June 21, 1955 M. A. GOLDMAN 2,710,992

MACHINE FOR MAKING CROSS-LAID FABRICS

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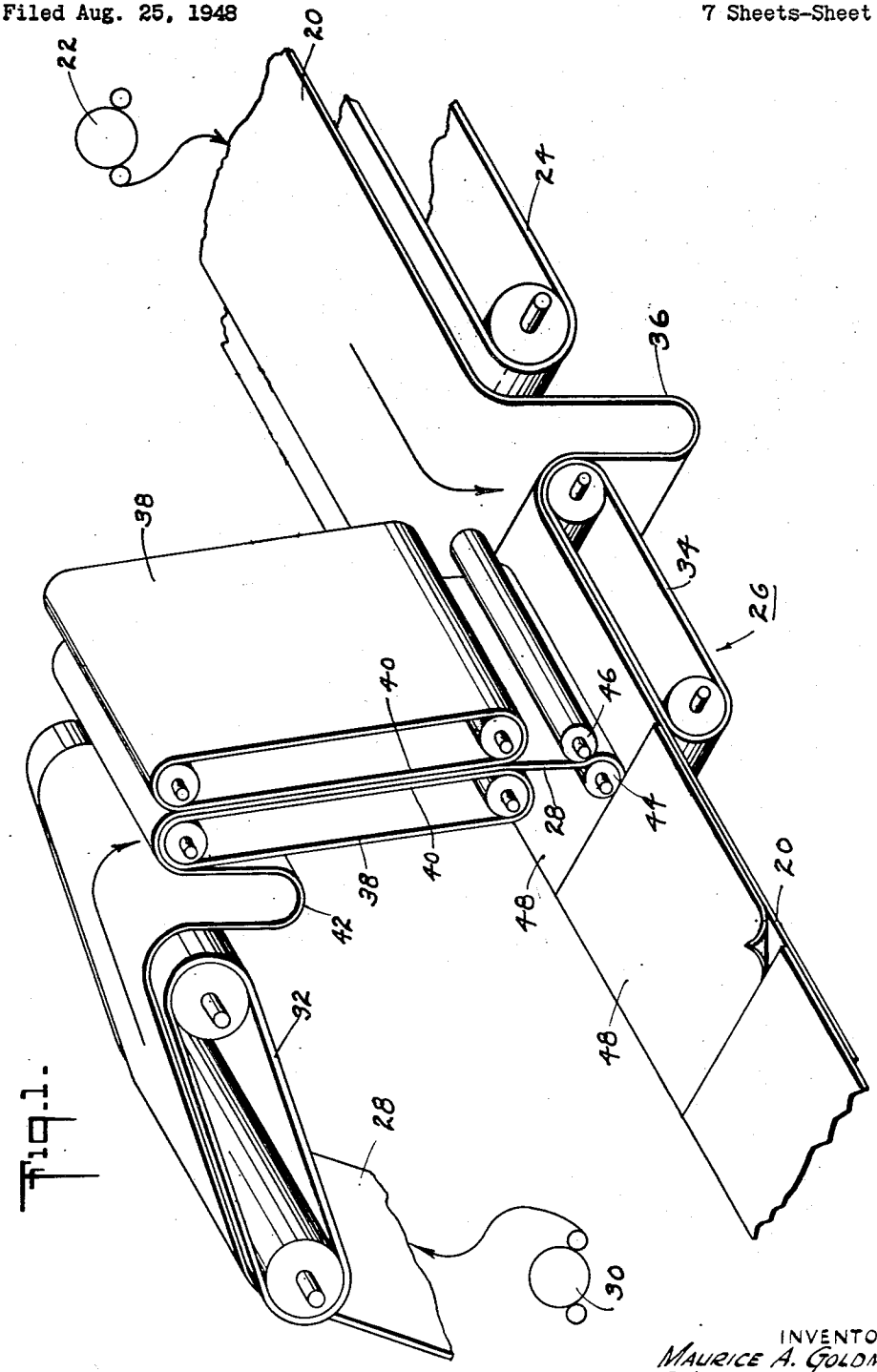


Fig. 1.

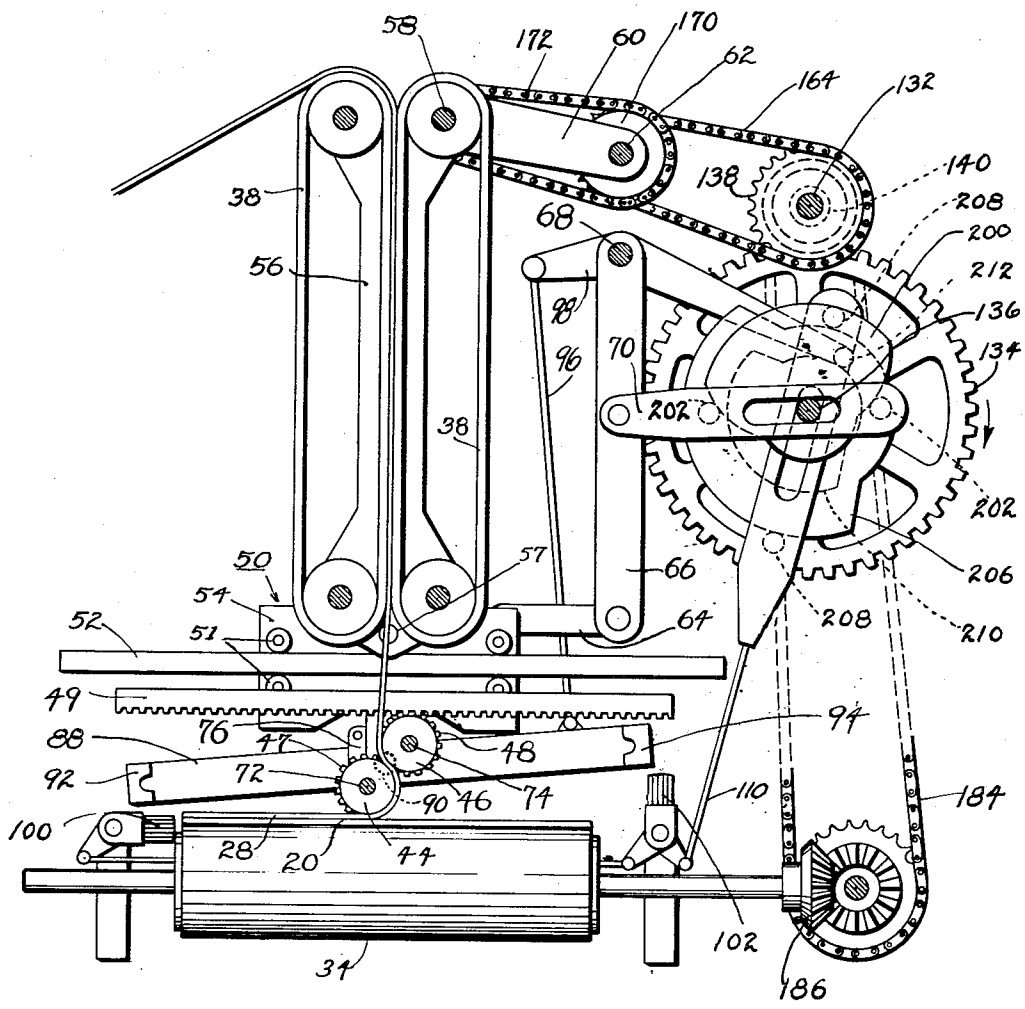
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MACHINE FOR MAKING CROSS-LAID FABRICS

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Fig. 2.



