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[54] **APPARATUS FOR STACKING FLAT FLEXIBLE COMPONENTS**

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[52] **U.S. Cl.** .... **214/6 FS,** 271/186, 271/196

[51] **Int. Cl.** **G65g 57/04**

[58] **Field of Search** .... 214/6 DS, 6 FS, 8.5 C, 214/8.5 D, 650 SG; 271/186, 196, 204; 198/178, 179, 184, 180

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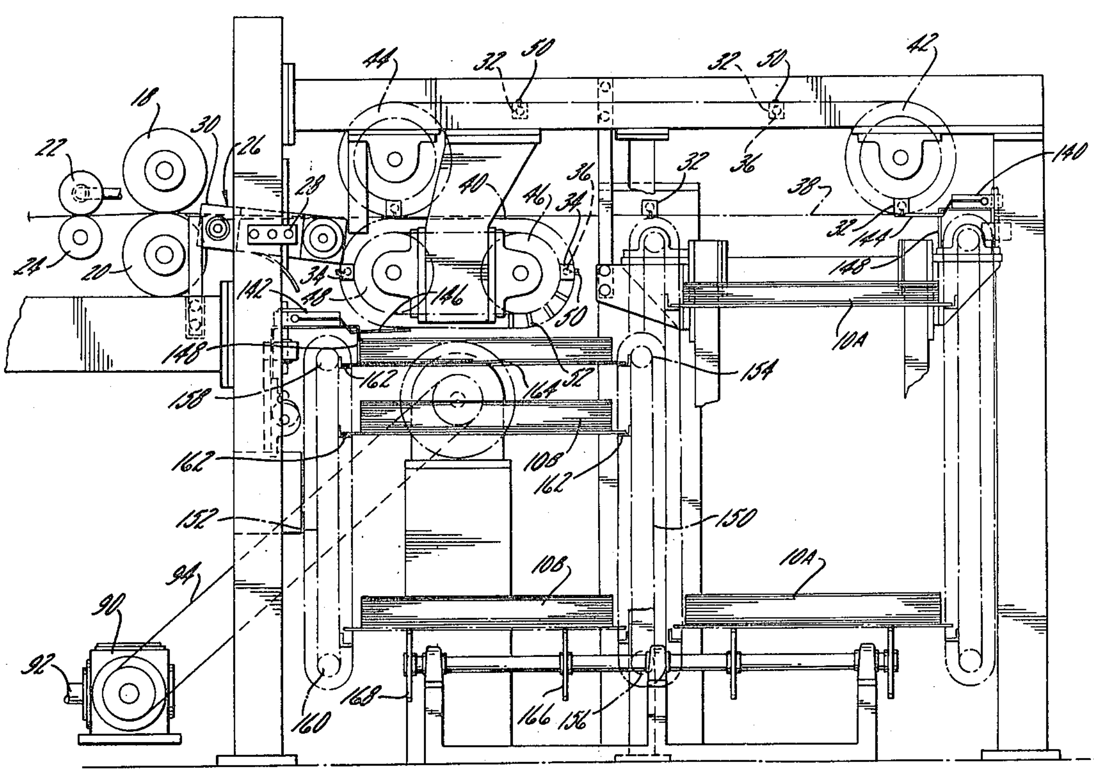
[57] **ABSTRACT**

A method and apparatus for stacking generally flat, flexible components, such as garment components is disclosed. The apparatus includes at least one transversely extending header having vacuum or reduced air pressure applied thereto which holds the leading end portion of each of the advancing components and carries the components around an end portion of an elongated endless loop prior to termination of the reduced air pressure which releases the components to form a component stack. The apparatus may also include at least one second header movable around a second elongated endless loop, which is adapted to hold and advance second components that are adjacent the first components and thereafter release them to a second stack of uninverted components.

