July 20, 1965 W. F. SOUTHWELL ETAL 3,195,883

APPARATUS FOR FOLDING FABRICS

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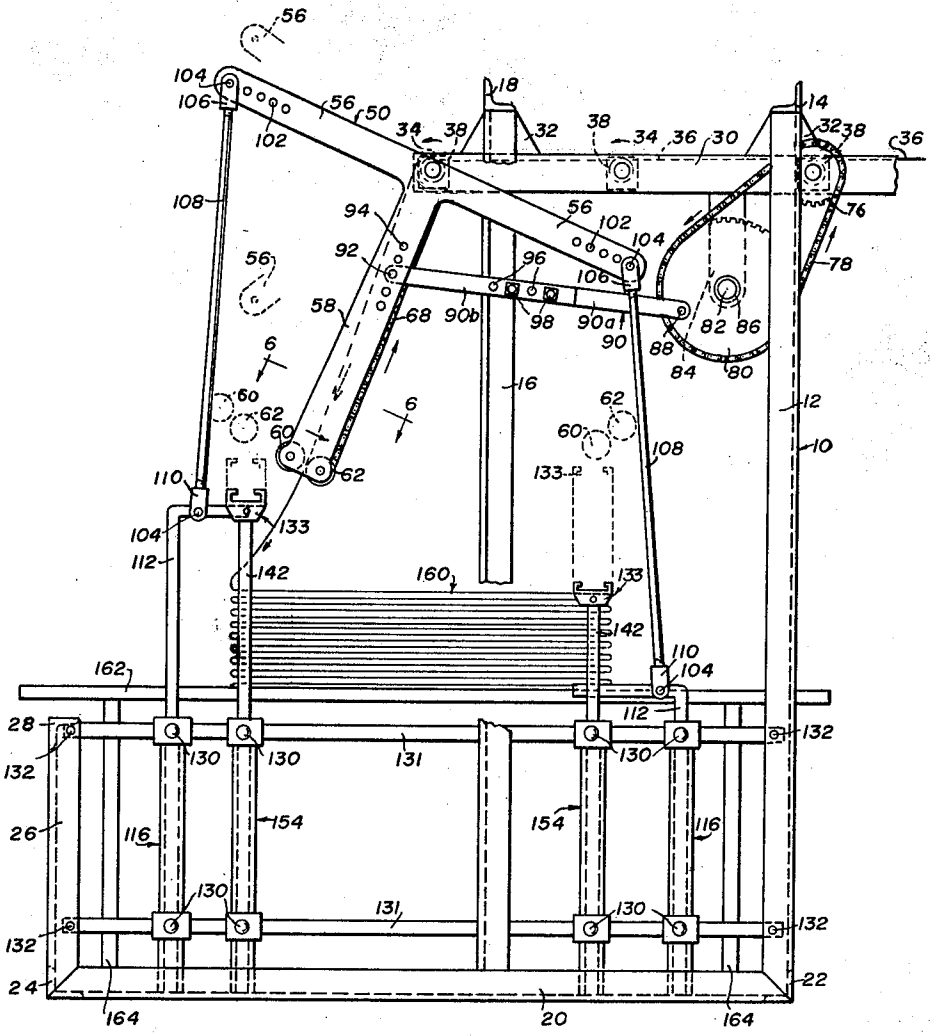


FIG. 1

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APPARATUS FOR FOLDING FABRICS

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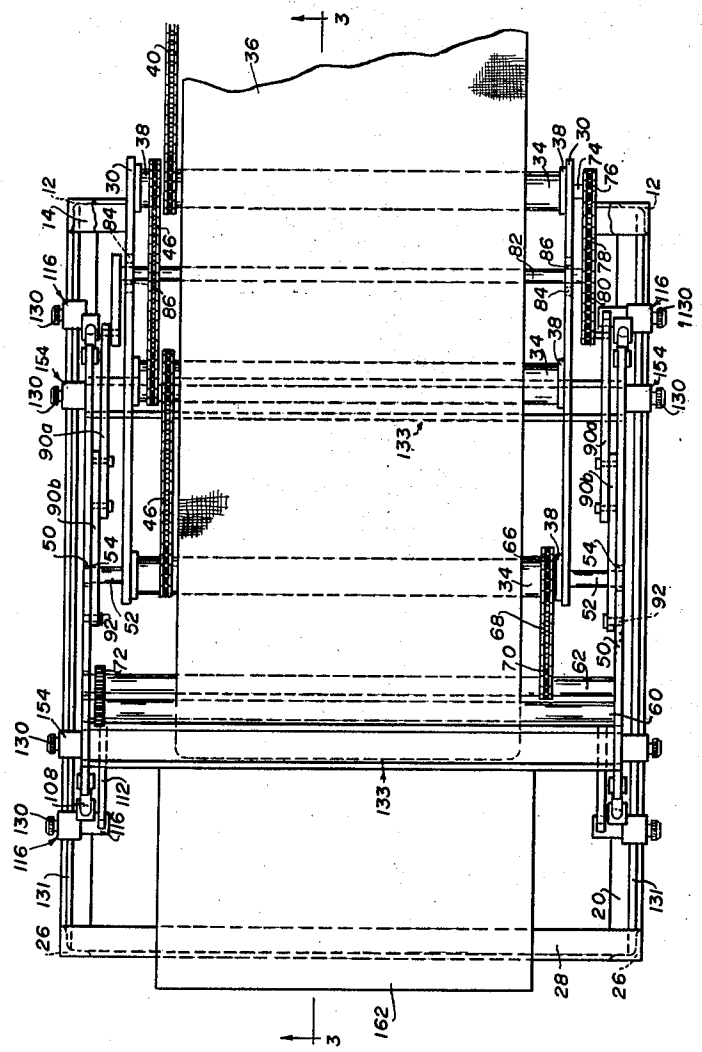


FIG. 2

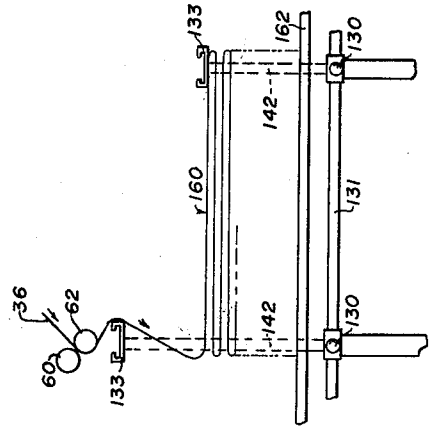


FIG. 4

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APPARATUS FOR FOLDING FABRICS