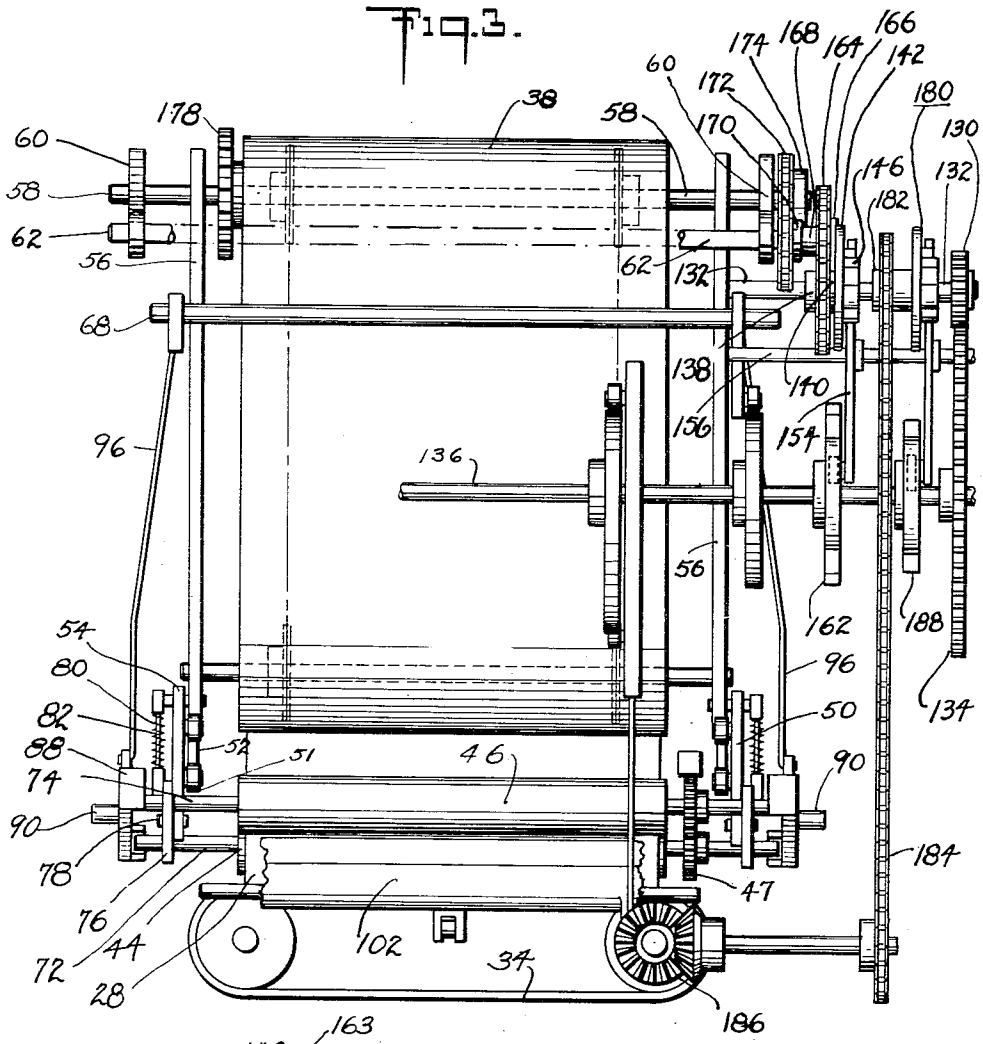
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MACHINE FOR MAKING CROSS-LAID FABRICS

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Fig. 3.



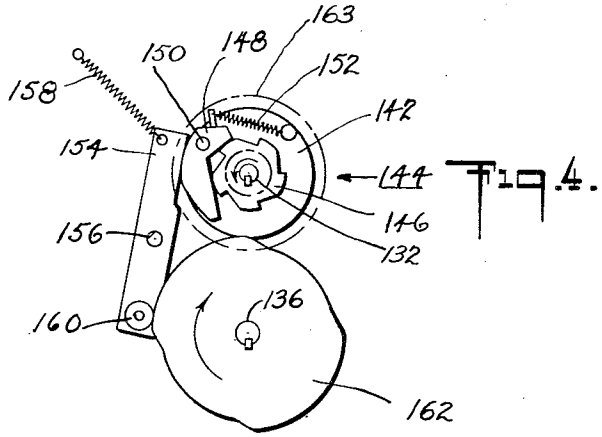


Fig. 4.

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Fig. 5.

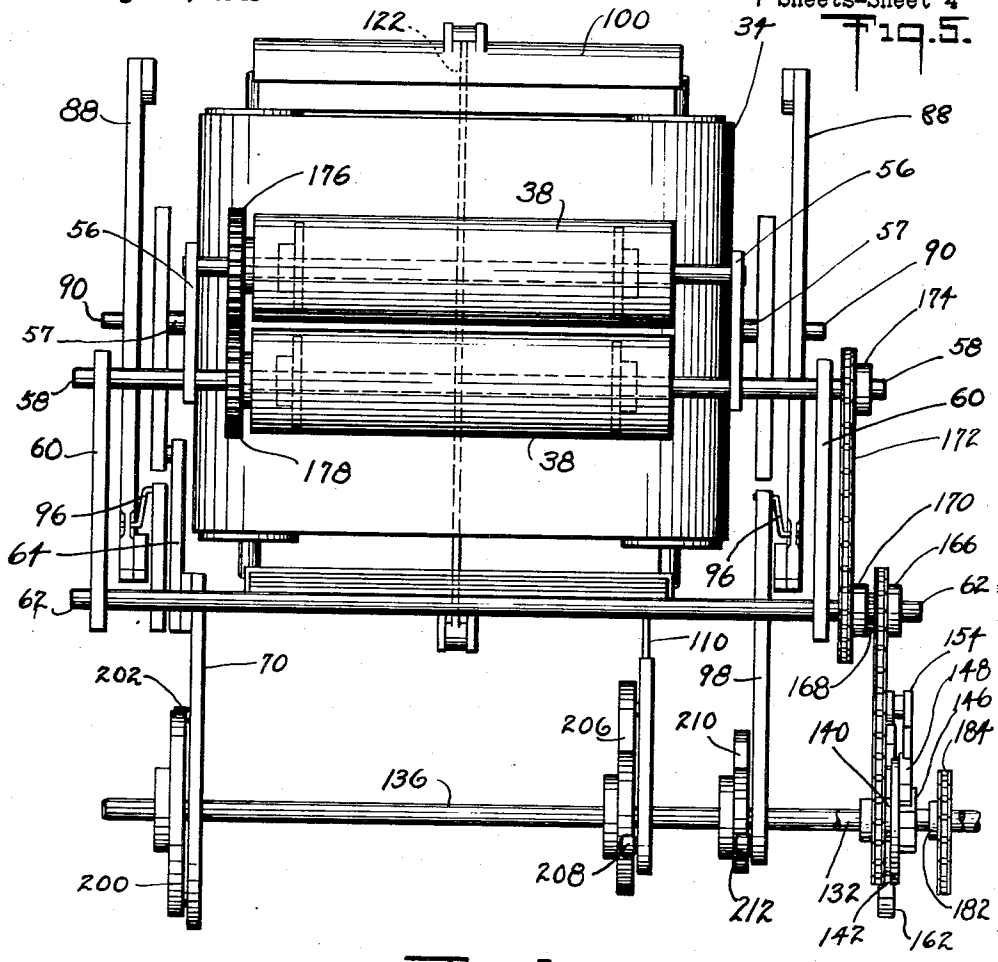
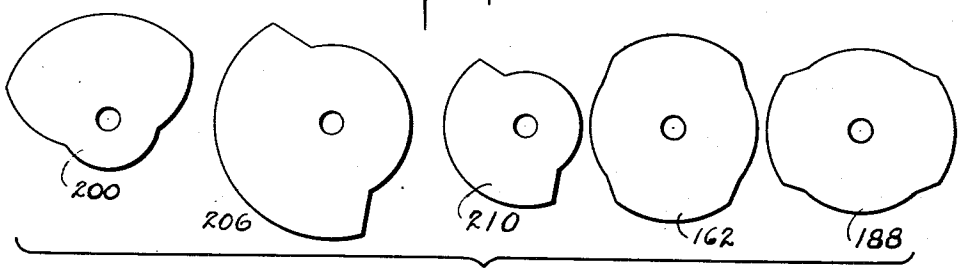