8 Claims, 8 Drawing Figures



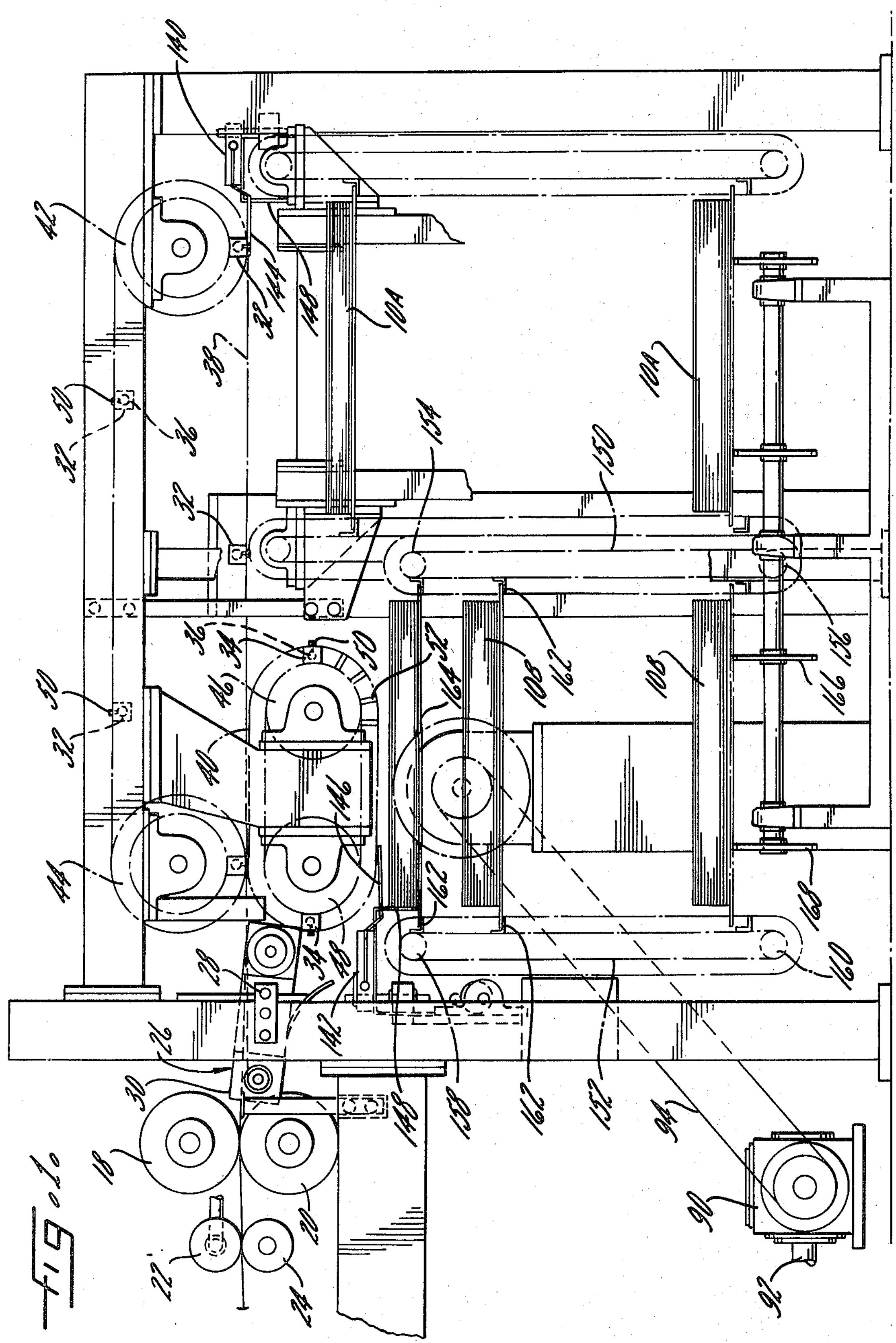


Fig. 1

FIG. 2

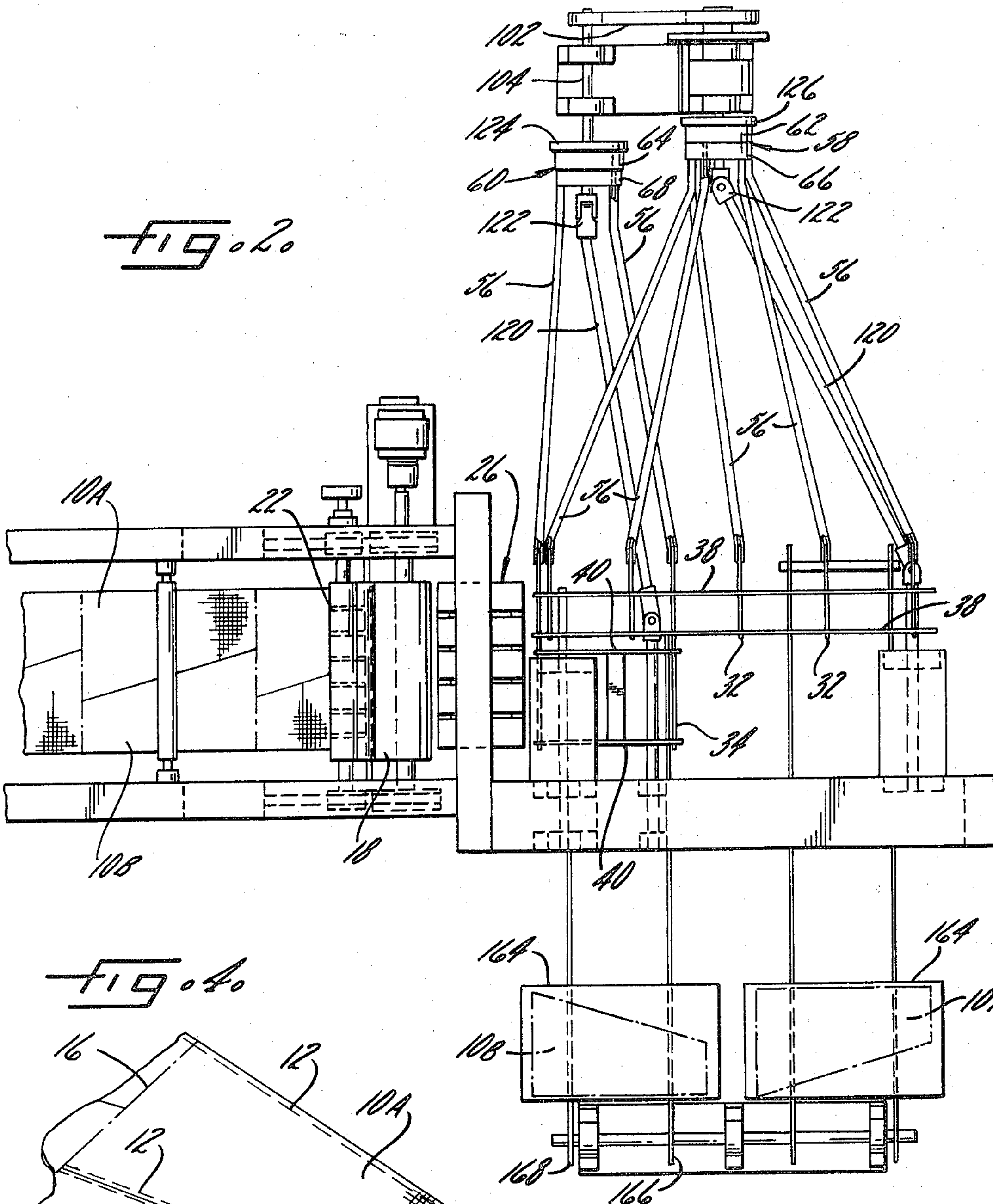


FIG. 4

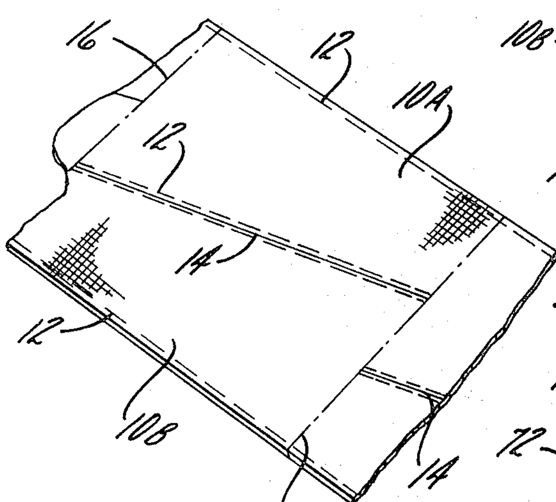


FIG. 7

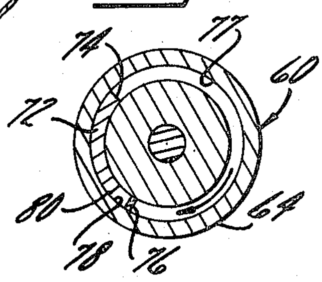


FIG. 8

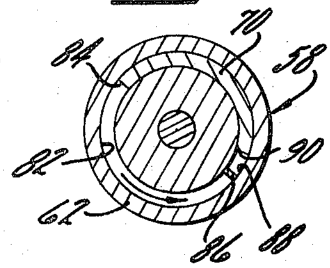


FIG. 3

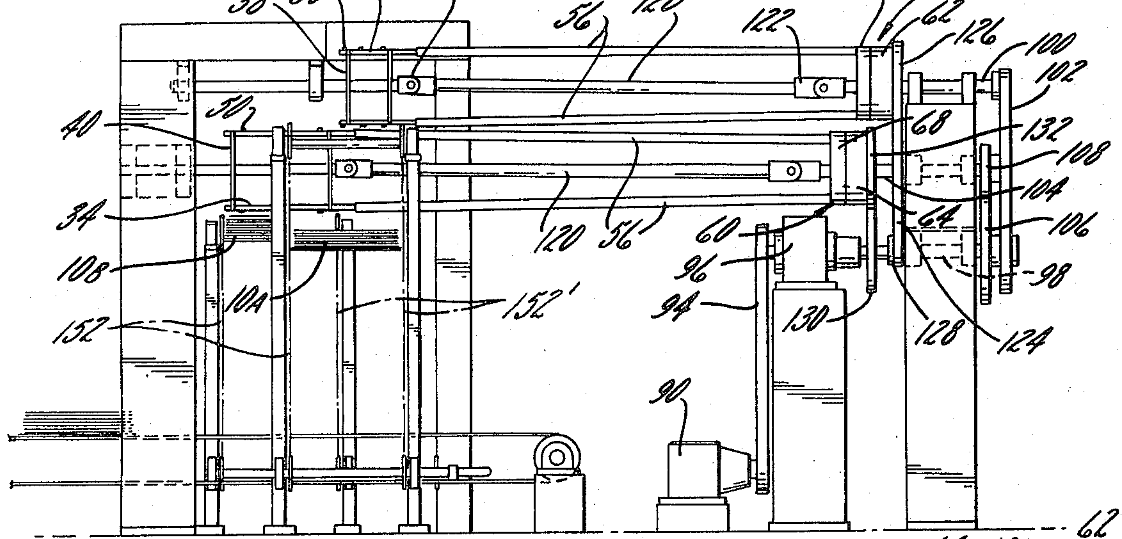


FIG. 5

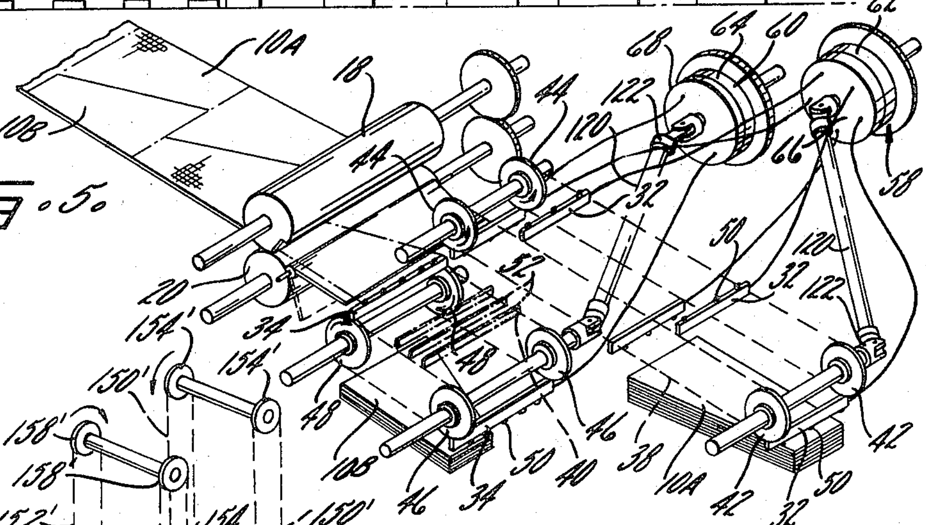
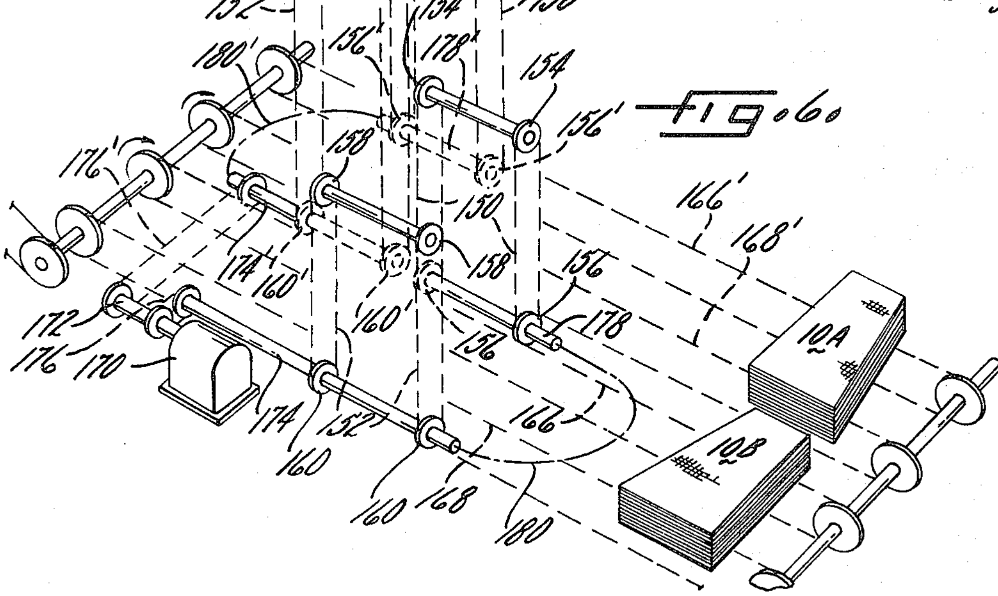


FIG. 6



APPARATUS FOR STACKING FLAT FLEXIBLE COMPONENTS

This invention generally relates to garment production and, more specifically, relates to a method and apparatus for stacking generally flat, flexible components, such as garment sleeves or the like for use in the fabrication of garments.

While the present invention is particularly adapted for stacking generally flat, flexible sleeves or similar garment components, it may easily be adapted for other non-garment related applications, wherever it is desired to stack components that are being advanced along a path in generally end-to-end relation. While such components may, of course, be stacked by workers in a production line, the step of manually lifting the components and forming the stack is, at best, a tedious task that engenders the usual labor problems of quality control in terms of the evenness of the resulting stack, limited production speed and other difficulties that are often encountered.

