Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

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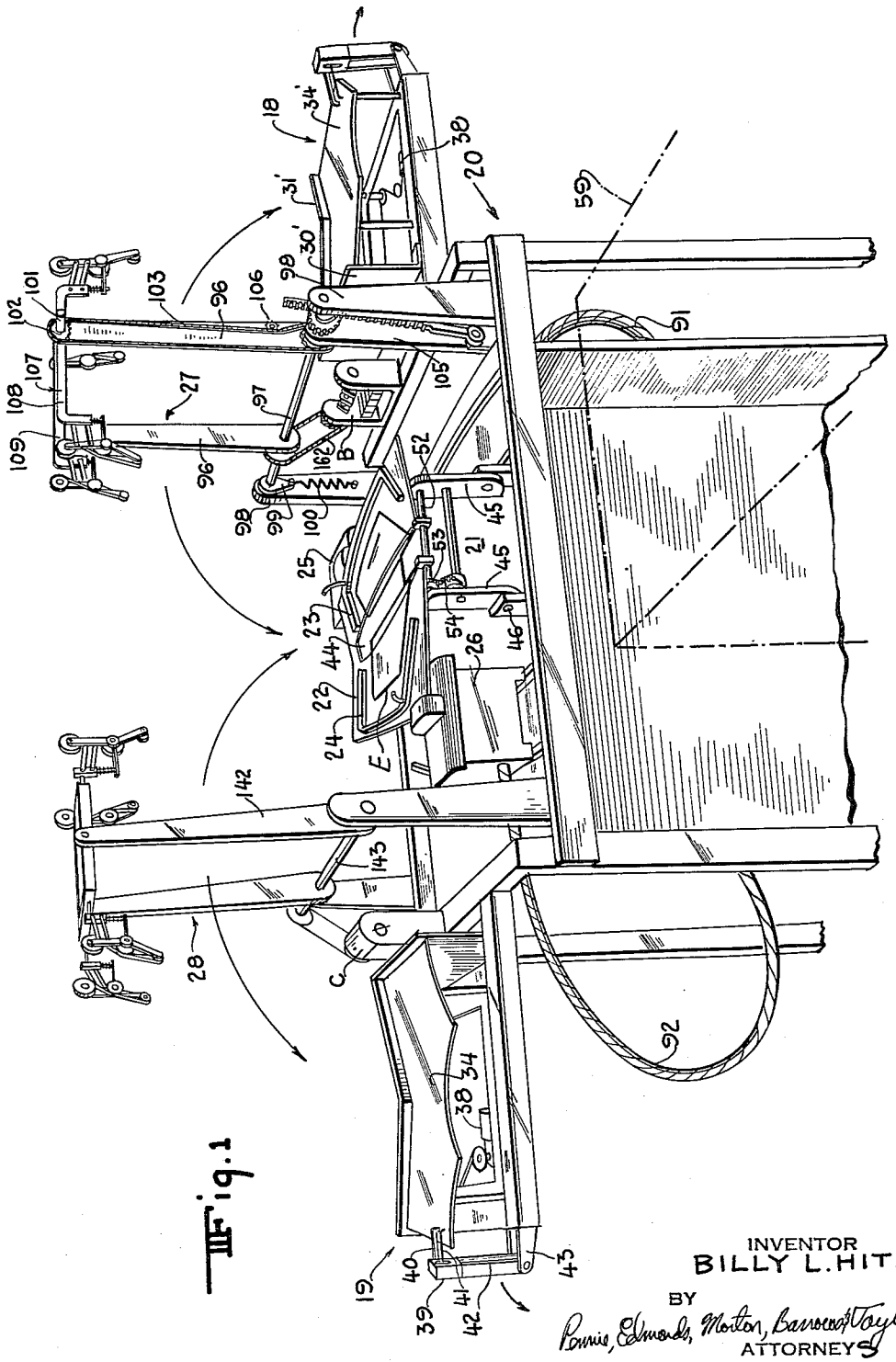

Fig. 1

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Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 2

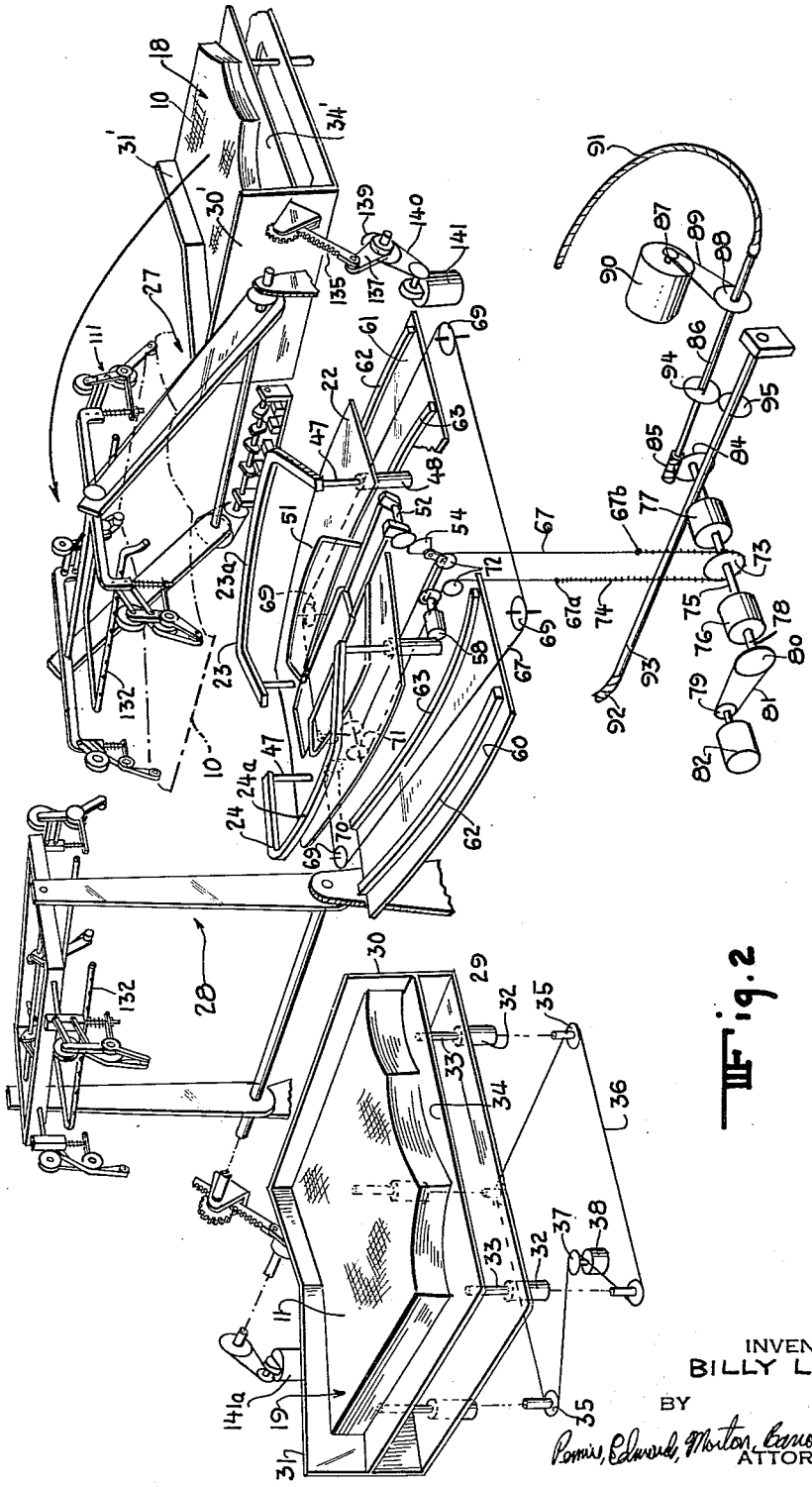

Fig. 2

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GARMENT WORKING APPARATUS

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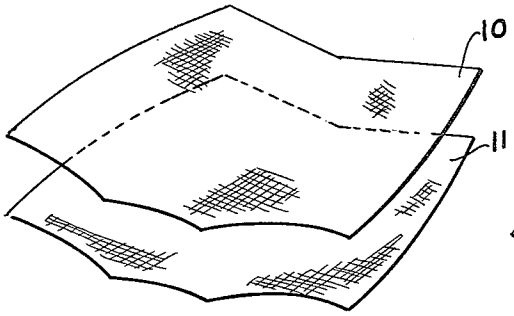

Fig. 3

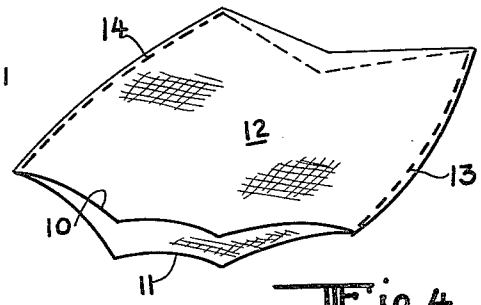

Fig. 4

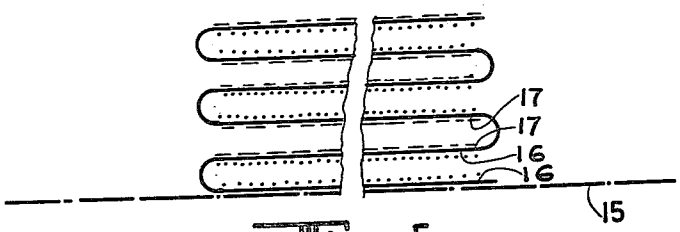

Fig. 5

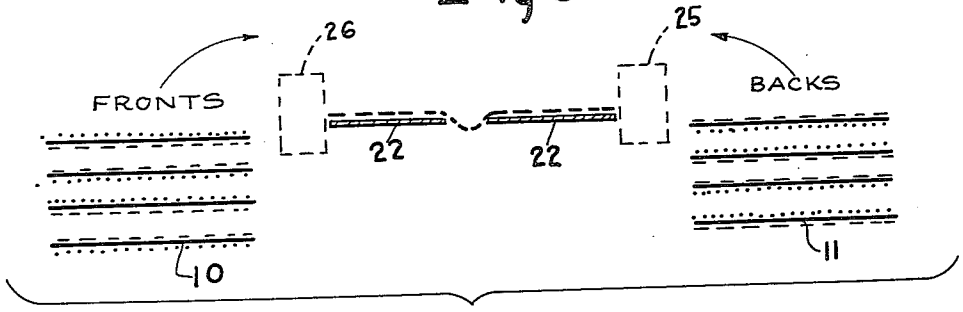

Fig. 6

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Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 4