Fig. 6.



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Fig. 7.

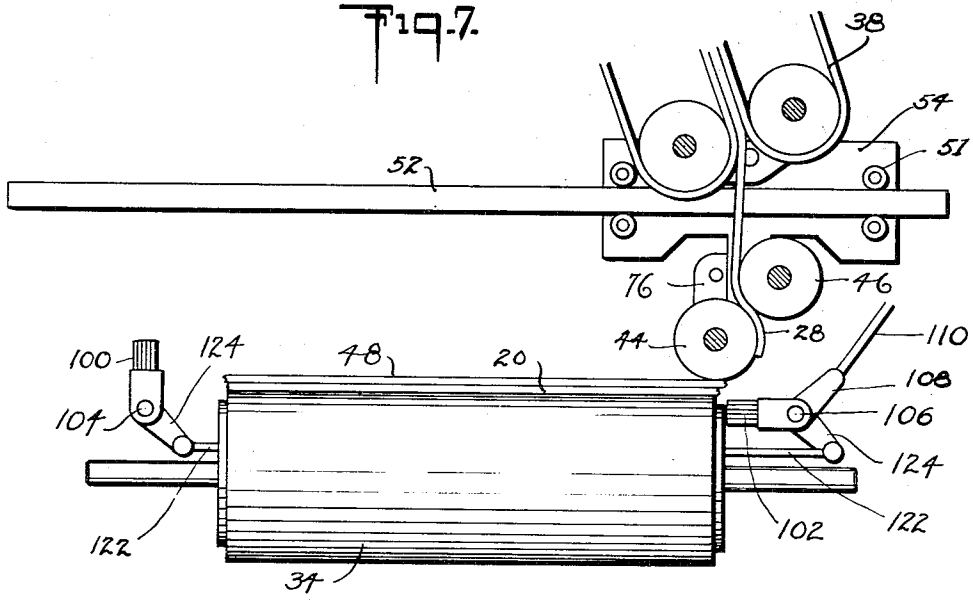
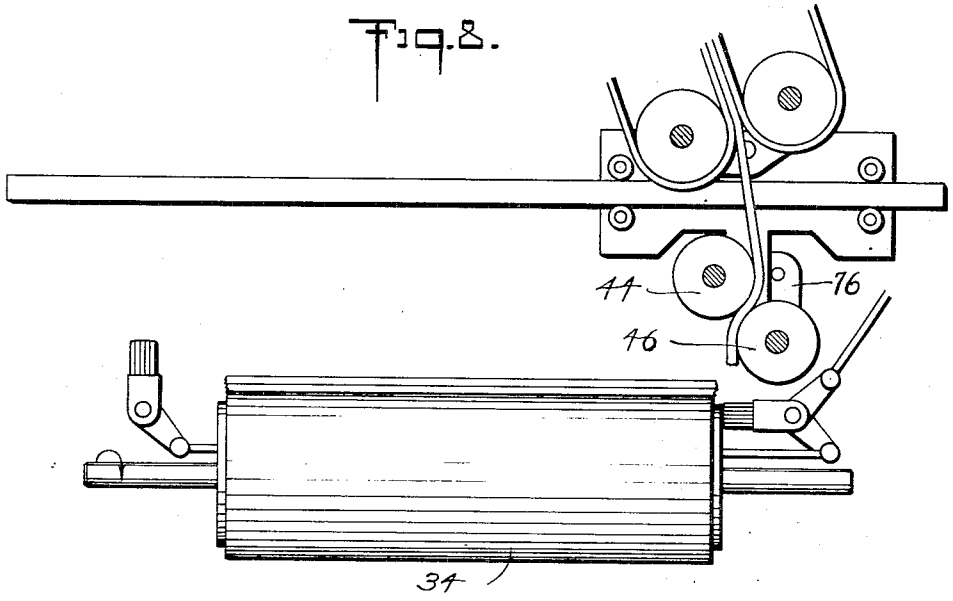


Fig. 8.



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Fig. 9.