Accordingly, it is a primary object of the present invention to provide a method and apparatus for stacking generally flat, flexible components that are traveling in generally end-to-end relation along a path, wherein the stacks of components are consistently and reliably formed in terms of quality control, while substantially reducing the amount of operator time and expense and therefore reducing the element of human error and inconsistency.

Another object of the present invention is to provide a method and apparatus for stacking such components at production line speeds that are not consistently attainable by manual operation.

Yet another object of the present invention is to provide a method and apparatus for stacking generally flat, precut first components traveling in generally end-to-end relation and which are also in side-by-side relation with second components wherein the first components are inverted relative to their original orientation so that they can be placed in other apparatus without further manipulation with regard to their orientation.

Yet another object is to provide apparatus which is synchronized with the movement of the components advancing toward the apparatus so that a great variety of production speeds are attainable without requiring independent control of the apparatus of the present invention.

Other objects and advantages of the present invention will become apparent from reading the ensuing specification, while referring to the drawings, in which:

FIG. 1 is a side elevation of the apparatus of the present invention;

FIG. 2 is a top plan view of the apparatus of the present invention as well as with portions of a sleeve producing machine;

FIG. 3 is a downstream end elevation of the apparatus of the present invention;

FIG. 4 is a perspective view of the garment components that may be stacked while using the method and apparatus of the present invention;

FIG. 5 is a perspective view of a portion of the apparatus of the present invention, shown with a minimum of detail;

FIG. 6 is a perspective view of another portion of the apparatus of the present invention, shown with a minimum of detail; and,

FIGS. 7 and 8 are enlarged side elevations of portions of the vacuum turrets.

While the invention will be described in connection with certain preferred embodiments, it will be understood that it is not intended to limit the invention to these particular embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as expressed in the appended claims.

Turning now to the drawings, and particularly FIGS. 4 and 5, the apparatus of the present invention is shown together with downstream portions of a sleeve making apparatus which continuously produces precut sleeves for disposable gowns, such as nonwoven surgical gowns or the like. The sleeves are produced by combining two layers of material, adhesively bonding the layers along adhesive lines **12**, cutting the layers along a diagonal cut line **14** and transverse end cut lines **16**. Thus, right and left sleeves of a garment may be produced from two layers of material having a constant width and thereby produce sleeves having a wide portion corresponding to the shoulder end and a narrow portion corresponding to the cuff end. Typical measurements of such sleeve constructions may have a length of approximately 20 to 21 inches, a width of about 12½ inches for the shoulder end portion and about 6½ inches for the sleeve end portion. Although the portions of the sleeve making apparatus that applies the adhesive, and performs the cutting along the diagonal cut line **14** are not shown herein, it is seen in FIG. 5 that cooperating knife and anvil rollers **18** and **20** are shown for performing the transverse cutting of the sleeve at the cut lines **16**. It should be understood that upon cutting along the lines **16**, the sleeves are substantially completed and are ready to be incorporated into other garment components which complete the fabrication of the surgical gowns or the like.

Referring to FIGS. 1 and 2, there is shown immediately upstream of the knife and anvil rollers **18** and **20** upper and lower feed rollers **22** and **24** which advance the components **10A** and **10B** to the knife and anvil rollers. The components then advance to a transition section, indicated generally at **26**, which may simply be a relatively short conveyor mechanism or, as is shown in FIG. 1, may be a rejecting mechanism. The mechanism is shown to have a pivot point **28** and is provided with a actuating means so that the upstream end portion **30** may be elevated to prevent defective sleeves from entering the stacking apparatus of the present invention.

After passing through the transition section **26**, the components advance to the stacking apparatus of the present invention. Broadly stated, and referring to FIG. 5, the components **10A** come in contact with a header or manifold that has a vacuum or reduced air pressure applied to it creating a suction force that holds the component to the header as it advances to a predetermined position where the vacuum is terminated and the components are released to form a component stack. The components **10B** also come in contact with another vacuum header which carries that component around the end portion of an elongated endless loop so that it is inverted relative to its original position of orientation whereupon the reduced air pressure is terminated to release the component and form another stack.