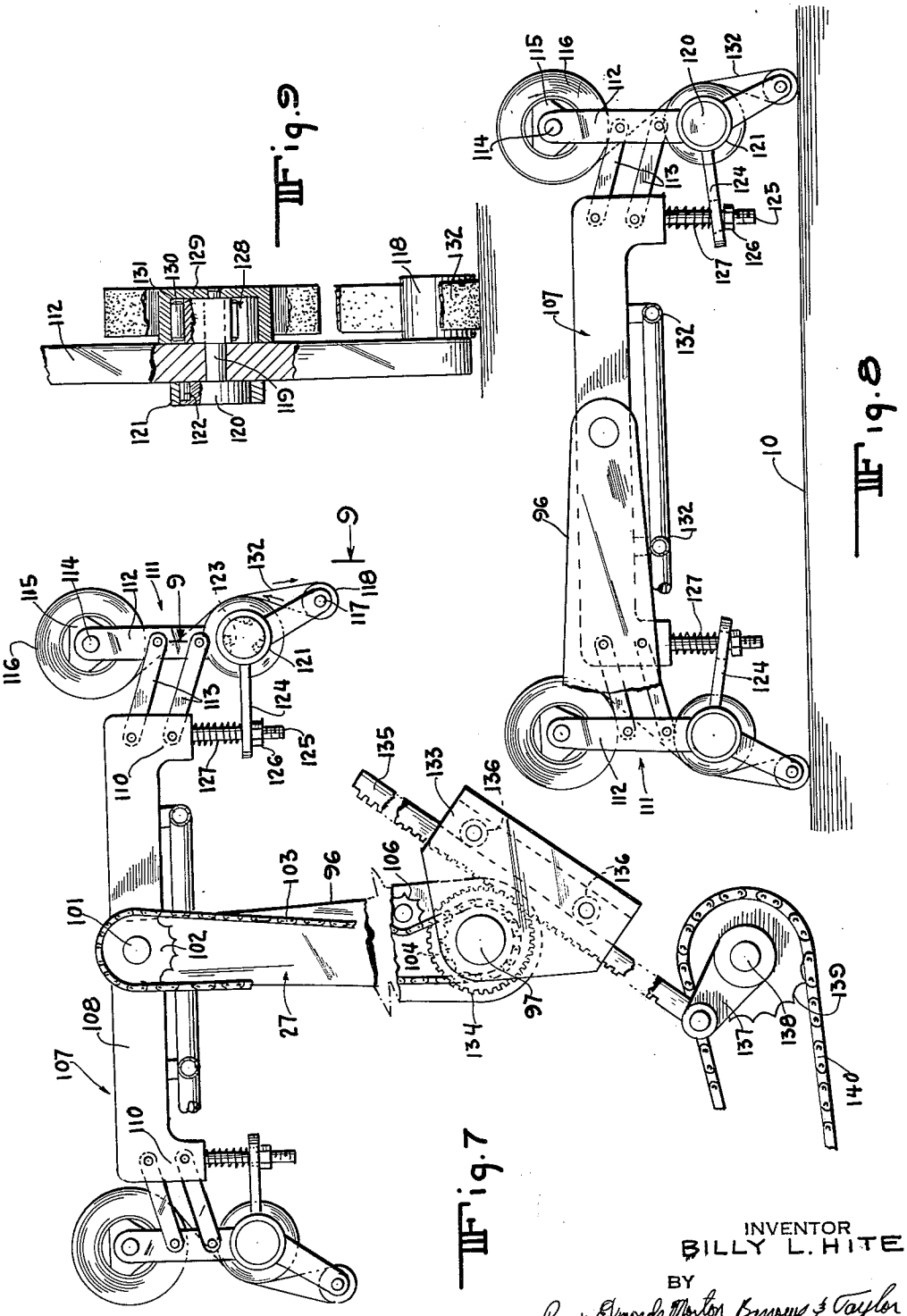

Fig. 7

Fig. 8

Fig. 9

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Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 5

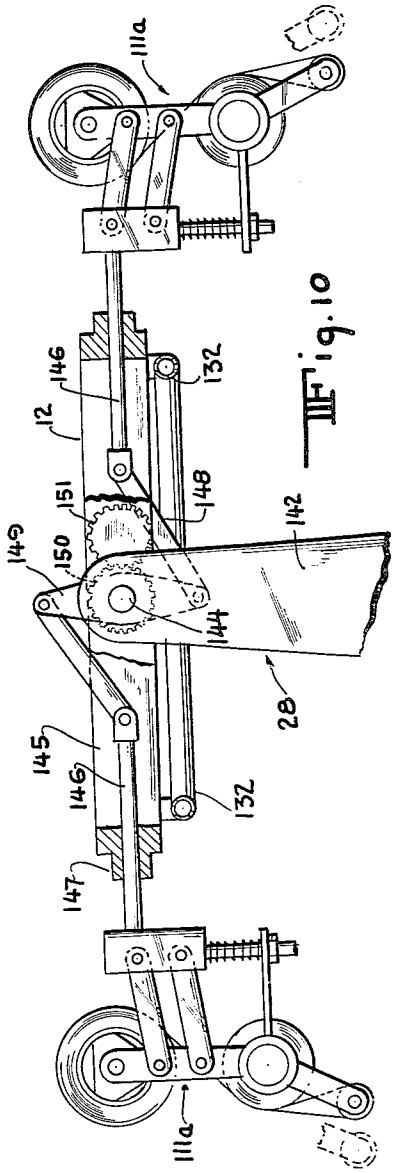

Fig. 10

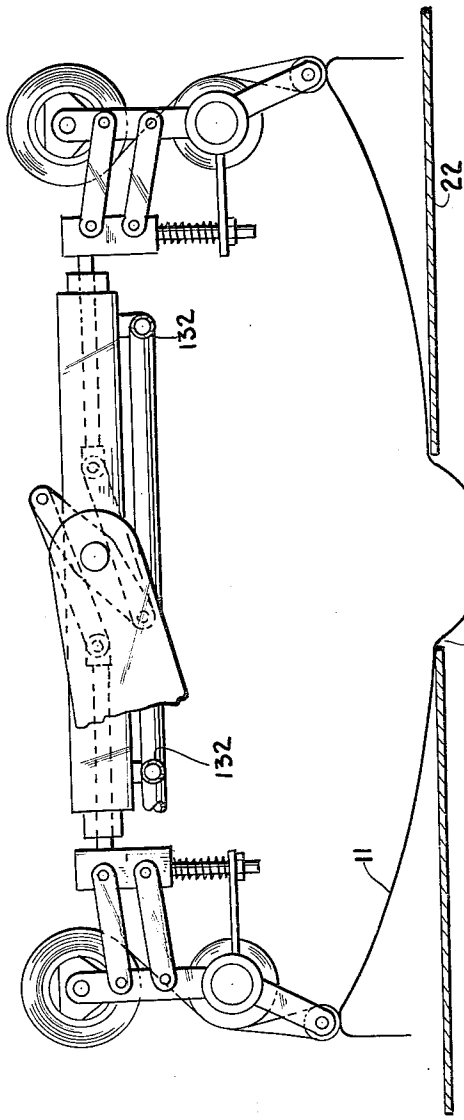

Fig. 11

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Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 6

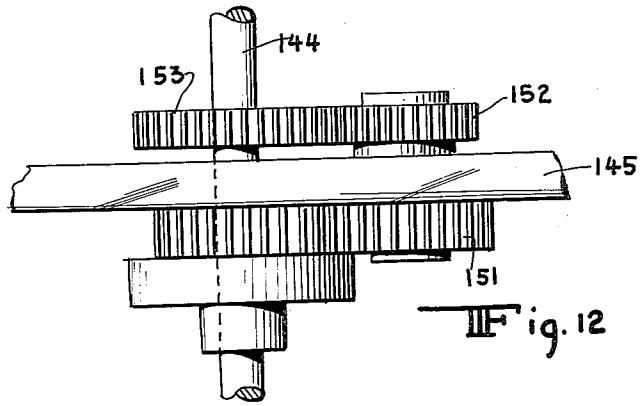

Fig. 12

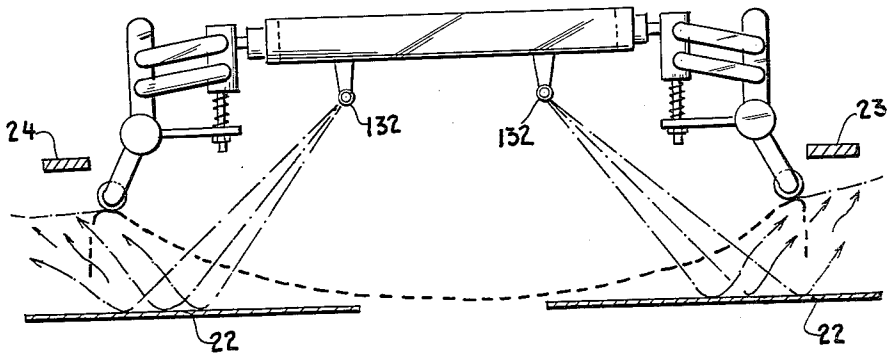

Fig. 13

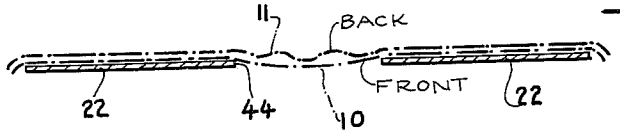

Fig. 14

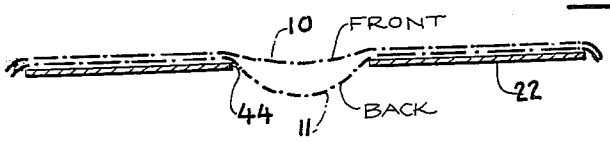

Fig. 15

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Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 7

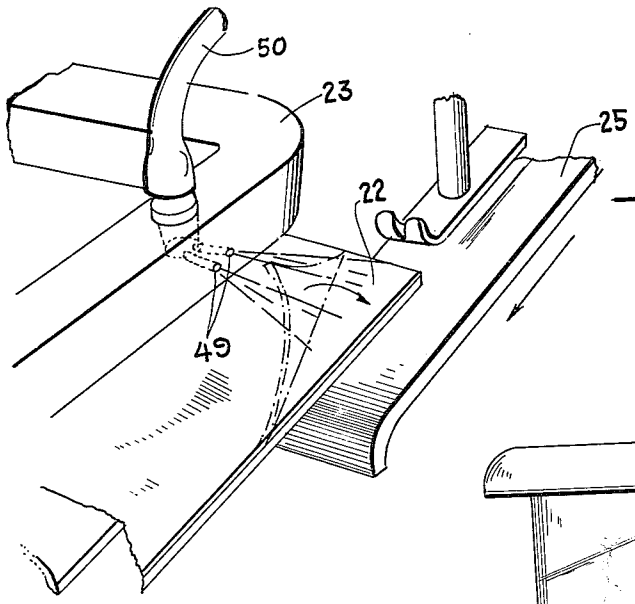

Fig. 16

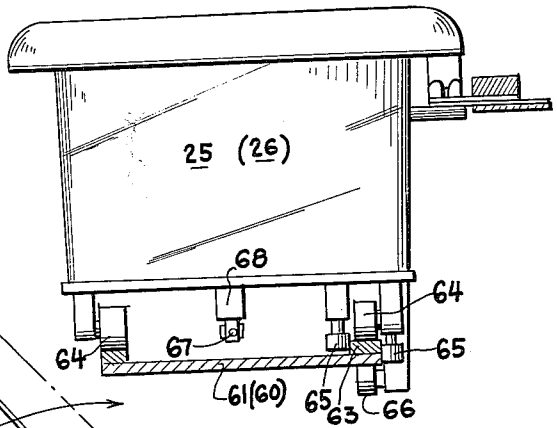

Fig. 17

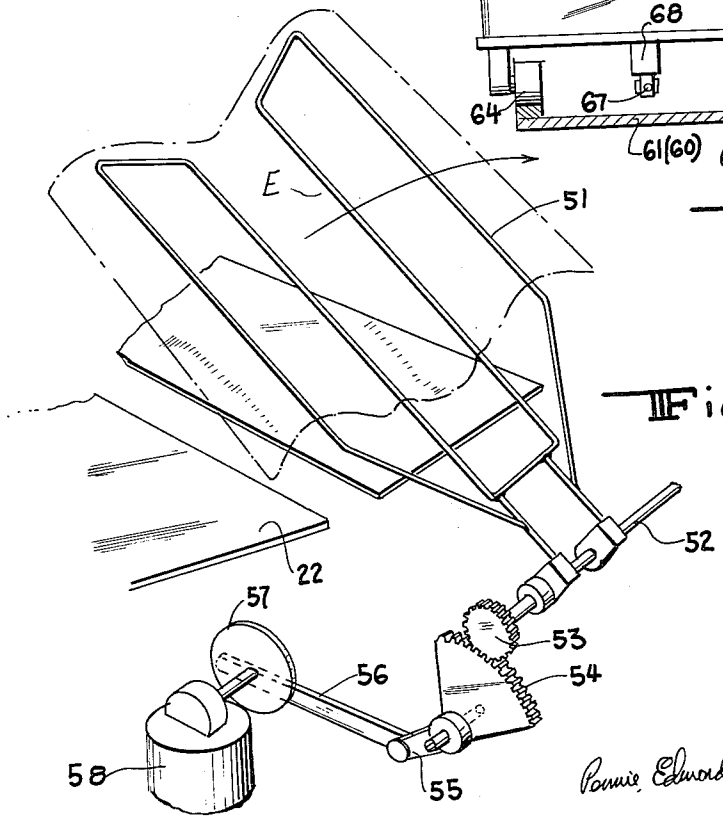

Fig. 18

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Aug. 6, 1963 B. L. HITE 3,099,970

GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 8

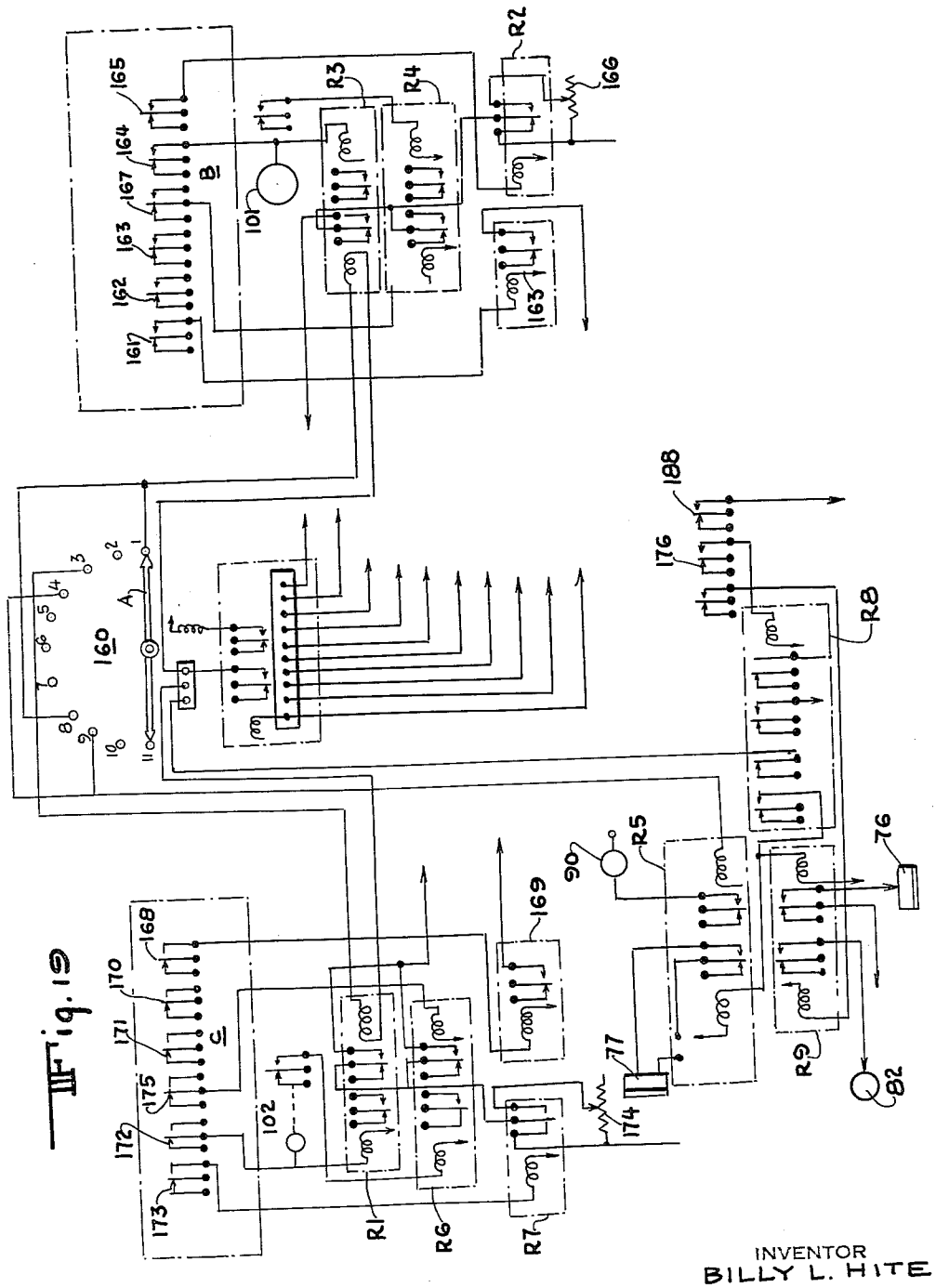

Fig. 19

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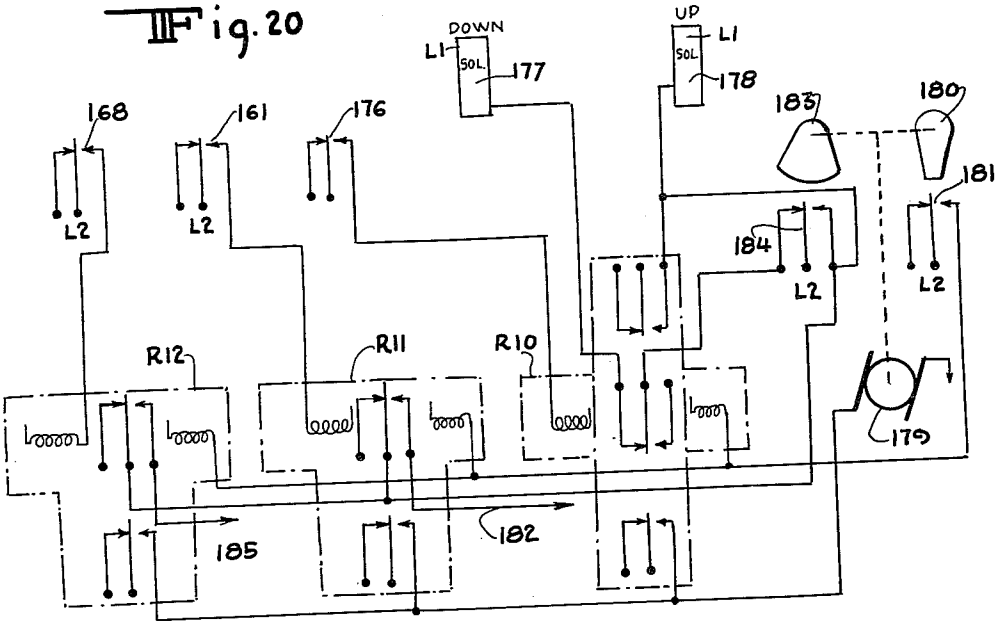
GARMENT WORKING APPARATUS

Filed June 28, 1960 9 Sheets-Sheet 9

Fig. 20



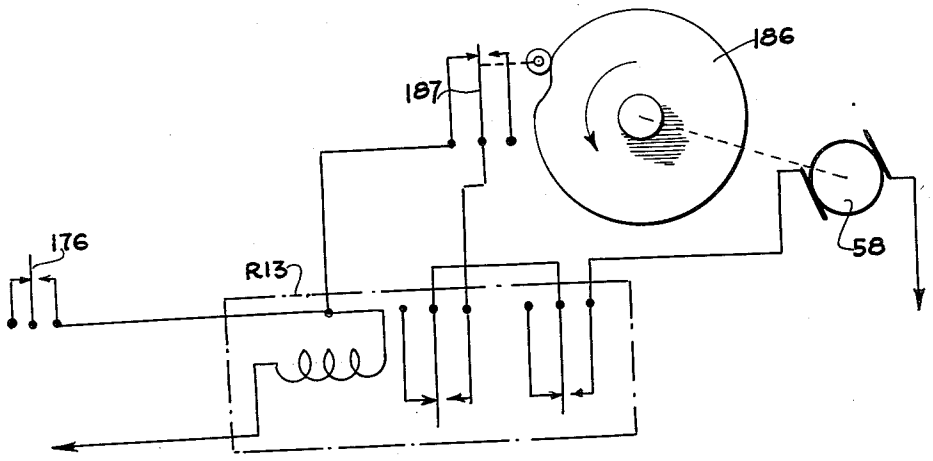


Fig. 21

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United States Patent Office

3,099,970

Patented Aug. 6, 1963

3,099,970

GARMENT WORKING APPARATUS

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Filed June 28, 1960, Ser. No. 39,308
13 Claims. (Cl. 112—2)

The present invention relates to apparatus for handling and performing operations on garments and sections thereof, and is directed more particularly to a novel and improved apparatus for automatically assembling and performing seaming operations on garments. The invention also is directed to certain advantageous and unique mechanisms or assemblies forming part of the complete apparatus of the invention.

In the manufacture of certain garments, such as panties, for example, it is conventional practice to cut front and back garment sections from large stacks or lay-ups of material, which may be nylon, rayon or the like. Under present practice, the cut garment sections are initially assembled by a hand operation which comprises selecting the respective front and back sections, orienting the surfaces of the sections so that the "outside" surfaces will face out in the finished garment, and securing the two sections together by matching the side edges thereof and performing successive sewing operations at the opposite sides to make the side seams. The thus assembled garments then may be transferred to other work stations, where further successive operations are performed. As will be readily apparent, a substantial number of manual manipulative operations are required to complete the initial assembly operations on a garment, such as panties, so that substantial labor costs are present in the finished garment.

In accordance with one of the specific aspects of the invention, a novel and improved complete apparatus is provided which manipulates and processes cut garment sections automatically, to assemble the sections in proper orientation, align the side edges thereof, and perform the necessary side seaming operations, all in rapid sequence and without the attention of an operator.

In the sequence of operations going into the makeup of a garment, a substantial length of material is laid out on a cutting table by being laid back and forth over the table in many successive layers. The laid-up material is marked and skilled cutters then cut out the garment sections simultaneously through the entire multi-layer stack of material on the table. As will be understood, in the back and forth lay-up of the material, an "outside" surface will be folded over upon another outside surface, and so forth. Accordingly, in a cut stack of garment sections, alternate sections will be face up and face down. Thus, in accordance with another and important aspect of the invention, improved arrangements are provided for manipulating the respective garment sections and positioning them for seaming operations in such a manner that the outer surfaces of the sections always face outward in the finished garment.

Another specific aspect of the invention resides in the provision, in an apparatus for performing assembly and seaming operations on a garment, of novel arrangements for automatically aligning the opposite side edges of garment sections of different size. Thus, in a typical panty, for example, the back section is somewhat larger from edge to edge than the front section. Accordingly, provision is made for narrowing the edge-to-edge dimension of the back garment section prior to performing the seaming operation, so that the garment edges automatically are positioned properly with respect to the sewing heads.

A further specific aspect of the invention resides in the

provision of a novel, comprehensive apparatus for handling, positioning, holding and sewing garment sections, wherein a plurality of garment sections are transferred from supply positions to a sewing station and held in proper orientation in the sewing station and wherein the sewing heads are advanced automatically and simultaneously along different edges of the garment to form a plurality of seams at the same time.

