the clutch associated with motor 30 and permits the internal spring within the clamp-starting cylinder C4 to restore the same to the illustrated starting position. Also, opening of stop switch SS opens the energization circuit for relay R4 which once again places the system under control of the track positioner TP which simultaneously reestablishes the initial adjusted position for the guide track as set in the first instance by the adjustment of dial 180. For example, as described in conjunction with FIG. 5, the contactor TP*a* may be on segment TP*a*'' when the end of the stitching interval is signaled by stop switch SS and the deenergization of relay R4 will thereby bring about the repositioning of the guide track to the requisite starting position. Transfer of contact R3*a* of relay R3 against contact R3*a*' energizes the solenoid controlled valve lifting clamp pin 120 and simultaneously sends the clamp assembly 108 back to the adjusted starting position by activation of the clamp-return cylinder and piston C3.

Although the opening of stop switch SS also disrupts the holding circuit over contact R2*b* for relay R2 transferring its contacts to complete the energization circuit for relay R1, the time delay of relay R1 is such that contact R1*a* will remain open for a time which, although relatively short, is sufficient to allow the end of the fabric to pass the stitching location. There is sufficient inertia in the drive of the sewing machine 16 to continue feed via the feed dog thereof and the supplemental rotary puller 46, notwithstanding the release of the clutch 38. As a final step, in response to closing of contact R1*a*, presser foot 28 is lifted to the elevated position and cutter disc 46 is swung over the trailing threads of the completed assembly to cut such threads.

The sequence is completed under control of the track positioner TP in response to deenergization of relay R4 which restores the guide track 88 to the initial adposition whereupon the operator loads the next piece or fabric assembly into the equipment. At the end of any given production run, it is a relatively simple matter to make the necessary readjustments to accommodate the next stitching pattern.

What I claim is:

1. A machine for stitching material along a prescribed stitch line coextensive with and spaced inwardly from an edge thereof comprising a support, sewing mechanisms on said support including a reciprocating needle operable at a stitching location for successively stitching said material along said prescribed stitch line, said material being arranged forwardly of said stitching location and advanced toward and through said stitching location along a normal feed path relative to said needle, guide means engageable with said material and operable to impart steering motion to said material as the same is advanced toward said stitching location for displacing said material from side to side relative to said normal feed path such that said material will be stitched substantially along said stitch line, said guide means including an elongated guide rail projecting forwardly of said needle and a clamp movably mounted on and guided by said rail, means mounting said guide rail on said support for movement relative to said normal feed path, said clamp being engageable with said material contiguous to the trailing end of said edge when the leading end of said edge is initially positioned at said stitching location, means responsive to deviations of said edge relative to said normal feed path for moving said guide rail in a direction to restore said edge, said guide rail being effective in response to its movement to impart steering motion to said clamp as the latter is moved therealong and toward said stitching location to continuously orient and present successive edge-adjacent portions of said material in relation to said sewing mechanisms at said stitching location for stitching along said prescribed stitch line.

2. A machine according to claim 1 including material-advancing means engageable with said material for transporting the same through and beyond said stitching location.

3. A machine according to claim 1 wherein said elongated guide rail is rigid and including means for pivotally mounting said guide rail on said support.

4. A machine according to claim 1 including control means for moving said rail relative to said normal feed path and having a pair of photocells disposed contiguous to said needle and at opposite sides of said normal feed path for sensing deviations of said edge.

5. A machine according to claim 4 including means responsive to and under control of said photocells for positioning said guide rail to impart the requisite steering motion to said clamp.

6. A machine according to claim 1 including means under control of the machine operator for initiating a stitching interval during which said clamp moves from an adjustable starting position remote from said needle to a finishing position adjacent said needle and means responsive to movement of said clamp to said finishing position for concluding said stitching interval.

7. A machine according to claim 6 wherein said sewing mechanisms including a spring biased presser foot and means for holding said presser foot in an elevated position until the initiation of said stitching interval.