In accordance with an aspect of the present invention, and referring to FIGS. 1, 2, 3 and 5, the components 10A and 10B that are advanced downstream to come in contact with the respective headers or manifolds 32, 34 each have internal passages 36 for communicating the vacuum or reduced air pressure to the outer surface thereof. The headers 32, 34 are attached to respective flexible chains 38 and 40, with the chains 38 being movable around sprockets 42 and 44 and the chains 40 being movable around sprockets 46 and 48. Thus, the respective headers 32 and 34 attached to their respective chains 38 and 40 are movable around elongated endless paths. As particularly shown in FIGS. 1 and 5, the headers are substantially equally spaced around the length of the endless loops defined by the respective chains, and the distance between successive headers corresponds to the repeat length of the components being advanced. The headers contact and hold the leading end portion of the components by the suction created in the header passages 36. The length of the respective headers 32 and 34 generally correspond to the width of the leading end portion of the components 10A and 10B and, accordingly, the headers 32 which contact and hold the leading end portion of the components 10A are shorter than the headers 34 which contact the leading end portion of the components 10B. In addition to the internal passages that extend substantially the length of the headers, the reduced air pressure is communicated to the respective components by outward tubular or cylindrical extensions 50 that are spaced along the length of the headers. As shown in FIG. 5, the headers 32 have three equally spaced extensions 50 while the correspondingly longer headers 34 have five of such extensions. The extensions enable suitably positioned finger elements to pass between the headers and the components being held which aid in releasing the components to form the respective component stacks as will be more fully explained hereinafter. While the particular number of headers on the respective chains are not important except insofar as the spacing between the headers should correspond to the repeat length of the component being stacked, the length of the endless loop defined by the chains 38 is longer than the elongated endless loop defined by the chains 40 and a total of five headers 32 are attached to the chains 38 in the illustrated embodiment. Correspondingly, on the relatively shorter loop defined by the chains 40 only two headers 34 are attached to the chains 40. Unlike the chains 38 which have no supports intermediate the headers 32, a number of transversely extending support members 52 are attached to the chains 40 intermediate the headers 34. The support members are preferably spaced about 3 inches from one another equally around the endless loop for the purpose of supporting the component on the upper flat portion of the loop, since this portion of the loop is below the components. Thus, it should be understood that the components are supported during the flat portion of travel of the headers until they are advanced around the downstream end of the endless loop prior to being released to form the component stack. In this connection, a supporting screen of the like (not shown) may be positioned beneath the lower upstream flat portion of the other loop defined by the chains 38 to support the components 10A while they are advancing to the area of the component stack.

To apply the reduced air pressure or vacuum to the headers, a flexible, non-collapsible tubing or conduit 56 is connected to each of the headers, with the other end of the conduit being connected to one of two vacuum turrets 58 and 60. As seen in FIG. 1, the elongated endless loops defined by the chains 38 are at a different elevation than the loops defined by the chains 40 so that the conduits associated with the headers 32 do not interfere with the headers 34 associated with the chains 40. The portion of each of the vacuum turrets 58, 60 to which the flexible conduits 56 are attached is rotatable so that the conduits are free to advance around the respective loops without becoming entangled, twisted or stretched. In this connection, it should be understood that the length of the conduits 56 should be sufficient to permit their traveling around the entire endless loop without placing them in excessive tension which could loosen the connections as well as shorten the effective life of the tubing.

Referring to FIGS. 2, 7 and 8, the vacuum turrets 58, 60 have respective non-rotatable cylindrical portions 62, 64 and respective rotatable abutting cylindrical portions 66, 68. The flexible conduits 56 are attached to the rotatable portions 66, 68 which have internal passages that communicate the tubing 56 to the stationary portions 62, 64.

To selectively communicate the reduced air pressure to the flexible tubes 56 and headers, the stationary cylindrical portion 62, 64 have circular recesses 70 and 72 which communicate a generally constant vacuum or reduced air pressure originating from a source (not shown) to the passages in the rotatable portions 66, 68. Referring to FIGS. 2, 5, 7 and 8, it is seen that to advance the components 10A and 10B in the downstream direction, the movable portion 68 associated with the headers 34 move in a clockwise direction while the movable portions 66 of the vacuum turret 58 moves in a counterclockwise direction. With respect to the vacuum applied to the recess 72, suitably adjustable barriers 74 and 76 are positioned therein define a vacuum port 77 so that during clockwise movement of the rotatable portion 68, vacuum or reduced air pressure is communicated to the flexible tubes 56 during the rotation from the barrier 74 clockwise to the barrier 76 and is effective to hold the components 10B to the headers until they are released to form the stack of components 10B. After the movable portion 68 of the vacuum turret 60 reaches the barrier 76, the flexible conduits communicate with a portion 78 defined by the barrier 76 and a second barrier 80. This port 78 is communicated to atmospheric or greater air pressure which tends to produce a small blast of air to the headers and thereby tends to push the component away from the header immediately after termination of the suction or vacuum force.

With respect to the vacuum turret 58, its stationary portion 62 also has an annular recess 70 and a port 82 defined as the area between adjustable barriers 84 and 86. Vacuum is supplied to the port 82 so that vacuum is communicated to the movable portion 66 of the turret 58 as it rotates in a counterclockwise direction as shown by the arrow in FIG. 8. A port 88 between the barrier 86 and another barrier 90 is supplied with atmospheric or greater air pressure to push the component away from the header immediately after termination of vacuum or reduced air pressure.