Other and more specific features and advantages of the invention, including advantageous and comprehensive control circuit arrangements, will become apparent upon reference to the following detailed description, and to the accompanying drawings, in which:

FIG. 1 is a perspective representation of a complete apparatus, incorporating the features of the invention, for assembly and seaming garments, such as panties, on an automatic and continuous basis;

FIG. 2 is an exploded representation of certain mechanisms of the apparatus of FIG. 1, particularly those for handling the garment sections;

FIGS. 3 and 4 are simplified, perspective representations of typical garment sections used in the manufacture of panties, for example, FIG. 4 illustrating the garment sections as secured together along the side seams;

FIG. 5 is a simplified representation illustrating the form of fabric lay-up on a cutting table, prior to cutting the fabric into garment sections for assembly by the apparatus of the invention;

FIG. 6 is a schematic representation of the system employed in the apparatus of the invention for assembling garments from supplies of front and back garment sections;

FIGS. 7 and 8 are fragmentary, elevational views of one form of transfer mechanism, incorporated in the apparatus of the invention for handling and positioning garment sections;

FIG. 9 is an enlarged, fragmentary, cross-sectional view taken generally along line **9—9** of FIG. 7, illustrating details of an advantageous form of pick-up element for handling garment sections;

FIGS. 10 and 11 are fragmentary, cross-sectional and elevational views of a second advantageous form of mechanism, used in the apparatus of the invention, for handling and positioning garment sections;

FIG. 12 is an enlarged, fragmentary, cross-sectional view taken generally along the line **12—12** of FIG. 2;

FIG. 13 is a simplified representation of the handling and transfer mechanism of FIGS. 10 and 11 illustrating particularly novel and advantageous means provided thereon for positioning edge portions of the fabric in preparation for a sewing operation;

FIGS. 14 and 15 are simplified representations of assembled garment sections, ready for sewing, as accomplished during alternate cycles of operation of the apparatus of the invention;

FIG. 16 is an enlarged, fragmentary, perspective view illustrating certain details of sewing and clamping means used in the apparatus of the invention, with particular reference to air jet means used to assist the start of the sewing operation;

FIG. 17 is a fragmentary, cross-sectional view of the apparatus of the invention illustrating particularly the manner in which sewing heads are mounted therein;

FIG. 18 is a fragmentary, perspective view illustrating a novel arrangement, used in the apparatus of the invention, for ejecting assembled garments, after sewing; and

FIGS. 19–21 are various simplified, schematic representations of control circuit arrangements incorporated in the apparatus of the invention.

Referring now to the drawings, and initially to FIGS. 3–6 thereof, the numerals **10**, **11** represent typical garment

sections, such as used in the manufacture of panties, for example. Typically, the garment is comprised principally of a front section **10** and a back section **11**, the back section usually being somewhat wider, edge to edge, than the front section. As a first step in the manufacture of a garment, indicated generally at **12** in FIG. 4, the side edges of the respective front and back sections **10**, **11** are brought into registry, and seams **13**, **14** are stitched along the side edges. This is a preliminary assembly operation, and the garment then is passed along for further operations, in themselves well known in the art. The present invention, being directed specifically to the preliminary assembly operation of manipulating the garment sections and forming the side seams, the further description will be limited to exclude the various subsequent operations. Moreover, it should be understood that the invention is not limited to the specific, described, preliminary assembly operation, but makes use of principles having considerably wider application. For purposes of illustration only, the invention will be described with reference to the preliminary assembly of garments, such as panties, since such preliminary assembly operations are known to be a particularly advantageous application of the inventive concepts disclosed herein.

In the manufacture of a garment, such as panties, a substantial length of material, in web form, is laid up on a cutting table, by being passed back and forth in successive layers on the table. A lay-up may comprise one hundred successive layers of material, for example.

As shown in FIG. 5, a typical garment material having opposite surfaces of slightly different characteristics (hereinafter referred to as inside and outside surfaces) upon being laid up on a cutting table **15** will be so arranged that, in alternate layers, inside surfaces **16** will be facing other inside surfaces, and outside surfaces **17** will be facing other outside surfaces.

Following the lay-up, the entire stack of material is cut simultaneously to form the desired garment sections. And, as indicated particularly in FIG. 6, alternate garment sections in a cut stack will be of reversed orientation. That is, one section will be face up while the next is face down, and so on. Accordingly, in the assembly operations, which are now conducted largely by hand, the respective garment sections must be manipulated so that, in the assembled garment, the "outside" surfaces of both the front and back sections will face outward.

In accordance with the invention, an automatic apparatus is provided which is supplied with stacks of cut garment sections, directly from the cutting table and so manipulates the respective sections as to effect the preliminary assembly operation of forming side seams, while assuring that the garment sections of each successive assembled garment are oriented with the desired "outside" surface facing outward.

Referring now to FIG. 1, the reference numerals **18**, **19** designate generally platform assemblies for receiving stacks of front and back garment sections. For the purpose of this description, it will be assumed that the platform assembly **18** receives back sections **11**, while the left hand platform assembly **19** receives front sections **10**. In the specific, illustrated form of the invention, the platform assemblies **18**, **19** are supported by and extend outward from a principal frame assembly designated generally by the reference numeral **20**.

Mounted on the frame **20**, between the respective platform assemblies **18**, **19**, is a sewing station, generally designated by the reference numeral **21**, which includes a platform **22** for receiving and supporting the respective garment sections, clamps **23**, **24**, located at each side of the sewing platform **22** for engaging the garment sections by their edges, and sewing heads **25**, **26** disposed adjacent the edges of the sewing platform. A garment ejector E also is provided in association with the sewing platform **22**, for automatically removing garments therefrom following a preliminary assembly operation.

In accordance with one of the specific aspects of the invention, and as will be described more fully hereinafter, the sewing heads **25**, **26** are mounted for movement along the side edges of the sewing platform **22**. Accordingly, in the garment assembly procedure, front and back garment sections are clamped on the platform **22**, with their side edges substantially in registry and projecting slightly beyond the edges of the platform. Thereupon, the sewing heads **25**, **26** are caused to traverse along the edges of the platform while forming continuous seams along both sides of the assembled sections.

In the assembly procedure contemplated by the invention, the respective front and back garment sections are transferred individually from stacks, supported on the supply platforms **18**, **19**, and positioned on and clamped to the sewing platform **22**. Such transfer is effected by transfer arm assemblies **27**, **28**, to be described in more detail, which are operative to pick up the top garment section from a stack, effect proper registration of its side edges and position it on the sewing platform **22**, all in timed, sequential relationship to the functioning of other elements of the apparatus, to the end that the substantial plurality of individual manipulations or steps involved in effecting proper assembly and sewing of front and back garment sections may be carried out with substantial speed and efficiency.

Referring now more specifically to FIG. 2, the supply platform assembly **19** is shown in more detail to comprise a base plate **29**, from which extend upward a pair of guide plates **30**, **31** disposed along the inside and back edges, respectively. The base plate **29** has mounted thereon a plurality (typically four) of threaded bushings **32**, each receiving a threaded post **33**. A supply platform **34** is supported by the threaded post **33** for vertical movement with respect to the base plate **29**, in accordance with the adjusted positions of the threaded post.

As indicated in FIG. 2, a supply of garment back sections **11** is placed upon the supply platform **34**, with the inside and back edges of the garment sections placed against the guide plates **30**, **31** to maintain the vertical registration of the many garment sections of the stack. Advantageously, the level of the top section of the stack is maintained substantially constant by upward adjustment of the supply platform **34**, as garment sections are taken individually from the top of the stack. To this end, each of the threaded posts **33** has fixed thereto a sprocket **35**, and a chain **36** is trained about the series of sprockets **35** and about the drive sprocket **37** of a platform adjusting motor **38** mounted suitably on the base plate **29**.

For automatically controlling the level of the garment stack, there advantageously is provided a switch **39** (FIG. 1) whose actuating arm **40** extends over the top of the supply platform **34** and is adapted to rest upon the top garment of a stack. As garment sections are removed successively from the top of the stack, the switch actuating arm **40** lowers gradually and, after removal of a few garments, the switch **39** is actuated to close an energizing circuit for the adjusting motor **38**. This automatically raises the supply platform **34**, with the entire supply of garment sections, until the switch arm **40** is lifted sufficiently to re-actuate the switch **39**. The adjusting motor **38** is thereupon deenergized and maintained inactive during the successive removal of a few more garment sections.

The apparatus of the invention also advantageously incorporates circuit means for responding automatically to complete exhaustion of the supply of garment sections to shut down the entire apparatus. In the illustrated arrangement, the automatic shut-off control is provided advantageously by grounding the supply platform **34** and arranging for cooperation therewith a conductive detector element **41** positioned normally to overlie the top of the stack of garment sections. The platform **34** and detector element **41** form part of a low voltage control circuit, and this circuit is completed when the detector element **41** comes into contact with the supply platform **34**,

which occurs only after the last garment section has been removed from the platform.

After the last garment has been removed from the supply platform, the platform 34 is lowered to its initial position, by appropriate energization of the adjusting motor 38. A new stack of cut garment sections may then be placed on the platform, to ready the apparatus for a new series of assembly operations. Advantageously, the switch 39 and detector element 41 are mounted on a bracket 42 supported at 43 for pivoting movement with respect to the supply platform 34. This permits the overhanging detector element 41 and switch actuating arm 40 to be swung out of the way to facilitate replenishment of the stack of cut garment sections.

It will be understood that the platform assembly 18 may be substantially identical to the platform assembly 19, described above, so that the assembly 18 will not be described separately. Of course, the proportions of the supply platform 34' and guide plates 30', 31' of the assembly 18 will be appropriately different to accommodate the different (usually smaller) proportions of the front garment sections 10. Where necessary to refer to specific elements of the platform assembly 18, such elements will be referred to by primed numerals, corresponding to the reference numerals used in connection with the description of the platform assembly 19.

Referring particularly to FIGS. 1 and 2, the sewing platform 22 advantageously takes the form of a plate provided with a central, longitudinal slot 44, imparting to the plate a generally U-shaped configuration. The size and shape of the platform are such as to conform generally to the configuration of the garment sections, and the contour of the side edges of the plate and the spacing between the edges, are such that the side edges of the garment sections (or of the smaller garment section where, as in the illustrated case, there are two sections of different size) can project a predetermined distance beyond the edges of the platform.

In the specific, illustrated form of the invention, the sewing platform 22 is secured rigidly at one end to a pair of vertically disposed supporting arms 45. The arms 45, in turn, are pivoted at 46 to the frame structure 20. The opposite end of the sewing platform 22 is merely supported by suitable means (not specifically illustrated) such that the platform 22 normally lies in a generally horizontal plane. The arrangement is such, however, that the entire platform may be pivoted upward and downward, to expose not only the underside of the sewing platform but various other mechanisms in the internal area of the frame structure. The described arrangement is advantageous in facilitating such maintenance and repair as may be necessary or desirable from time to time.

As shown best in FIG. 2, the clamps 23, 24 advantageously take the form of generally U-shaped elements, each supported at the ends of the U in cantilever fashion by the rods 47 of small fluid actuators 48. The actuators themselves are secured to the underside of the sewing platform 22.

The configuration of the clamps 23, 24 is such that the central portions thereof extend generally along the side edges of the sewing platform, while the end portions extend inwardly, generally following the end contours of the platform. The spacing of the actuator rods 47, in a direction endwise or lengthwise of the platform 22 is greater than the length (from top edge to bottom edge) of the respective garment sections 10, 11, so that the garment sections may be conveyed downward onto the sewing platform 22, without interference from the actuators. The distance between the center portions 23a, 24a, on the other hand, is less than the edge-to-edge dimension of the garment sections, so that, when a garment section is placed on the platform, with its side edges extending beyond those of the platform, the clamps 23, 24 may be lowered to grip the side margins of the garment sections.

As will be described in more detail in connection with the control facilities of the apparatus and in connection with the operational sequences thereof, the fluid (usually air) actuators 48 are arranged to be actuated simultaneously as a garment section is transferred from its supply platform and placed down upon the sewing platform 22. The clamps raise momentarily, to permit the edges of the garment section to be urged outward, underneath the clamps, whereupon they are immediately lowered to grip the fabric.

As shown best in FIG. 16, diagonally opposite corner areas of the respective clamping elements 23, 24 are provided with suitable bores 49 forming generally horizontal air passages. A suitable source of air under pressure, represented by air hose 50, suitably valved and controlled as will be described, causes jets of air to be directed outward along the top surface of the sewing platform 22, at diagonally opposite corners, at the start of sewing operations. This causes the garment sections in the immediate area to lie flat on the sewing platform 22, facilitating the initial movements of the sewing heads into operative relation to the positioned and clamped garment sections. Once a sewing operation is initiated, the fabric margins are guided automatically into proper relation to the sewing needles.

