June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 1

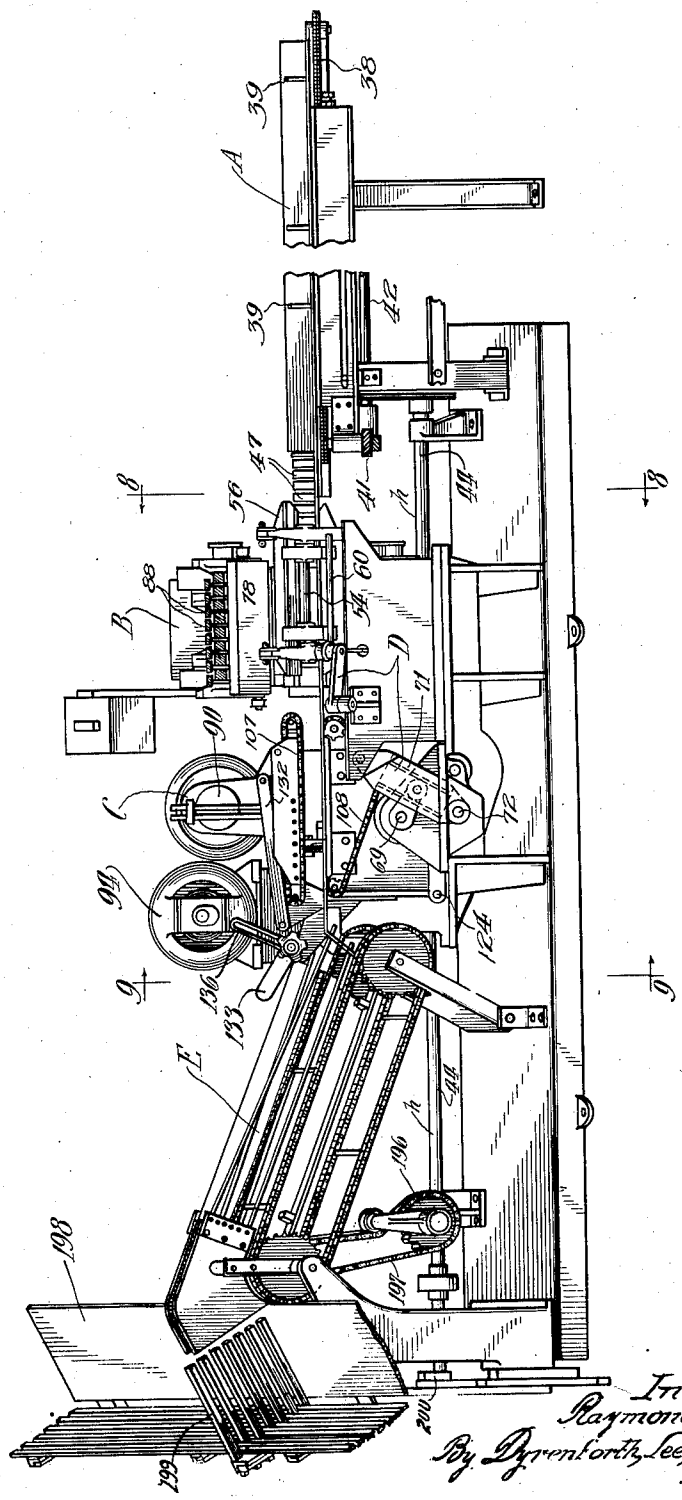


Fig. 1.

Inventor:
Raymond E. Ackley
By Dyrenforth, Lee, Chritton & Wiles.
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 2

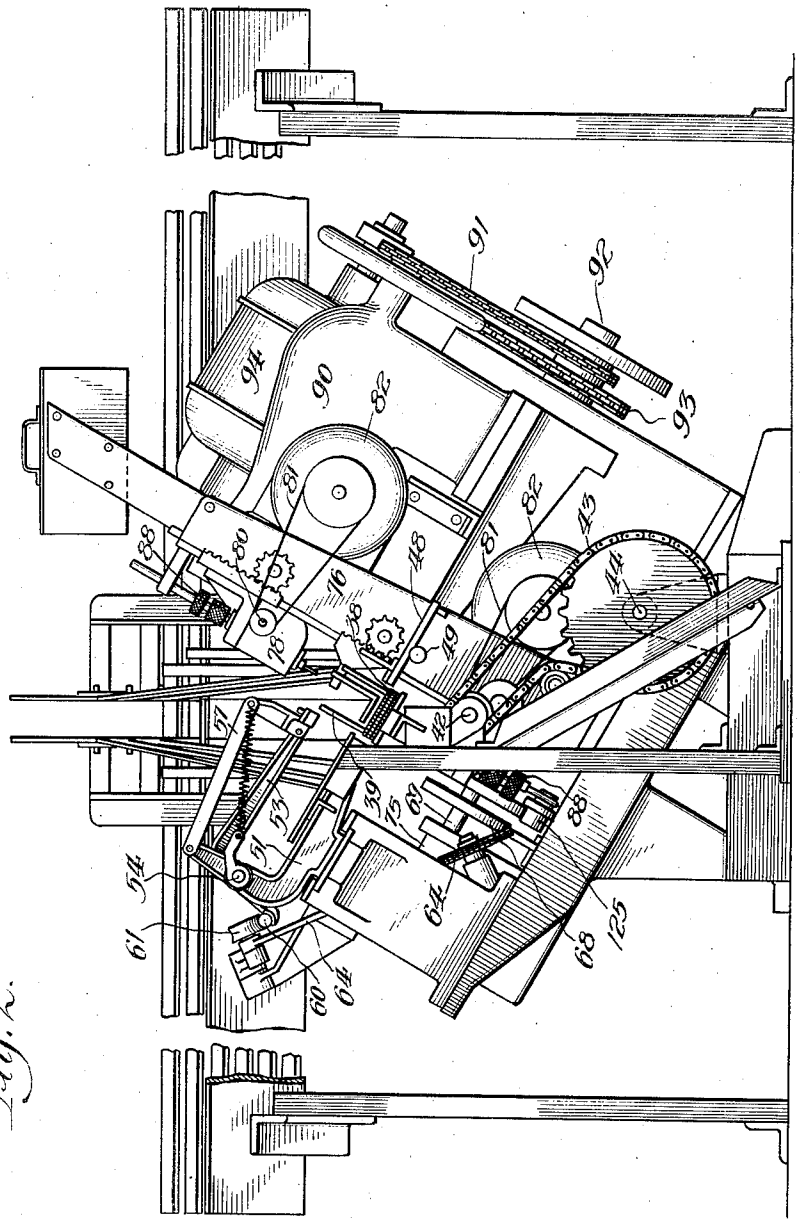


Fig. 12.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 3

Fig. 3.

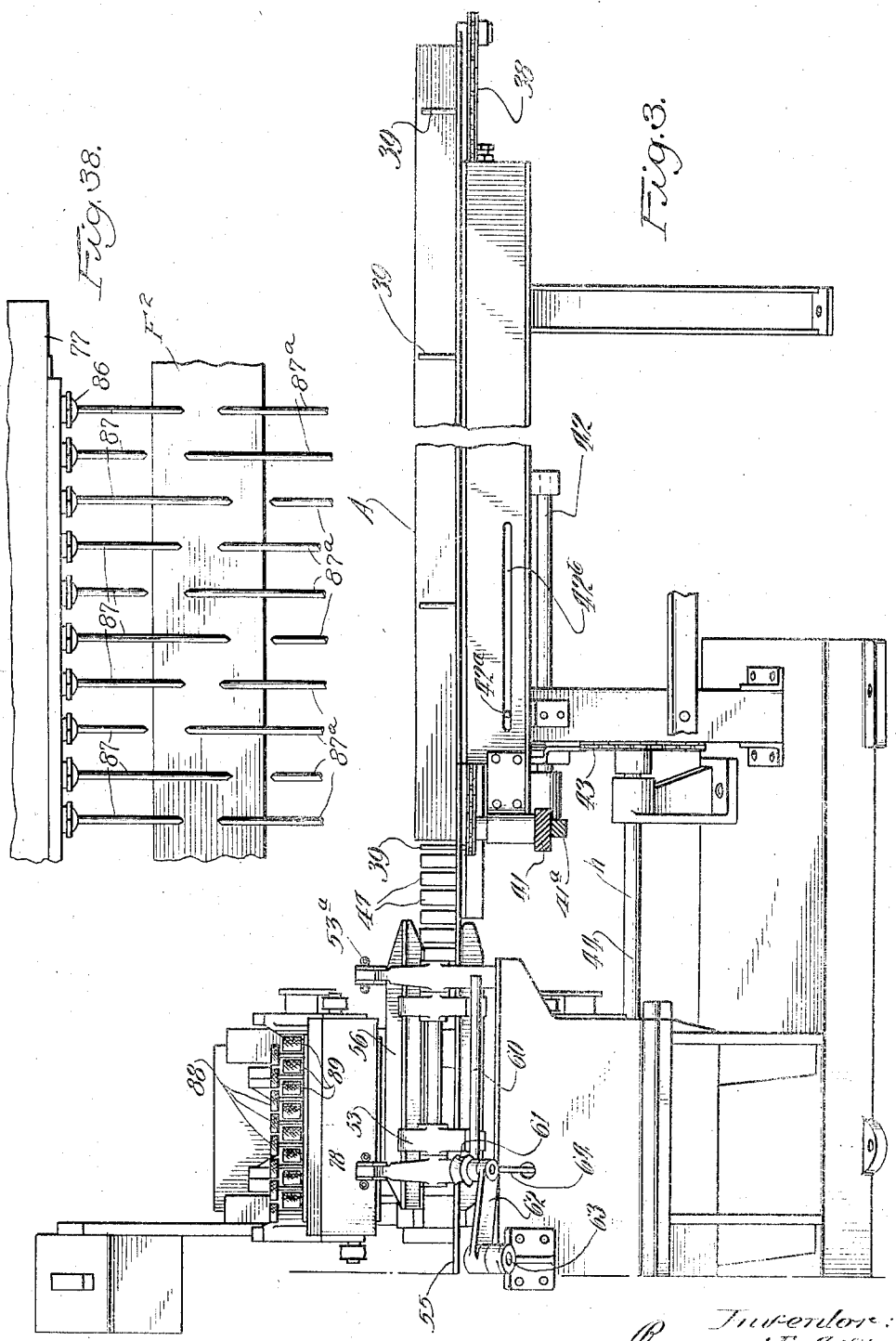


Fig. 3a.

