Jan. 21, 1969 V. D. SHERRILL 3,423,083

APPARATUS FOR FOLDING FABRIC

Filed Dec. 9, 1966 Sheet 1 of 6

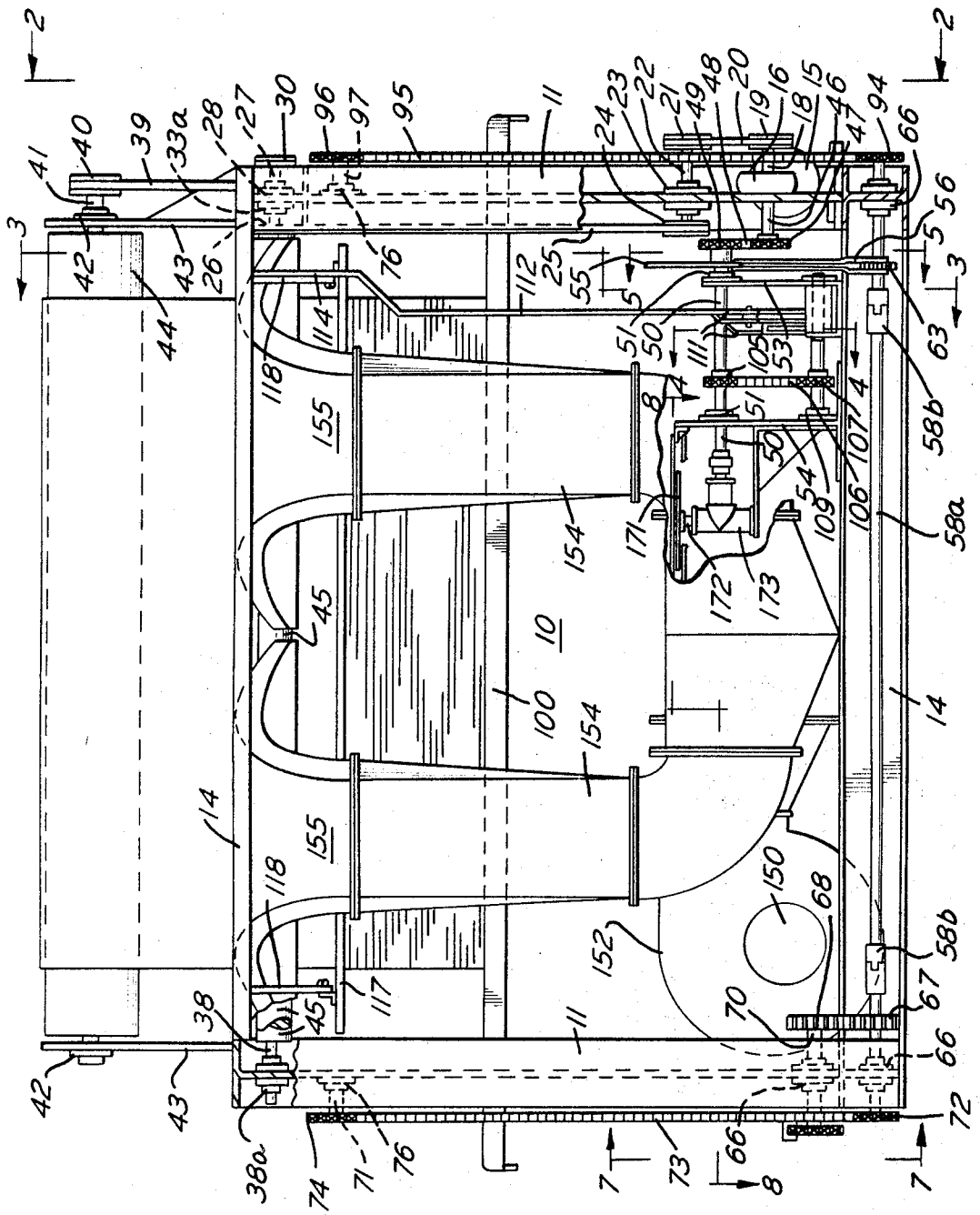


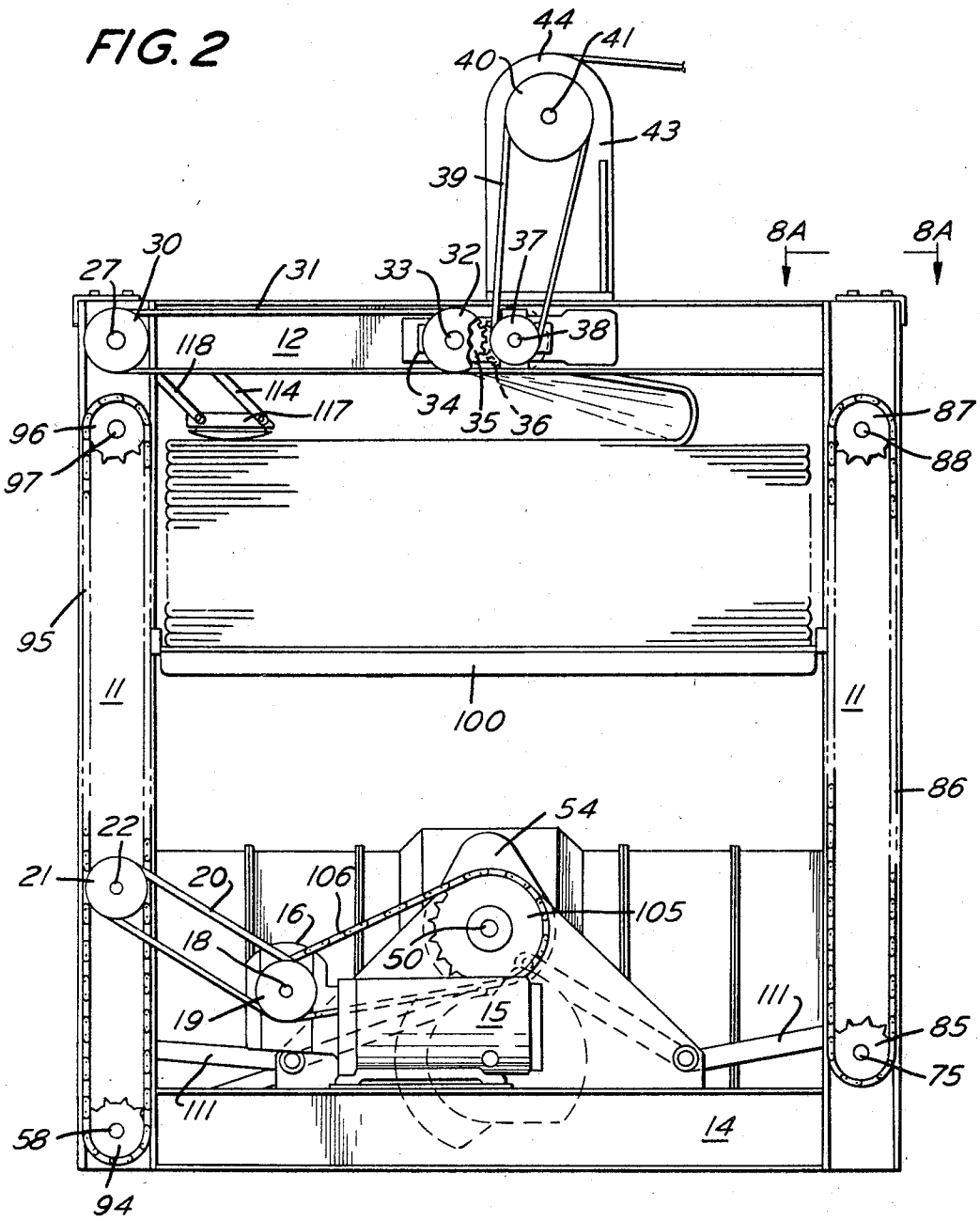