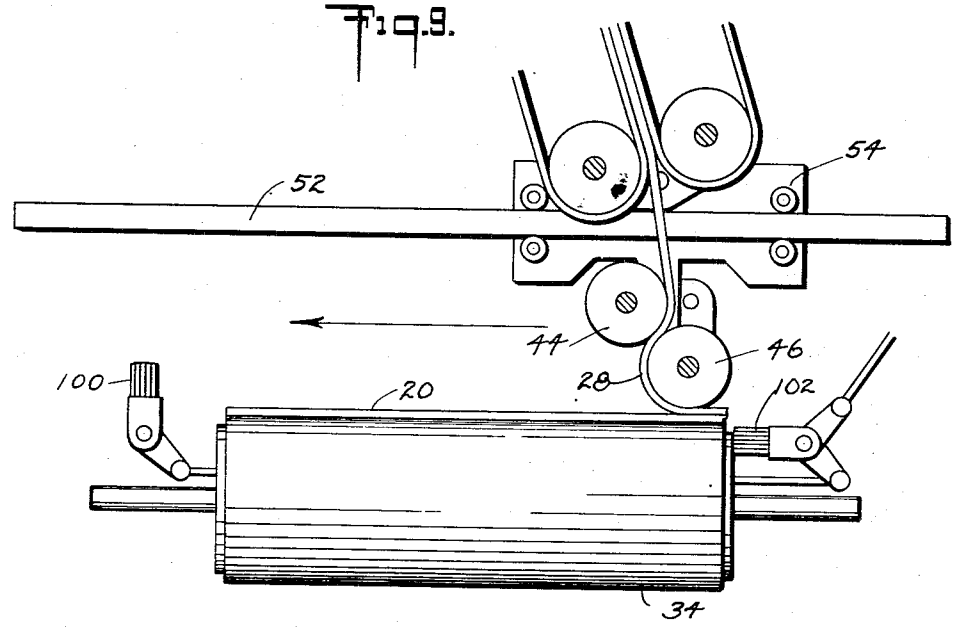
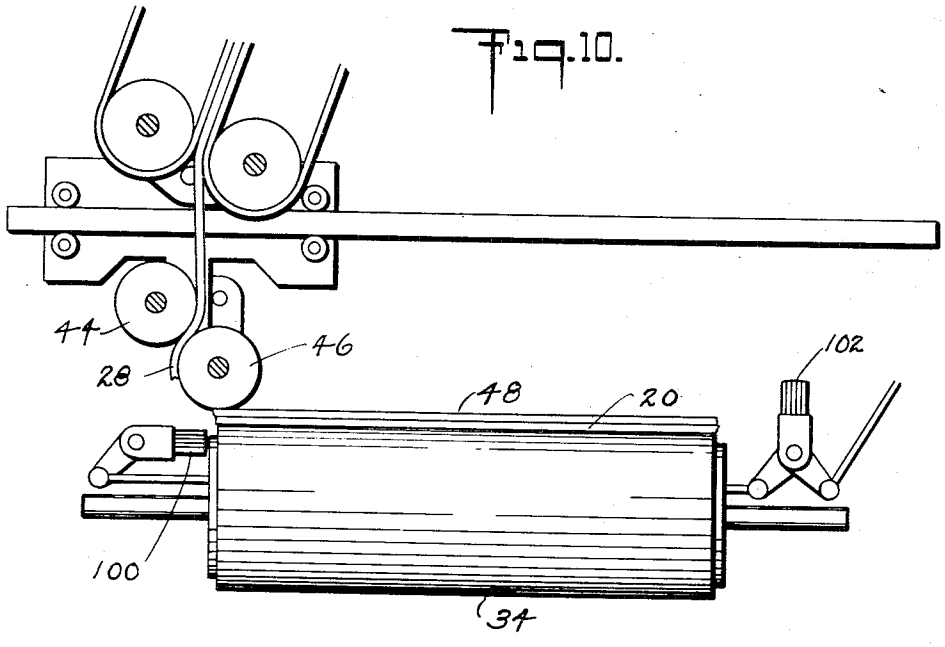


Fig. 10.



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Fig. 11.

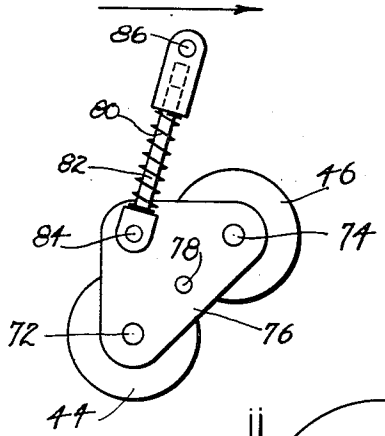


Fig. 12.

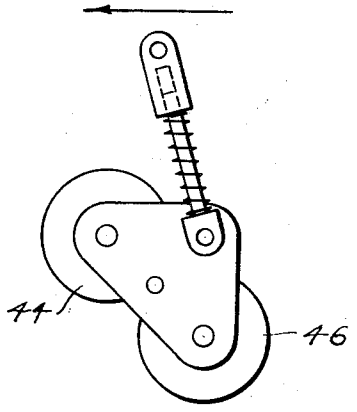
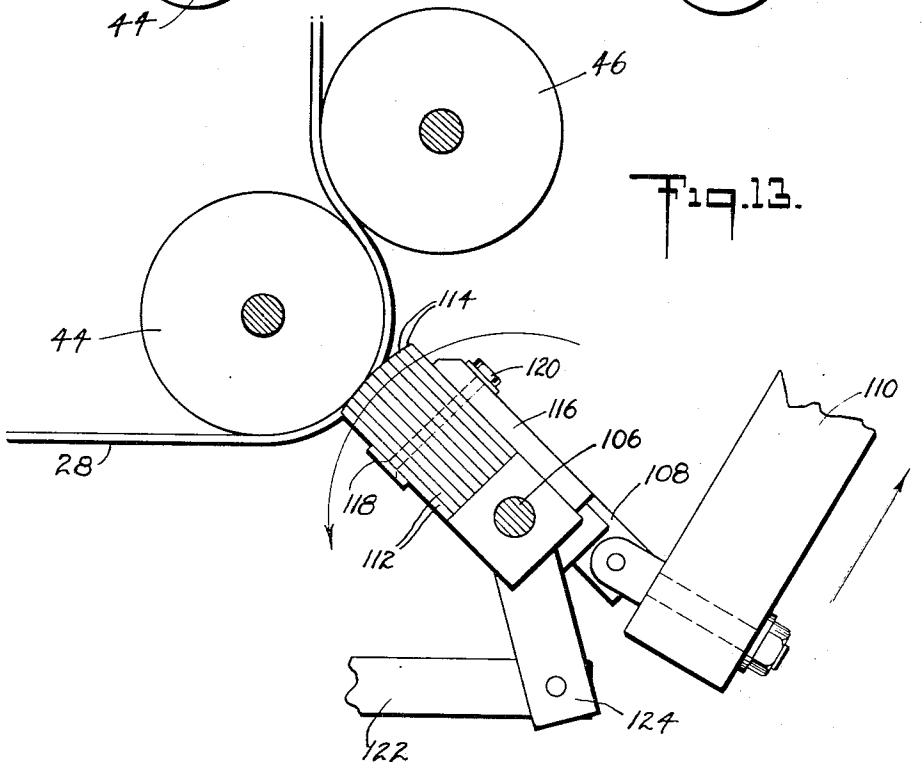


Fig. 13.



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United States Patent Office 2,710,992 Patented June 21, 1955

2,710,992

MACHINE FOR MAKING CROSS-LAID FABRICS

Maurice A. Goldman, Highland Park, N. J., assignor to Chicopee Manufacturing Corporation, a corporation of Massachusetts

Application August 25, 1948, Serial No. 46,153

21 Claims. (Cl. 19—161)

This invention relates to an improved method of making cross-laid fabrics and to improved apparatus for carrying out the method. It is especially applicable to making fabrics having substantially equal tensile strength longitudinally and crosswise from carded webs of textile fibers, or similar delicate fibrous webs in which the fibers are unavoidably arranged predominantly in one direction. Therefore the invention will be described, for illustration only, as applied to the making of such fabrics. Heretofore when carded webs have been bonded to form fabrics the resultant fabrics have had inadequate cross strength.