Inventor:
Raymond E. Ackley,
By Pyrenforth, Lee, Chittan & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 4

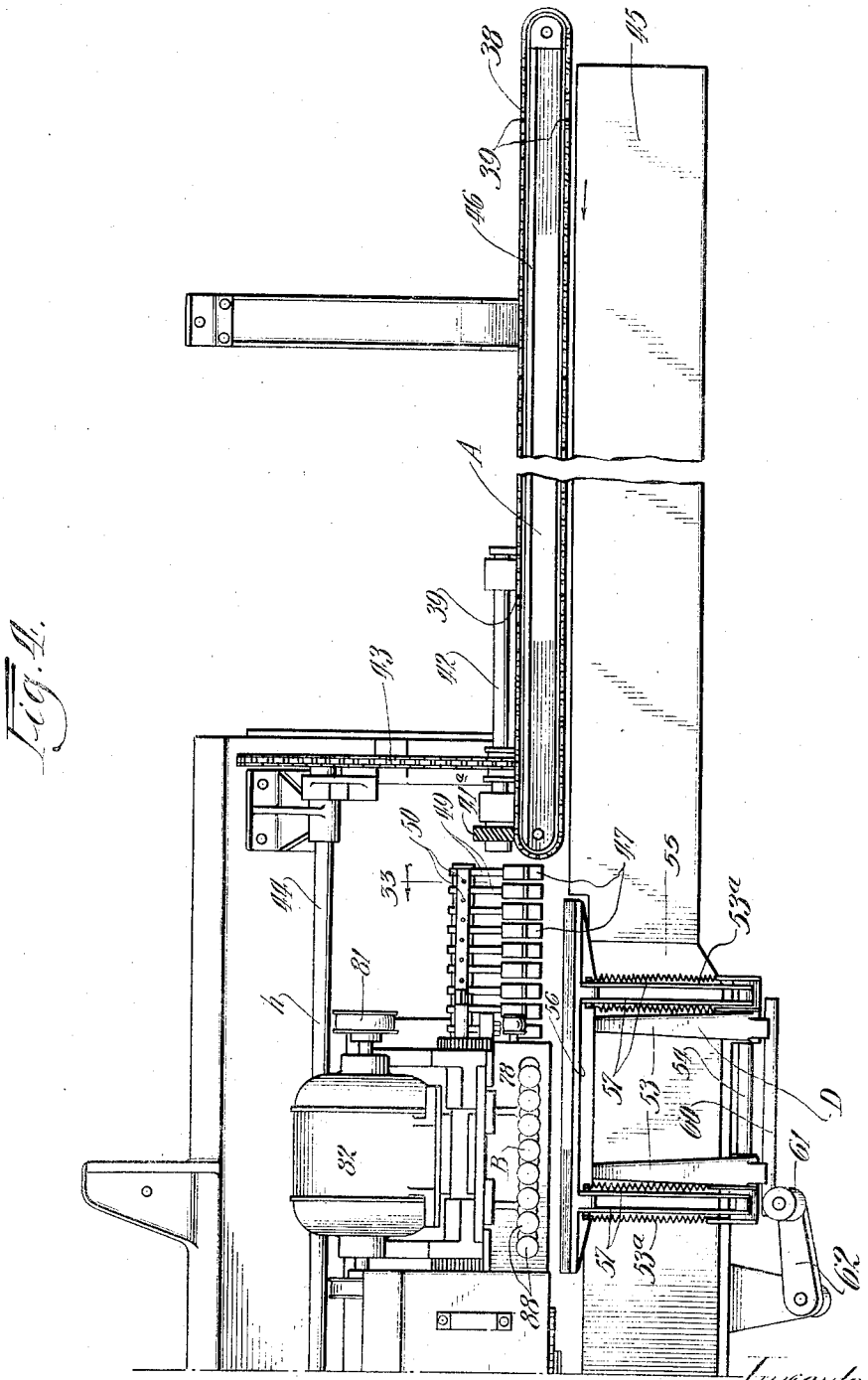


Fig. 4.

Inventor,
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 5

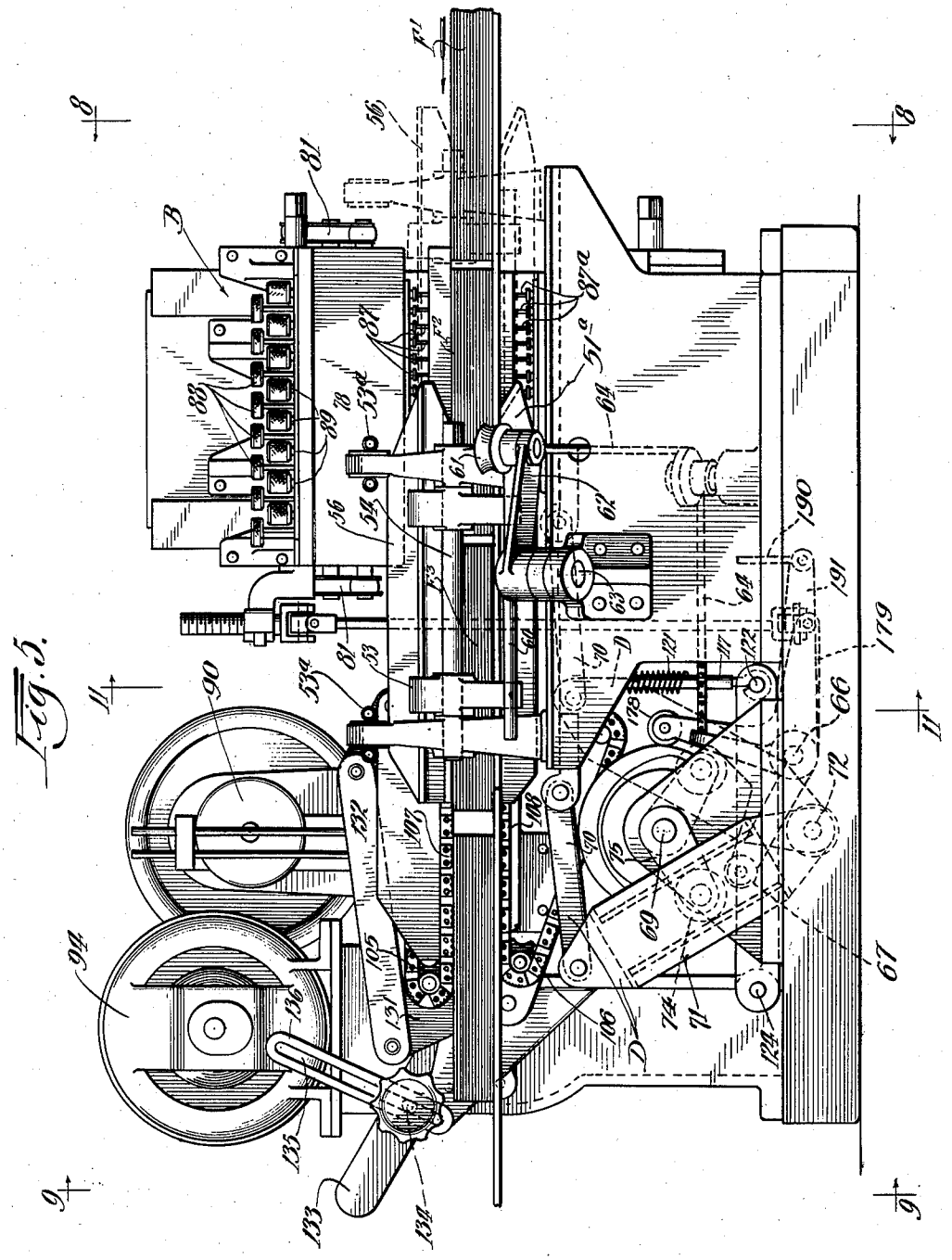


Fig. 5.

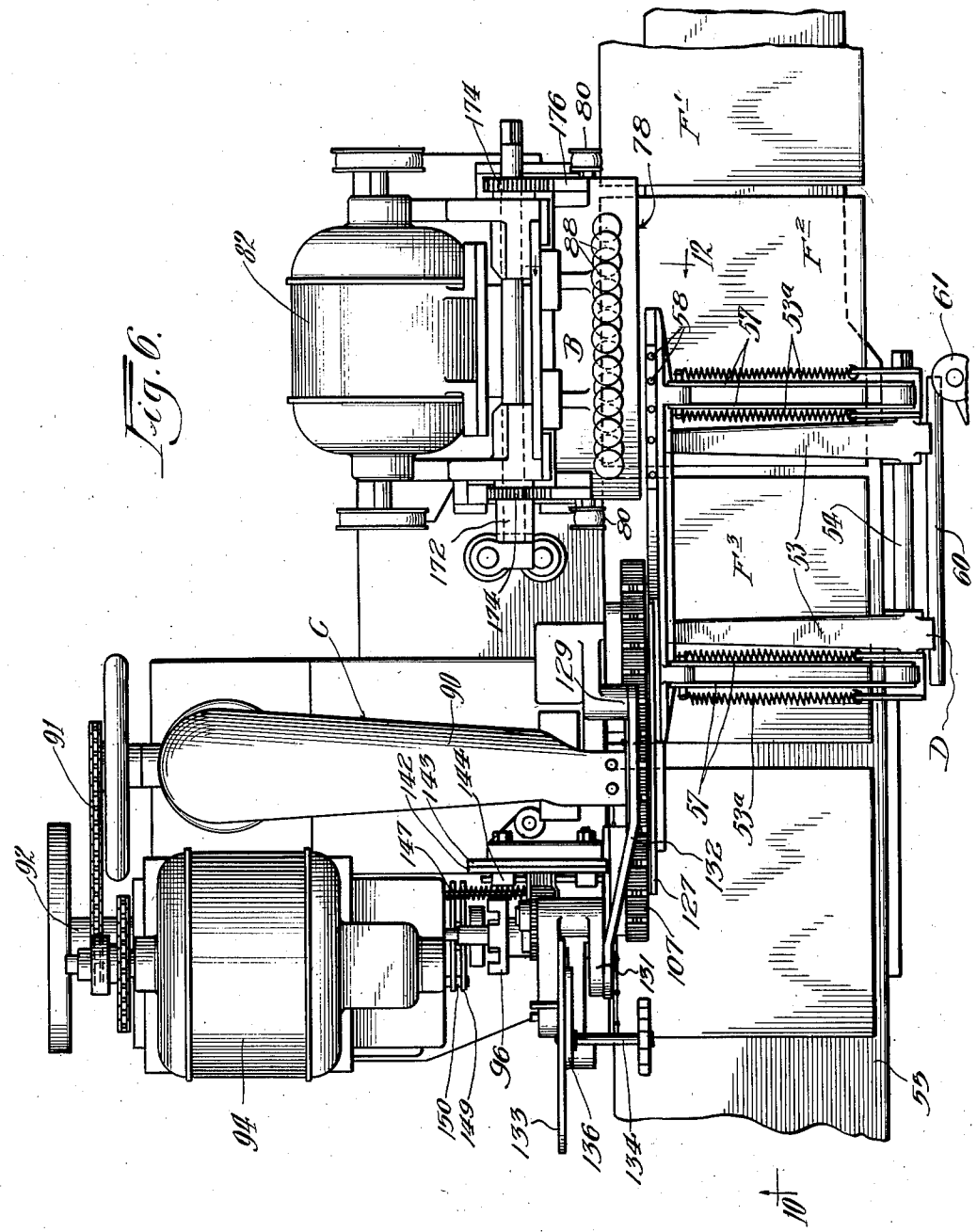
Inventor:
Raymond E. Ackley,
By Pyrenforth, Lee, Britton & Miles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 6

Fig. 6.



Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 7

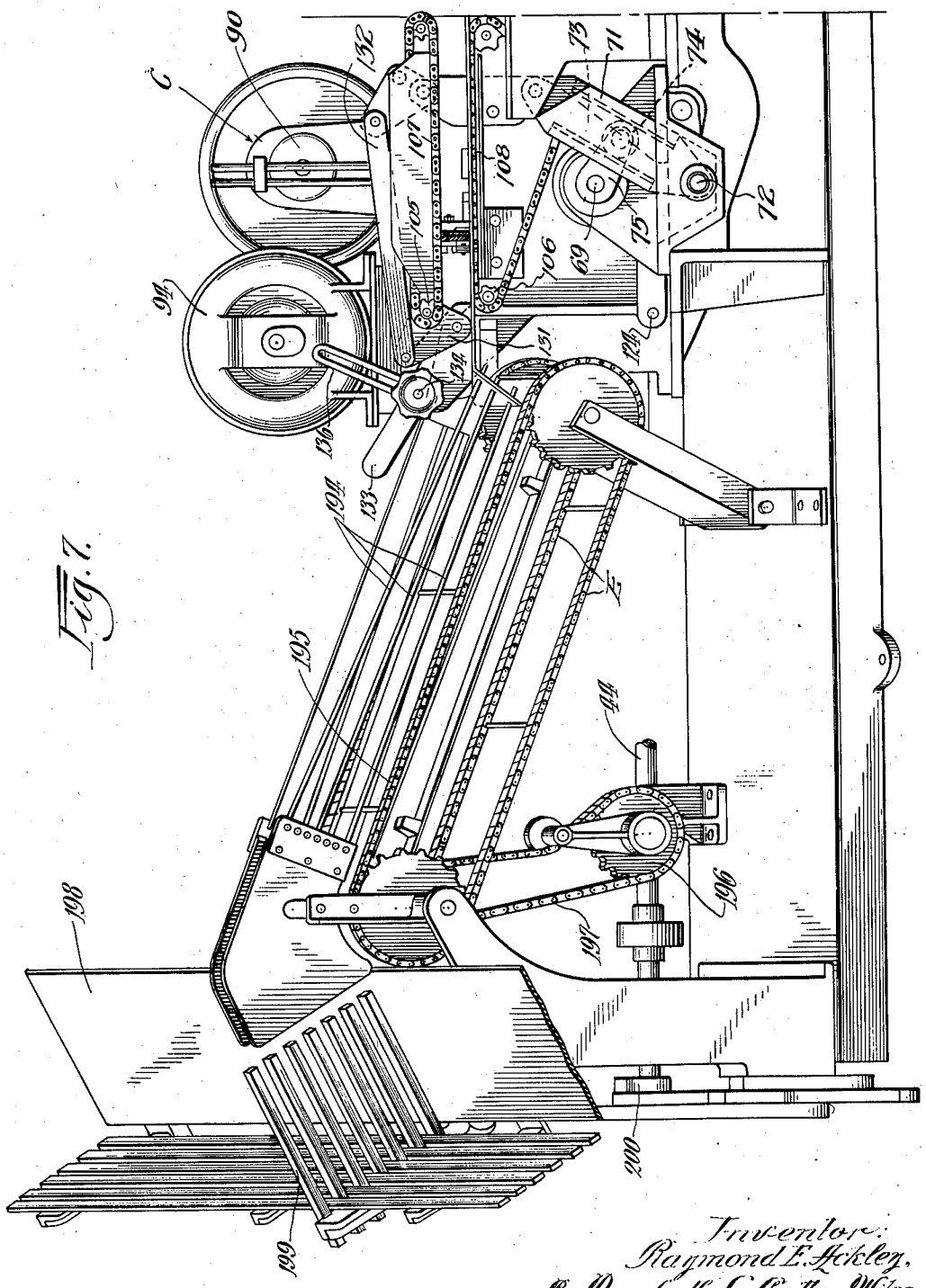


Fig. 7.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chrisman & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 8

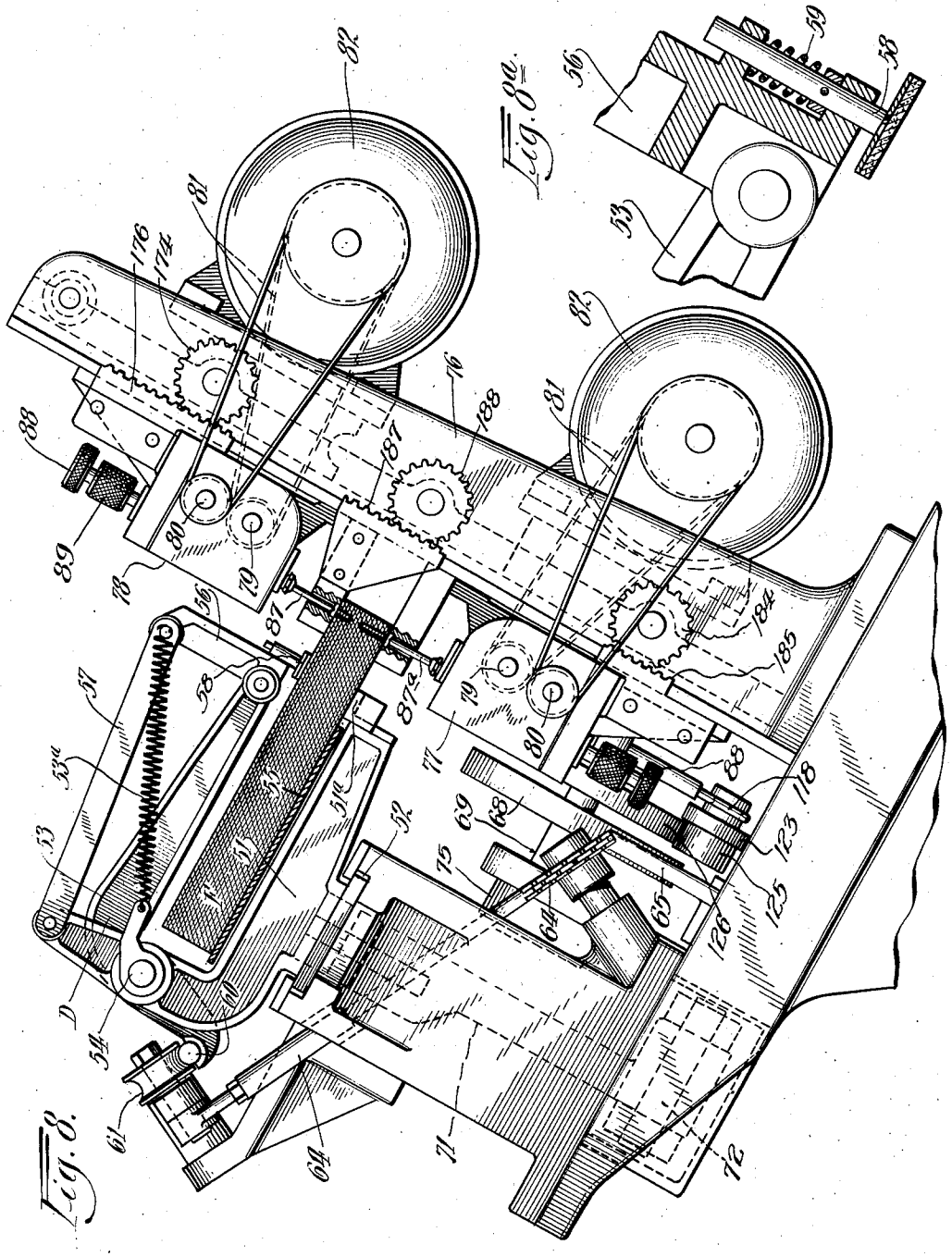


Fig. 8.

Fig. 8a.

Inventor:
Raymond E. Ackley,
By Dyrenforth, See, Orvilton & Miles,
H. Homeys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 9

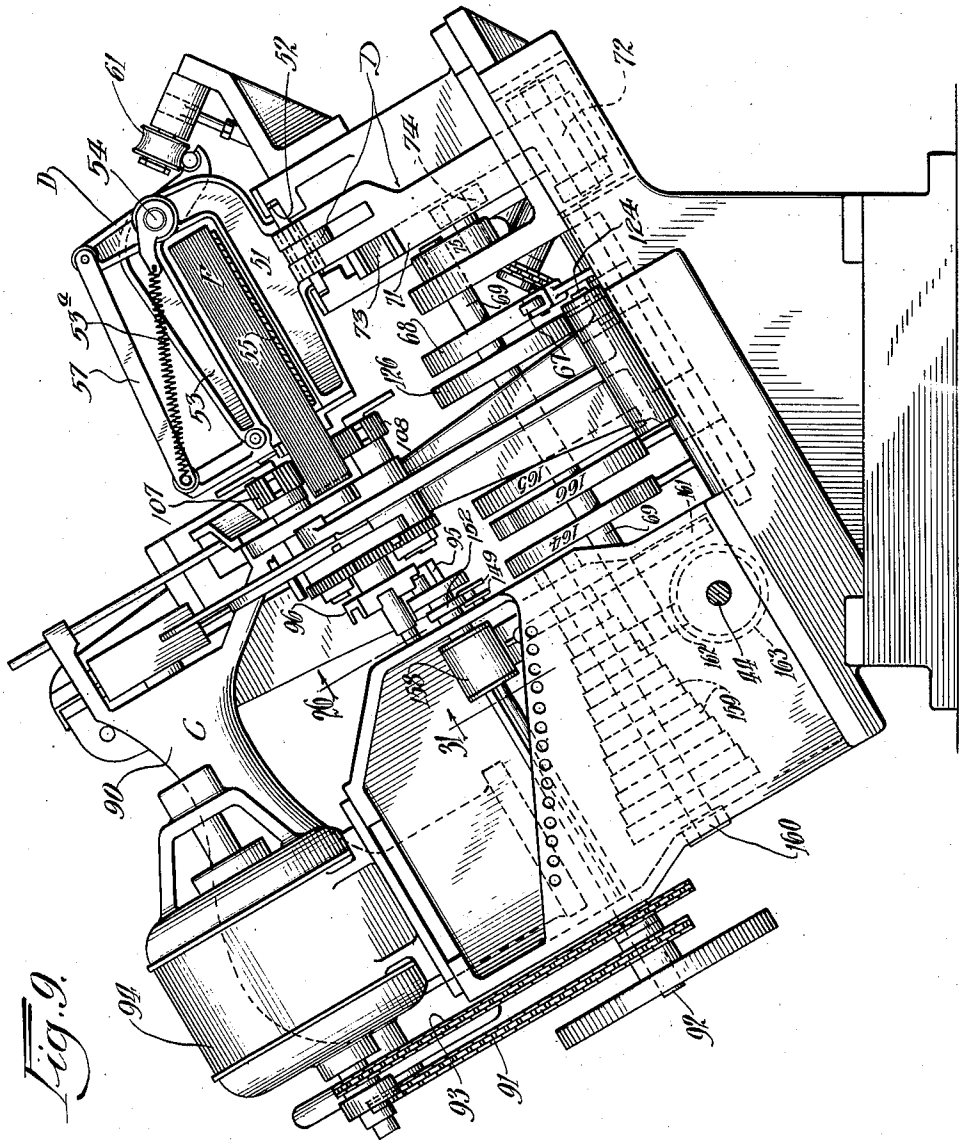


Fig. 9.