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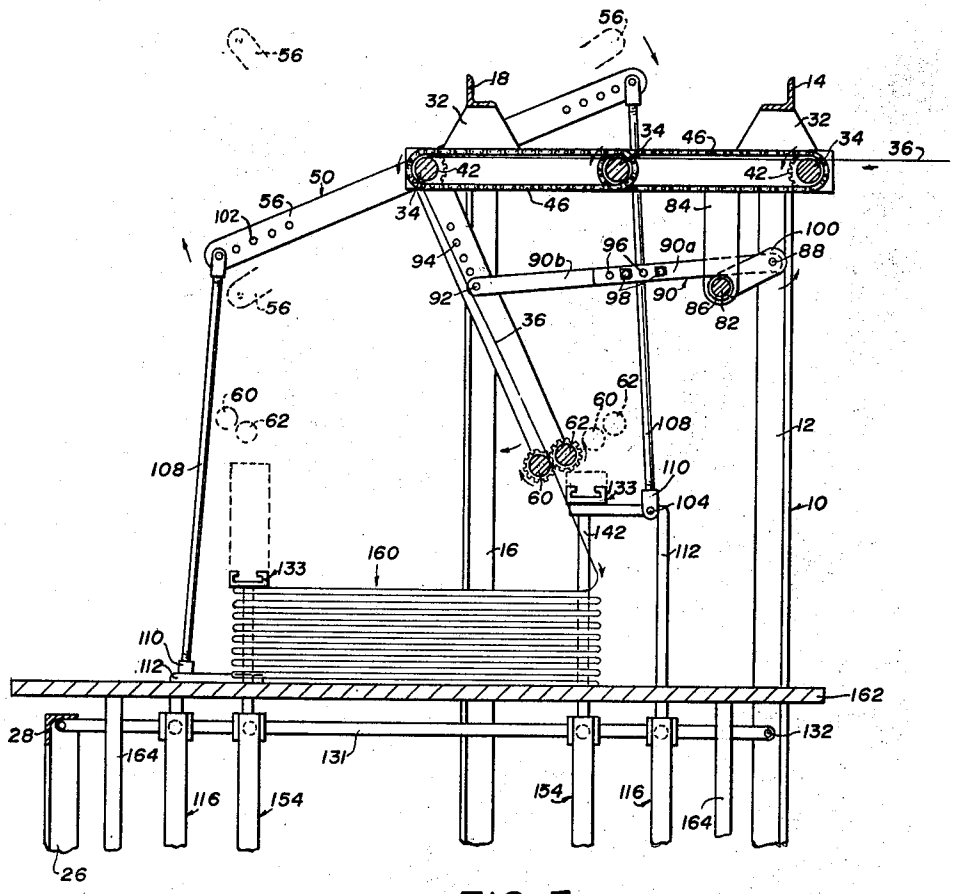


FIG. 3

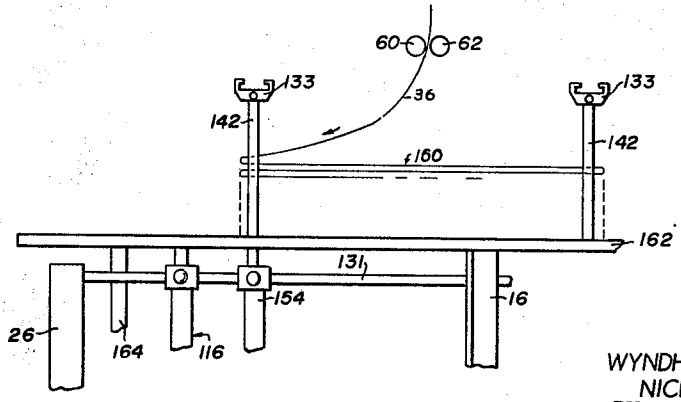


FIG. 5

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APPARATUS FOR FOLDING FABRICS

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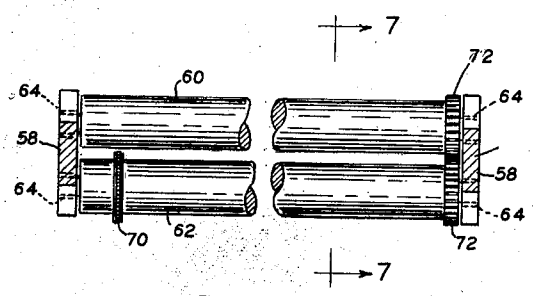


FIG. 6

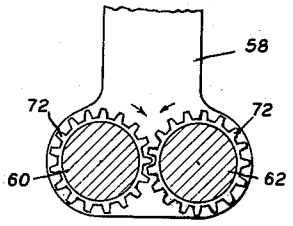


FIG. 7

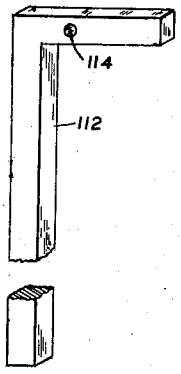


FIG. 8

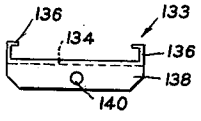


FIG. 10

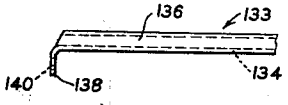


FIG. 11

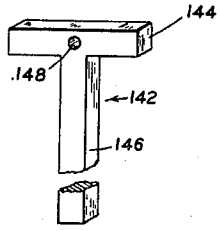


FIG. 12

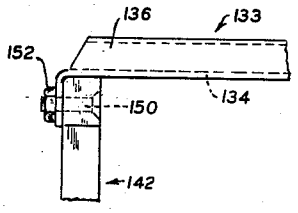


FIG. 13

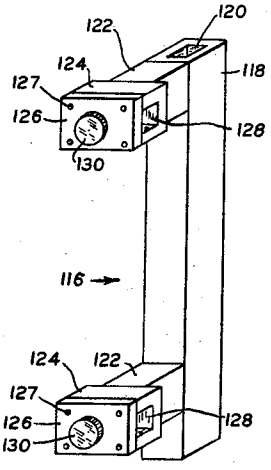


FIG. 9

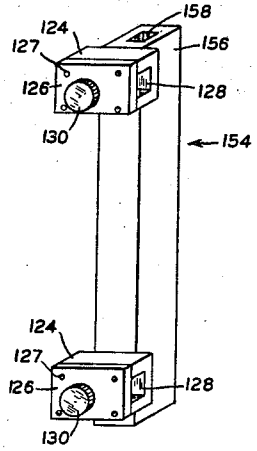


FIG. 14

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APPARATUS FOR FOLDING FABRICS

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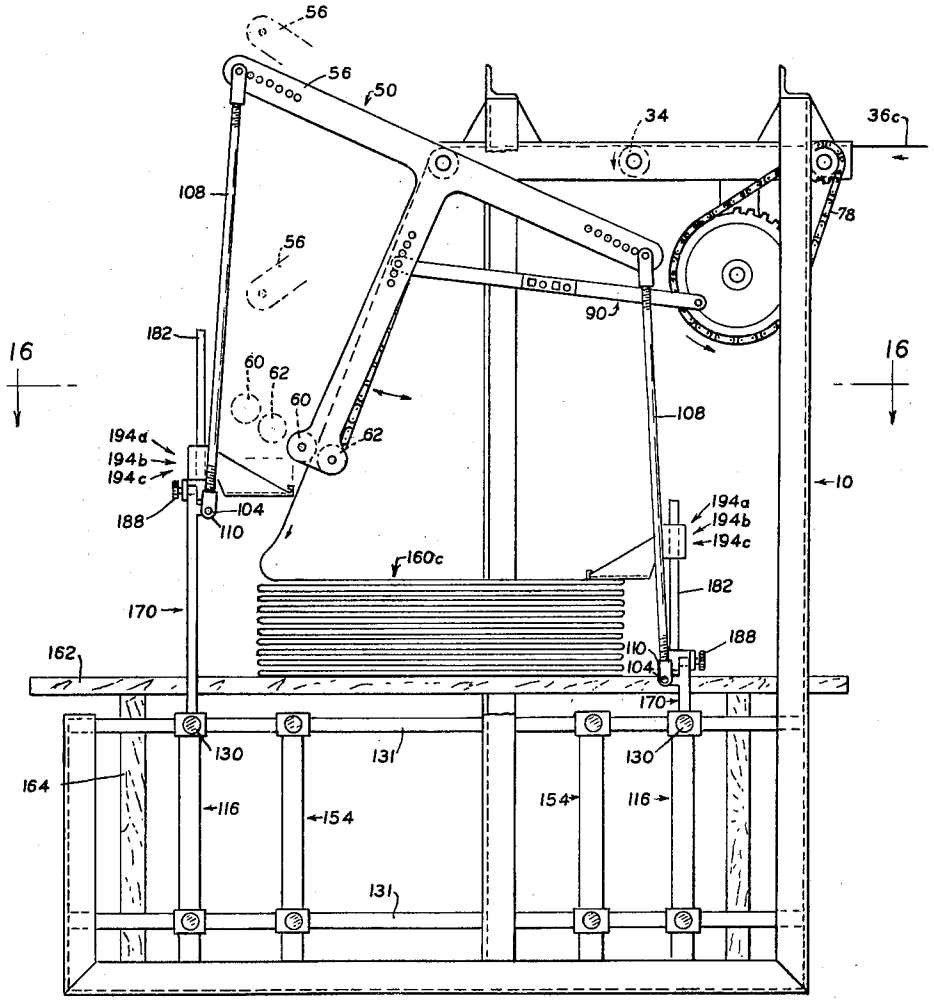