FIG. 1

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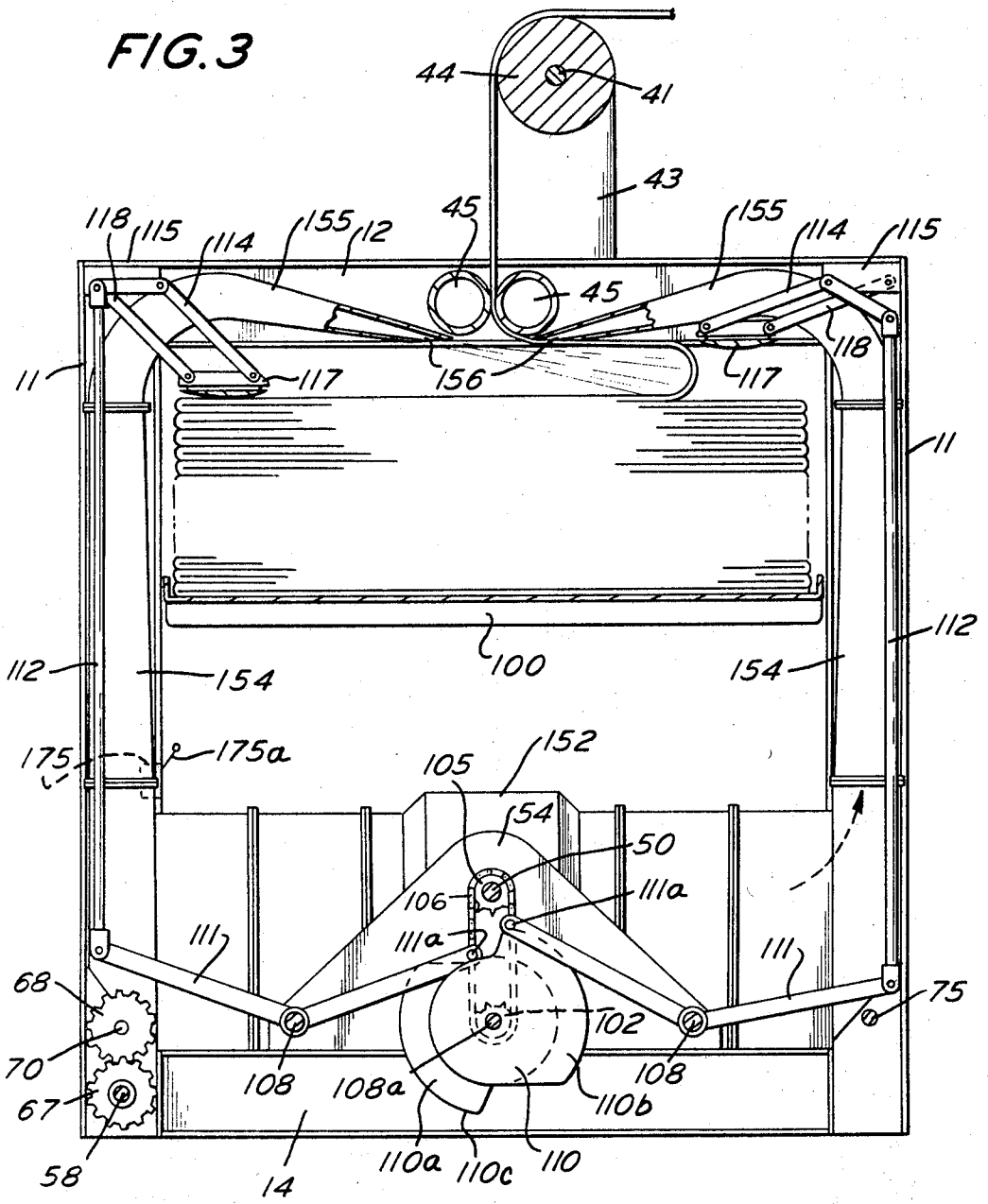
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FIG. 2