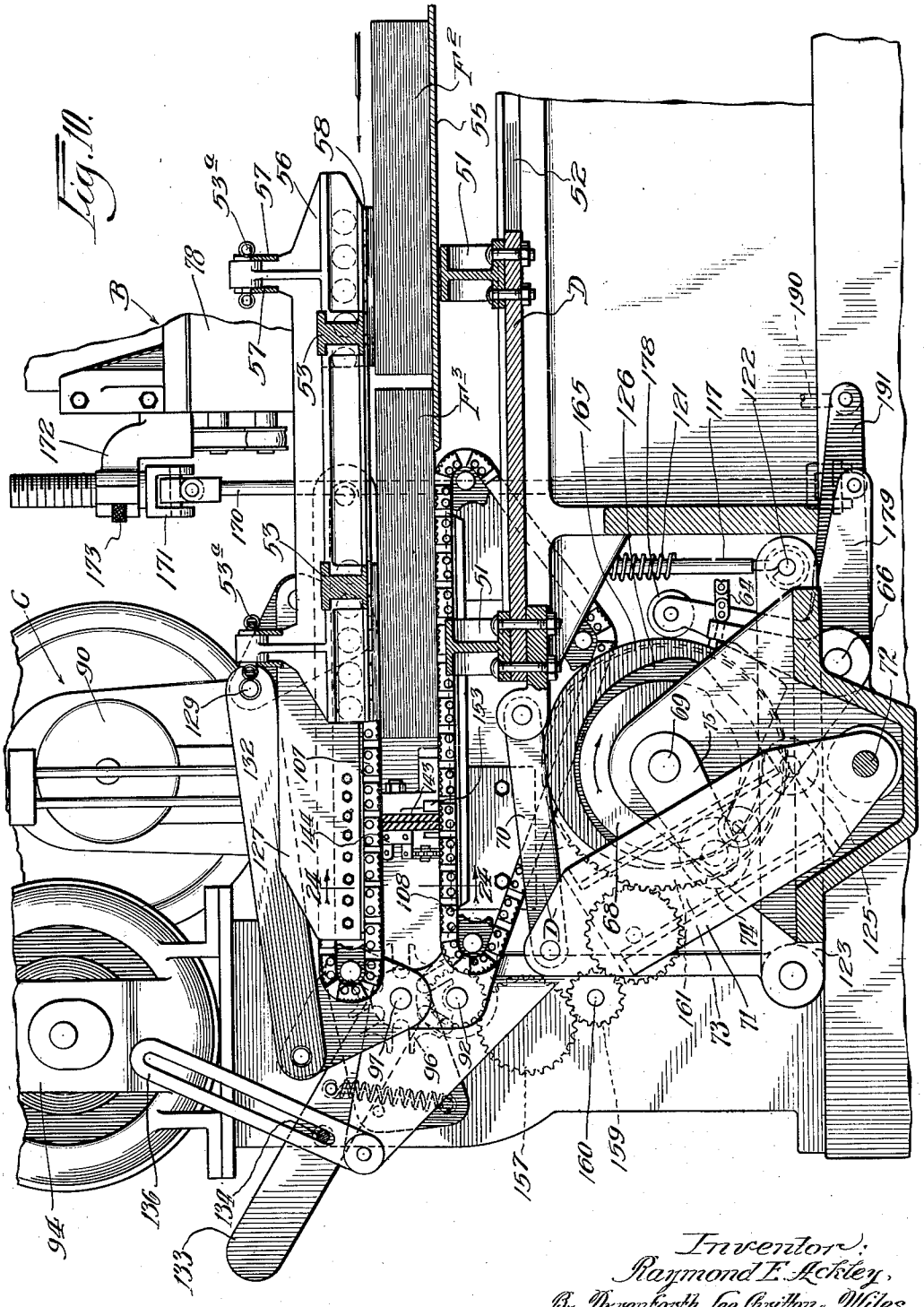
Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 10

Fig. 10.



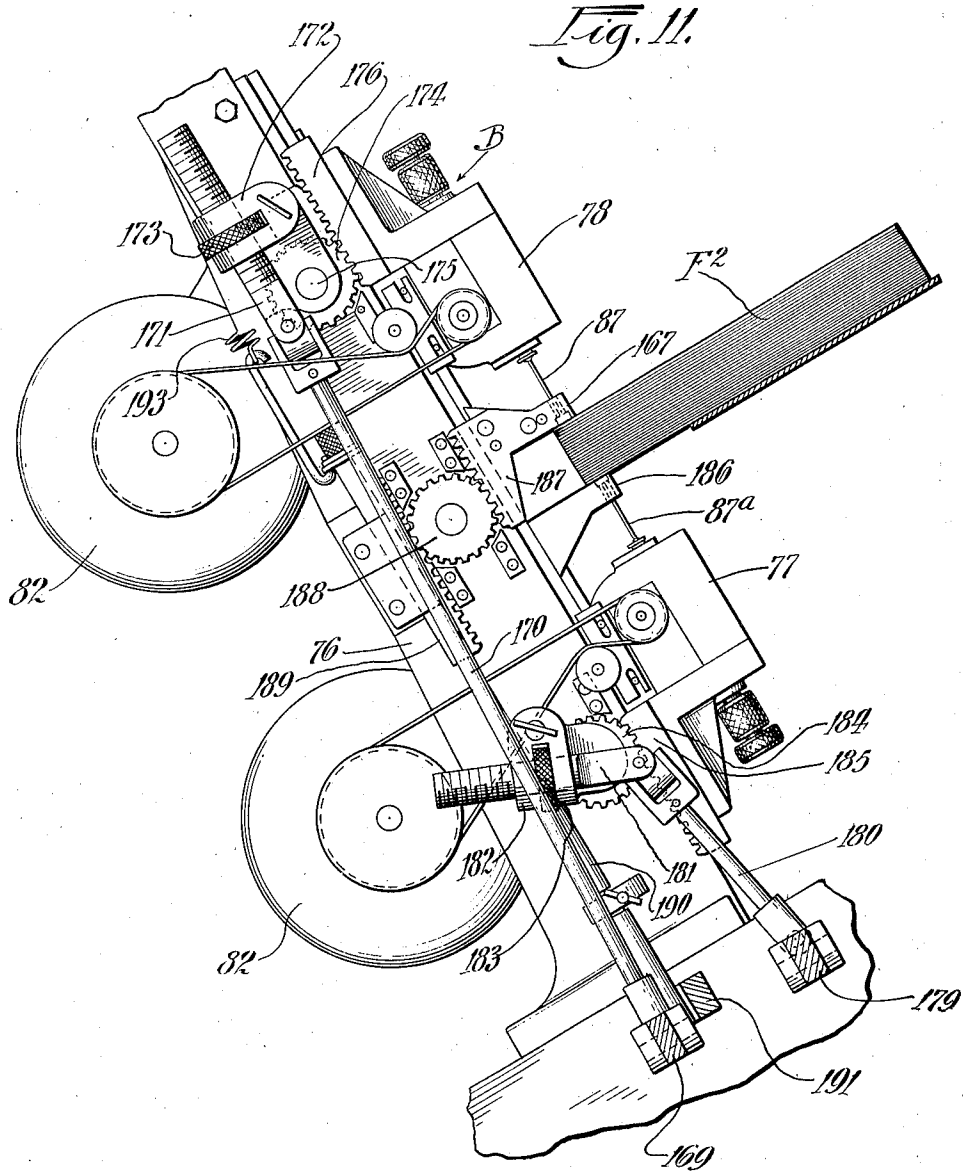
Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Christon & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 11

Fig. 11.



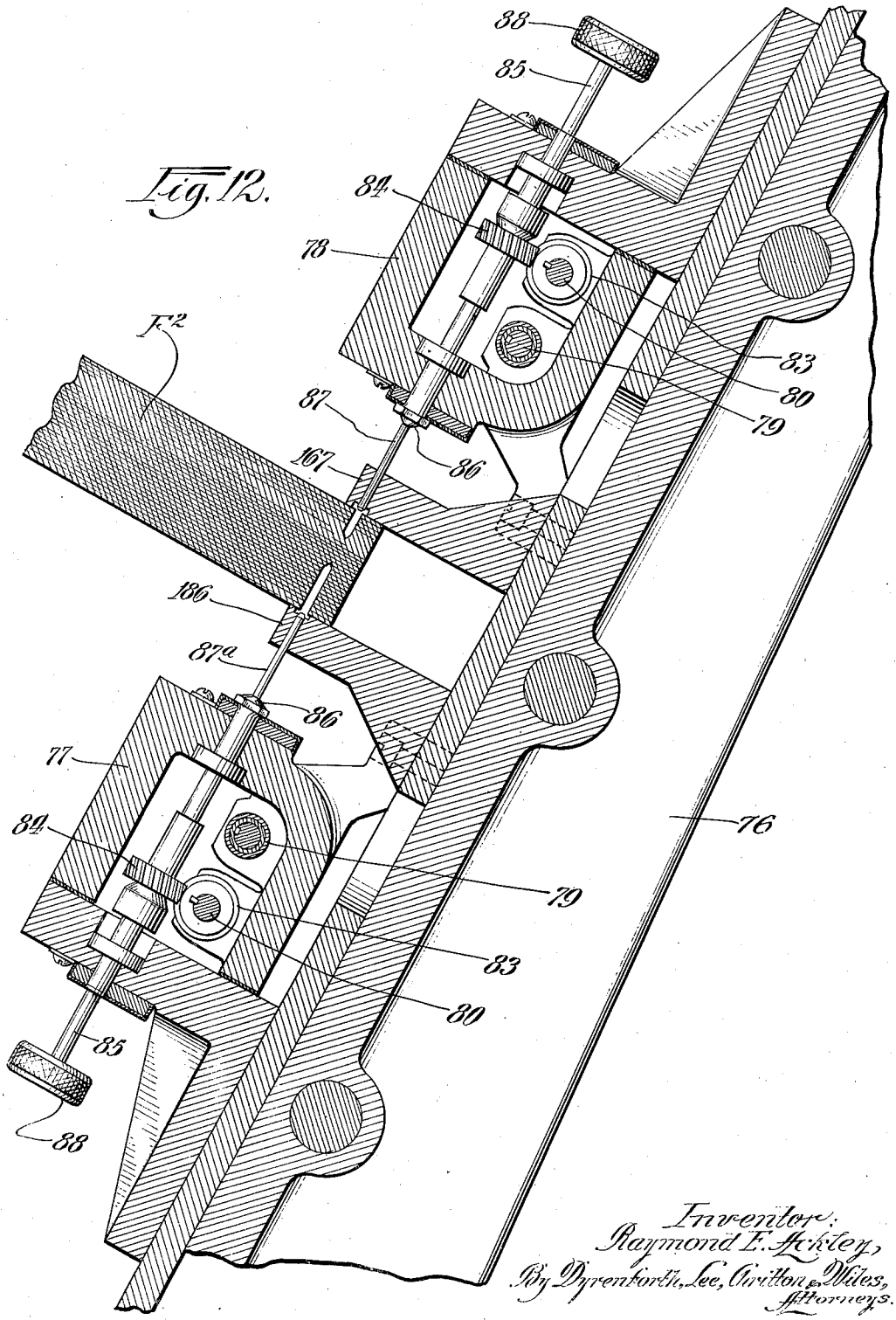
Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 12

Fig. 12.



Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Ayrton & Miles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 13

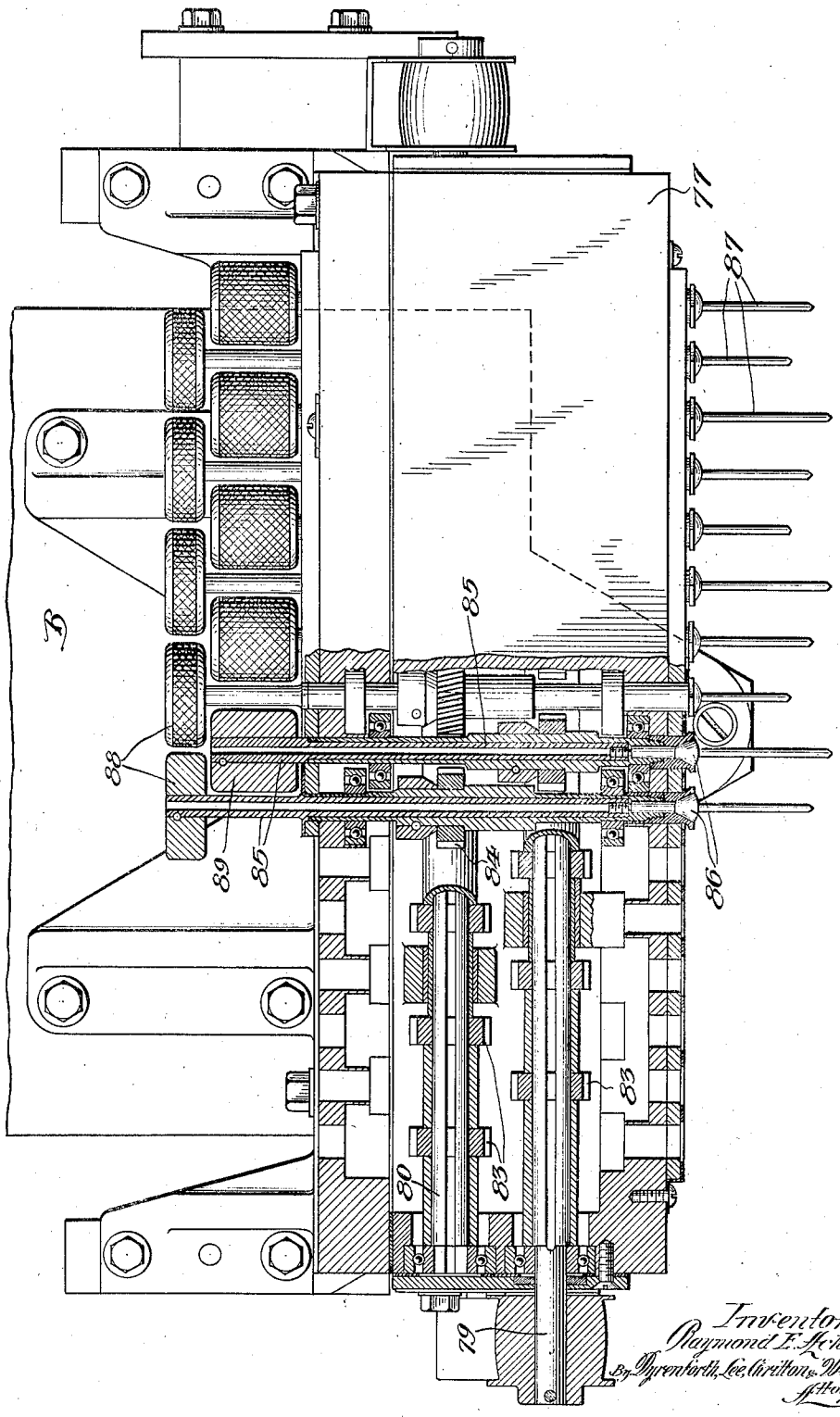


Fig. 13.

Inventor:
Raymond E. Ackley,
By Pyrenforth, Lee, Carlton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 14

Fig. 14.

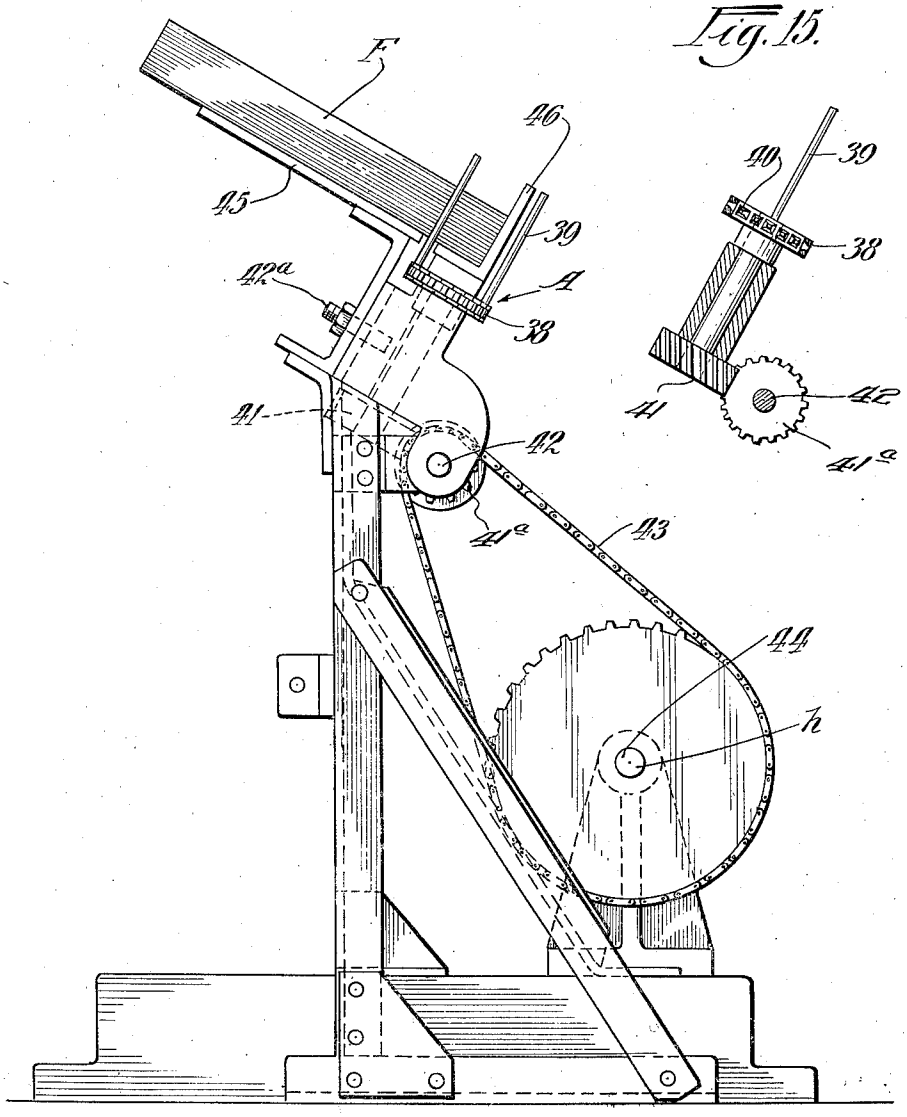


Fig. 15.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Christy & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 15

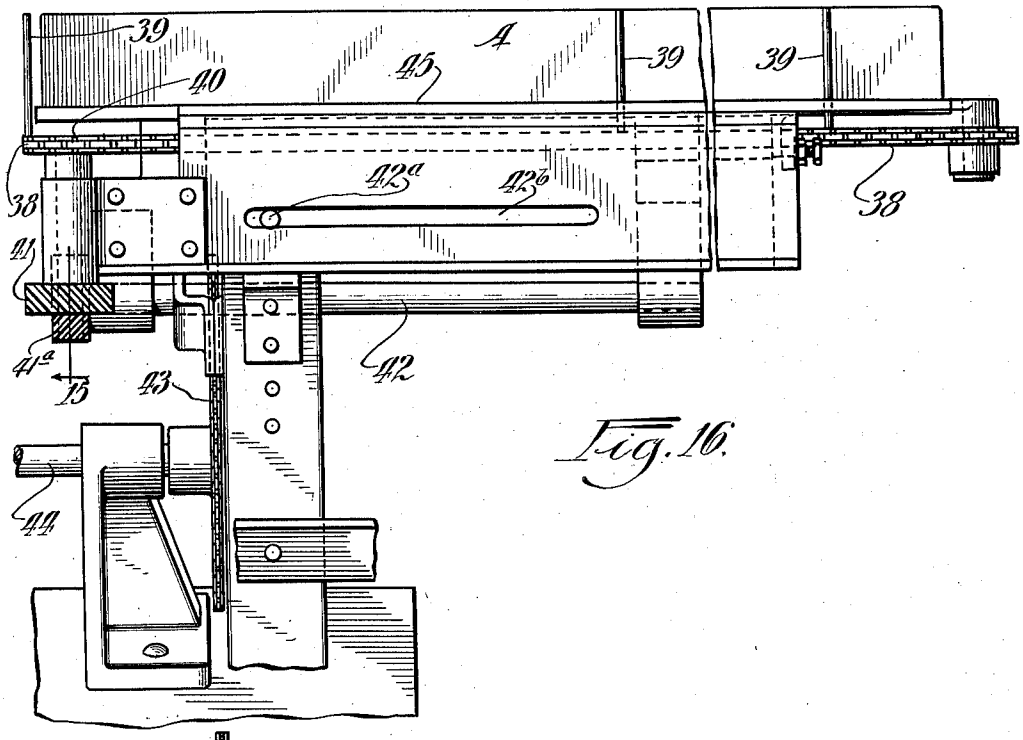


Fig. 16.

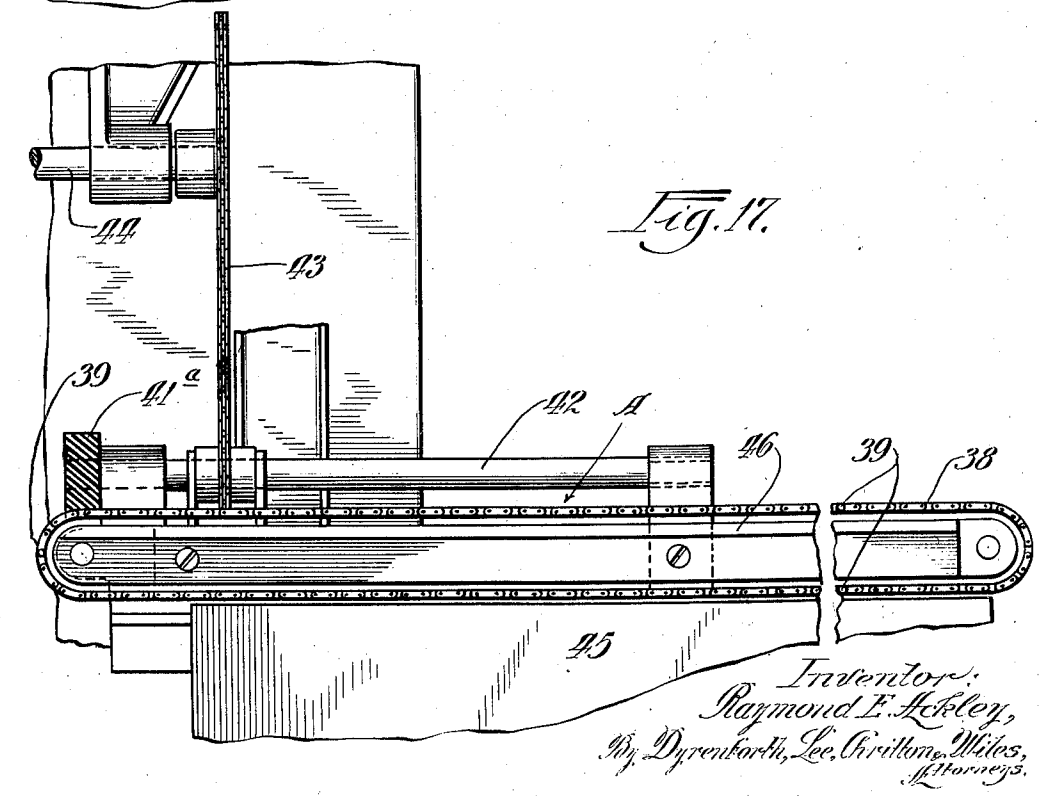


Fig. 17.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chrisman & Miles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 16

Fig. 18.