FIG. 15

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APPARATUS FOR FOLDING FABRICS

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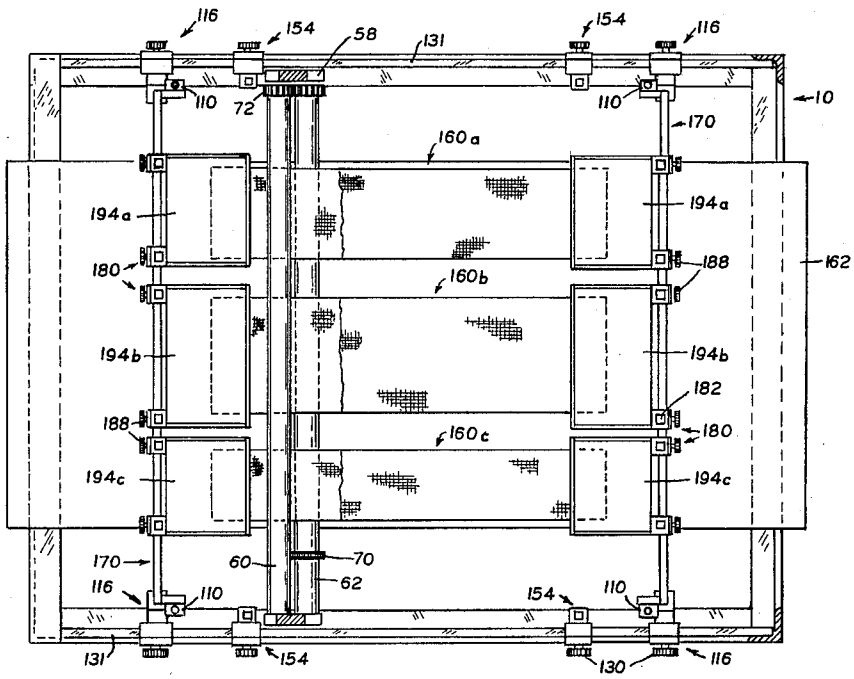


FIG. 16

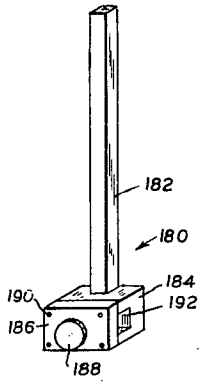


FIG. 18

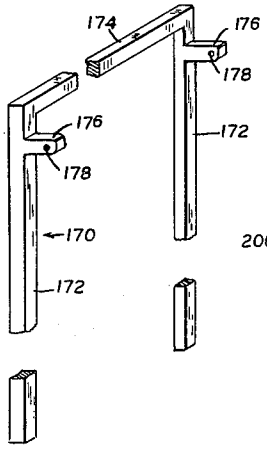


FIG. 17

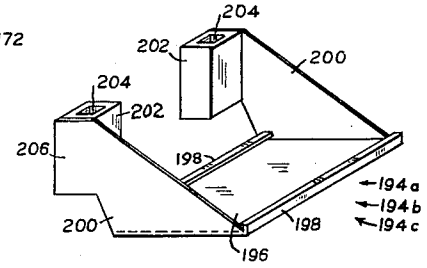


FIG. 19

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APPARATUS FOR FOLDING FABRICS

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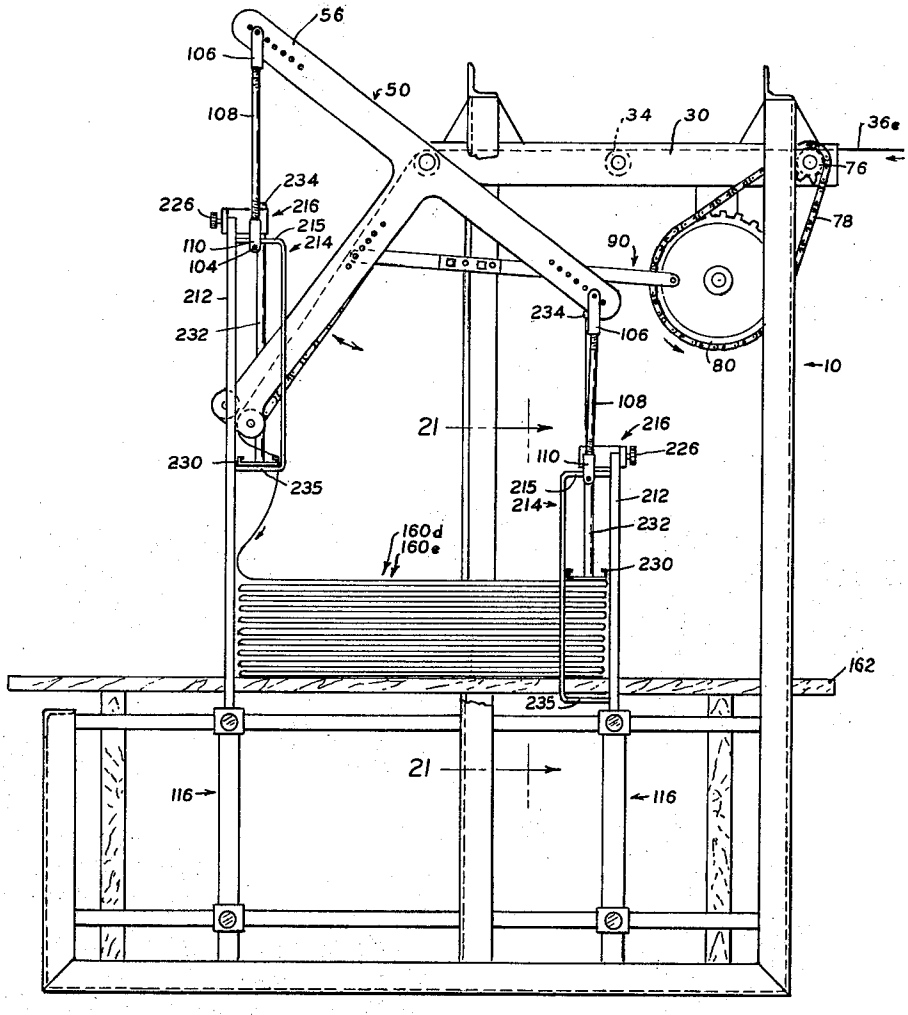