The invention is particularly adapted to the making of fabrics as disclosed in Patent 2,039,312 which discloses a non-woven fabric having many of the properties of woven cloth. This is made by laying one carded web of cotton on another, with the fibers of one web perpendicular to the fibers of the other, and binding the two webs together with adhesive. Such fabric is highly desirable because of its substantially equal longitudinal and crosswise tensile strength. However it is very difficult to make. In fact no method nor apparatus has been devised to my knowledge for making such cross-laid fabric continuously on a commercially practical scale. Many of the difficulties heretofore encountered are involved in the handling, moving, laying and severing of carded webs which are extremely delicate and fragile.

It is among the objects of the present invention to provide an improved method of making a continuous cross-laid fabric from continuous strips or webs, particularly of carded webs, and to provide efficient and economical apparatus for handling, moving and severing such webs and assembling them into a continuous strip of cross-laid fabric.

In the accompanying drawings:

Fig. 1 is a diagrammatic perspective of one form of machine for making webs in accordance with the invention;

Fig. 2 is a schematic end elevation, partly in section, of the principal portion of the machine which lays one web across another, certain parts, such as bearings and frames, being omitted for clarity;

Fig. 3 is a schematic side elevation of the part of the machine shown in Fig. 2, certain parts being broken away;

Fig. 4 is a diagrammatic illustration of a clutch for driving the intermittent conveyors of the machine shown in Figs. 2 and 3;

Fig. 5 is a schematic plan of the parts shown in Figs. 2 and 3, certain parts being broken away and certain parts being omitted for clarity of illustration;

Fig. 6 is an exploded view of the cams shown in Figs. 3 and 5, showing the profiles of various cams and their relationship for timing and actuating various parts of the machine;

Fig. 7 is an enlarged schematic end elevation of a fragment of the machine as shown in Fig. 2, showing the cross-laying mechanism at one edge of the strip of fabric and just after the cross-laid web has been severed;

Fig. 8 is a view similar to Fig. 7 an instant later in the operation of the cross-laying mechanism, showing the mechanism reversed and about to begin its return motion to the other edge of the strip;

Fig. 9 shows the mechanism of Fig. 8 a moment later than in Fig. 8, after the start of the cross-laying operation in the reverse direction;

Fig. 10 shows the apparatus of Figs. 7–9 at the end of the reverse run and after the cross-laid web has been severed;

Fig. 11 is an end elevation of a support for the cross-laying rolls in the position it takes when the rolls are moving from left to right, as in Fig. 7;

Fig. 12 is a view similar to Fig. 11 but with the rolls moving from right to left as in Fig. 9; and

Fig. 13 is an enlarged end elevation of one of the severing wipers shown in Fig. 2, the wiper being shown at the instant of severing the cross-laid web.

Fig. 1 illustrates my improved method and indicates diagrammatically the principal important features of my apparatus. A carded web **20** is made continuously on one or more carding machines or any suitable fiber arranging machines, diagrammatically indicated at **22**. As used herein the term carded web means any web of the general type of fibrous webs made on cards, garnetting machines or the like. In these, textile fibers such as cotton, rayon and the like are laid down in a thin web, the fibers unavoidably being predominantly in the one direction of the length of the web.

The web **20** is conveyed by a conveyer **24** continuously and at uniform speed to a cross-laying apparatus generally denoted by **26**. The web **20** corresponds to the warp of a woven fabric in that it is continuous, and herein is termed warp web for convenience.

A second web **28**, herein termed the filling web, is continuously produced on a second set of cards or similar machines **30** and delivered by a continuous conveyer **32** toward the cross-laying apparatus, where the filling web is intermittently laid crosswise of the warp web. I use the term crosswise herein to indicate that the filling web is substantially perpendicular to the warp web, and to distinguish from those arrangements in which crosswise tensile strength has been attempted (but not achieved) by diagonal or angular arrangements of the two webs.

The cross-laying apparatus includes an intermittent conveyer **34** driven by mechanism to be disclosed, which supports a length of the warp web in a horizontal plane. A variable bight or loop **36** permits the stopping of the intermittent conveyer without affecting the continuous motion of the conveyer **24** or production by the cards **22**.

A pair of intermittent endless conveyers **38** are arranged side by side so that their advancing flights **40** are in adjacent planes and support the filling web **28** in a plane between them which is transverse to the plane of the supported warp web. A variable bight or loop **42** permits stopping of this conveyer without affecting the continuous motion of the conveyer **32** or production of the web by the cards **30**. The conveyers **38** advance the filling web in its plane of support to a pair of resilient rollers **44** and **46** normally in contact which are positively driven by gears **47** and **48** (Fig. 2) meshing with each other and with a stationary rack **49**. The rolls feed the web between them. The roller **44** rolls across the portion of the warp web supported on the conveyor **34** progressively pressing the filling web on the warp web and causing fiber entanglement between the webs. The two conveyers **38** and rolls **44** and **46** are mounted in a unitary pivoted structure to be described and are swung back and forth over the warp web in synchronism.

In operation the conveyer **34** is stopped, the filling web is laid across it by the rolls **44** and **46**, the conveyers **38** and rolls are stopped, the web is severed along the

edge of the warp, the warp web is advanced by the conveyer **34** a distance equal to the width of the filling web, and the conveyers **38** and rolls **44** and **46** are then swung back to lay the filling web across the warp in the reverse direction. In this way a number of strips **48** of filling web are laid on the warp web with the fibers of one web predominantly perpendicular to the predominant direction of the fibers of the other web. This completes the method of operation in accordance with the present invention. Thereafter the superposed webs are bound together by any suitable adhesive, as known in the art, to produce a unitary fabric having many of the qualities of cloth, but with this advantage over non-woven fabrics made by apparatus heretofore available, that my fabric has tensile strength which is substantially the same, both in the longitudinal or warp direction and in the crosswise or weft, or filling direction.

The cross-laying apparatus

The invention includes suitable apparatus for carrying out the operations described. As shown in Figs. 2, 3, and 5, each end of the assembly, including filling conveyers **38** and the cross-laying rolls **44** and **46**, is mounted on a unitary support **50**. The two supports **50** are provided with antifriction rollers **51** and slide back and forth on rails **52**, rigidly supported in any suitable manner, not shown. Each support **50** includes two principal parts, a plate **54** carrying the antifriction rollers **51**, and a link **56** pivoted to the plate at **57**. Both links **56** are pivoted at their upper ends on a shaft **58** which forms a floating pivot mounted on the ends of a pair of links **60** (Fig. 5) supported on a fixed pivot **62**. This arrangement holds the upper ends of the conveyers in a fixed locality, permitting sufficient movement to allow the lower ends to swing from end to end of the rails **52**. The lower ends are swung back and forth by the sliding movement of the plates **54** which are moved back and forth on the rails **52** by links **64** pivoted to the links **66** which turn about a fixed pivot **68**, being actuated by a link **70** moved and timed by cams as will be explained. The conveyers **38** are driven, while being swung from side to side, by suitable timed mechanism which will be described.