Associated directly with the sewing platform 22 is the finished garment ejector E, shown best in FIGS. 1, 2 and 18. Referring particularly to FIG. 18, the garment ejector comprises a wire frame or panel 51 having portions extending along both sides of the longitudinal slot 44 in the sewing platform and being of thin, flat configuration to be received in flat relation on the upper surface of the sewing platform 22, so that garment sections may be laid directly over the ejector frame without undue distortion.

The ejector frame 51 is mounted at one end on a shaft 52, which is pivoted by the vertical sewing platform support 45. The shaft 52 has fixed thereto a pinion 53 which meshes with a gear segment 54 mounted for rocking movement on one of the supports 45. The gear segment 54 is in turn fixed to a crank arm 55 connected by a link 56 to a driving crank 57. The driving crank 57 is operably associated with a single revolution motor 58 appropriately mounted on the underside of the sewing platform 22.

In the operational sequence of the apparatus, as will be described, the garment ejector motor 58 is energized after the preliminary garment assembly operations have been completed by the formation of the side seams. The motor 58 (and related gear train, if utilized) thereupon operates the driving crank 57 through a single revolution, rocking the crank arm 55 and gear segment 54 back and forth through a predetermined arc. The ejector frame 51, which lies underneath the assembled garment, is rocked swiftly through an arc, advantageously at 90° or more, to carry the assembled garment away from the sewing platform and deposit it in a basket 59 or other receptacle. The frame 51 then returns, during the last half revolution of the driving crank 57, to its initial position, flat against the top surface of the sewing platform 22.

Mounted on the frame structure 20, at each side of the sewing platform 22, are the sewing mechanisms 25, 26, typically referred to as sewing heads. The sewing heads per se may be of conventional design and advantageously may be "Superlock" models, as manufactured by Wilcox and Gibbs Sewing Machine Company. In accordance with one aspect of the invention, the sewing heads are mounted for traversing movement along the edges of the sewing platform 22. To this end, supporting plates 60, 61 are mounted in the frame structure 20, below the sewing platform 22, and are provided with guiding tracks or rails 62, 63 of a configuration corresponding to the edge configuration of the sewing platform. The sewing heads 25, 26, shown typically in FIG. 17, are provided with supporting rollers 64 positioned right along the upper surfaces of the guide rails, affording smooth, friction-free

movement of the machines. In addition, a plurality of guide rollers 65, 66 are provided to engage the side edges of at least one of the rails 63, as well as the bottom surface of the platform 60 or 61. The rollers 64—66 form a cluster around the inner guide rails 63, and such clusters are provided at spaced points, so that the machine is guided accurately in its traverse along its supporting platform.

In accordance with one aspect of the invention, novel and improved drive arrangements, shown particularly in FIG. 2, are provided for effecting proper traverse of the sewing heads 25, 26. Advantageously, though not necessarily, the initial or starting positions of the sewing heads are at diagonally opposite corners of the sewing platform, substantially as indicated in FIG. 1. Each of the sewing heads is secured in fixed relation to a traverse cable 67, by means such as a depending lug 68 shown in FIG. 17.

The traverse cable 67 is trained about four pulleys 69, so that the cable reaches generally longitudinally above the sewing head platforms 60, 61 and across the front area of the frame structure between the two platforms.

Adjacent the back of the machine frame, the cable reaches inward, underneath the sewing platform 22, passes over pulleys 70 which direct the cable downward, and then passes around pulleys 71 which direct two reaches of the cable longitudinally forward beneath the sewing platform. The cable then passes over two additional pulleys 72 and is directed downward toward a driving sprocket 73 forming part of a drive mechanism mounted suitably on the machine frame.

Advantageously, the end extremities 67*a*, 67*b* of the cable 67 are connected to a chain 74, which is trained about the sprocket 73, so that a positive driving relationship is established between the sprocket 73 and the traverse cable 67.

The sprocket 73 is fixed to a shaft 75 journalled suitably in the machine frame and connected at its opposite ends to the output elements of alternatively energizable magnetic clutches 76, 77. Thus, the shaft 75, sprocket 73 and traverse cable 67 are capable of being driven alternatively through one or the other of the magnetic clutches 76, 77.

Advantageously, one of the magnetic clutches 76 of the drive mechanism has its input shaft 78 driven through suitable sprockets 79, 80 and a chain or belt 81 by a motor 82, which may be of a relatively high-speed, low-torque design. The motor 82 is arranged to be energized simultaneously with the clutch 76, at the end of a sewing traverse, to drive the traverse cable 67 rapidly in a reverse direction, to return the sewing heads to their initial or starting positions.

The second magnetic clutch 77 advantageously has an input shaft 83 carrying a worm wheel 84. The worm wheel 84 is driven by a worm gear 85 mounted on a shaft 86 and driven through sprockets 87, 88 and a chain 89 by a high-torque motor 90. The motor 90, which is the main drive motor, is arranged to be energized simultaneously with the magnetic clutch 77 to drive the cable and sewing heads in a forward or sewing direction.

It is important, of course, that the traverse movement of the sewing heads be correlated accurately with the action of the sewing needles. Accordingly, the apparatus of the invention includes provisions for driving the sewing needles directly from the main drive motor 90, assuring substantially exact synchronism with traverse movements. To this end, the shaft 86 is connected at one end to a flexible drive cable 91, which is connected directly to the sewing mechanism of the sewing head 25 to drive the sewing mechanism in accordance with rotations of the shaft 86. The output end of the drive cable 91, of course, moves back and forth with the traverse movements of the sewing head. The second sewing head 26 is driven by means of a similar flexible drive cable 92 (FIG. 1) whose input end is connected to a shaft 93 journalled in the machine frame and driven by gears 94, 95 from the shaft 86. Accordingly, the shafts 86, 93 and their associated drive cables 91, 92 rotate at identical speeds but in opposite directions.

In a typical sewing sequence, after the respective garment sections have been placed upon the sewing platform 22, properly registered and clamped, the motor 90 is energized, along with the magnetic clutch 77, the magnetic clutch 76 remaining deenergized and disengaged. The main drive motor 90 causes simultaneous traverse of the two sewing heads from the initial positions shown in FIG. 1 to positions at opposite diagonals of the sewing platform. At the end of the sewing operation, as determined by automatic control arrangements to be described, the main drive motor 90 and its associated clutch 77 are deenergized and the clutch 76 and return motor 82 are energized. This returns the sewing heads 25, 26 rapidly to their initial positions, in readiness for a subsequent sewing operation. During the sewing traverse the main drive motor 90 drives the respective stitching mechanisms of the sewing heads 25, 26 in exact synchronism with the traverse movements of the heads.

In accordance with one of the important aspects of the invention, a novel and improved arrangement is provided for handling and transferring garment sections, to pick up individual pieces of fabric from the supply stacks, transfer them to the sewing platform 22 and position them properly in registry with the side edges of the platform in preparation for a sewing operation. One of the fundamental problems involved in the manipulation of garment sections by automatic means arises from the inherent flimsy nature of the material. In addition, the material in many cases is a sheer, synthetic fabric, such as nylon, in which case adjacent sections of fabric tend to adhere together, making it difficult to remove a single section from the top of the stack without disturbing one or more garment sections directly below.

In the apparatus of FIG. 1, separate transfer mechanisms 27, 28 are provided for each of the supply platforms 18, 19. These separate mechanisms are substantially identical, except for certain features provided in the left side mechanism 28. Accordingly, the right side mechanism 27 will be described first in detail, and the left side mechanism 28 will be further described by reference to the pertinent differences.

Referring particularly to FIGS. 1, 2 and 7–9, the transfer mechanism 27, associated in the illustrated apparatus with the supply platform 18 for the smaller front garment sections, comprises a pair of transfer arms 96 fixed to a shaft 97 which is journalled on upstanding arms 98 on the machine frame. Adjacent one end, the shaft 97 has fixed thereto a lever arm 99 connected to a spring 100 anchored on the arm or post 98. The transfer arms 96 are aligned with the lever arm 99, so that the spring 100 tends to urge the transfer arms into vertical positions, as shown in FIG. 1. The spring 100 thus serves as a counter-balancing means to facilitate pivoting movements of the transfer arms 96 in either direction.

Journalled by the transfer arms 96, adjacent their outer ends, is a shaft 101, which may be referred to as a positioning shaft. The positioning shaft has fixed thereto, adjacent one end and outside of one of the transfer arms 96 a sprocket 102, about which is trained a chain 103. The chain 103 also is trained about a sprocket 104, which is concentric with the transfer shaft 97 but is fixed to a post 105 positioned adjacent one of the main journalling posts 98 and forming part of the journal support for the shaft 97. A small idler gear 106 is mounted on the front transfer arm 96, and is adjustable appropriately to enable the chain 103 to be adjusted to a taut condition.

Inasmuch as the sprocket 104 is fixed to the post 105, and the sprocket 102 on the positioning shaft is fixedly related to the sprocket 104 through the taut chain 103, the sprocket 102 is fixed in its rotary position with respect to the machine frame, regardless of the position of

the transfer arms 96. Accordingly, the transfer arms 96 may be pivoted in either direction from the vertical position shown in FIG. 1 while at all times maintaining a positive, predetermined orientation of the positioning shaft 101

Fixed to the positioning shaft 101 is a transfer frame 107, which may simply be a rectangular frame structure, advantageously having side frame members 108, 109 provided at their ends with downwardly projecting portions 110. As will be understood, the entire transfer frame structure 107, being secured in fixed relation to the positioning shaft 102 and being oriented initially in horizontal relation, will maintain such horizontal orientation at all times, regardless of the orientation or position of the transfer arms 96.

Mounted on each of the end portions 110 of the side frame members is a garment pick-up unit, generally designated by the reference numeral 111, the configuration of the transfer frame 107 being such that when the transfer frame 107 is moved to a position directly over a stack of the smaller front garments 10, the four pick-up units 111 are positioned generally at the corner areas of the fabric, being spaced somewhat inward, however, from the side edges thereof.

As shown best in FIGS. 7–9, the pick-up units advantageously comprise a frame bar 112, oriented in a generally vertical direction and connected to a downwardly extending portion 110 of the frame by means of parallel links 113. The arrangement is such that the frame bar 112 is movable vertically with respect to the frame 107 while retaining its original general orientation. At the upper end of the frame bar 112 is a stub shaft 114 which journals a hub 115 on which is supported a roll 116 of pressure-sensitive tape. The tape may be of a well known commercial variety, such as "Scotch" brand pressure-sensitive tape, having a width of, for example, one-half inch.

The extreme lower end of the frame bar 112 extends outward slightly and mounts a stub shaft 117 journalling an idler wheel 118. The lower area of the idler wheel 118, as will appear, forms a pressure surface for urging a portion of the pressure-sensitive tape into contact with a garment section.

Intermediate the ends of the frame bar 112 is a shaft 119, journalled for free rotation in the frame bar and extending outward of the bar in both directions. At one end, the shaft 119 carries the driven member 120 of a one-way or "overrunning" clutch device. The driving member of the clutch device comprises a ring 121 which surrounds the driven member and contains one or more rolling members 122 received in wedge-shaped recesses 123 in the driven member. When the driving ring 121 is rotated clockwise with respect to the driven member, as viewed in FIG. 7, the ring rotates freely. However, when the ring is rotated in a counterclockwise direction, the rolling members 122 wedge between the recesses and the ring to establish a direct driving relationship between the ring and the driven member 120. The driving ring 121 has connected thereto an actuating lever 124 which is slotted to receive a post 125 projecting downward from the outer portion 110 of the transfer frame. An adjustable member 126, such as a nut, supports the lever 124, and a spring 127 acts downward thereon, urging the lever into contact with the adjustable nut.