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FIG. 3



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APPARATUS FOR FOLDING FABRIC

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FIG. 4

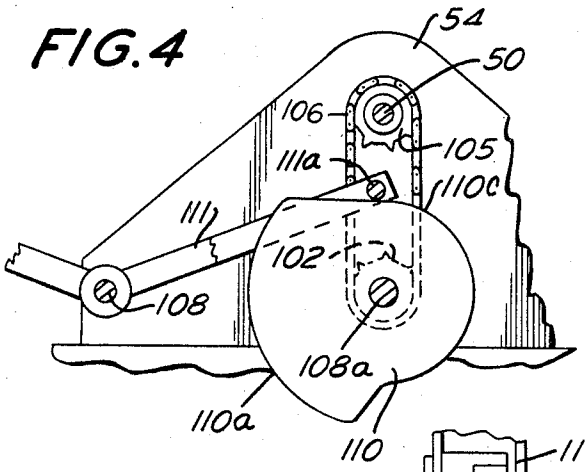


FIG. 5

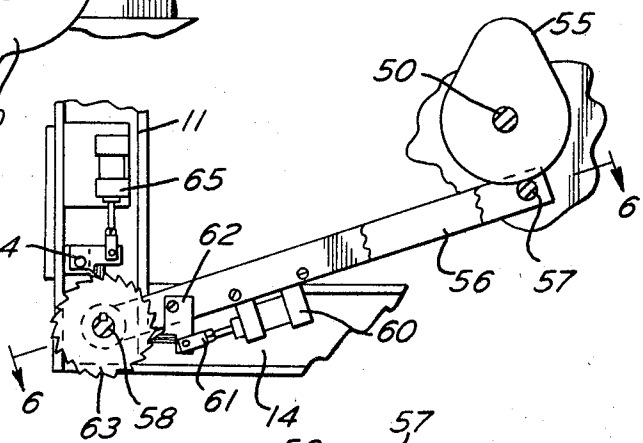
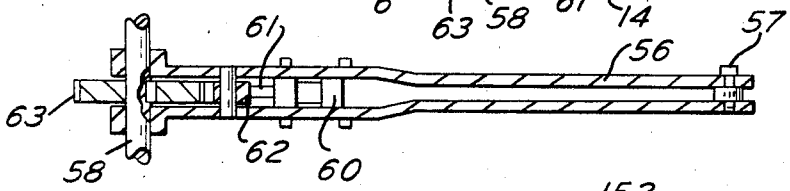