To drive the chains **38** and **40** carrying the respective headers and referring to FIGS. **2** and **3**, a right angle gear box **90** is provided which has a shaft **92** which is connected to upstream portions of the sleeve making apparatus. The gear box **90** is connected by means of a timing belt **94** to a gear box **96** having an output shaft **98** which is connected to a shaft **100** by means of another timing belt **102**. A shaft **104** associated with the vacuum turret **60** is driven by a gear **106** fixed to the shaft **98** which meshes with gear **108** fixed to the shaft **104**. The shafts **100** and **104** pass through the center of the respective vacuum turrets **58, 60** and are connected to respective sprockets **42** and **46** which drive the chains by means of shafts **120** having universal joints **122** located at opposite ends thereof. By proper selection of gear ratios within the drive components, the speed of the headers is synchronized with the speed of the components **10A** and **10B** that are advanced to the stacking apparatus.

To rotate the turret portions **66** and **68** so that they make one complete revolution per revolution of the chains around their respective elongated loops, the output shaft **98** of the gear box **96** is also operably connected to the rotatable portions of the respective turrets **58** and **60**. To drive the rotatable portion **66** of the turret **58**, a timing belt **124** passes around a pulley **126** which is internally connected to the rotatable portion **66** such that its movement is independent of the movement of the shaft **100**. The timing belt **124** is driven by a pulley **128** fixed to the output shaft **98**.

To drive the rotatable portion **68** of the turret **60**, a gear **130** fixed to the output shaft **98** meshes with a gear **132** which is internally connected to the rotatable portion **68** of the vacuum turret **60**. The gear **132** is not connected to the shaft **104** and is thus free to rotate at a speed different from the speed of the shaft **104**. By proper selection of sizes of the pulleys **126** and **128** as well as the gear ratios of the gears **130** and **132**, the rotatable portions **66, 68** of the vacuum turrets are synchronized so that the rotatable portion may make one complete revolution for each revolution of the headers around the elongated loops. Such synchronization prevents the flexible conduits **56** from becoming entangled or subjected to undue tension or the like and insures that the reduced air pressure or vacuum is communicated as well as terminated at the proper time so that the components will be stacked as desired.

To insure that the components are separated from the headers at the proper time and location and referring to FIG. **1**, brackets **140** and **142** may be provided adjacent the chains **38, 40** where the components are released to drop and form the respective component stacks. The brackets **140, 142** have a number of outwardly extending fingers **144, 146**, respectively, which are spaced apart to pass between the tubular extensions **50** of the headers and pass between the components and the outer surface of the headers so as to insure separation of the component as the header continues its travel around the elongated loop. Also attached to the brackets are barrier plates **148** which are positioned to stop the horizontal movement of the component as they fall to form the stack and thus insure that the end of the stack is uniform.

Referring to FIGS. **1, 3** and **6**, an elevator mechanism is provided for each of the component stacks to maintain the top elevation of each of the stacks at a relatively constant elevation during their formation. The mechanisms are also operable to lower the component stacks so that they may be conveyed away from the stacking apparatus. To this end and referring to the stack of components **10B**, the elevation mechanism associated therewith comprises opposing pairs of chains **150** and **152** which are driven by sprockets **154, 156** and **158, 160**, respectively. Attached to these chains are opposing angle irons **162** which provide a support for thin, nonflexible trays or shelves onto which the components are deposited into the stack. As the thickness of the stack increases, the chains are lowered until they reach the desired thickness, for example, about 5 inches, whereupon the elevator lowers the stack, and another support shelf or tray **164** is manually inserted to receive additional components. As the stacks are lowered they eventually come in contact with a conveyor defined by chains or belts **166, 168** which are suitably driven to convey the stacks outwardly away from the elevator mechanism as shown in FIG. **6**. Since the elevator and conveying mechanism for the component stacks **10A** are substantially similar to those described with respect to the component stacks **10A**, and are shown to have corresponding primed reference numbers.

To drive each of the elevator mechanisms, a preferably two directional independently controlled power source **170**, such as a reversible electric motor is provided and has an output shaft **172** connected to a shaft **174** by means of a timing belt **176** or the like. The shaft **174** is connected to a shaft **178** carrying the sprockets **156** by a flexible rotatable coupling **180**. The coupling is effective to change the direction of rotation of the shaft **178** relative to the shaft **174** as is required so that movement of the opposing angle irons **162** are in the same direction.

Although it is not shown on the drawings, it is preferred that a pneumatic sensor or the like control the power source **170** so that the elevation of the top surface of the stacks is maintained generally constant. In this connection, a pneumatic sensor may be attached to the fingers **146**, and thus monitor the elevation of the top of the components being stacked. When the thickness of the stack approaches 5 inches, a manual override causes the elevator to lower and another tray **164** may be inserted in position to receive added components to build another stack.

Thus, a stacking mechanism has been reached which is adapted to provide reliable operation at high production speeds, and also satisfies the foregoing objects and advantages.