The other end of the shaft 119 extends through a member 128 of a one-way locking clutch, the member 128 being fixed to the frame bar 112 and mounting a cup-shaped hub 129. The elements 128, 129 form the principal elements of the locking clutch mechanism, which is similar to that just described. The mechanism also includes rolling elements 130 received in wedge-like recesses 131 in the inner member 128, but these wedge-shaped recesses are oriented in reverse relation to those of the driving clutch, so that the cup-shaped hub 129 rotates freely when the ring 121 drives the member 120, but is locked against rotation in the opposite direction. The hub 129 forms a take-up reel, and functions to draw tape in increments from the supply reel 116.

As indicated in FIG. 7, the tape 132 is drawn off the supply reel, taken downward and passed around the idler roll 118 in such manner that the adhesive surface of the tape is exposed. The tape is then passed upward and secured to the hub 129 constituting the take-up reel.

When the transfer frame 107 is lowered onto the stack of garment sections 10, as indicated in FIG. 8, the adhesive surface of the tape at each of the four pick-up units 111 is pressed into contact with the top garment section. This develops sufficient adhesion between the exposed tape areas and the top garment section to permit the garment section to be lifted from the stack. Of course, only the uppermost garment is contacted by the adhesive areas of the tape, so that there is no tendency, due to the action of the pick-up units themselves, to pick up more than one garment section from the stack.

As indicated by comparison of FIGS. 7 and 8, when the transfer frame 107 is lowered into garment pick-up position, the lower ends of the garment pick-up units 111 contact the top garment of the stack before the transfer frame 107 reaches its lowermost position. Accordingly, the frame bars 112 and the parts carried thereby are raised with respect to the frame 107, as permitted by the parallel links 113. As the frame bars 112 are raised, the springs 127 act downward upon the clutch levers 124, effecting driving rotation of the clutch rings 121. This causes rotation of the shaft 119 and hub 129, effecting an incremental take-up of tape on the hub. In this manner, fresh adhesive areas of tape are presentd continually at the bottom areas of the idler rolls 118 for the pick-up of successive garments. And, in this respect, it will be understood that the incremental take-up of tape on each occasion is so small (e.g., two or three thousandths of an inch) that the take-up can take place without detriment to the action of picking up a garment section.

When the transfer frame 107 is raised, to effect removal of a garment from the stack, the frame bars 112 of the pick-up units will lower until stop positions are reached, and the lever arms 124 will swing back in non-driving movement. The locking clutch 128—131 prevents any tendency of the take-up hub 129 to rotate backward during this interval.

In accordance with one aspect of the invention, a garment section is removed from the stack, following engagement by the pick-up units 111, by an initially slow upward movement of the transfer frame 107. Such slow initial movement is thought to be substantially critical in the case of manipulation of thin filmy material, such as sheer nylon fabric, for example, since adjacent layers of the material tend to stick together, and the slow initial movement permits the second and subsequent layers of fabric to peel away from the moving top layer or section without disturbing the stack. If the initial pick-up is carried out too rapidly, two or more layers of fabric will move initially with the top layer and throughout a distance sufficient to disturb the stack when these layers fall back thereon. Such an occurrence would, of course, require the apparatus to be stopped for the stack to be re-arranged by hand, so that further garment sections could be picked up properly by the apparatus.

After a garment section has been picked up, the transfer arms 96 are pivoted to carry the transfer frame 107 to a position directly over the sewing platform 22, the level of which advantageously is about the same as that of the top of the stack of garment sections. FIG. 2 illustrates an intermediate stage of the transfer movement.

Complete transfer movement of the frame 107 causes the picked up garment section to be laid directly on the sewing platform 22, the respective pick-up elements 111 being so spaced and positioned as to be received within the outlines of the U-shaped clamping members 23, 24. By automatic control means to be described, the clamp actuators 43 are energized to raise the clamps momen-

tarily as the garment section is brought into place on the platform 22. Simultaneously, air jets are caused to issue from pipes 132 suspended below the transfer frame. These air jets are directed such, as illustrated in FIG. 13, that the drooping side margins of the garment section are extended horizontally, underneath the clamping elements 23, 24, as the garment section reaches its rest position on the platform.

After the side edge portions of the garment section are directed horizontally over the sewing platform 22, by the air jets issuing from pipes 132, the clamping elements 23, 24 are lowered, to clamp the fabric tightly to the sewing platform. Thereupon, the transfer frame and pick-up units are raised and return to the supply stack to pick up a new garment section.

As in the case where the transfer mechanisms lower the pick-up units onto the garment stacks, the take-up means for the pressure-sensitive tapes are advanced incrementally when the mechanisms descend upon the sewing platform 22 to position garment sections thereon.

In accordance with one aspect of the invention, novel and improving arrangements are provided for effecting the desired movement of the transfer frame, such that the desired slow pick-up motion is provided initially, with higher speed movement occurring thereafter. Further, the drive mechanism of the invention functions to particular advantage in conjunction with the various novel control facilities (to be described) used in the new apparatus. Referring more particularly to FIG. 7, there is shown a drive bracket 133, of generally U-shaped cross-section, which is supported on the transfer shaft 97, between the posts 98, 105. Suitable bearing means (not specifically shown) are provided to enable the transfer shaft 97 to rotate freely with respect to the drive bracket.

Between the arms of the U-shaped drive bracket 133 is a gear 134, which is keyed to the transfer shaft for rotation therewith. A rack 135 is held in meshing engagement with the gear 134 by means of rollers 136 on the drive bracket 133, and the rack 135 is connected at its lower end to a crank arm 137 and shaft 138 journalled in the machine frame. The shaft 138 is driven by a sprocket 139 connected by a chain 140 to a drive motor 141.

In view of the particular control procedures utilized in the operation of the apparatus of the invention, including substantial stop-start operation of the transfer mechanisms and the initial, slow-speed pick-up from the supply stack, it is particularly advantageous to utilize, for the transfer mechanism drive motor 141, an extremely low inertia, D.C. universal motor. Such a motor permits of rapid start-stop control, as well as the desired speed regulation. A particularly advantageous motor for the purpose, in a typical apparatus according to the invention, is a 0.08 horse power D.C. universal motor manufactured by Dayton Electric Manufacturing Company, under their type No. 2M087. Such a motor advantageously may be provided with a 360 to 1 speed reducing gear head.

In order to obtain advantageous mechanical advantages for manipulation of the transfer mechanism in or near horizontal positions (i.e., when picking up or positioning garment sections) the relationships between the rack 135, gear 134 and crank 137 advantageously are such that the transfer arms 96 are in vertical positions when the crank 137 is substantially at right angles to the rack 135 and the transfer arms are in substantially horizontal, pick-up or deposit positions when the crank arm 136 is in dead-center relationship with the rack. Accordingly, the relationship of the crank 137 and rack will be such as to provide maximum mechanical advantages (i.e., near dead-center relationships) the transfer arms 96 are near horizontal positions.

The left side transfer mechanism 28, employed in the illustrated apparatus for the transfer of the larger or back garment sections, is identical in most respects to the transfer mechanism 27 described above. However, as one of the significant aspects of the invention, the left side transfer mechanism 28 incorporates means operative automatically to effect registration of the side edge margins of the back garment sections 11 with those of the narrower front garment sections 10. Thus, referring more specifically to FIGS. 10 and 11, the transfer mechanism 28 comprises a pair of transfer arms 142 fixed to a shaft 143 (FIG. 1) for pivotal movement, by means of a drive mechanism similar to that described in connection with the right side transfer mechanism 27. The outer ends of the transfer arms support and journal a control shaft 144 which, in turn, supports a transfer frame 145. The transfer frame 145 is held in a horizontal position at all times, regardless of the orientation of the transfer arms 142 by sprocket and chain means (not specifically illustrated) including a first sprocket fixed with reference to the machine frame and a second sprocket fixed to the transfer frame 145, the arrangement being similar in its operation to the elements 102—104 of the right side transfer mechanism.

The left side transfer mechanism includes a plurality of pick-up units 111*a* (usually four) in a configuration appropriate for engaging the back garment sections 11 in their corner areas. The pick-up units 111*a* may be similar in all respects to the pick-up units 111 of the right side transfer mechanism. However, instead of being mounted directly on the transfer frame, the pick-up units 111*a* are mounted by rods 146 which, in turn, are supported by the transfer frame 145 and guided for sliding movement therein by means of appropriate bushings 147.

As illustrated best in FIG. 10, the inner ends of the slide rods 146 are connected by links 148 to a crank 149 which is keyed to the shaft 144. Accordingly, by rotation of the shaft 144 relative to the transfer frame 145, the slide rods 146 and pick-up units 111*a* may be caused to move toward or away from each other.

In order to effect registration or substantial registration of the side edge areas of the back garment sections 11 with those of the front garment sections 10, the side edges of the back garment sections must be moved closer together. Accordingly, in the apparatus of the invention, a mechanism is provided for rotating the control shaft 144 with respect to the transfer frame 145 in a manner such that the pick-up units 111*a* will be at maximum width during the pick-up of a back garment section 11 from the supply stack and that the pick-up units will be moved closer together, by a distance sufficient to effect side edge registration of the front and back garment sections, when the back garment section is deposited on the sewing platform 22. To this end, a pinion 150 is fixed to one of the left side transfer arms 142. An idler gear 151 mounted on the transfer frame 145 meshes with the pinion 150 and is caused to rotate by relative rotation between the transfer arm 142 and frame 145. The idler pinion 151 is connected directly to a second idler pinion 152 (FIG. 12), mounted inside the side member of the transfer frame and meshing with a gear 153 keyed to the control shaft 144.

Viewing the apparatus as in FIG. 1, and with reference to FIGS. 10 and 11, counterclockwise pivoting movement of the transfer arms 142, to carry the transfer frame 145 into position to pick up a garment from the supply platform 34 will cause the pinion 150 to rotate counterclockwis with respect to the transfer frame 145, which is maintained in a horizontal disposition. Accordingly, the gear 153 and control shaft 144 likewise will be caused to rotate counter clockwise with respect to the frame 145, although perhaps at a different speed where (as in the illustrated instance) the idler gears 151, 152 are of different size.

When the control shaft 144 rotates counterclockwise with respect to the transfer frame 145, the crank 149 causes the slide rods 146 to extend. Thus, when the transfer arms 142 are horizontal, the pick-up elements 111*a* are at maximum separation. Subsequently, when the transfer arms 142 are raised and rotated approximately 180° in clockwise direction, to effect a deposit of a picked up back garment section 11 on the sewing platform 22, the control shaft 144 and crank 149 will rotate clockwise with respect to the transfer frame 145, substantially to a

position as shown in FIG. 11. This causes the slide rods 146 to be drawn inward, so that the pick-up elements 111*a* are at minimum separation during deposit of a garment section on the sewing platform.

By appropriately relating the pertinent gear ratios, crank throws, etc., the combined inward movement of the pick-up units 111*a* is made to be substantially equal to the difference in width between the front and back garment sections (i.e., each pick-up unit 111*a* moves one-half of the necessary distance). Accordingly, when a back garment section 11 is picked up from the supply platform 34 and conveyed to the sewing platform 22 its edge-to-edge width is equal to that of the front garment sections, so that the edges are in the desired registry for a side-seam sewing operation.

As one of the more important aspects of the invention, to be described in more detail, successive garment sewing operations will involve, on one occasion, the deposit of a back garment section 11 directly on the sewing platform 22, followed by the deposit of a front garment section on top of the back garment section. The next succeeding sewing operation will involve the deposit of a front garment section directly on the sewing platform and a back garment section over the front garment section. Now, inasmuch as the back garment sections 11 are made narrower, prior to deposit on the sewing platform 22, provision must be made to prevent bulgy gathering of the excess material, such as would distort a front garment section which is laid on top. For this reason, the sewing platform 22 is provided with the longitudinal slot 44 running generally centrally along its length. The excess material of the back garment section merely sags down into this slot or opening, substantially as indicated in FIG. 15. The front garment section then may be laid directly over the top of the back section without distortion. In alternate cases where the front section 10 is laid directly on the sewing platform 22, the excess material of the back section 11, which is laid on top, is allowed to gather at random, since it cannot affect the already laid and clamped front section 10. This arrangement is illustrated in FIG. 14.