FIG. 20

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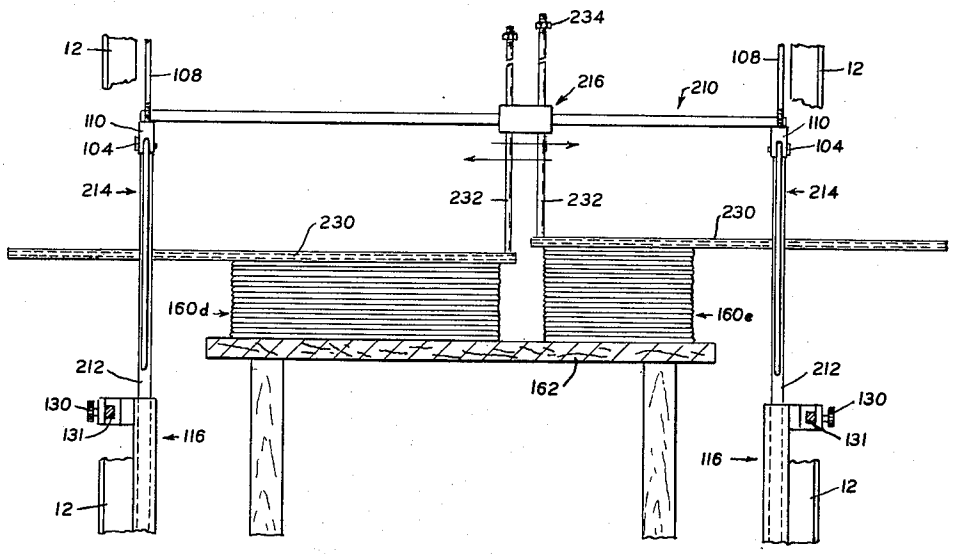


FIG. 21

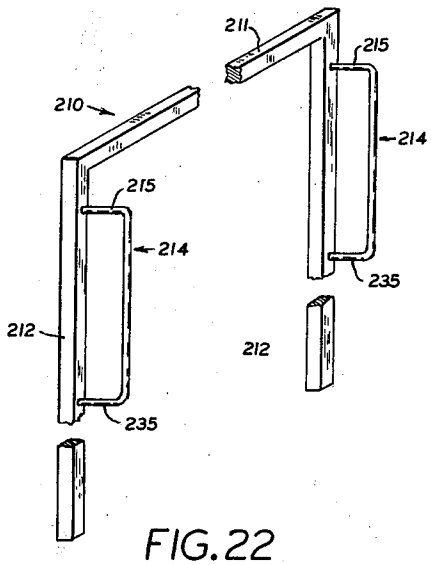


FIG. 22

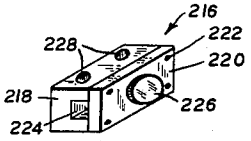


FIG. 23

FIG. 24

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United States Patent Office 3,195,883 Patented July 20, 1965

3,195,883

APPARATUS FOR FOLDING FABRICS

Wyndham F. Southwell, Wilkesboro, and Nicholas Wehrmann, North Wilkesboro, N.C., assignors to L & L Manufacturing, Inc., a corporation of Delaware

Filed May 6, 1963, Ser. No. 277,996
6 Claims. (Cl. 270—79)

This invention relates to improvements in apparatus for folding fabrics and similarly foldable materials and, in certain of its more specific aspects, to apparatus that will simultaneously feed and fold a multiplicity of strips of material of varying widths and thicknesses.

In the production of knitted, woven or otherwise formed strips of fabric or other material, it is often desirable to complete the manufacturing process by folding the material in preselected lengths for cutting, storage, shipping or for use in other work stations. It is accordingly important that no stretching or wrinkling of the material be done while the material is being laid-up. Moreover, when fabric is laid up as it comes from a preshrinking operation, it is important that it be handled in a manner such that the shrinkage control characteristics thereof are not adversely affected.

Present day apparatus used for folding one particular width and thickness of material often knowingly or unknowingly induces longitudinal stresses in the material being folded.

Furthermore, while apparatus adapted for the folding of a strip of material of one particular width, thickness and composition has been available, apparatus for the simultaneous feeding and folding of a multiplicity of strips of material of varying widths, thicknesses and compositions has not heretofore been available.

This invention is accordingly directed toward providing a mechanism which will accurately feed and fold foldable material in a zig-zag manner, and which is readily adaptable for folding materials of different thicknesses, widths, and/or compositions.

It is a further intent that this invention will provide means to smooth and press the folds of the material in a manner that will prevent wrinkling, stretching or distortion of the material and that each fold will lie immediately above each other.

In certain of its aspects, moreover, the invention contemplates the provision of a mechanism adapted to simultaneously feed a multiplicity of strips of varying widths and/or thicknesses, and fold such strips of material in a uniform manner.

It is contemplated that this invention will provide a mechanism which is economical of construction, easy to precisely adjust to varying requirements, and to be trouble-free in operation and performance.

The invention is exemplified in connection with apparatus which provides a feeding means to transport a fabric strip to a distributor arm assembly. A pair of swinging dependent distributor arms in parallel arrangement carry between them at the dependent end a pair of oppositely-turning rollers spaced apart so as to permit free passage of the strip of material. In accordance with the invention in certain of its aspects, the rollers are driven at a faster peripheral speed than the feeding speed of the strip of material. Preferably, the movement of the end of the delivery arm is equal to the delivery speed of the material so as to avoid a drag of the strip by the movement of the arm. As the strip is moved to folding position, a paddle element is raised above it so that a loose fold can be accomplished and then, as the distributor arm moves away from this fold the paddle is lowered so as to engage and press the fold of material.

In certain of its aspects, moreover, the present invention provides paddle elements with guide means movable in vertical guideways so that each paddle as it is raised and lowered always moves in a vertical manner. Preferably each paddle is formed with a flat pressing surface extending at right angles to the vertical guideways. The pressing surface of the paddle, as it is raised and lowered, approaches and presses each just-formed loop of material into a fold. The vertical approach of the paddle causes the fold to be formed without exerting a back and forth movement of the paddle on the fold. For one strip of material a single paddle on each end is required, whereas when a plurality of strips are to be folded, separate paddle elements of suitable lengths are desirably used. A lift element operating in synchronism with the distributor arm raises the paddle or paddles on one end to a selected height. The lift element then lowers the paddle or paddles to the last material fold at whatever height that may be, after which the lift element no longer supports the paddle but itself proceeds to the low point of the operating cycle.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a side view of the folding apparatus;

FIG. 2 is a top view showing the folding apparatus of FIG. 1;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2 and showing the distributor mechanism in a different portion of arc;

FIG. 4 is a fragmentary view showing the flow of the fabric when the distributor mechanism is at one end of its arc;

FIG. 5 is a similar view with the mechanism in the central portion of the arc;

FIG. 6 is a sectional view of the dependent end of the distributor arm taken on the line 6—6 of FIG. 1;

FIG. 7 is a sectional view taken on the line 7—7 of FIG. 6;

FIG. 8 is an isometric view of an L-member;