FIG. 6



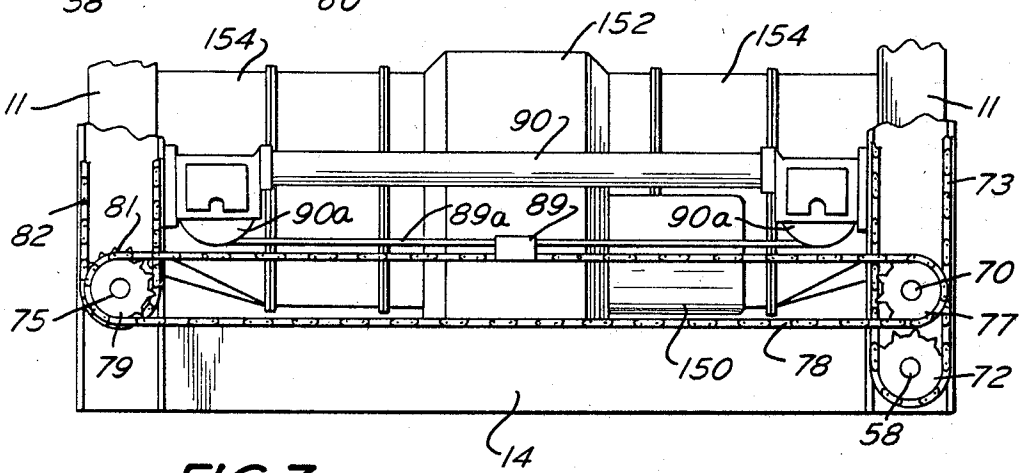


FIG. 7

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FIG.8

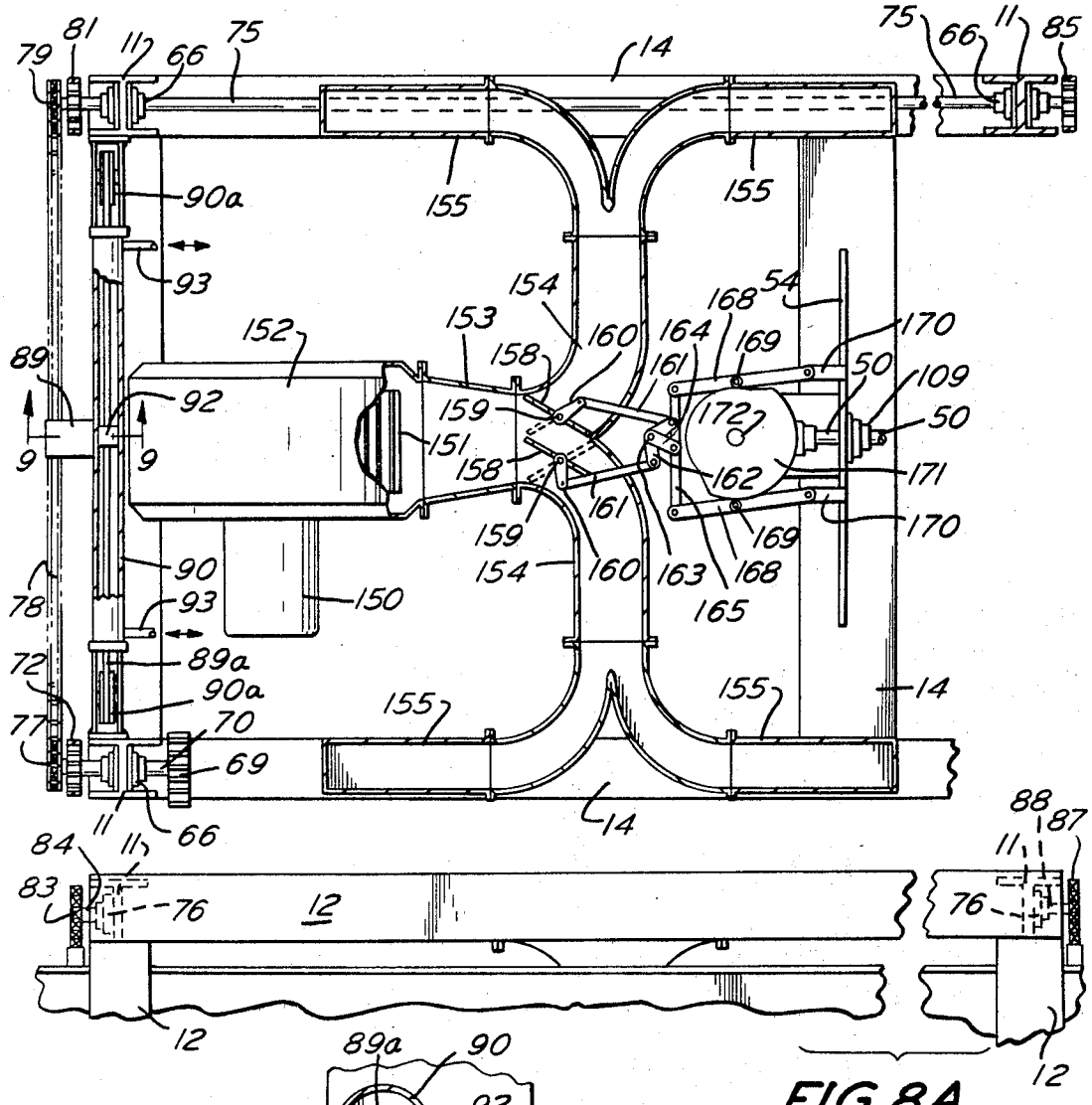


FIG.8A

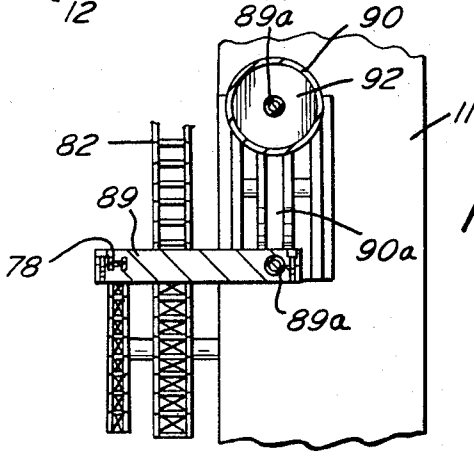


FIG.9

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APPARATUS FOR FOLDING FABRIC

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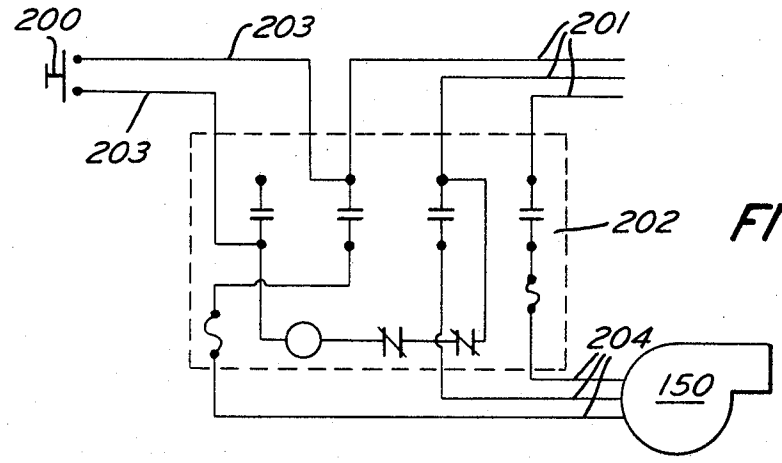