The cross-laying rolls **44** and **46** are mounted on shafts **72** and **74**, which as shown in Figs. 11 and 12 are journaled at both ends in triangular plates **76** pivoted at **78** to the plates **54** (see Fig. 3). Each triangular plate is also connected to the plate **54** by a biasing snap action including a compression spring **80**, telescoping rod **82**, and pivot bearings **84** and **86**. This holds the plates **76** either in the position of Fig. 11 or the position of Fig. 12, and yieldingly urges either the roll **44** or the roll **46** against the layers of web on the conveyer **34**. Thus when the mechanism is swinging from left to right as seen in Fig. 7, roll **44** tends to bear on conveyer **34** and lays the filling web on the warp, while when moving from right to left as seen in Fig. 9, roll **46** tends to bear on the conveyer and lays the filling web.

The rolls are switched from the position of Figs. 7 and 11 to that of Figs. 8 and 12 by the bars **88** shown in Figs. 2 and 3. Each bar is pivoted on a central pivot **90** (Fig. 5) mounted in any suitable fixed support, not shown. At each end of each bar is a stop **92** or **94** having a notch for receiving a shaft **72** or **74**. When the traveling support **50** is moving to the right as seen in Fig. 2, a gear **48** meshes with the rack **49** and with gear **47**, rotating the rolls at a peripheral speed equal to the average linear speed of the conveyers **38** and feeding the filling web and rolling it into contact with the warp web at a sufficient pressure to cause the fibers of one web to entangle with the fibers at the surface of the other web, which entanglement holds the webs together for further treatment. At the end of the movement of the support **50** toward the right of Fig. 2, shaft **74** enters the notches in stops **94**. At this moment the bars **88** are rocked on

their pivots **90** by the links **96** to depress their right ends. The links **96** are actuated by the levers **98** turned on the fixed pivot **68** by a cam, as will be explained. This rocking of the bars **88** moves shaft **74** down. It is evident from Figs. 11 and 12 that downward movement of the shaft **74** first compresses the springs **80** until the three pivots **78**, **84** and **86** are in line and then lets the springs expand on the other side of the center line, which expansion turns the triangular plates **76** to the position of Fig. 12 and yieldingly presses the roll **46** (instead of **44**) against the conveyer **34**, or rather against the webs supported on this conveyer. In this position gear **48** on shaft **72** is clear of the rack **49** but continues to mesh with gear **47** which now engages the rack and thus drives roll **44** (and incidentally roll **46**) in the same rotational directions as before when the assembly is thereafter moved from right to left. Thus on the return motion to the left as seen in Fig. 9, roll **46** lays the weft web on the warp web and the roll **44** acts as a feed roll against roll **46**. At the end of the motion toward the left, shaft **72** enters the notches in stops **92** (which had been raised by the previously described rocking of the bars **88**). The link **96** is now depressed to rock the bars **88** in the reverse sense and the rolls are restored to the position of Fig. 11, assisted by the snap action shown in Figs. 11 and 12.

The web-severing means

The filling web is severed at each edge of the warp web by the novel means shown in Figs. 7–10 and 13. Resilient wiping means such as a pair of bristle brushes, or preferably felt wipers **100** and **102**, are pivoted on shafts **104** and **106** parallel and adjacent to each edge of the warp web on the conveyer **34** and in such position that when swung on its shaft each felt can wipe firmly against the roll **44** or **46** when the appropriate roll is in its extreme position at the end of its travel in laying the filling web (see Fig. 13). The shaft **106** is rotated by an arm **108** actuated by a rod or link **110**, moved and timed by a cam to be described. When the roll **44** is in the position shown in Fig. 7, it is at rest and presses the filling web against the warp web and conveyer **34** in a narrow strip along the edge of the warp web, due to the force of the springs **80**. The filling web is also held firmly between the rolls **44** and **46** along a second narrow strip across the full width of the filling web and parallel to the edge of the warp. This clamps or holds all the fibers across those strips or zones of the filling web. While the fibers are so held the link **110** is actuated to wipe the felt across the roll **44** as shown in Fig. 13, preferably, but not necessarily counterclockwise. The resilient pressure of the felt against the roll and the motion across the roll in the predominant direction of the lengths of the fibers severs the filling web along the edge of the warp by pulling the fibers not held away from the held fibers. This severs the web in an approximately straight line, within the limits of the length of the fibers. Preferably each wiper consists of a stack of felt sheets **112** providing a plurality of wiping edges **114** which repeat the wiping action many times with a single stroke of the felts. The individual felt sheets are given the desired degree of stiffness by the backing member **116** and compression effected by the plate **118** and bolts **120**.

The felt brushes **100** and **102** are linked by a tie rod **122** and crank arms **124** so that when the brush **102** is operated to sever the filling web along one edge of the warp web as in Fig. 7, the brush **100** is raised to be in position to sever it along the other edge of the warp web upon arrival of the roll **46** in the position shown in Fig. 10.

The drive and timing mechanism

Any suitable drive and timing devices can be used to drive the conveyers **34** and **38** at intervals having the proper frequency relative to the speed of the con-

veyers 24 and 32, and in timed relation to each other so that the warp conveyer 34 is stopped when the filling conveyer starts its travel across the warp, and so that the filling conveyer is stopped and held clear of the warp web when the warp conveyer moves.

As exemplified herein the drive and timing mechanism (Figs. 2–5) includes a main drive gear 130 (Fig. 3) constantly driven from any suitable source of power and keyed to a drive shaft 132. A second gear 134 meshes with gear 130 and drives cam shaft 136 which carries a series of cams (Fig. 6) which time the driving of the two intermittent conveyers and both actuate and time the other devices of the cross-laying mechanism.

The conveyers 34 and 38 are intermittently driven through any suitable power-transmitting means controlled by clutches on the main drive shaft 132. Thus the cross-laying conveyers 38 are driven by a sprocket 138 (Figs. 2, 3) connected by a hub 140 to the shell 142 of a clutch 144 (Figs. 3, 4, 5), the shell being loosely mounted on the shaft. The clutch includes a ratchet 146 keyed to the shaft 132 which can be connected to rotate the shell by a pawl 148 pivoted at 150 to the shell and normally held in driving engagement with the ratchet by a spring 152. The clutch shell is disconnected from the shaft 132 by a bar 154 mounted on a fixed pivot 156 and normally held out of engagement with the pawl by spring 158. A cam follower 160 on the bar engages the weft conveyer control cam 162 keyed to the cam shaft 136. When a high point of the cam engages this cam follower the bar 154 is rocked into the path 163 of the pawl to rotate the pawl on its pivot against spring 152 and thus disconnect the clutch to stop sprocket 138. The sprocket is connected by a chain 164 to a second sprocket wheel 166 (Fig. 3) turning loosely on shaft 62 and connected by a hub 168 to a third sprocket 170 (Fig. 2) connected by chain 172 to a fourth sprocket 174 (Fig. 3) which drives shaft 58, thus driving the right hand conveyer 38 as seen in Fig. 2. The left hand conveyer 38 is synchronously driven by gear 176 (Fig. 5) meshing with gear 178 keyed to shaft 58.

Thus when a high spot of the cam 162 engages the cam follower 160 on bar 154 the cross-laying conveyers 38 are at rest, and when a low part of the cam engages the cam follower the conveyers are driven to feed filling web to the cross-laying rolls 44 and 46.