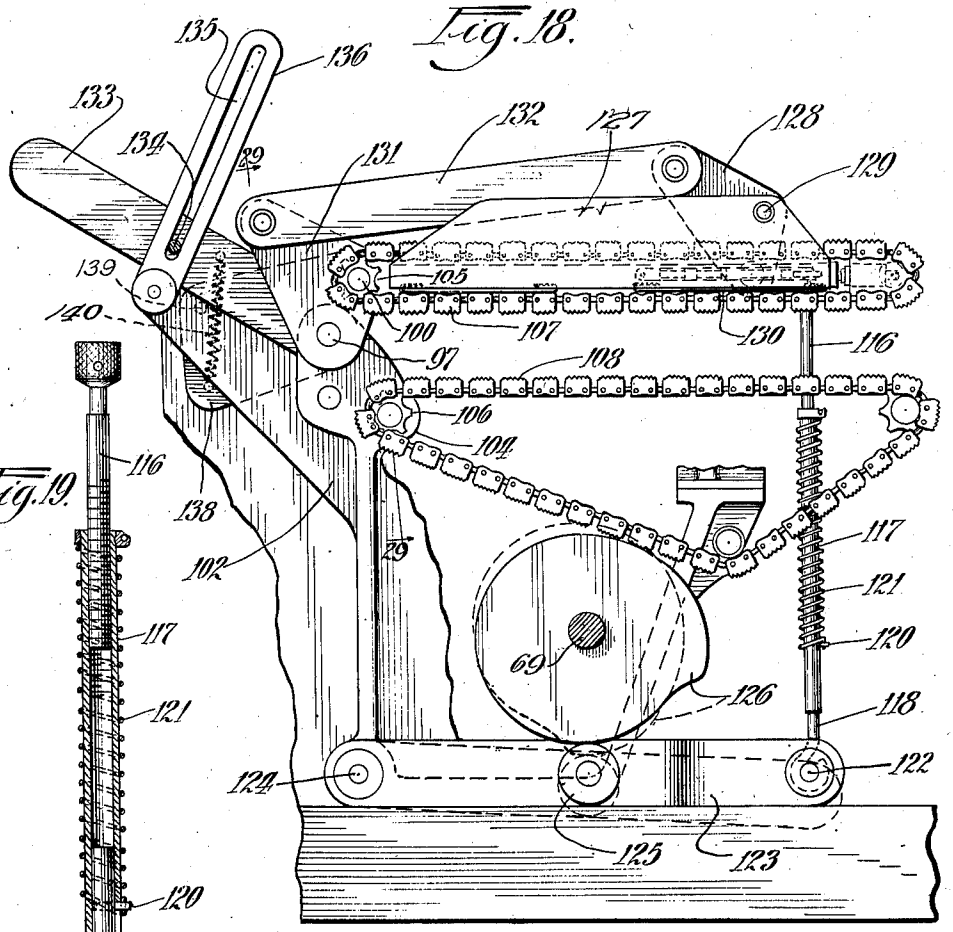
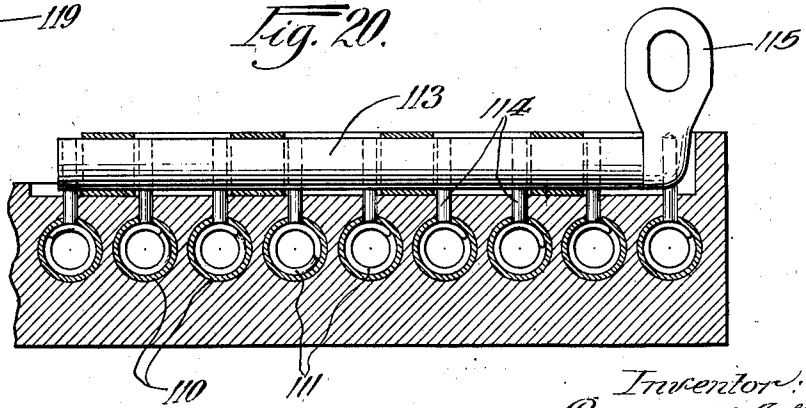


Fig. 19.

Fig. 20.



Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 17

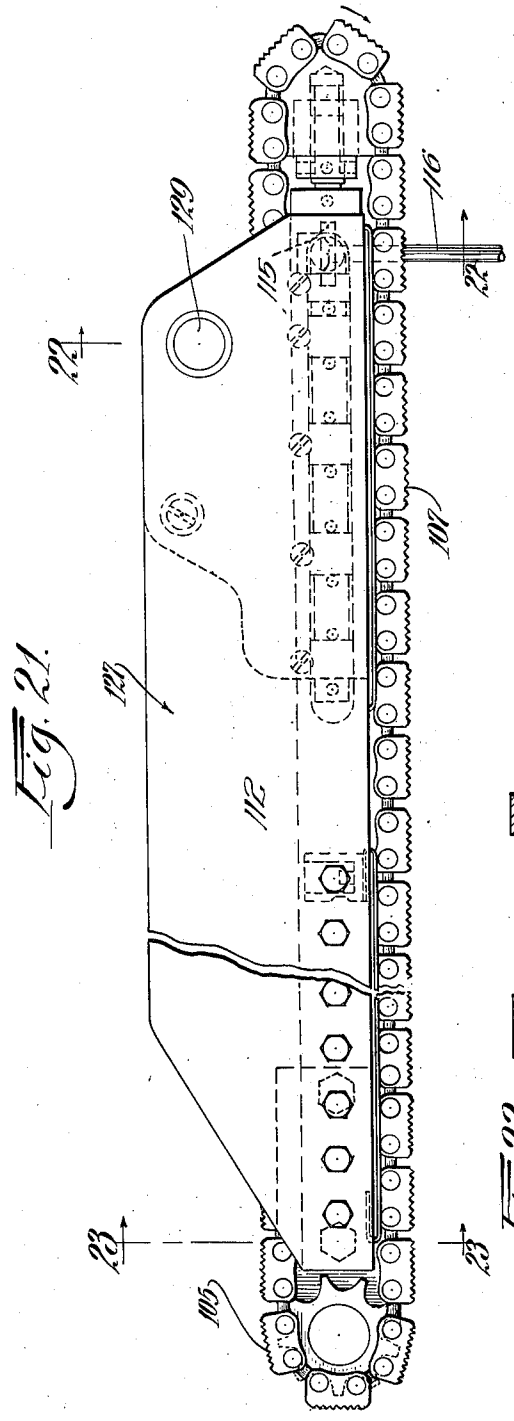


Fig. 21.

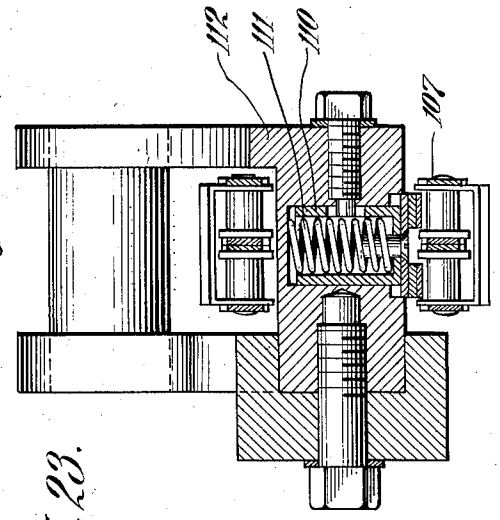


Fig. 23.

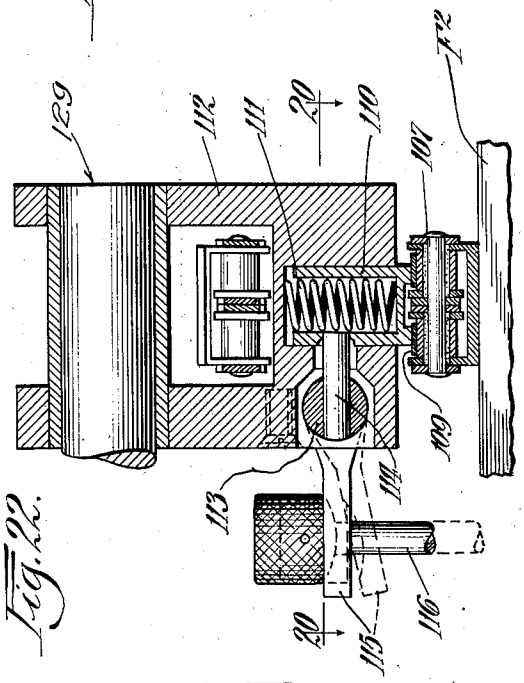


Fig. 22.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chrisman & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 18

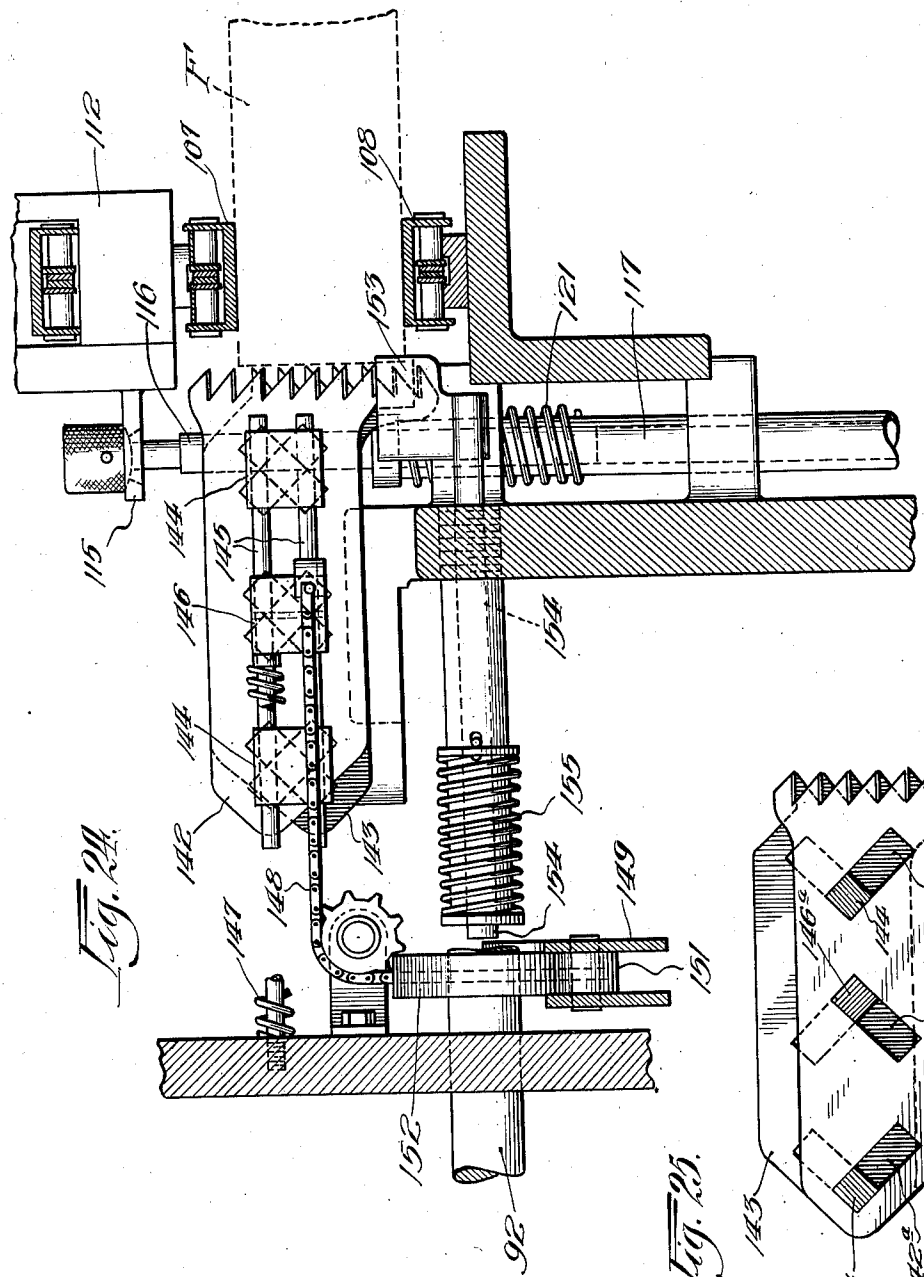


Fig. 24.