FIG. 10

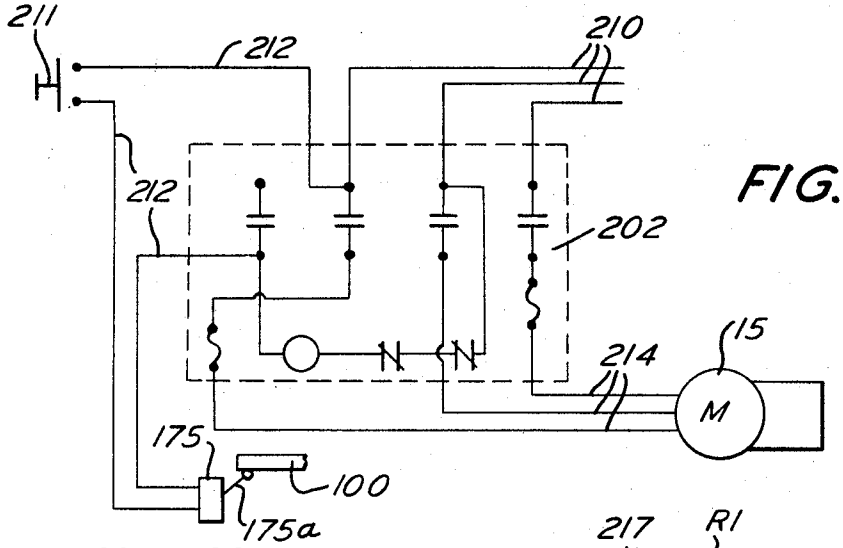


FIG. 11

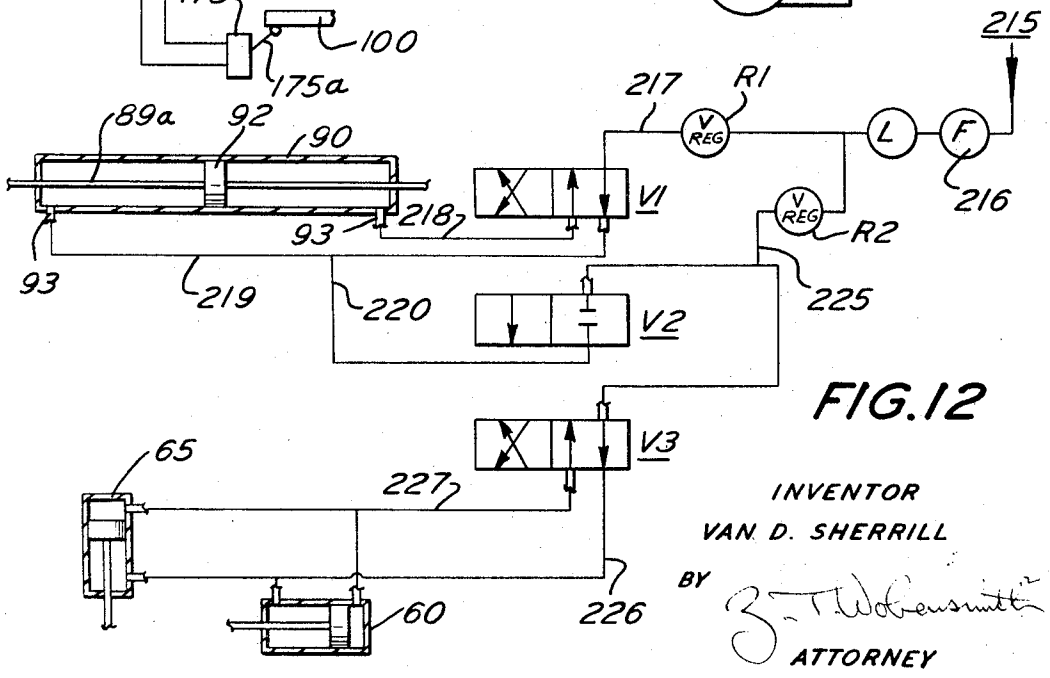


FIG. 12

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United States Patent Office 3,423,083 Patented Jan. 21, 1969

3,423,083

APPARATUS FOR FOLDING FABRIC

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Filed Dec. 9, 1966, Ser. No. 600,431
U.S. Cl. 270—69 9 Claims
Int. Cl. B65b 45/105

ABSTRACT OF THE DISCLOSURE

Apparatus for folding a downwardly moving continuous length of fabric which directs the moving fabric into folds onto a table by use of a plurality of alternate air streams and clamping members.

This invention relates to an apparatus for folding textile fabric and the like and more particularly to such an apparatus wherein air streams are used to direct the fabric during folding.

The present apparatus in use for fabric folding is complicated, expensive and cumbersome. One example of such apparatus is shown in the patent to Cohn et al. No. 2,761,678, where a complicated roller arrangement is used to deposit by gravity successive layers of a continuous length of fabric onto a table. This arrangement necessitates many chains, drive shafts, rollers and reversing mechanisms, all of which are subjected to wear and require frequent adjustment and maintenance.

Fabric that is light in weight is difficult to fold by the gravity means employed in the Cohn patent in that it tends to resist falling due to air resistance acting on its undersurface and in addition positive control of the edges of the pile of fabric is difficult to obtain so that a non-uniform pile often results.

The present invention provides apparatus for folding fabric by blowing air against alternate sides of a downwardly moving length of a fabric which is held down at one side by a first hold down bar while the air stream forces it over to the other side under a raised second hold down bar which then moves down and clamps the fabric at the side, air is then blown from this side and first bar is raised so that the fabric may be moved under it, the first bar is brought down, and the cycle repeated.

The principal object of the present invention is to provide apparatus for folding fabric that is rapid and positive in operation.

A further object of the present invention is to provide apparatus for folding fabric that is simple in construction but reliable in service.

A further object of the present invention is to provide apparatus for folding fabric that can be used to fold a multiplicity of widths and kinds of fabric.

A further object of the present invention is to provide apparatus for folding fabric that permits of precision controlled folding of the fabric with constant hold down and controlled pile height.

A further object of the present invention is to provide an apparatus for folding fabric that uses a controlled incremental downward table movement in conjunction with each fold of fabric but which table can be quickly returned to initial position from any lowered position.

A further object of the present invention is to provide apparatus for folding fabric that does not soil or damage the fabric.

Other objects and advantageous features of the invention will be apparent from the description and claims.