The warp conveyer 34 is driven in intervals when the filling conveyer is at rest by a clutch 180 similar to that previously described, connectable to a sprocket 182 driving chain 184 which drives the bevel gears 186. The clutch 180 is controlled by cam 188 similar to cam 162 but keyed to shaft 136, 90° out of phase with cam 162.

The cam shaft 136 also carries cams for reciprocating the filling conveyer, rocking the bars 88 to reverse the rollers and operating the cutoff brushes 100 and 102. Referring particularly to Figs. 2, 5 and 6, the cam 200 operates the link 70 through a pair of cam followers 202 which provide positive motion through links 70, 66 and 64 for the carriages 54 on the rails 52. The cam 206 operates the link 110 through a pair of cam followers 208, providing positive motion for rocking the brushes 100 and 102. The cam 210 operates the lever 98 through cam follower 212 to rock the bars 88 through the links 96. In this case the weight of the lever 98 causes the cam follower to follow the cam and hold the bars 88 in position corresponding to the position of the cam.

Operation

It will be understood that the apparatus is started with a length of warp web on the conveyer 34 and with the filling conveyer and filling web in the position (for example) of Fig. 9. Upon starting, the warp conveyer 34 is at rest. The filling conveyer is being driven, the clutch 144 being engaged. The cam 200 pushes the link 70 to the left as seen in Fig. 2 and the roller 46 lays the filling web. When the rollers 44 and 46 reach the position of Fig. 10, the clutch 144 is disengaged by the cam 162 to stop the filling conveyer and the cam 200 causes the carriage 54 to stop. The cam 206 then rocks the brushes 100 and 102 from the position of Fig. 9 to the position of Fig. 10, severing the filling web. At the next instant the cam 188 engages the clutch 180 to advance the warp conveyer one interval equal to the width of the filling web. The warp conveyer then comes to rest. After this the cam 210 rocks the bars 88 to shift the rolls 44 and 46 from the position of Fig. 12 to the position of Fig. 11. Thereafter two things happen at once. The cam 162 starts the filling conveyer and the cam 200 starts to pull the carriages 54 from left to right. When the carriages reach the position of Fig. 7, the filling conveyer is stopped, the cam 200 dwells, and the brushes are rocked to sever the web. Thereafter the warp conveyer is advanced an interval, the rolls 44 and 46 are reversed and the cycle repeats itself.

The invention claimed is:

1. The method of making a continuous strip of unwoven fabric whose lengthwise tensile strength approximately equals its crosswise tensile strength from webs whose tensile strength in one direction markedly exceeds the tensile strength in the perpendicular direction which includes the steps of supporting one web in a plane, progressively laying a second web crosswise on the first web from the first edge to the second edge of the first web while continuously supporting the second web in a plane transverse to the plane of support of the first web, severing the second web along the second edge of the first web, advancing the first web in the direction of its length a distance equal to the width of the second web and progressively laying the second web from the second edge to the first edge of the first web while continuously supporting the second web in a plane transverse to the plane of support of the first web.

2. The method of making a continuous strip of unwoven fabric whose lengthwise tensile strength approximately equals its crosswise tensile strength from thin fragile unbonded webs of carded fiber which includes the steps of supporting one carded web in a plane, progressively laying a second carded web on the first web from the first edge to the second edge of the first web while continuously supporting the unlaid portion of the second web in a plane transverse to the plane of support of the first web, severing the second web along the second edge of the first web, advancing the first web a distance equal to the width of the second web and progressively laying the second web from the second edge to the first edge of the first web while continuously supporting the unlaid portion of the second web in a plane transverse to the plane of support of the first web.

3. The method of making non-woven fabric having substantially equal lengthwise and crosswise tensile strength which includes the steps of taking two continuous webs of fibers arranged with the lengths of the fibers predominantly in the direction of the lengths of the webs, continuously and progressively supporting the first web throughout its width while intermittently advancing it through successive increments of length equal to the width of the second web, continuously and progressively supporting the second web throughout its width, progressively laying increments of the second web on the first web between the periods of its advance with its length substantially perpendicular to the length of the first web, and progressively pressing the webs together to effect entanglement of fibers between the two webs.

4. The method of making non-woven fabric having substantially equal lengthwise and crosswise tensile strength which includes the steps of taking two continuous webs of fibers arranged with the lengths of the fibers predominantly in the direction of the lengths of the webs, continuously and progressively supporting the

first web throughout its width while intermittently advancing it through successive increments of length equal to the width of the second web, continuously and progressively supporting the second web throughout its width, progressively laying increments of the second web on the first web between the periods of its advance with its length substantially perpendicular to the length of the first web, and progressively rolling the webs together to effect entanglement of fibers between the two webs.

5. In apparatus for making laminated fabric the combination of means for forming a web continuously and for conveying it at substantially uniform speed in the direction of its length, means for alternately stopping a portion of the web, supporting the stopped portion in a plane and then conveying it in the direction of its length, means for forming continuously a second web and for conveying it at substantially uniform speed, means for continuously supporting a portion of the second web in a plane transverse to the first plane, means for alternately stopping the supported portion of the second web and then advancing it in its plane of support and in the direction of its length and means for laying the second web crosswise of said supported portion of the first web during the intervals when the first web is stopped.

6. Apparatus for making cross-laid fabrics comprising in combination means for feeding with alternate periods of motion and rest a continuous web in the direction of its length and for supporting an arrested portion of the web in a plane, means for laying a second continuous web crosswise of the first web while the first web is at rest, means for holding the second web against the edge of the first web, and means for severing the second web along the edge of the first web.

7. Apparatus for making cross-laid fabrics comprising in combination means for feeding with alternate periods of motion and rest a continuous carded web in the direction of its length and for supporting an arrested portion of the web in a plane, means for laying a second continuous carded web crosswise of the first web while the first web is at rest, means for holding the second web against the edge of the first web, and means for pulling the second web uniformly across its width and in the direction of its length away from the holding means to sever the second web along the edge of the first web.

8. Apparatus for making cross-laid fabrics comprising in combination means for supporting at rest in a plane a portion of a continuous web, means for laying a portion of a second continuous web crosswise on the first web from the first edge to the second edge thereof, means for severing the second web along the second edge of the first web, and means for moving the first web in the direction of its length a distance equal to the width of the second web, said laying means being operable in the reverse direction to lay the second web from the second edge to the first edge on the first web.

9. In apparatus for making non-woven fabric the combination of means for supporting a web in a plane, a pair of rolls adapted when rotated to feed a second web between them, a unitary support holding the rolls in rolling contact with each other, said unitary support being rotatable to one extreme position in which only one roll can contact the first mentioned supporting means and being rotatable to a second extreme position in which only the other roll can contact the first mentioned supporting means, positioning means tending to urge the unitary support toward either extreme position, means for moving said positioning means to cause it to urge the unitary support toward its other extreme position, and a track for supporting said unitary support for movement parallel to the first mentioned supporting means.