Fig. 25.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Christman & Miles.
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 19

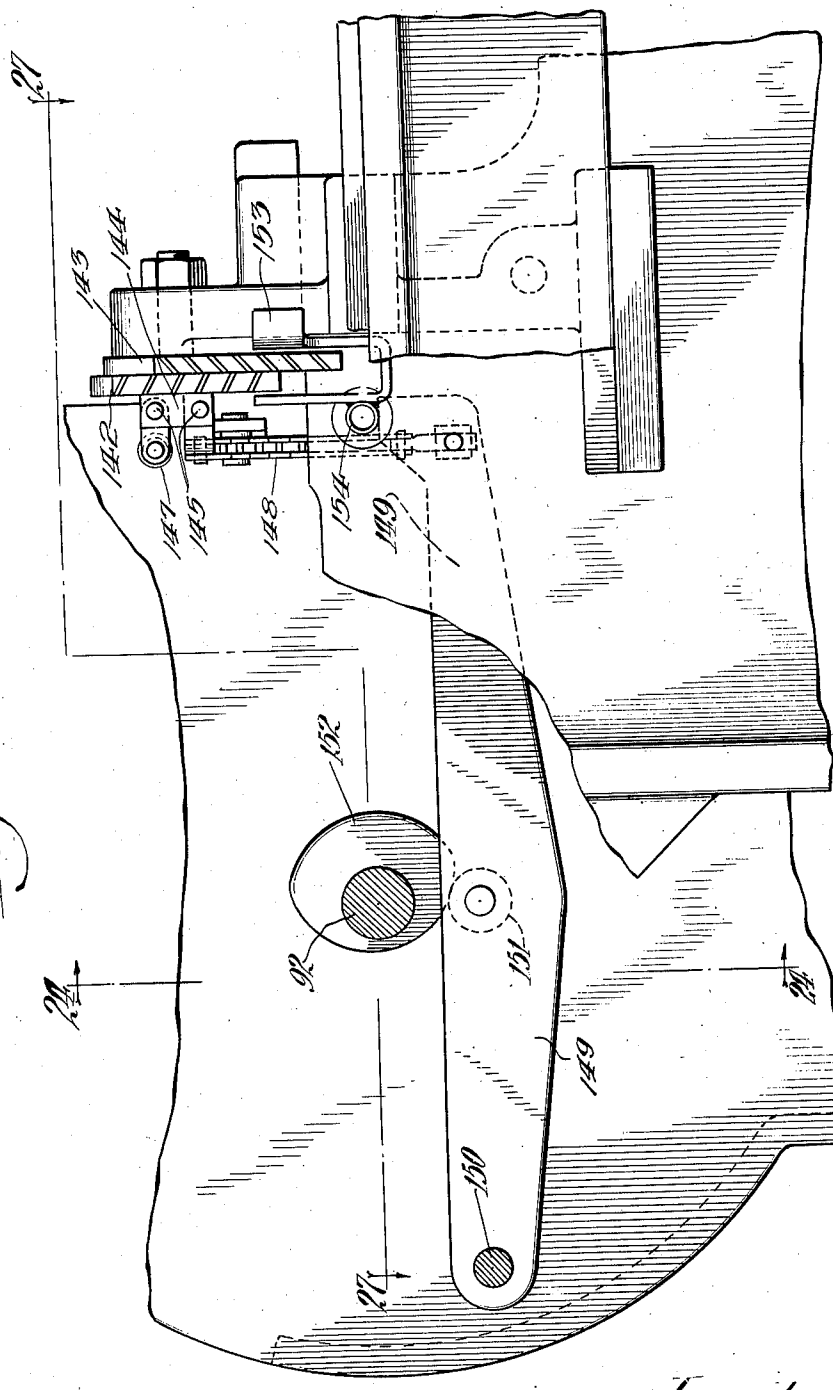


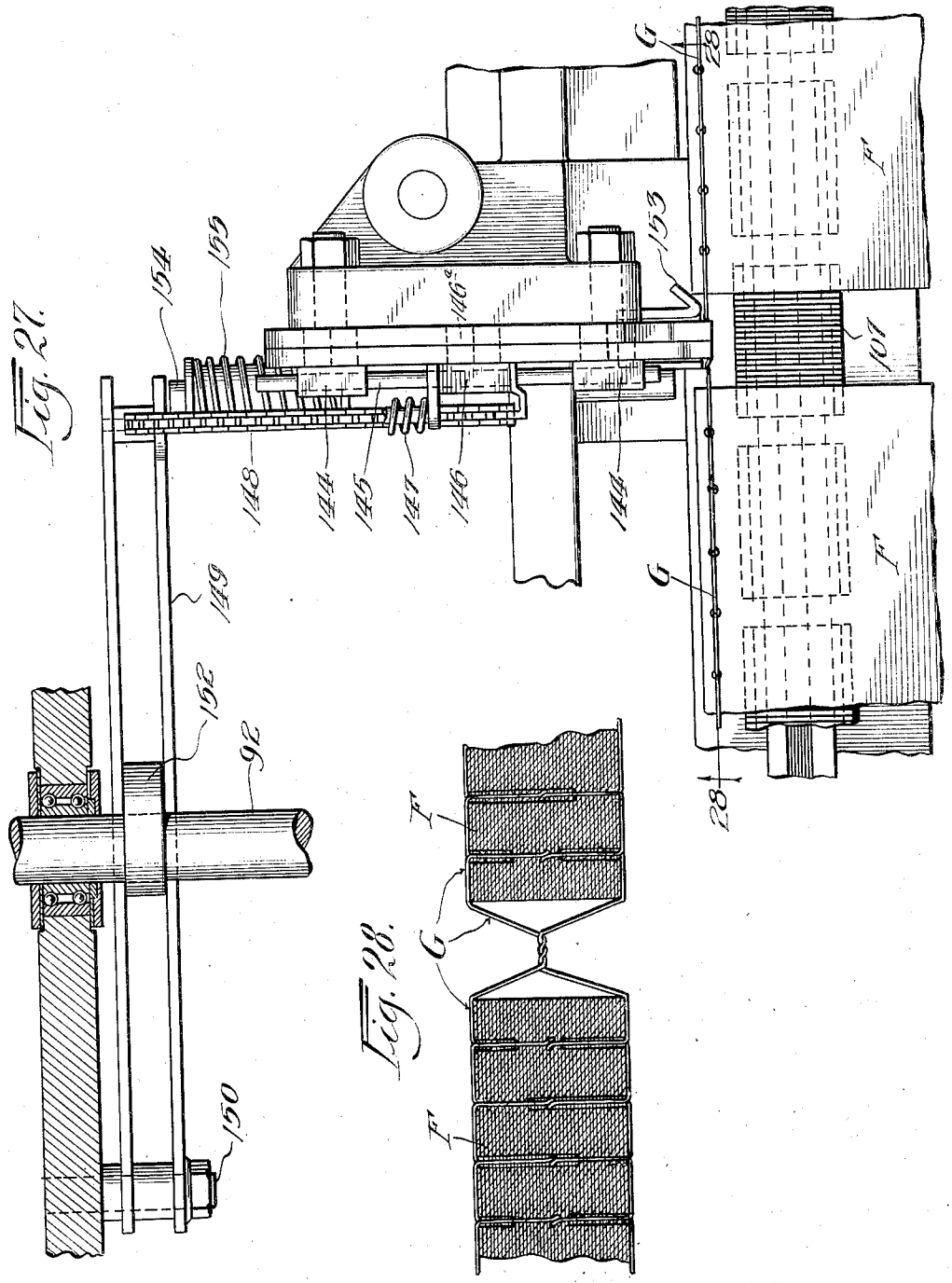
Fig. 26.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 20



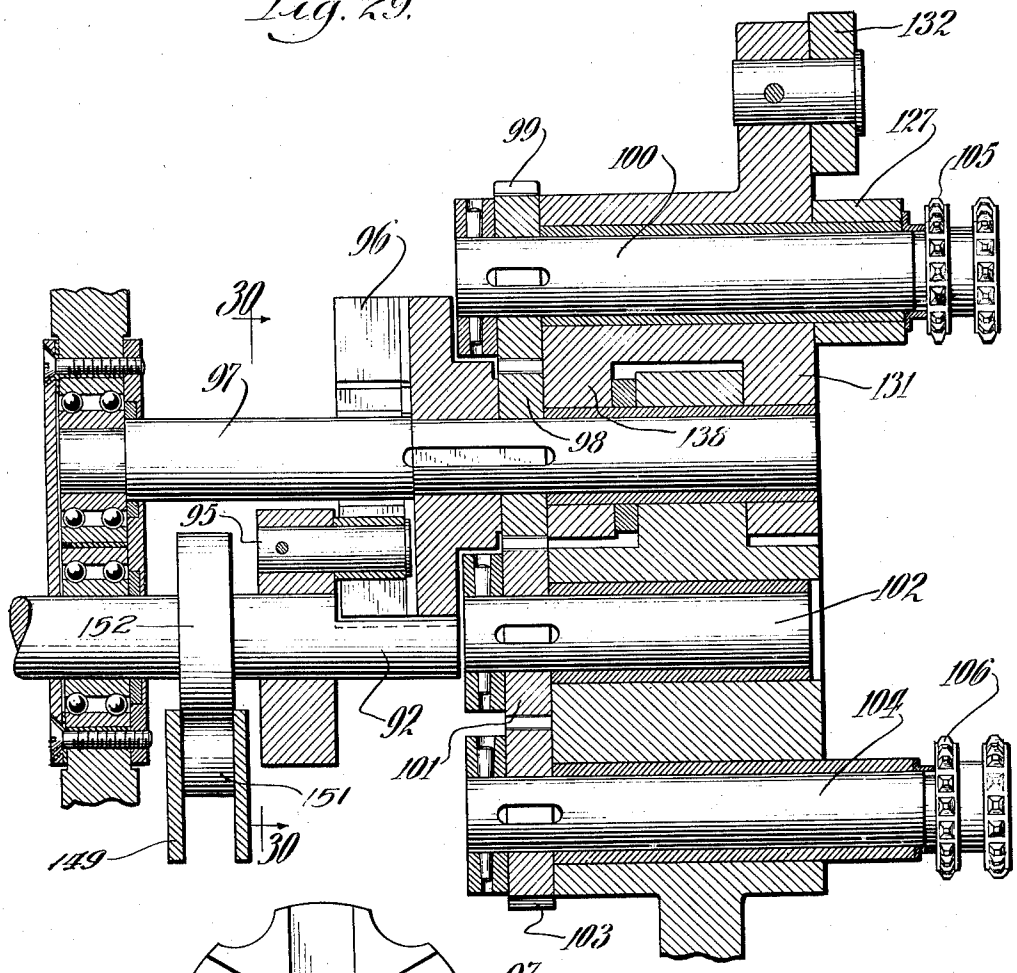
Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chritton & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 21

Fig. 29.