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawings forming part thereof, in which:

FIGURE 1 is a side view of the fabric folding apparatus in accordance with the present invention, parts being broken away and in phantom to illustrate the internal construction;

FIG. 2 is a vertical sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view taken approximately on the line 3—3 of FIG. 1;

FIG. 4 is a vertical sectional view, enlarged, taken approximately on the line 4—4 of FIG. 1;

FIG. 5 is a vertical sectional view, enlarged, taken approximately on the line 5—5 of FIG. 1;

FIG. 6 is a sectional view taken approximately on the line 6—6 of FIG. 5;

FIG. 7 is a vertical sectional view taken approximately on the line 7—7 of FIG. 1;

FIG. 8 is a horizontal sectional view taken approximately on the line 8—8 of FIG. 1;

FIG. 8A is a fragmentary horizontal sectional view taken approximately on the line 8A—8A of FIG. 2;

FIG. 9 is a vertical sectional view, enlarged, taken approximately on the line 9—9 of FIG. 8;

FIG. 10 is a schematic view of an electrical circuit for operating the air supply portion of the present invention;

FIG. 11 is a schematic view of an electrical circuit for operating the table and fabric let down portion of the present invention, and

FIG. 12 is a schematic view of a fluid control system for operation of the apparatus of the present invention.

It should, of course, be understood that the description and drawings herein are illustrative merely, and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

Referring now more particularly to the drawings, the fabric folding apparatus of the present invention includes a supporting frame **10** with a plurality of vertical frame members **11**, connected by pairs of horizontal upper and lower connecting members **12** and **14**.

An electric driving motor **15** of well known type is provided mounted on a lower horizontal member **14** and having a speed reduction gear box **16** mounted thereon and integral therewith.

The gear box **16** has a drive shaft **18** extending horizontally forwardly therefrom with a pulley **19** attached thereto.

A belt **20** connects the pulley **19** to a pulley **21** which is mounted on a rearwardly extending shaft **22** which is journaled in bearings **23** mounted on frame member **11** and has a pulley **24** keyed thereto at its end opposite to pulley **21**.

A belt **25** engages the pulley **24**, extends vertically and engages pulley **26** mounted on shaft **27** which is journaled in bearings **28** mounted at the top of a frame member **11**.

The shaft **27** which extends forwardly from pulley **26** has a pulley **30** keyed thereto at the opposite end from pulley **26**.

The pulley **30** is engaged by a belt **31** which extends horizontally and engages pulley **32** mounted on shaft **33** which is mounted in adjustably positioned bearings (not shown) in slot **34** of upper frame member **12**. The shaft **33** has connected thereto on the end opposite to the pulley **32** and driven thereby a gear **35** which is engaged with and drives a similar gear **36** on a shaft **38** which is also mounted in adjustably positioned bearings (not shown) in slot **34**. The shaft **38** has a pulley **37** keyed thereto and a belt **39** engaged with the pulley **37** connects it with a pulley **40** which is keyed to a shaft **41**.

The shaft **41** is journaled in a pair of bearings **42** which are mounted on a pair of uprights **43** attached to an upper frame member **12**. The shaft **41** supports a let down roll **44** of conventional type between the bearings **42**.

Shafts **33** and **38** extend rearwardly and are journaled in bearings **33***a* and **38***a* adjustably mounted on the frame member **12**. A pair of nip rolls **45** is provided supported by shafts **33** and **38** which rolls direct and guide the length of fabric brought to them by the let down roll **44**. Both shafts **33** and **38** are adjustable horizontally in order to compensate for different thickness of fabric.

The gear box **16** of motor **15** has a shaft **46** extending rearwardly therefrom with a sprocket **47** attached thereto. A chain **48** connects sprocket **47** to sprocket **49** which is mounted on the end of a shaft **50**. The shaft **50** extends rearwardly and is journaled in a pair of bearings **51** which are connected respectively to uprights **53** and **54** which are mounted on lower frame member **14**.

A main drive cam **55** is provided fastened on shaft **50** in front of upright **53** behind and integral with the sprocket **47**.

An arm **56** is provided with follower stud **57** thereon engaged with the cam **55**, the arm **56** being pivotally mounted on a shaft **58** at its end opposite stud **57**. The arm **56** is bifurcated as shown more fully in FIG. 6 and has an air cylinder **60** mounted thereon with a projection **61** engaged with a ratchet pawl **62** which is swingably mounted on the arm **56**. A ratchet wheel **63** is provided keyed to the shaft **58** extending between the Y of the arm **56** and is engaged by the pawl **62**.

The ratchet wheel **63** is also engaged by a pawl **64** which is swingably mounted to one of the vertical members **11** and connected to an air cylinder **65** which is also mounted on one of the vertical members **11**. The pawls **62** and **64** are preferably provided with a plurality of pawl teeth to provide smaller increments of table travel.

The shaft **58** extends rearwardly and forwardly of ratchet wheel **63** and is provided with a central portion **58***a* and two universal joints **58***b*. At the rear, shaft **58** is journaled in bearings **66** mounted in frame member **14** and has a gear **67** keyed thereto and engaged with a gear **68** which is keyed to a shaft **70**. The shaft **70** is journaled in bearings **66** mounted on upright **11**. The shaft **58** has keyed thereto a sprocket **72** and a chain **73** engaged with the sprocket **72** extends vertically upwardly and engages sprocket **74** mounted on shaft **71** which is journald in bearings **76** of frame member **11**.

A sprocket **77** is provided mounted on shaft **70** and with chain **78** engaged therewith which connects sprocket **77** to a sprocket **79** which is keyed to a shaft **75**. Shaft **75** is journaled in bearings **66** in frame member **11** and is of similar construction to shaft **58**.

The shaft **75** has a sprocket **81** mounted thereon with a vertical upwardly extending chain **82** engaged therewith connecting sprocket **81** to an idler sprocket **83** which is keyed to shaft **84** journaled in bearings **76** on upper frame member **12**.

The shaft **75** is journaled in bearings **66**, and extends horizontally forwardly and has a sprocket **85** keyed to the end of the shaft **75** opposite sprocket **79**. A chain **86** connects the sprocket **85** to an idler sprocket **87** mounted on shaft **88** which is journaled in bearings **76** of upper frame member **12**.