10. In apparatus for making non-woven fabric the combination of means for supporting a web in a plane, a pair of rolls adapted when rotated to feed a second web between them, a unitary support holding the rolls in rolling contact with each other, said unitary support being rotatable to one extreme position in which only one roll can contact the first mentioned supporting means and being rotatable to a second extreme position in which only the other roll can contact the first mentioned supporting means, positioning means tending to urge the unitary support toward either extreme position, means for moving said positioned means to cause it to urge the unitary support toward its other extreme position, a track for supporting said unitary support for movement parallel to the first mentioned supporting means, and means for rotating the rolls when the unitary support is moved along the track in either direction.

11. In apparatus for making non-woven fabric the combination of means for supporting a web in a plane, a pair of rolls adapted when rotated to feed a second web between them, a unitary support holding the rolls in rolling contact with each other, said unitary support being rotatable to one extreme position in which only one roll can contact the first mentioned supporting means and being rotatable to a second extreme position in which only the other roll can contact the first mentioned supporting means, positioning means tending to urge the unitary support toward either extreme position, means for moving said positioning means to cause it to urge the unitary support toward its other extreme position, a track for supporting said unitary support for movement parallel to the first mentioned supporting means, means for moving the unitary support from one end of the track to the other, and means acting upon the arrival of the unitary support at each end of the track for moving the positioning means to rotate the unitary support from one extreme position to the other.

12. In apparatus for making non-woven fabric, means for laying a carded web from edge to edge of another web including a pair of rolls each of which is adapted to lay the carded web in the direction opposite to that of the other roll, a resilient wiper adapted to wipe against one roll at the first edge of the other web to sever the carded web along that edge of the other web, and a second resilient wiper adapted to wipe against the other roll at the second edge of the other web to sever the carded web along said second edge.

13. In apparatus for making non-woven fabric, means for laying a carded web from edge to edge of another web including a pair of rolls each of which is adapted to lay the carded web in the direction opposite to that of the other roll, a pair of resilient wipers, one adapted to contact each roll at one edge of said other web, means for operating the wipers in opposite directions in unison and means for actuating said operating means when either roll is at the edge of the other web to sever the carded web at that edge.

14. In apparatus for making non-woven fabric, means for laying a carded web from edge to edge of another web including a pair of rolls each of which is adapted to lay the carded web in the direction opposite to that of the other roll, a pair of resilient wipers, one adapted to contact each roll at one edge of said other web, means for operating the wipers in opposite directions in unison and in reverse directions and means for actuating said operating means when either roll is at the edge of the other web to sever the carded web at that edge.

15. Apparatus for making cross-laid fabric comprising in combination means for supporting a first web, a pair of rolls adapted to feed a web between them, means for supplying a second web to the rolls, means for moving the rolls alternately from one side edge to the other side edge of the first web to cause the first roll to lay the second web on the first web in one direction and to cause the second roll to lay the second web on the first web in the opposite direction, a resilient wiper at each edge of the first web adapted to contact one of said rolls to sever the second web, means for operating the wipers

simultaneously in opposite directions and means for actuating said operating means when the rolls reach each edge of the first web.

16. In apparatus for making laminated fabrics, the combination of mechanism for advancing in one direction a continuous web of material through increments of advance equivalent to the width of a second web of material, means for progressively laying down in lateral edge to edge relation for each such increment of advance one of a succession of lengths of the second web of material in a direction widthwise of the first web, means for establishing zero relative movement between the first web and the successive lengths of the second web in the direction of advance as each such successive length of the second web is laid down, devices for supplying said second web of material in continuous form to the laying down means, means operable over the entire width of the second web after each such length thereof has been laid down to clamp said web along a line parallel with an edge of the first web, and devices operable while the web is so clamped to sever the length thereof that has been laid down from the remainder of said web.

17. In apparatus for making laminated fabrics, the combination of mechanism for advancing in one direction a continuous web of material through increments of advance equivalent to the width of a second web of material, means for progressively laying down in lateral edge to edge relation for each such increment of advance one of a succession of lengths of the second web of material in a direction widthwise of the first web, means for establishing zero relative movement between the first web and the successive lengths of the second web in the direction of advance as each such successive length of the second web is laid down, devices pivotally mounted at the top for swinging movement transversely of the first web for supplying the second web in continuous form to the laying down means, and a web severing device operable simultaneously over the entire width of said second web and along a line parallel with an edge of the first web for severing the successive lengths from said second continuous web after each such length has been laid down.

18. In apparatus for making laminated fabrics, the combination of mechanism for advancing with alternate periods of motion and rest a continuous web of material in one direction, means operable during said periods of rest for progressively laying down in lateral edge to edge relation a succession of lengths of a second web of material in a direction widthwise of the first web, and timing devices having a common drive for effecting operation of the advancing mechanism and the laying down mechanism in proper sequence.

19. In apparatus for making laminated fabrics, the combination of mechanism for advancing with alternate periods of motion and rest a continuous web of material in one direction, a carriage arranged to reciprocate in a direction widthwise of said web for progressively laying

down in lateral edge to edge relation and during said periods of rest a succession of lengths of a second web of material, driving devices for the web advancing mechanism and for the carriage, and timing mechanism for effecting operation of the advancing mechanism and the carriage in proper sequence, said carriage including a pair of rollers between and in engagement with which the web material is fed as it is laid down by the carriage and a web severing device acting in conjunction with one of said rollers for severing the length of web laid down by the carriage.

20. In apparatus for making laminated fabrics, the combination of mechanism for advancing with alternate periods of motion and rest a continuous web of material in one direction, a carriage arranged to reciprocate during said periods of rest in a direction widthwise of said web and operable on each stroke thereof progressively to lay down in lateral edge to edge relation a succession of lengths of a second web of material, driving devices for the web advancing mechanism and for the carriage, and timing mechanism for effecting operation of the advancing mechanism and the carriage in proper sequence, said carriage including a plurality of rollers between which the web material is fed at it is laid down by the carriage and operable each on a different stroke of the carriage to press the web material laid down thereby into close contact with the first mentioned web material, a pair of web severing devices, operable one at the end of each carriage stroke and in conjunction with the roller operable on such stroke, for severing the length of web laid down by the carriage, and common means for operating said web severing device.

21. Apparatus according to claim 16 wherein the means for laying down the successive lengths of the second web of material includes a carriage, and wherein the means operable to clamp such webs across the width thereof includes a pair of rollers arranged in the carriage and between which the second web is fed as the successive lengths thereof are being laid down.

References Cited in the file of this patent

UNITED STATES PATENTS

33,426	Butler	Oct. 8, 1861
92,750	Robinson	July 20, 1869
180,063	Range	July 18, 1876
363,217	Dolge	May 17, 1887
511,749	Bohle	Jan. 2, 1894
1,434,917	Sewell et al.	Nov. 7, 1922
1,642,178	Schorsch	Sept. 13, 1927
2,434,887	Repass et al.	Jan. 20, 1948
2,562,891	Cotchett	Aug. 7, 1951
2,565,647	Brown et al.	Aug. 28, 1951
2,566,922	Brown et al.	Sept. 4, 1951

FOREIGN PATENTS

1,242	Great Britain	of 1872