I claim as my invention:

1. Apparatus for stacking generally flat components each of which have one end wider than the other and which are traveling in two adjacent rows, one of said rows having the wider end of each component leading in the downstream direction and the second row having the shorter end of each component leading in the downstream direction, comprising in combination:

a plurality of transversely extending first headers movable about an endless loop and adapted to successively contact the downstream leading end portions of the components of said first row, said endless loop being elongated and having generally flat upper and lower portions with said loop upper portion being gnerally coplanar to the components of said first row as said components are advanced down stream into contact with said first headers, said headers each having fluid passages,

means for communicating a reduced air pressure to said first headers and the fluid passages therein for holding said contacted components against said header,

means for advancing said first headers around said endless loop whereby each said header and component held thereby are inverted relative to their original position,

means for terminating said reduced air pressure of said first headers at a predetermined position of each header to release the component and thereby accumulate said components in a first component stack,

a plurality of second headers movable around a second endless loop adjacent said first loop, said second loop being elongated and having generally flat upper and lower portions with said second loop lower portion being generally coplanar with the components of said second row as said components are advanced into contact with said second headers, said second headers having fluid passages and being adapted to successively contact the downstream leading end portions of the components of said second row,

means for applying a reduced air pressure to said second headers for holding the leading end portion of each of said contacted components against said second headers,

means for advancing said second headers about said second loop and terminating said reduced air pressure applied to said second headers after each header has carried a component held thereby to a predetermined position so that said components are released and accumulated in a second component stack with the wide end of each of the components in said second stack being parallel to and on the same side of said component as are the wide ends of the components of said first stack.

2. Apparatus as defined in claim **1** wherein said first and second headers have a number of outward hollow extensions communicating with said passages, said extensions being spaced apart along the length thereof, and a plurality of spaced fingers positioned adjacent each of said first and second loops near said predetermined positions for extending between said spaced hollow extensions to aid in releasing said components.

3. Apparatus as defined in claim **1** wherein each of said component stacks is supported by an elevator means adapted to lower said stack as said components are placed on each of said component stacks.

4. The apparatus as defined in claim **1** wherein said means for applying a reduced air pressure to said first headers includes a first rotatable turret, a plurality of flexible conduits each connecting said turret to one of said first headers, and means for rotating said turret such that said first headers make one revolution around said first loop per revolution of said turret,

and said means for applying a reduced air pressure to said second headers includes a second rotatable turret, a plurality of conduits each connecting said second turret to one of said second headers, and means for rotating said second turret such that said second headers make one revolution around said second loop per revolution of said turret.

5. A method of stacking generally flat, flexible components each having one end that is wider than the other and traveling in two adjacent rows, one of said rows having the larger end of each component leading and the other row having the shorter end of each component leading, comprising the steps of:

advancing each of said components of said first row downstream into operative relation to movable headers,

applying a reduced air pressure to said movable headers to hold the leading end portion of each component against one of said headers,

advacing said headers around an elongated, endless loop whereby each said header and component are inverted relative to their original position,

terminating said reduced air pressure at a predetermined position of each header to release each of said components and thereby accumulate said components in a first component stack,

advancing each of the components of said second row downstream into operative relation to other movable headers,

applying a reduced air pressure to said other headers to hold the leading end portion of each of said components against said headers,

advancing said other headers along a generally flat portion of a second elongated endless path, and

terminating said reduced air pressure applied to said other headers at a predetermined position of each header to release each of the components carried thereby and accumulate said components in a second component stack with the wide end of each of the components in said second stack being parallel to and on the same side of said component as are the wide ends of the components of said first stack.

6. A method as defined in claim **5** wherein the upper portion of said first loop is generally coplanar with said components as said components are advanced downstream into operative relation to said header.

7. A method as defined in claim **6** wherein the lower generally flat portion of said second elongated endless path is generally coplanar with said other components as said other components are advanced downstream in operative relation with said other movable header.

8. Apparatus for stacking generally flat, flexible components each of which have one end which is wider than the other and which are traveling in two adjacent rows, one of said rows having the wider end of each component leading in the downstream direction and the other row having the shorter end of each component leading in the downstream direction, comprising in combination:

a plurality of transversely extending first headers movable around an elongated, endless loop and adapted to contact the downstream leading end portion of each of the components of said first row, said headers each having fluid passages adapted to communicate a reduced air pressure for holding said components thereto,

means for advancing said first headers around a portion, including the downstream end, of said elongated endless loop and for selectively communicating said reduced air pressure to said headers, and means including flexible conduits connected to each of said first headers, said means being effective to hold said components until reaching a predetermined position after having inverted said components during said advancement, whereupon said reduced pressure is terminated to release said components and form a first component stack,

a plurality of second headers movable around an elongated second loop adjacent and to one side of said first loop, said second headers being adapted to contact the downstream leading end portion the components of said second row, said second headers each having fluid passages adapted to communicate a reduced air pressure for holding said components thereto,

second means for advancing said second headers around said second endless loop and for selectively communicating reduced air pressure to said second headers, said second means including other of said flexible conduits connected to each of said headers, said second means being effective to hold said components during generally horizontal advancement until reaching a predetermined position whereupon said reduced pressure is terminated to form a second component stack with said components positioned with their wider edge parallel to and on the same side of the component as are the wider ends of components of the first stack.

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