FIG. 9 is an isometric view of an L-member guide assembly;

FIG. 10 is an end view of a paddle;

FIG. 11 is a partial side view of the paddle of FIG. 10;

FIG. 12 is an isometric view of a paddle guide rod;

FIG. 13 is a partial side view showing the paddle assembled to the guide rod;

FIG. 14 is an isometric view of a guide assembly for the paddle guide rod;

FIG. 15 is a side view of the folding apparatus showing an embodiment adapted for folding multiple strips of material using multiple paddles;

FIG. 16 is a sectional view of the folding apparatus taken on the line 16—16 of FIG. 15;

FIG. 17 is a partial isometric view of a lift bar thereof;

FIG. 18 is an isometric view showing the back of an upright guide assembly thereof;

FIG. 19 is an isometric of a paddle construction thereof;

FIG. 20 is a side view of the apparatus showing a further paddle embodiment for folding one or two strips;

FIG. 21 is a partial end view of the apparatus taken on the line 21—21 of FIG. 20;

FIG. 22 is a partial isometric view of a lift bar bracket assembly used therewith;

FIG. 23 is an isometric view of an adjustable guide bracket for use on the bar of FIG. 22; and

FIG. 24 is a partial isometric view of a paddle and guide rod for use with the apparatus of FIGS. 20–23.

Referring now more particularly to the drawings, one embodiment is shown in FIGS. 1–14 wherein a frame support structure, generally designated as **10**, is construced using a pair of upright members **12** with a tie element **14** connecting the upper ends of the members. A second pair of upright members **16** are located a short distance from end members **12** with a tie element **18** joining the upper ends of these uprights **16**. A pair of base members **20** are joined to members **12** and **16** and form part of the bottom support unit. An end element **22** acts as a base tie and spacer for one end of the frame while on the other end a similar end elements **24** is used as a base and tie for the frame. A pair of short uprights **26** extend upward and terminate with a cross tie element **28** which joins the uprights **26** together. In the particular embodiment shown the frame may be made 3 x 3 x ¼ inch angle iron of welded construction.

Within frame **10** a pair of roller support plates **30** are disposed a short distance below tie elements **12** and **16** and are secured to each tie element by means of gusset plates **32**. Carried by plates **30** are three feed rollers **34** which support and continuously feed a strip of material **36** which is to be folded. The strip **36** as exemplified is a knitted fabric in tubular form with the sides lying one above the other and still connected at their longitudinal edges. Attached to the roller support plates **30** are bearings **38** which support the ends of the feed rollers **34** and enable each roller **34** to turn freely. The speed and rotation of the rollers **34** are controlled by means of a roller chain drive which includes an input driver chain **40** driven from a shaft or motor (not shown) which, in the present instance, is controlled by a preceding operation or apparatus, and sprockets **42** and chains **46**. Since each of the sprockets are of the same pitch and number of teeth and, as in the present instance, the three feed rollers **34** are also of the same size, the rollers **34** will turn at an equal speed and will transport the fabric strip **36** at a predetermined forward speed.

The distributing means in the exemplified embodiment includes two T-frames **50** supported on journals **52** extending through support plates **30**. The journals **52**, in the present instance, are reduced ends of the third feed roller **34**. These T-frames **50** are supported at the junction of the T and are made independent of the movement of the roller **34** by means of a bearing **54** located in the T-frame **50**. In the present instance, the T-frames **50** are disposed outside of support plates **30**. A pair of arms **56** form the top bars of the T-frames **50**, which, as exemplified, swing together in an arc of approximately thirty-eight degrees on each side of the vertical. In FIGS. 1 and 3 this degree of swing is indicated with the ends of the arms **56** shown in phantom outline. By locating the T-frames **50** outside of the support plates **30** the frame can be swung about the arms **56** interfering with the strip **36** as it is carried on the rollers **34**. The depending portion of each T-frame **50** is in the form of a swing arm **58** which has its lower end arranged to support one end of a pair of oppositely turning distributor rollers **60** and **62** between which the strip **36** is fed. In the arrangement shown, the rollers **60** and **62** are arranged so as to provide approximately one-quarter inch space between so as to permit the free passage of a fabric strip **36** therebetween. As shown in FIG. 6 the rollers **60** and **62** have their ends reduced forming journals which turn in bearings **64**. As shown in FIGS. 1 and 2 the power to turn rollers **60** and **62** is derived from a driver sprocket **66** mounted on the third feed roller **34**; and, by means of a driven chain **68**, a driven sprocket **70** mounted on roller **62** is caused to rotate. In the present instance the roller **62** is caused to rotate at a higher peripheral speed than roller **34**, since sprocket **66** has more teeth than sprocket **70**. It has been found that a surface speed of roller **62** amounting to approximately two or three times the surface speed of roller **34** has been most satisfactory. Roller **60** is constructed the same size as roller **62** and is driven at the same speed by means of a pair of matched gears **72** having an equal number of teeth, one gear **72** being mounted on each roller **60** and **62**. Gears **72**, being in mesh with each other (FIG. 7), turn toward each other.

To impart a precise, prescribed swing to the depending arm **58** and moving of this arm at a predetermined rate of speed, a drive system is provided which receives its power and timing from the first feed roller **34**. This feed roller has the end opposite the sprockets **42** and **44** turned down to form a journal **74**. The journal **74** thus formed extends through the bearing **38** and also through support plate **30**. A drive sprocket **76** is mounted on this journal portion extending beyond support plate **30**. Engaging this drive sprocket **76** is a driven chain **78** which transmits power to a driven sprocket **80**. Being a direct ratio drive as shown in FIG. 1, and being a chain and sprocket drive, sprocket **80** is caused to rotate in a selected timed relationship with roller **34**. The sprocket **80** is mounted on a shaft **82** which is supported by a pair of hangers **84**, one hanger being attached to each support plate **30**. This shaft **82** is rotatable in a pair of bearings **86**, one bearing being mounted in each of the hangers **84**. Affixed to the web of the sprocket **80** is a stud **88** upon which one end of a pitman arm **90** is mounted. The other end of the arm **90** is provided with a shoulder bolt **92** which acts as a removable stud in one arm **58**, and which may, for the adjustment to the swing of arm **58**, be inverted in a selected one of a series of holes **94** spaced in a line on arm **58**. It has also been found desirable, in the present instance, to make arm **90** adjustable in length so as to more precisely control and adjust the swing of the arm **58** to an equal amount on both sides of a theoretical vertical position. Pitman arm **90** therefore, in the exemplified embodiment, has been made in two elements designated as **90*a*** and **90*b***. A series of equally spaced holes **96** in both pieces are arranged so that two bolts **98** are able to fasten the elements **90*a*** and **90*b*** to provide an arm **90** of desired length. The selection of a hole **94** in arm **58** and the assembly of arm **90** by bolts **98** in holes **96** as selected enable the operator to precisely adjust the amount of swing of arms **58**, as well as equalizing the swing of the arm to equal amounts on each side of the vertical position. The near pitman arm **90** as seen in FIG. 1 is driven by the sprocket **80** while a corresponding pitman arm **90**, similarly assembled, is arranged to drive the far side arm **58**. As seen in FIG. 3, a crank arm **100** is attached to shaft **82** on the end opposite sprocket **80**. The crank **100** also has a stud **88** mounted theron and at the same distance from the axis of the shaft **82** as the stud **88** in sprocket **80**. The stud **88** on the sprocket **80** and the stud **88** on the crank arm **100** are also mounted so as to have a common axis.