A typical sequence of operations of the apparatus of the invention is perhaps best described with reference to the circuit arrangements shown in FIGS. 19–21. It will be assumed, for the purpose of the description, that the supply platforms 34, 34' initially are loaded and that each of the transfer mechanisms 27, 28 is in the position shown in FIG. 1, the right side mechanism 27 holding a garment section previously picked up. A stepper switch 160 is assumed to have its A blade in the number one control position, wherein it is causing the right side transfer mechanism to be swinging counterclockwise, to deposit a front garment section 11 on the sewing platform 22.

When the right side transfer mechanism 27 reaches a position about 10° from the horizontal, with its garment section supported directly above the sewing platform 22, a switch 161, comprising one of a group B of cam actuated switches operated in accordance with the position of the right side transfer mechanism, through a drive chain 162, is closed to actuate a relay 163 and effect opening of the clamps 23, 24. Timer means (to be described in connection with FIG. 20) are provided for controlling the interval during which the clamps are open, enabling the garment section to be placed on the platform. Simultaneously, an appropriate air valve is opened so that air jets issue from the pipes 132 to lay the fabric properly under the clamps, substantially as indicated in FIG. 13. The driving crank 137 for the right side transfer mechanism continues to rotate in the same direction, so that the transfer arms 96 begin to raise immediately. A predetermined dwell period, during which clamping of the fabric is effected, being provided, however, by the vertical travel of the transfer frame downward, after the pick-up units 111 have engaged the sewing platform.

During the upward movement of the transfer arms 96, and at a point where the arms are raised about 15° from the horizontal, a switch 162 of the cam actuated switch group B is tripped, advancing the stepper switch 160 to position number two without effect. When the transfer arms 96 have raised to a position about 20° above the horizontal, a switch 163 of the cam actuated switch group B is tripped, advancing the stepper switch 160 to position number three and causing energization of the drive motor for the left side transfer mechanism 28, through energization of a latching relay R1. The left side transfer mechanism which just previously has picked up a garment section from its supply stack then proceeds to deposit a garment section on the sewing platform 22, in a manner to be described, and the sequencing of the apparatus temporarily is taken over by the left side transfer mechanism.

After tripping the switch 163, to initiate operation of the left side transfer mechanism 28, the right side transfer mechanism proceeds independently of other operations of the apparatus to pick up a new garment section in preparation for a subsequent sequence of operations. To this end, the transfer arms 96 continue clockwise movement, bringing the pick-up units 111 into pressure contact with the top garment of the supply resting on the platform 34'. At this time, a limit switch 164 is tripped, energizing a timer TD1, and a speed control switch 165 is tripped to energize a relay R2 and switch a resistor 166 into the power circuit for the universal D.C. drive motor 141 which actuates the right side transfer mechanism.

The timer TD1, when actuated, actuates a latching relay R3 to effect deenergization of the transfer drive motor 141. This provides a dwell period (e.g., one second), allowing the pick-up units 111 to rest upon and adhere firmly to the top garment section of the stack.

At the end of the timing period, a latching relay R4 is actuated to energize the transfer drive motor 141 and initiate return movement of the right side transfer mechanism. However, the initial movement of the transfer mechanism, upward from the supply stack, takes place at very low speed, by reason of the fact that the resistor 166 is connected in the power circuit of the motor, and also by reason of the near-dead-center relationship of the crank 137 and rack 135. Advantageously, the nature of the resistor 166 is such that the motor operates at about half speed, and the orientation of the speed control switch 165 is such that low speed operation continues for about two inches of lift from the stack, providing ample time for sticking garment sections, if any, to peel from the lifted garment section without disturbing the stack. At the end of the slow speed lift, the transfer drive motor 141 operates at high speed, until the transfer arms 96 reach a vertical position, at which time a switch 167 of the cam actuated switch group B is tripped, deenergizing the drive motor with the transfer mechanism 27 in the vertical or "wait" position.

During the "pick-up" activity of the right side transfer mechanism 27, the left side mechanism 28 proceeds in clockwise movement to place a back garment section 11 in position over the sewing platform 22, it being recalled that the back garment section is narrowed in this operation to effect registration of the side edges of the front and back sections 10, 11. When the left side mechanism 28 reaches a position about 10° above horizontal, a switch 168, comprising one of a group of cam actuated switches C, similar to the switch group B, is tripped to actuate a relay 169, initiating timed opening and closing of the clamps 24, 25.

As in the case of the deposit of the front garment section 10, air jets are applied to the edge portions of the garment section 11 during the moments when the clamps are raised and the garment section is deposited on the platform. This assures that the margins of the fabric will lie under the clamps when they descend. It will be understood, of course, that the previously deposited front garment section 10 is not disturbed during

the deposit of the back garment section 11, even though the clamps 23, 24 are raised momentarily.

Continued operation of the left side transfer motor 141*a* causes the mechanism to lift off the sewing platform 22 immediately after depositing a garment section. When the mechanism reaches a position approximately 15° above horizontal, a switch 170 of the cam actuated switch group C is tripped, advancing the stepper switch 160 to position number 4, energizing a latching relay R5 to effect simultaneous energization of the main drive clutch 77, the main drive motor 90 of the sewing system and a suitable valve (not specifically shown) for activating the air jets 49 (FIG. 16). The left side transfer mechanism continues in its counter-clockwise pivotal movement toward the supply platform 34, tripping a switch 171 of the cam actuated group as it raises to about 20° and thereby advancing the stepper switch 160 to position number 5 without effect. Thereafter, the left side mechanism proceeds independently of other operations of the machine, the machine sequencing having now been taken over by the sewing system, as will be described.

During the further independent movement of the left side mechanism 28, a switch 172 of the cam actuated group C is tripped when the mechanism reaches its garment pick-up position, energizing a timer TD2 and actuating the latching relay R1. This provides a dwell or delay of approximately one second, during which the garment is picked up, whereupon a latching relay R6 is actuated by the timer to initiate return movement of the mechanism. Simultaneously with the actuation of the switch 172 a switch 173 of the cam actuated group is tripped to actuate a relay R7, connecting a resistor 174 into the power circuit of the transfer drive motor 141*a*. The left side elevator thus begins its upward movement with the motor 141*a* operating at approximately half speed, for about the first two inches of lift. At that time, the switch 173 opens, deenergizing the relay R7 and removing the resistor 174 from the motor circuit to permit full speed operation. The transfer mechanism then proceeds upwardly to the vertical or "wait" position, at which point a switch 175 of the cam actuated group C is tripped to actuate the latching relay R6 and deenergize the drive motor 141*a* until a further signal has been given.

It will be recalled that, during the counterclockwise movement of the left side transfer mechanism from the sewing platform, the switch 170 was actuated to advance the stepper switch 160 to the number four position. This effected initiation of the sewing operation by energizing relay R5, clutch 77 and the main drive motor 90. The sewing operation then proceeds, while the left side elevator goes through its pick-up cycle independently.

Upon energization of the motor 90 and clutch 77, the sewing heads 25, 26 are traversed from the positions shown in FIG. 1 to diagonally opposite corner positions, with the stitching mechanism being driven in exact synchronism through the flexible drive cables 91, 92.

The end of the sewing operation is signalled by tripping of a switch 176 upon the sewing heads reaching the end of the sewing traverse. This actuates a relay R8, resulting in the simultaneous operations of deenergizing the main drive motor 90 and clutch 77, momentarily releasing the garment clamps 23, 24 through appropriate actuation of the clamp control circuit of FIG. 20, and actuation of the garment ejecting mechanism through actuation of the circuit of FIG. 21. Thus, energization of the relay R8 actuates the relay R5, to shut off the main drive motor 90 and its clutch 77, and also actuates a relay R9 to energize the sewing head retracting motor 82 and its clutch 76.

Momentary release of the clamps, at the end of the sewing operation, is effected through the circuit of FIG. 20, which includes a relay R10 actuated by tripping of the switch 176 at the end of sewing. Actuation of the relay R10 deenergizes a "down" solenoid valve 177, energizes an "up" solenoid valve 178 and sets into operation a 60 r.p.m. timing motor 179. After one revolution of the timing motor 179 (one second) a cam 180 driven thereby trips a switch 181, actuating the latching relay R10 in the opposite direction, to deenergize the "up" solenoid valve 178 and energize the "down" solenoid valve 177. Thus, the clamps are released for a period of about one second.

It should be noted that the clamp control circuit of FIG. 20 also is utilized in connection with the timed actuation of the clamps in conjunction with the deposit of garment sections by the transfer mechanisms. Thus, cam actuated switch 161, 168 of the right and left side transfer mechanisms, respectively, when tripped in the proper sequence, actuate latching relays R11 or R12. When the relay R11 is actuated, for example, a line 182 is energized to actuate air supply means (not shown) to the jet pipes 32. Simultaneously, the timing motor 179 is set into operation, rotating the timing cam 180 and a control cam 183. The control cam 183, after a predetermined delay of about 3/10 of a second, actuates a switch 184 to deenergize the "down" solenoid valve 177 and energize the "up" solenoid valve 178. At the end of a single revolution, the switch 181 is reclosed to actuate the latching relay R11 in a reverse direction, and the switch 184 is released to effect energization of the "down" solenoid valve and deenergization of the "up" solenoid valve. Actuation of the latching relay R12, through the left side cam actuated switch 168 produces a similar sequence of operations, including the energization of a line 185 for activation of air jets.

A further consequence of the actuation of the limit switch 176, at the end of the sewing operation, is the energization of a relay R13 of the garment ejector circuit of FIG. 21. This energizes the garment ejector motor 58, so that the mechanism of FIG. 18 goes through the motions described, lifting a now unclamped and sewed garment from the sewing platform 22 and transferring it to a suitable receptacle, such as the box or basket 59 shown in FIG. 1. Momentary energization of the relay R13 and motor 58 will cause partial rotation of a control cam 186, driven by the motor, completing a self-holding circuit for the relay R13 through a cam actuated switch 187. The relay R13 and motor 58 thus will remain energized until the cam 186 is driven through a complete revolution, whereupon the switch 187 will open, deenergizing the relay and consequently the ejector motor 58. At this point, the garment ejector frame 27 has been returned to its flat position on the sewing platform 22.

In the illustrated form of the apparatus, a partial return movement of the sewing heads 25, 26 to their starting positions, following tripping of the limit switch 176, causes a sequencing switch 188 to be tripped by movement of one of the sewing heads. Advantageously, this occurs after about one-third of the retracting movement (i.e., after about 0.4 seconds of retraction, where complete retraction requires about 1.5 seconds). Actuation of the switch 188 energizes the stepper switch 160, moving its control arm A to the number 6 position to actuate the latching relay R1 to start up the left side transfer mechanism to bring in and deposit upon the sewing platform 22 a back garment section 11. In this respect, it is of particular importance to note that whereas, in the garment sewing operation described immediately above, the right side elevator brought the first garment section to the sewing platform, the left side transfer mechanism is now caused to bring in the first section.

Complete return of the sewing heads results in tripping of a limit switch 176*a* to effect deenergization of the retraction motor and its magnetic clutch.

Movement of the left side mechanism 28 to the deposit position trips the cam actuated switch 168, actuating the clamp control circuit of FIG. 20 in the manner just described. The drive motor 141*a* continues to operate and immediately begins to raise the left side mechanism.

After being raised about 15°, the left side mechanism trips the cam actuated switch **170**, advancing the stepper switch **160** to position number 7 without effect. Further lifting movement, to about 20° above horizontal, causes the cam actuated switch **171** to be tripped, advancing the stepper switch **160** to position number 8 and energizing the latching relay R3 to initiate inward movement of the right side transfer mechanism from its "wait" position. The left side mechanism proceeds to pick up a new garment section and advance to its "wait" position in the manner before described.