The chain **78**, intermediate the pulleys **77** and **79**, is connected to an operating member **89** of a double acting air cylinder **90** of conventional cable cylinder construction. The operating member **89** includes an endless cable **89***a* of round cross section and nylon covered which is connected to a piston **92** in cylinder **90** and passes over a pair of guide wheels **90***a* which are rotatably mounted at each end of the cylinder **90**. The air cylinder **90** has fluid ports **93**. The cylinder **90** is horizontally mounted between two vertical frame members **11** as shown more clearly in FIG. 7. The shaft **58** at its forward end has a sprocket **94** keyed thereto and has a chain **95** engaged therewith and with an idler sprocket **96** which is keyed to shaft **97** journaled in bearings **76** of frame member **11**.

Inside the uprights **11** and between the upper connecting members **12** and lower frame members **14** a table **100** is provided, of substantially rectangular shape and with its upper surface coated with a resilient wear resistant material, neoprene being particularly suitable but any other desired material can be used.

The table **100** is supported and positioned by chains **73**, **82**, **86** and **95** which are respectively attached to each of the four corners of the table and control the vertical displacement of the table **100** in conjunction with the folding of fabric onto the table.

The shaft **50** between the cam **55** and the upright **54** is provided with a sprocket **105** which is keyed to the shaft **50** and has a chain **106** connecting it to a sprocket **102** mounted on a shaft **108** which is journaled in bearings **109** mounted on upright **54**. A double acting cam **110** is keyed to the shaft **108**. The cam **110** has two like cam portions **110***a* and **110***b*, one of which is 180° in advance of the other. Bell cranks **111** of opposite hand are provided, carried on short stub shafts **108***a*. Each bell crank **111** has a cam follower **111***a* engaging the surface **110***c* of one of the cam portions **110***a* and **110***b*. The bell cranks **111** are swingably mounted on the shafts **108***a* and are free to pivot thereon.

The bell cranks **111** are pivotally engaged at the ends opposite to the cam followers **111***a* with vertically extending rods **112**, which rods **112** connect the bell cranks **111** to bell cranks **114**.

The bell cranks **114** are each pivotally mounted on plates **115**. The plates **115** are fixedly attached to the upper frame member **12**. A pair of hold down bars **117** are provided pivotally attached to the bell cranks **114** and having straight guide links **118** pivotally attached thereto and also pivotally attached to the plates **115** permitting the hold down bars **117** and bell cranks **114** to pivot about the plates **115** and so that the hold down bars remain essentially parallel to the table **100** during its operation.

An air supply system is provided to supply air to fold the fabric. The supply system includes a motor **150** with a fan **151** attached thereto. The motor **150** and fan **151** are housed in a chamber **152** which is mounted on the lower frame member **14** and has an air delivery duct **153** connected thereto.

A pair of ducts **154** are provided connected to duct **153** and extending respectively to each side of the apparatus and then vertically to a pair of discharge ducts **155** connected to each of the ducts **14**. The discharge ducts **155** have an opening **156** for discharge of air and extend substantially along the sides of the apparatus within the four corner uprights **11**.

Within each of the ducts **154** a valve plate **158** is provided pivotally mounted on a shaft **159** and movable about the shaft **159** to open or close the duct **154** to the passage of air from the air delivery duct **153**. Each of the shafts **159** has a first arm **160** fixedly attached thereto with a link **161** connecting it to a second arm **162** which is fixedly mounted to a shaft **163**. The shaft **163** has a link **164** fixedly attached thereto and pivotally attached to a link **165** which is attached at each of its ends to a pair of cam follower arms **168**. The cam follower arms **168** extend forwardly and are pivotally connected to a pair of brackets **170** which are mounted on the rear of the upright **54**.

A cam follower **169** is provided on each arm **168** and engaged by a cam **171**. The cam **171** is mounted on a shaft **172** which is attached to a gear box **173** with its output shaft **172** at 90° with respect to its input shaft **50**.

The machine can be stopped at any time prior to movement of the table **100** to its lowermost position for removing short stacks.

A limit switch **175** (see FIGS. 3 and 11) can be pro-

vided as a safety feature on an upright **11** and having an actuating member **175***a* engageable by the table **100**, so that when the table **100** "bottoms" further lowering will be prevented.

The electrical circuit for the air supply system is illustrated in FIG. 10 and includes a main control switch **200**, input leads **201** which may have any desired potential applied thereto, but as illustrated are a 3 wire 230 volt 60 cycle alternating current system.

A starter **202** of conventional type can be provided.

The input leads **201** are connected to the starter **202**, leads **203** connect the switch **200** to starter **202** and output leads **204** connect the starter **202** to the air supply system motor **150**.

The driving motor circuit is illustrated in FIG. 11 and includes input leads **210** merely by way of example of 3 wire 230 volt 60 cycle alternating current, a starter **202** of the same type as that for the motor **150**, and a control switch **211**. The switch **211** is connected to the starter **202** by leads **212** one of which is connected through the limit switch **175** and the other of which is connected to the starter **202**. Output leads **214** connect the starter **202** to the motor **15**.

The air control system is illustrated in FIG. 12 and includes a connection **215** to a suitable source of fluid, preferably of air under pressure, a filter **216**, a first regulator R1, a second regulator R2 and air valves V1, V2 and V3. The regulator R1 is normally set at 40 p.s.i. but may be set as desired, and is connected by pipe **217** to the valve V1. The purpose of the air thus supplied is to provide a back or loading pressure against the table **100** to prevent the table **100** from falling and also to provide a low loading force on the pawls **62** and **64**. The valve V1 is connected by pipes **218** and **219** to the ports **93** at opposite ends of the cylinder **90**. A pipe **220** connects to the pipe **219** and connects it to the valve V2. The supply connection **215** is also connected to regulator R2 which is normally set at 90 p.s.i. A pipe **225** connects the regulator R2 to the valve V2 and to the valve V3.