8. A machine according to claim 6 including a cutter positioned behind said needle for severing stitching threads which normally interconnect completed stitched material assemblies.

9. A machine according to claim 6 including means operable in response to the initiation of said stitching interval to propel said clamp along said guide rail out of said adjustable starting position toward said finishing position.

10. A machine according to claim 6 including means operable at the end of said stitching interval for disengaging said clamp from said material.

11. A machine according to claim 6 including means operable when said material clamp is in said finishing position and after release thereof from said material to propel said clamp back toward said starting position.

12. A guiding mechanism for advancing material to a work location while continuously orienting said material in accordance with the contour of an edge thereof comprising an elongated guide member extending toward said work location, means for mounting said guide member for movement relative to said work location, a follower

engaging said guide member and movable therealong and clamp means operatively connected to said follower and engageable with said material such that the latter is guided in response to movement of said follower along said guide member as the latter moves relative to said work location.

13. A guiding mechanism according to claim **12** including means for moving said follower along said guide member toward said work location.

14. A guiding mechanism according to claim **12** including a conveyor arranged to underlie and engage said material and to advance the same along a feed path toward said work location.

15. A machine for stitching material along a prescribed stitch line comprising sewing mechanisms at a stitching location for successively stitching said material along said prescribed stitch line, said material being arranged forwardly of said stitching location and advanced toward and through said sewing mechanisms along a normal feed path relative thereto, guide means engageable with said material and operable to impart steering motion to said material as the same is advanced toward said sewing mechanisms for displacing said material relative to said normal feed path such that said material will be stitched substantially along said stitch line, said guide means including a cam member and a follower movably mounted on and guided by said cam member, means mounting said cam member for movement relative to said normal feed path, said follower being engageable with said material contiguous to the trailing end of said edge when the leading end of said edge is initially positioned in operative relation to said stitching mechanisms, means responsive to deviations of said edge relative to said normal feed path for moving said cam member in a direction to restore said edge, said cam member being effective in response to its movement to impart steering motion to said follower as the latter is moved therealong and toward said stitching mechanism.

16. A machine according to claim **15** including material-advancing means engageable with said material for transporting the same through and beyond said stitching location.

17. A machine according to claim **15** wherein said cam member is an elongated guide rail and including means for pivotally mounting said guide rail.

18. A machine for stitching material along a prescribed stitch line in relation to an edge thereof comprising a support, sewing mechanisms on said support operable at a stitching location for successively stitching said material along said prescribed stitch line, said material being arranged forwardly of said stitching location and advanced toward and through said stitching location along a normal feed path relative to said needle, movable guide means engageable with said material and operable to impart steering motion to said material at the same is advanced toward said stitching location for displacing said material relative to said normal feed path such that said material will be stitched substantially along said stitch line, said guide means being engageable with said material contiguous to the trailing end of said edge when the leading end of said edge is initially positioned at said stitching location, means responsive to deviations of said edge relative to said normal feed path for moving said guide means in a direction to restore said edge, said guide means being effective in response to its movement to impart steering motions to said material as it moves toward said stitching location to continuously orient and properly present successive edge-adjacent portions of said material in relation to said sewing mechanisms.

19. A machine according to claim **18** including means for mounting said guide means for movement in relation to said normal feed path such that said guide means may be adjustable before initiating a stitching interval.

20. A machine according to claim **19** including means operable at the end of said stitching interval for restoring said guide means to the adjusted initial position.

21. A machine according to claim **20** wherein said guide means includes an elongated pivoted guide rail projecting forward of said sewing mechanisms and a clamp movably mounted on and guided by said guide rail and movable toward said stitching location during said stitching interval.

22. A machine according to claim **21** including control means for moving said guide means relative to said normal feed path, said control means including photocells positioned in relation to said normal feed path for sensing deviations of said edge in relation to said normal feed path.

23. A machine according to claim **18** including vacuum means disposed adjacent said normal feed path for positioning said material for operation thereon of said sewing mechanisms.

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U.S. Cl. X.R.

112—102; 83—410