The right side transfer mechanism proceeds into the deposit position with its front garment section **10**, effecting momentary release of the clamps **23**, **24** and actuation of the air jet pipes **132** by tripping the cam actuated switch **161**.

After the right side transfer mechanism has deposited its garment section and raised to about 15° above horizontal, it trips the cam actuated switch **162**, advancing the stepper switch **160** to the number nine position and initiating a sewing operation by the actuation of the latching relay R5. Further upward movement of the right side mechanism, approximately to a 20 degree position, trips the cam actuated switch **163** and advances the stepper switch **160** to the number ten position without effect. A second sewing operation is now proceeding, and upon its completion the limit switch **176** is tripped to effect garment ejection and retraction of the sewing heads. Shortly thereafter, during the retraction movement, the switch **188** is tripped, advancing the stepper switch **160** to the number one position, actuating the latching relay R3 and causing the right side transfer mechanism **27** to bring in a front garment section as the first element of a new operation.

Continuous re-cycling of the apparatus occurs in the manner above specified, until one or both of the supply stacks are exhausted, whereupon the apparatus automatically is shut down until the supply is replenished.

One of the important, advantageous features of the invention resides in the provision of a novel apparatus and control instrumentality for altering the order of laydown of the different garment sections, to compensate for the back and forth lay-up of material on the cutting table. Thus, the sewing of successive garments proceeds with one garment sewed in a face-down position, the next garment sewed in a face-up position, and so on, the arrangement being such that the "outside" surfaces of the material will at all times be on the outside of the finished garment, as desired. In accordance with the invention, this is accomplished advantageously through the use of a cycling control system arranged such that a complete cycle of machine operations includes two complete sewing sequences.

Another important, advantageous feature of the invention resides in the design of the pick-up and transfer mechanisms, and the actuating or drive means therefor, whereby a single piece of filmy garment material, such as sheer nylon, for example, may be picked off of the top of a supply stack in a reliable manner, without disturbing other garment sections of the stack. In part, this is accomplished by the provision of special pick-up assemblies, utilizing pressure-sensitive tapes for adhesively engaging the material, and effecting automatic, step-by-step advance of the tapes to present new adhesive areas. Such automatic advance of the tapes is effected advantageously by taking advantage of otherwise desirable, lost motion relationships between the pick-up units and the transfer frames from which they are supported, so that a small advance of the tapes takes place each time the transfer mechanisms move down upon the supply stacks or upon the sewing platform.

One of the important practical features of the transfer mechanism resides in the provision of a novel drive means therefore, including an extremely low intertia, D.C. universal motor capable of speed control and of extremely rapid start-stop motion, which is particularly advantageous in the two-sequence control cycle provided by the new control system.

The novel transfer means of the invention further includes unique arrangements for effecting side edge registration of garment sections of different width dimensions. Thus, the transfer mechanism **28**, used in the illustrated apparatus for transferring wider, back garment sections **11**, incorporates a mechanism effective automatically in accordance with the back-and-forth movements of the transfer mechanism to move the side edges of a back garment section together, to a width substantially equalling that of the front garment sections. The specific, illustrated mechanism makes advantageous use of the fact that the transfer frame **145** of the left side mechanism **28** is maintained in a horizontal disposition throughout angular movements of the transfer arms **142**. Accordingly, the relative motion between the transfer frame and transfer arms is utilized to advantage to effect the desired widthwise adjustment of the pick-up units **111***a*.

The apparatus of the invention also incorporates a novel and advantageous combination of fixed sewing and supply platforms with movable sewing heads arranged to be driven through a sewing traverse along appropriate edges of garment sections clamped on the sewing platform. This greatly facilitates the handling and manipulation of the garment sections, to effect and maintain the desired registration and positioning thereof.

The new apparatus is capable of extremely rapid production of seamed garments, such as panties, since many of the manipulative operations are caused to take place during traverses of the sewing heads, whereby almost immediately upon completion of a sewing traverse a waiting transfer mechanism begins to descend to effect placement of a new garment section. Moreover, the apparatus is fully automatic in operation, except for such occasional attention as is required in the periodic replacement of the supply stacks, so that a single operator easily may handle or tend four or five of the machines. This results in a many-fold multiplication of output per worker, it being understood that the preliminary assembly operations performed by the new apparatus presently are performed almost entirely by hand, with the use of conventional sewing machines.

It should be understood, of course, that the specific form of the invention illustrated and described herein is intended to be representative only, as certain changes may be made therein without departing from the clear teachings of the disclosure. Further, certain of the individual features and concepts making up the overall apparatus described herein are deemed to be valuable inventions in and of themselves, capable of application to a variety of specific uses. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

I claim:

1. A side seaming machine for sewing the opposite side seams of garments comprising a sewing platform, sewing heads positioned for travel relative to said platform to form seams along the edges of a garment on said platform, a pair of supply stations adjacent said platform for retaining supplies of garment sections, transfer means for transporting garment sections from said supply stations to said platform and positioning said garment sections in superimposed relation for sewing, and drive means for said transfer means including cycling control means for effecting the transfer of garment sections in a cycle such that the garment section from a first supply station is on top of the garment section from a second supply station during the sewing of a first garment and below the garment section from said second supply station during the sewing of a second and succeeding garment section.

2. The side seaming machine of claim 1, adapted especially for the sewing into a garment of a pair of garment sections of different widths, in which clamping

means are associated with said platform for clamping marginal portions of said garment sections in predetermined position on said platform, said transfer means comprises at least one transfer mechanism for association with the wider garment section and having means for engaging the wider section adjacent its side edges and means for drawing said side edges toward each other to a width substantially equal to that of the narrower garment section, said clamping means being operative to clamp said sections to said platform while the side edges of said wider garment section are drawn toward each other whereby the side edges of said sections are substantially coincident during sewing.

3. The side seaming machine of claim 1, in which said control means includes a sequencing system operable in step-by-step manner in response to predetermined operations of said machine to initiate further operations thereof, said sequencing system operating repetitively in cycles, each of said cycles comprising a plurality of complete garment sewing operations, said plurality being divisible by the integer two.

4. The side seaming machine of claim 3, in which said sequencing system includes a step switch, a predetermined plurality of control switches are provided on said machine for actuation in sequence in accordance with operations of said machine, and said step switch has a plurality of operative positions equal in number to twice the number of control switch actuations during a complete garment sewing cycle.

5. A side seaming machine comprising a sewing platform, a supply platform on each side of the sewing platform for holding stacks of garment sections, means for transferring garment sections individually from said supply platforms to said sewing platform, means on said sewing platform to clamp a garment section thereto, sewing heads positioned adjacent the side edges of said platform in sewing relationship to garment sections clamped thereon, and means for moving said sewing heads along said side edges to effect side seaming operations, including cable-like means connected to said sewing heads for drawing said sewing heads through their respective traverses, a first drive motor and first selectively engageable clutch associated with said cable-like means for driving the same in a forward direction, a second drive motor and second selectively engageable clutch associated with said cable-like means for driving the same in a reverse direction, and control means for alternatively actuating and engaging said motors and clutches to draw said sewing heads selectively in forward and reverse traverse directions.

6. The side seaming machine of claim 5, which includes flexible drive means associated with said first drive motor and clutch and connected with each of sewing heads for driving the sewing needles thereof in synchronism with forward traverse movement of said heads.

7. A machine for positioning and holding a garment section or the like, a platform for receiving and supporting the garment section to be positioned, garment section transfer means movable to said platform for positioning a garment section thereon, said transfer means comprising, a frame mounted for movements substantially parallel to said platform and means for alternatively positioning on said platform narrow and wide garment sections, said transfer means also including means operative automatically to reduce the effective width of said wide sections substantially to that of the narrow sections, said platform having an open center portion to accommodate gathering of portions of said wide sections upon reduction in the effective width thereof, clamp means on said platform engageable with margins of a garment section positioned thereon and control means actuated in response to movements of said transfer means to said platform to open and close said clamp means in timed relation.

8. A machine for picking up and transferring thin sections of fabric from a stack thereof which comprises a pick-up frame movable in translating directions to and away from said stack, a plurality of pick-up units on said frame for engagement with spaced portions of the top section of said stack adjacent to the marginal edges thereof, each pick-up unit including pressure-sensitive tape means providing adhesive surfaces for engagement with the top section of said stack, a two-speed drive means for moving said pick-up frame to and away from said stack, control means separate from said drive means and operative in conjunction therewith upon said pick-up frame moving to said stack to cause said frame to dwell for a predetermined time with said pick-up units in contact with the top layer of said stack, said control means being further operative to effect a predetermined initial movement of said frame away from said stack at low speed and further movement at higher speed, said low speed being such as to permit lower layers of fabric to peel away from the top layer without disturbing the stack.

9. The machine of claim 8 wherein the drive means includes a crank rotatable in one direction and having a first substantially dead-center relationship when said frame is in fabric pick-up position at said stack and a second substantially dead-center relationship when said frame is moved away from said stack to a position for depositing said section of fabric.

10. A machine for picking up and transferring thin sections of fabric from a stack thereof which comprises a pick-up frame movable in translating directions to and away from said stack, a plurality of pick-up units on said frame for engagement with spaced portions of the top section of said stack adjacent to the marginal edges thereof, each pick-up unit including pressure-sensitive tape means providing adhesive surfaces for engagement with the top section of said stack, a two-speed drive means for moving said frame to and away from said stack, said drive means including a crank rotatable in one direction and having a first substantially dead-center relationship when said frame is in fabric pick-up position at said stack and a second substantially dead-center relationship when said frame is moved away from said stack to a position for depositing said section of fabric.

11. A machine for positioning and holding a flat garment section or the like comprising a supply platform for holding a garment section, a second platform for receiving and supporting the garment section to be positioned, garment section transfer means movable between said supply and second platforms for picking up the garment section from said supply platform and for positioning said garment section on said second platform, said transfer means including a frame mounted for generally translating movement substantially parallel to said second platform, clamp means on said second platform engageable with margins of a garment section positioned thereon, and control means actuated in response to movements of said transfer means to said second platform to open and close said clamp means in timed relation to release and to secure a garment section when positioned on said second platform, said transfer means engaging said garment sections inside the said margins thereof, air jet means for urging said margins in generally flat relation to said second platform, and valve means including said control means for actuating said air jets when said clamps are open.

12. A transfer mechanism for transferring garment sections or the like from one horizontal platform to another comprising a supporting frame, a pair of transfer arms mounted for pivoting movement on said frame, a transfer frame mounted on said arms for pivoting and translating movement and carrying pick-up means for engagement with said garment sections adjacent to marginal edge portions thereof, and means connecting said supporting and transfer frames to maintain said transfer frame horizontal

in all pivoted positions of said transfer arms, said pick-up means being movably mounted on said transfer frame, linkage means mounted on said transfer frame for adjustably moving said pick-up means, and linkage control means actuated in response to the relative movements of said transfer frame and said transfer arms to adjust the positions of said pick-up means in accordance with the relative positions of said transfer frame and transfer arms.

13. A machine for assembling a garment from a plurality of garment sections from garment section stacks cut on a lay-up table, comprising a pair of garment section supply stations for receiving said stacks, mechanically operated means to transfer sections from each of said supply stations to a common assembly position, and control means for cycling said transfer means whereby the sequential order of transfer of garment sections from said supply stations is reversed after each garment assembly operation, said control means comprising a control element operative in increments and through cycles, said control element being advanced incrementally in accordance with sequential operations of assembly, a complete cycle of said control element comprising sequential assembly operations for a plurality of garments.

References Cited in the file of this patent

UNITED STATES PATENTS

1,305,510	Wheeler	June 3, 1919
1,575,892	Ashby	Mar. 9, 1926
1,649,319	Molyneux	Nov. 15, 1927
1,694,787	Molyneux	Dec. 11, 1928
2,286,943	Verson et al.	June 16, 1942
2,351,367	Rider	June 13, 1944
2,492,925	Segur	Dec. 27, 1949
2,793,370	Stein	May 28, 1957