The apparatus described above controls the movement of the strip of fabric **36** in such a manner that the strip is delivered to the folding operation in an even and smooth manner. The speed of the strip **36** is the speed at which it is delivered to the three rollers **34**. The strip is then transported at that same delivered speed on the three rollers **34** whereupon it then extends downwardly toward the lower end of the swing arm **58** where, between rollers **60** and **62**, the strip is fed to the folding operation. As the arm **58** is caused to be swung back and forth, the strip will alternately contact either roller **60** or **62** depending on the direction of swing of the arm **58**. As described above, rollers **60** and **62** revolve at a peripheral speed in excess of the speed of the strip, therefore the strip between the last roller **34** and the contacting roller **60** or **62** will be maintained in a relatively taut condition during the major portion of each swing, and the excess speed of the roller **60** or **62** will urge the strip from the roller so that the strip that has passed the roller **60** or **62** will be effectively dispensed for zig-zag layup folding.

As one complete swing of arm **58** will cause one length of strip to be dispensed, it is important to a smooth, wrinkle-free lay-up that each fold be held and pressed in the laid up position, and that this just deposited length be held in fixed relationship to the previously placed lengths. To hold the deposited strip **36** in position and to assist in smoothing the fold, there is provided a movable pressure plate contacting each fold area. In the present instance these plates are called "paddles" for the sake of convenience.

It is important that the folding mechanism perform its function in timed relationship to the movement of the dependent arm **58**. In the preferred embodiment the T-frame **50** is arranged so as to utilize the arms **56** forming the top bar of the T-frame so as to activate in a positive manner the lifting of the paddles. The arms **56** extending at right angles from arm **58** each have near their outer end a series of holes **102**. Through one of these holes **102** is placed a clevis pin **104** which is used to hold a clevis end **106** in pivotal relationship to lever arm **56**. A threaded hole is formed in the clevis end **106** so that a rod member **108** may be threaded and screwed into the clevis end **106**. A pivot block **110** or clevis, having an oppositely threaded hole, is screwed onto the other end of rod **108**. The oppositely threaded ends of the rod **108** enable the rod to act as a turnbuckle adjuster. As seen in FIG. 2, there are four rods **108** used in the exemplified apparatus.

The lower end of the paddle operating mechanism is maintained in fixed relationship to the swing of the arm **58** by providing adjustably locatable guide means acting in cooperation with the paddles. An L-shaped member **112** (FIGS. 1, 3 and 8) is preferably formed from a metallic bar having a square cross section which, in the present instance, is made of a three-quarter inch square bar. A pivot pin hole **114** is formed in the short leg of member **112** through which a clevis pin **104** is inserted to pivotally connect L-member **112** to pivot block **110**. A guide tube assembly **116** (FIGS. 1, 3 and 9) provides a guide and locating means whereby L-member **112** is permitted to move only in a vertical manner when lifted and lowered by the swinging of arm **56**. The assembly **116**, as exemplified, comprises a square tube **118** of metallic construction and having a square passageway **120** therethrough. In use, the tube **118** is made square and straight, and has been found to provide a satisfactory sliding fit for member **112** when the passageway **120** is approximately thirteen-sixteenths inch square. Two spacer blocks **122** are attached to one of the outer sides of the tube **118**. These blocks **122** are arranged in a selected fixed spaced relationship with each other and with the top of the tube **118**. A U-guide and slide block **124** is attached to each spacer block **122** with the open part of the U facing outwardly and at right angles to the axis of tube **118**. A cover plate **126** is attached to the U-block by means of screws **127** closing the top of the U. A rectangular passageway **128** is thus formed by the U-block **122** and the plate **126**. A locking screw **130** is engaged in a threaded hold formed in plate **126**. The inner end of the hole opens into the passageway **128** so that screw **130** may be turned into the passageway **128**. A rectangular guide bar **131** is of a size so as to be slidable in the passageway **128** of the assembly **116**. In the embodiment shown, two guide bars **131** are used on each longitudinal side of frame **10**. Each pair of bars **131** are mounted in spaced, parallel relationship on uprights **12** and **26** by means of an attaching bolt **132** on each end of a bar **131**.

A paddle **133** made of aluminum, wood or other suitable material is shown in FIGS. 10, 11 and 13. In the instant exemplification the paddle **133** is constructed of aluminum sheet material approximately one-eighth of an inch thick and is formed with a flat pressing section **134**. A stiffening rib **136** is formed by turning upwardly then inwardly each lengthwise edge of the flat section **134**.

These stiffening ribs provide the necessary rigidity to section **134** so that the paddle will press with its own certain additional weight, if necessary, without untoward or excessive bending. The stiffening ribs **136** also provide a means of providing a smooth front and back edge to the section **134**. A turned tab end **138** is formed on each end of the paddle **133** by turning downwardly a small portion of the flat section **134**. An attaching hole **140** is constructed in each tabe end **138**. A T-shaped paddle guide rod **142** is shown in FIGS. 12 and 13 and in the preferred embodiment is made of three-quarter inch square metallic rod. A top bar element **144** is made of a length adapted to fit under and support the paddle **133** and, as shown, is constructed approximately the same length as the width of the flat pressing section **134**. A guide section **146** joins the center of the top bar element **144** and, as shown, forms a common plane with the top bar element. A bolt hole **148** is made through the top bar element **144**, the hole being spaced from the top of the bar a distance equal to the distance of hole **140** to the underside of flat section **134**. A bolt **150** and a nut **152** are used to assemble one guide rod **142** to each end of the paddle **138**. When the bolt and nut are tightened the top of bar element **144** abuts the underside of flat section **134** so that guide section **146** is rigidly held at substantially right angles to the paddle **133**.

A paddle guide assembly **154** (FIG. 14) is constructed so as to provide a vertical guide means for the guide section **146**. As shown, a guide tube **156** is of similar size and construction to square tube **118**. The guideway **158** is similarly square and in the preferred example is thirteen-sixteenths inch square. A pair of U-guide blocks **124** are attached to one side of the guide tube **156**, the blocks **124** being in the same spaced relationship and at right angles to the axis of tube **156** as the blocks **124** on assembly **116**. A cover plate **126** is attached to each U-block **124** by means of screws **127**, the cover plate closing the top of the U and forming a rectangular passageway **128**. Locking screw **130** is also provided in each plate **126** as in assembly **116**. When mounted on the pair of rectangular guide bars **131** as in FIG. 1 the guide assembly **154** provides an adjustable guide means for maintaining the paddle **133** in a preselected location yet provides a means whereby the paddle may be lifted and lowered in a vertical manner.

A folded pile **160** (FIG. 1) is laid up in a zig-zag manner as strip **36** is distributed from the end of the swinging arm **58**. A support surface for the successively placed layers of material that forms the pile **160** is provided by a table top **162** which in the present instance is supported by legs **164**. It is to be noted that the table top **162** preferably extends beyond both ends of frame **10**; however, the table top is made narrower than the distance between the L-members **112** so that ready adjustment of the paddle operation mechanism may be made with the minimum effort.