The V3 is connected to the air cylinders **60** and **65** by pipes **226** and **227**.

The mode of operation will now be pointed out.

A length of fabric to be folded is brought over the let down roll **44** between the nip rolls **45** beneath the left hold down bar **117**. The switches **200** and **211** are closed to energize driving motor **15** and air supply motor **150**.

Air is delivered from the chamber **152** through ducts **153**, **154** and **155** until it is discharged against a face of the fabric. The let down roll **44** and nip rolls **45** are driven from motor **15** by pulley **19**, shaft **18**, belt **20**, pulley **21**, shaft **22**, pulley **24** belt **25**, pulley **26**, shaft **27**, pulley **30**, belt **31**, pulley **32**, shaft **33**, gear **35**, gear **36**, pulley **37**, belt **39**, pulley **40**, shaft **41** and shaft **38** to move the fabric down onto table **100**. Air from the left hand discharge duct **155** forces the downwardly moving fabric toward the right under the hold down bar **117** at the right which for this purpose is in elevated or spaced position with respect to the table **100** to permit the advance of the fabric. The hold down bar **117** at the right is then lowered or moved downwardly to clamp and hold the fabric, such movement being effected through shaft **50**, sprocket **105**, chain **106**, cam **110**, bell crank **111**, cam follower **111***a*, rods **112**, bell crank **114** and links **118**. Air is discharged from the opening **156** in the right hand discharge duct **155**, such flow of air being effected by valve plate **158** closing off the left duct **154** and the valve plate **158** in right duct moving to open position. The valve **158** movement is effected from motor **15** through shaft **50**, gear box **173**, shaft **172**, cam **171**, cam follower **169**, arm **168**, link **165**, link **164**, arm **160** and shaft **163**, so that the valve plate **158** closes off the air flow through left duct **154** and allows it to go through right duct **154** and out through right duct **155**.

As the right hold down bar **117** is lowered, the left hold down bar **117** is raised by the action of the cam **110** so that the fabric may move under it. The left hold down bar **117** is brought down on top of the last fold of the fabric and the table **100** dropped a predetermined incremental distance as determined by the ratchet **63**. The table is lowered by the chains **73**, **82**, **86** and **95** which are actuated from motor **15** through sprocket **47**, chain **48**, sprocket **49**, shaft **50**, cam **55**, arm **56**, stud **57**, wheel **63**, shaft **58**, gear **67**, gear **68**, shaft **70**, sprocket **72**, chain **73**, pulley **77**, belt **78**, pulley **79**, shaft **75**, sprocket **81**, chain **82**, sprocket **85**, chain **86**, shaft **88**, sprocket **94**, chain **95**, sprocket **96** and shaft **97**.

The cycle is then repeated with air for folding supplied consecutively from each side against the fabric. The table **100** may be stopped if desired to remove a stack of folded fabric and if this removal is not effected the table **100** continues to move downwardly unit it strikes the actuating lever **175***a* of the limit switch **175**. When this occurs power to the motor **15** is cutoff and the motor **15** stops, causing table **100** to come to rest. The fabric can be severed and the pile removed as desired.

To cause the table **100** to move to its starting position, air is supplied to cylinder **90** from air supply connection **215**, regulator R2, valve V2, pipe **225** and pipe **220** at 90 p.s.i. to move the piston **92** and operating member **89** to lift the table **100** by chains **73** and **86**.

The cylinders **60** and **65** are supplied with air from valve V1 so that pawls **62** and **64** are disengaged from the wheel **63** and it is free to rotate and the table **100** moved to starting position.

Fabric is brought down over roll **44**, between nip rolls **45** and the operation repeated.

I claim:

1. Apparatus for folding a continuous length of fabric which comprises

a frame,

members for delivering the fabric to the frame along a vertical path,

a receiving member for folded fabrics located below said members for delivering fabrics, and

means in the frame for folding the fabric comprising

a connection to a supply of air under pressure,

a pair of facing air discharge members on opposite sides of the fabric and connected to said supply connection, and

valve means interposed between said supply connection and said discharge members alternately supplying air to said discharge members,

spaced holding members in facing relation on opposite sides of said receiving member and mounted for movement into and out of engagement with the fabric and alternately urging the fabric toward the receiving member, and

means for actuating said holding members in timed relation to the operation of the air discharge members whereby said air discharge members deliver folds of fabric to the holding members.

2. Apparatus for folding a continuous length of fabric as defined in claim **1** in which

said members for delivering the fabric to the frame include,

a pair of nip rolls.

3. Apparatus for folding a continuous length of fabric as defined in claim **1** in which,

said receiving member is a vertically movable table.

4. Apparatus for folding a continuous length of fabric as defined in claim **3** in which

positioning members are provided for controlling the positioning of said table.

5. Apparatus for folding a continuous length of fabric as defined in claim **4** in which

said positioning members include fluid pressure controlled supporting portions and fluid pressure controlled table elevating portions.

6. Apparatus for folding a continuous length of fabric as defined in claim **1** in which

said air discharge members include a pair of ducts with terminal nozzles.

7. Apparatus for folding a continuous length of fabric as defined in claim **1** in which

said valve means includes a swingably mounted air diverting member.

8. Apparatus for folding a continuous length of fabric as defined in claim **1** in which,

said holding members include a pair of spaced horizontal downwardly facing portions, and

operating connections are provided for simultaneously operating said holding members and said valve means.

9. Apparatus for folding a continuous length of fabric as defined in claim **1** in which

said valve means has timed operating members,

said holding members have timed operating members, and

common driving means is provided for said timed operating members.

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PAUL V. WILLIAMS, *Assistant Examiner.*

U.S. Cl. X.R.

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