As the pile **160** is being formed, the paddle **133** is caused to be alternately lifted and lowered in a reciprocating manner. To insure that each fold is made even and wrinkle free, while also maintaining the intervening measured length in a smooth and unstretched condition, the paddle **133** is moved in a controlled manner toward the fold being made. In the exemplified embodiment the paddles **133** move in a vertical path while the material being piled lies horizontally on the table top **162**. Accordingly paddle guide assembly **154** is clamped in a vertical position on guide bars **131** and guide section **146** is inserted therein. Paddle **133** is now free to be lifted up and lowered, as controlled vertically by guide assembly **154**.

As noted previously, the guide assembly **116** is constructed with tube **118** spaced away from guide block **124** by means of spacer **122** so that guideway **120** is farther from the bars **131** than the guideway **158** of paddle guide assembly **154**. L-member **112**, when inserted in a guide-

way **120**, is thus able to be brought under paddle **133** without interferring with T-guide rod **142** and, when activated by the swing of arm **58**, contacts paddle pressing surface **134** and lifts the paddle to the phantom outline shown in FIG. 1. As L-member **112** is lowered, the paddle **133**, resting thereon, will move downwardly until the paddle engages the pile **160** whence the paddle will stop and L-member **112** will continue to move downwardly to its low point just above guide assembly **116**.

In certain applications of this equipment it is desirable to simultaneously feed and fold a plurality of strips, often of different widths, and frequently of different materials and/or thicknesses. A form of apparatus arranged to simultaneously fold three strips of different widths is shown in FIGS. 15 thru 19. The apparatus as described above is unchanged except as indicated below. To convert to the multiple folding of strips, the paddles **133** are removed by lifting them out of guide assemblies **154** and L-members **112** are disconnected from pivot blocks **110** and removed from guide assemblies **116**. In the multiple folding of strips, the guide assemblies **154** are not used but are left on guide bars **131** at a location which does not interfere with the other paddle operations.

As exemplified in FIGS. 15 and 16 three strips of material **36***a*, **36***b* and **36***c* of different widths are shown folded as piles **160***a*, **160***b* and **160***c* on table top **162**. The feeding and piling of the strips is the same as described above for the feeding of one strip except that the three strips are fed in spaced side-by-side relationship from a previous operation or storage source. As the strip material **36***a*, **36***b* and **36***c* may be of different thicknesses, the piles **160***a*, **160***b* and **160***c* often reach different heights at different times, which requires that the paddles for pressing the folds operate independently of each other. A lift bar **170** (FIGS. 15, 16 and 17) of a generally U-shape has two downwardly directed square guide elements **172**. The two guide elements **172** are attached at one end to a square cross bar **174**. Short extension arms **176** are attached to each guide element **172**. A hole **178** is made in each arm **176**, the hole **178** being adapted for use with pin **104**. The lift bar **170** is brought into position and each element **172** is inserted into a guideway **120** of a guide assembly **116** on each side of the apparatus. In the present instance, as shown in FIGS. 15 and 16, six upright guide assemblies **180** are mounted on each bar **174**. Each guide assembly **180** (FIG. 18) comprises an upright guide bar **182** attached to or made a part of a U-slide block **184**. A cover plate **186** has a tightening thumb screw **188** engaged in a threaded hole in each plate **186**. Attaching screws **190** are used to fasten plate **186** to the open side of the U, the cover plate **186** and U-block **184** forming a passageway **192** adapted to slide on bar **174**.

Three paddle assemblies **194***a*, **194***b* and **194***c* are used with each bar **174**. Each paddle assembly (FIG. 19) is selected so that it is at least slightly longer than the width of the strip being folded. In the present instance, a pressing surface element **196** is made from aluminum sheet stock approximately one-eighth of an inch thick. A stiffening rib **198** formed from each front and back edge of element **196** is made similar in construction and use as rib **136** in paddle **133**. A turned upward tab end **200** is also made by cutting and bending upwardly a portion of element **196**. A square guide tube **202** is attached to each tab end **200**, each tube having a square guideway **204** therethrough, the guideway being at right angles to the pressing surface element **196**. It is to be noted that the tab ends **200** are formed with an offset **206** extending behind and above element **196**. This offset **206** is constructed so that when the paddle assembly **194** is slidably mounted on a pair of upright guide bars **182** the offset **206** with tube **202** attached is disposed above the under part of element **196** an amount sufficient for bar **174** with guide assembly **180** mounted thereon to rest on table top **162** while simultaneously the under surface of pressing surface element **196** also rests on the same table top **162**.

Still another form of apparatus is shown in FIGS. 20 through 24. In this form of construction, the paddle can be readily arranged for operation in connection with the folding of a single strip or of two strips either of the same width or of unequal widths such as **36***d* and **36***e* forming piles **160***d* and **160***e*. The mechanism of FIGS. 1–14 as disclosed above is used with the exception of the paddles **133**, L-members **112** and guide rods **142**. The guide assemblies **154** are removed from bars **131**, and the guides **116** are arranged and clamped on bars **131** near the position of the strip fold. An inverted U-shaped lift bar **210** (FIG. 22), as shown, is formed with a cross piece **211** and a pair of parallel square guide portions **212** adapted to slide freely in passageways **120** of guides **116**. Attached to each portion **212** and forming a paddle retainer and support therewith is a U-bracket **214**, having an upper horizontal portion **215** over which the clevis **110** fits, and pin **104** is inserted into the clevis so as to engage the under portion of the horizontal portion **215**.

Slidable on the cross piece **211** of bar **210** is a guide block assembly **216** which includes U-block **218** with a channel formed in one face. A cover plate **220** is attached to the block by means of screws **222** and forms therewith a slide guideway **224** of a size to be readily slid along the cross piece **211**. Engaging a threaded hole in plate **220** is a locking screw **226** whose inner end is adapted to enter guideway **224** and engage cross piece **211** so as to lock the assembly **216** at the desired position on the cross piece. Also located in block **218** are two rod guideways **228** for a rod to be hereinafter described.

Operating in conjunction with each bar **210** is a pair of paddles **230** (FIG. 24) which, in the present instance, are of aluminum and of the same size in cross-section as paddles **133** described above, but slightly shorter as shown. Attached at the inner end of each paddle and extending upwardly is a guide rod **232** which in the preferred instance has the upper end threaded. The paddle **230** is mounted with the outer end extending through the opening between portion **212** and bracket **214**, and with the rod **232** passing through and freely slidable within a guideway **228**. A nut **234** is mounted on rod **232** and is adjusted so as to level paddle **230** as it rests on the lower horizontal portion **235** of bracket **214**. It is to be noted in FIG. 21 that the inner ends of the paddles **230** are arranged so that there is approximately one inch between these ends of the paddles, permitting the paddles to rest on piles of different heights. It is to be noted that paddles **230** are made of sufficient length so that either one or the other of a pair may rest on a single pile of fabric the operating width of the table, the other paddle of such pair being removed in this instance. As shown in FIG. 21, however, the paddles are arranged so that the right-hand portion of the left-hand paddle rests on the wider pile **160***d* and the left-hand portion of the right-hand paddle rests on the narrower pile **160***e*, with the outer end portion of each paddle extending outwardly beyond its bracket **214**.

Use and operation

In the exemplified illustration the strip or strips of material **36** is transported from a previous process or storage source by means of a trio of feed rollers **34**. As the material is fed at a preselected speed, the pitman arm **90** is caused to move at a speed regulated by the rotation of the rollers. It is to be noted that the pitman arm movement is a translation of a circular motion described by stud **88** to an arcuate motion as described by shoulder bolt **92**. Accordingly arm **58** will be moved at a variable rate equal to a plotted cosine curve and will move most slowly at the apex or each end of the arc of swing. The

slowing of the arm **58** during the time the fold is being made permits an adequate amount of material to be dispensed to make a smooth regulated fold. The strip **36** after leaving the last of the rollers **34** is directed downwardly between rollers **60** and **62** which are mounted on the end of the swinging arm **58**. The rollers **60** and **62** are driven at a surface speed approximately twice the speed of the moving strip. The excess speed of these rollers causes the strip to be pulled taut from the last roller **34** to the contacting roller **60** or **62**. The excess speed additionally insures that the traveling material is prevented from congesting at the end of the delivery arm and that the material is deposited smoothly to the table top **162** or pile **160**. The strip as it is deposited is laid in predetermined lengths as controlled by the extent of the swing of the arm. As the arm **58** moves toward the extremes of its swing, the paddles **133** or **194***a*, **194***b*, and **194***c* or **230** is lifted to the phantom outlines shown in FIGS. 1, 3 and 15 or as shown in FIG. 20, as the case may be, the lifting of the paddles being by means of the upward swing of arm **56**. At the apex of its swing the arm **58** carries rollers **60** and **62** overtop the paddle and with the slow movement of arms **58** and **56** and with the constant delivery speed of the strip the material is caused to billow under the paddle in a soft loop. As the delivery arm **58** moves away from the end of the swing the paddle is caused to be lowered smoothing and pressing the loop of material into a smooth fold of material. As the operation is repeated the paddle is lifted and lowered smoothing and pressing successively each fold of material, the paddle lowering only as far as the top of the pile of material. Meanwhile, on the opposite end, a similar paddle is moving and operating a hundred and eighty degrees out of phase.

In the apparatus shown and described above there are provided precise adjustments whereby the length of the pile **160** can be predetermined and set by the operator. The length of the material from fold to fold is made by adjusting the stroke of the arm **58**. The paddle is then moved to a position just over the fold. The relocation of the paddle is made by loosening the lock screws **130** and moving guide assemblies **116** and **154** on bars **131** until the paddle just covers the fold of the fabric, after which the lock screws **130** are tightened. The adjustment of the lift of the paddle from the table top **162** to the height desired by the operator is made by moving clevis **106** to whichever hole **102** is desired and then turning the rod **108** for the final adjustment.

When a plurality of strips *36a*, *36b* and *36c* are to be dispensed and folded each paddle **194***a*, **194***b* and **194***c* is selected of greater length than the strip being folded. As shown, each paddle is mounted on and slides on a pair of guide assemblies **180** mounted on lift bar **170**. The guide assemblies **180** are arranged in the desired locations by first loosening thumb screws **188**, moving the assemblies as required on cross bar **174** then reclamping the assemblies **180** by tightening the thumb screws **188** against bar **174**. All the paddles **194** on one lift bar **170** are moved to accommodate the folds being made. The paddles are repositioned over the fold by moving oppositely disposed guide assemblies **116** on guide bars **131**. To adjust the assembly **116**, the locking screws **130** are first loosened, and the assembly **116** is moved to the desired position on guide rods **131** and then reclamped by tightening locking screws **130**. The paddle-lifting height is adjusted as outlined above. When a pile of material has reached the maximum or desired height the operator pulls the folded pile from under the apparatus which then proceeds to make another zig-zag folded pile of material.

To arrange the apparatus for two strips as in FIGS. 20 and 21, the screw **226** of guide assembly **216** is loosened and the assembly moved laterally on bar **211** until each paddle is over the end of the strip being folded. The assembly is then clamped by tightening screw **226**. The other adjustments for guide assemblies **116** and the swing of arm **58** is performed in the manner described above. No adjustment of assembly **216** is necessary to change over to run a single strip in this apparatus if the two paddles **230** on one side are to be operated as one when pressing and folding a single larger strip.

Since certain changes may be made in the above article and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. Folding apparatus for strip material, comprising means for providing a material-supporting surface at a preselected fixed position, means for laying-up a strip of material in zig-zag folded arrangement on said support surface, said laying-up means including a swinging arm and a pair of spaced-apart inwardly-turning rollers mounted on the end of said arm in generally horizontal relationship with each other, means to feed a strip material between said rollers, means to turn said rollers at a surface speed at least as great as the speed of the strip material fed thereto, at least one pair of paddles each adapted to be moved upwardly and then permitted to move downwardly to engage and press a just-formed fold of said strip material, and means operating in timed relationship to said swinging arm to alternately operate the paddles of a pair to press the folded-over edges of said strip material on each side while a fold on the other side is being provided by said laying-up means.

2. Folding apparatus for laying-up traveling strip of material in zig-zag folded arrangement comprising means providing a support surface for the folded material at a preselected fixed position, a swingably-mounted distributor arm assembly, means for swinging said arm assembly, adjustable means for controlling the extent of swing of said arm assembly to control the extent of fabric between folds, a pair of spaced rollers mounted on the end of said arm in generally horizontal relationship with each other, means to rotate said rollers inwardly at their upper surfaces at a surface speed not less than the effective speed of the feeding means, at least one pair of movable paddles movable between upward and downward positions and adapted to engage and press the just formed folds of strip material, means operable to lift each paddle while a fold is being made and operable for the lowering of the paddle to fold engaging position, and means to operate the last-mentioned means in timed relationship to the swinging of the distributor arm assembly.

3. Folding apparatus for traveling strip material comprising means providing a support surface at a given height, means swingable over said surface for simultaneously laying-up a plurality of strips of material in zig-zag folded arrangement in piles disposed in edge-to-edge relationship on said surface at said height, means for feeding a plurality of strips of material in generally edge-to-edge relationship to said swingable means, means for pressing the folds at the respective sides of the material in one pile as it is laid up, other means for pressing the folds at the respective sides of the material in another pile as it is laid up, means for synchronously positioning at the same height all the positioning means at any one side and for permitting them to drop each individually to whatever particular height may be determined by the particular height of a pile of a particular strip thereunder, and means to move all the pressing means on the same side downwardly simultaneously.

4. Folding apparatus for traveling strip material comprising means providing a support surface for the material at a given height, means for simultaneously laying-up each of a plurality of strips in piles in zig-zag folded

arrangement in edge-to-edge relationship on said support surface at said height, a presser member movable toward the just-formed fold at each side of one of said strips to engage and press the same while a fold at the other side is being made, an additional presser member movable toward the just-formed fold at each side of another of said strips to engage and press the same while a fold at the other side is being made regardless of the relative heights of the respective piles, and means at each side for synchronously positioning at the same height the pressing members at that side and for permitting them to drop each individually to whatever height may be determined by the particular height of a pile of a particular strip thereunder.

5. Folding apparatus for traveling strip material comprising means providing a material-supporting surface disposed at a preselected fixed position, means swingable over said surface for simultaneously laying-up a plurality of strips in a zig-zag folded arrangement in piles disposed in edge-to-edge relationship, means for feeding a plurality of strips of material in generally edge-to-edge relationship to said swingable means, means at each side for pressing the folds of the material in one pile as it is laid up, other means for pressing the folds of the material in another pile as it is laid up, and means for synchronously positioning the the same height all the positioning means at any one side and for permitting them to drop each individually to whatever particular height may be determined by the particular height of a pile of a particular strip thereunder.

6. Folding apparatus as in claim 3 wherein the support surface for the material is disposed at a preselected fixed position.

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