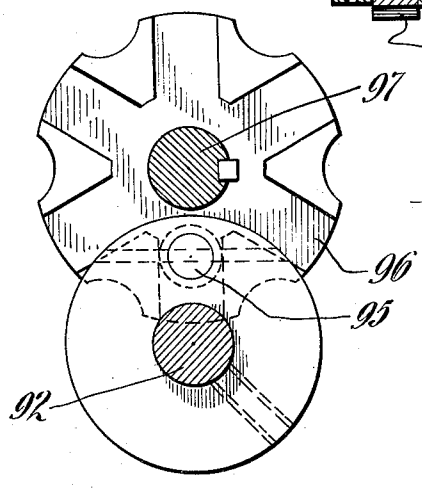


Fig. 30.

Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chrisman & Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 22

Fig. 31.

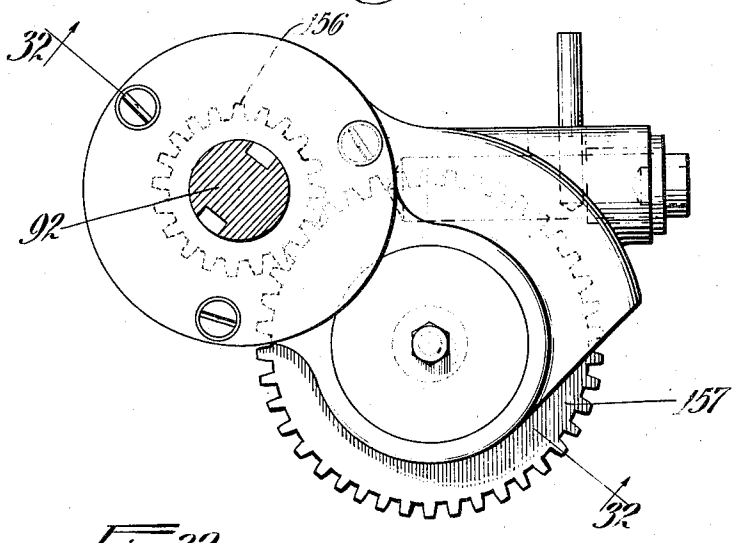


Fig. 32.

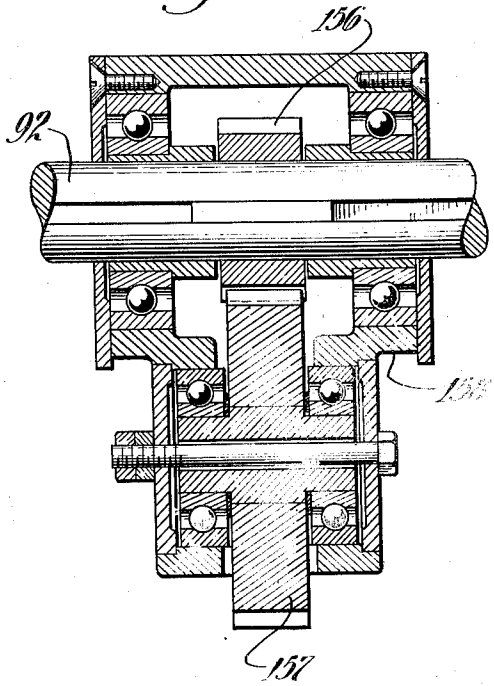
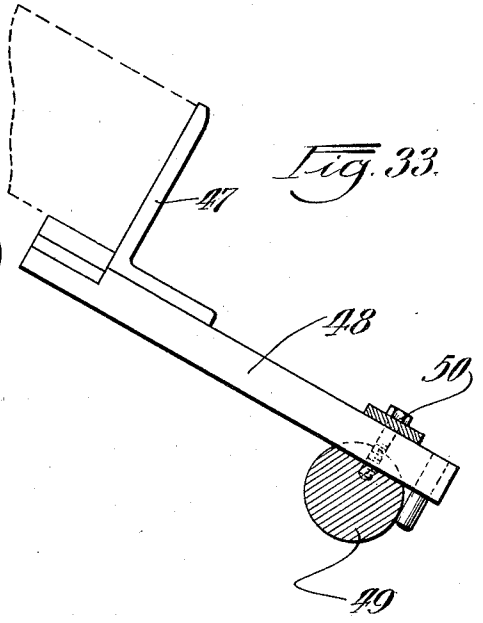


Fig. 33.



Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Chrittons, Wiles,
Attorneys.

June 17, 1930. R. E. ACKLEY 1,764,863

BOOK SEWING MACHINE

Filed June 10, 1927 23 Sheets-Sheet 23

Fig. 34.

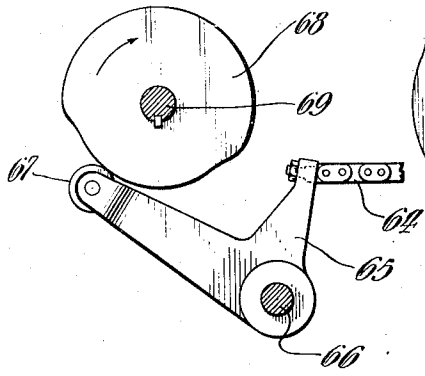


Fig. 35.

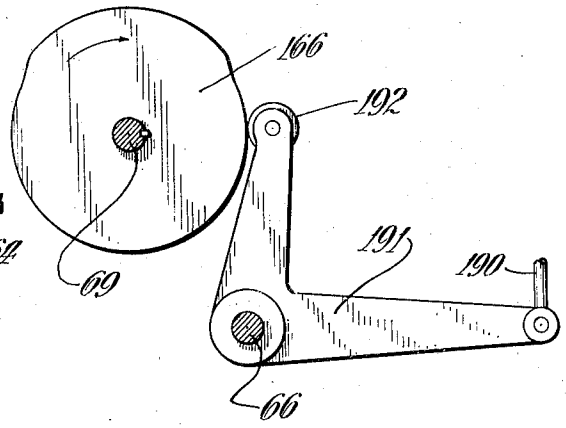


Fig. 36.

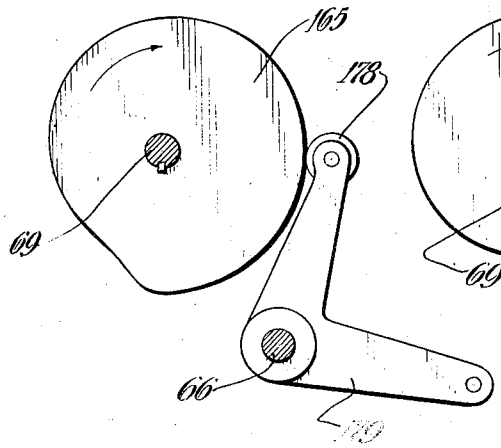
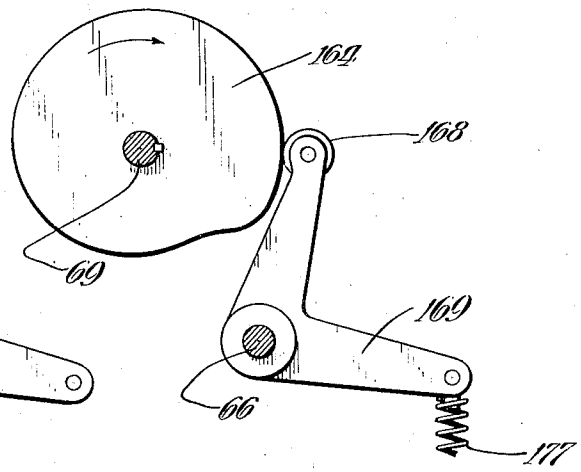


Fig. 37.



Inventor:
Raymond E. Ackley,
By Dyrenforth, Lee, Christensen, Miles,
Attorneys.

Patented June 17, 1930 1,764,863

UNITED STATES PATENT OFFICE

RAYMOND E. ACKLEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO R. R. DONNELLEY AND SONS COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

BOOK-SEWING MACHINE

Application filed June 10, 1927. Serial No. 197,865.

This invention relates to a method of and apparatus for sewing books and the like.

An object of this invention is to provide a method of, and machine for, sewing books of a thickness through which the ordinary book sewing needle is unable to penetrate, and to do this without splitting or cracking the material of the book, and which at the same time will provide a book in which all of the leaves of the book are punched directly by the sewing needle so that all of the leaves will be tightly held.

Another object is the provision of simple and convenient means for moving the book into the conveyor which feeds it under the sewing mechanism.

Another object is to provide an improved form of conveyor mechanism for feeding the book under the sewing mechanism together with an adjustment of the same to accommodate books of varying thickness, at the same time having a yieldable means for preventing damage which might result from wedging one or more books in said conveyor.

These and other objects as will hereinafter appear, are accomplished by this invention which is fully described in the following specification and shown in the accompanying drawings, in which—

Figure 1 is a front elevation taken on the tilted line 1—1 of Fig. 2;

Fig. 2 is an end elevation of the machine showing the end of the machine at which the books enter;

Fig. 3 is a view similar to Fig. 1, showing an enlarged front elevation of the feeding conveyor and the drilling mechanism;

Fig. 4 is a top plan view of the same;

Fig. 5 is an enlarged front elevation similar to Fig. 1, showing the drilling and stitching heads and the advancing mechanism;

Fig. 6 is a top plan view of the same;

Fig. 7 is a front elevation of the delivery end of the machine.

Fig. 8 is an enlarged view on the line 8—8 of Figs. 1 and 5;

Fig. 8ª is an enlarged detail in section of the spring-pressed gripping finger of the advancing mechanism;

Fig. 9 is a similar view on the line 9—9 of Figs. 1 and 5;

Fig. 10 is a view in section as viewed on the line 10 of Fig. 6;

Fig. 11 is a partial enlarged view on the line 11—11 of Fig. 5;

Fig. 12 is an enlarged sectional view on the line 12 of Fig. 6, showing the drilling mechanism;

Fig. 13 is an elevation of the drilling mechanism shown in Fig. 12, partly in section;

Fig. 14 is an end view of the feeding conveyor;

Fig. 15 is a section on the line 15 of Fig. 16;

Fig. 16 is a partial enlarged front elevation of the feeding conveyor;

Fig. 17 is a plan view of the same;

Fig. 18 is a view similar to Fig. 10, showing the conveyor for the sewing mechanism in elevation;

Fig. 19 is a detail of the yieldable operating rod therefor;

Fig. 20 is a partial section on the line 20—20 of Fig. 22;

Fig. 21 is an enlarged front view of the upper section of the conveyor for the sewing mechanism;

Fig. 22 is an enlarged section on the line 22 of Fig. 21;

Fig. 23 is a similar section on the line 23 of the same;

Fig. 24 is an enlarged partial transverse view on the line 24—24 of Fig. 26, showing the mechanism for cutting the thread after the book has been sewed;

Fig. 25 is a similar view of the device showing the same in the advanced and cutting position;

Fig. 26 is an enlarged view partly in section on the line 26 of Fig. 9;

Fig. 27 is a section on the broken line 27—27 of Fig. 26;

Fig. 28 is a partial section through the adjacent ends of two books which have been sewed, previous to cutting the sewing thread;

Fig. 29 is a partial enlarged section on the broken line 29—29 of Fig. 18;

Fig. 30 is a transverse section on the line 30—30 of Fig. 29;

Fig. 31 is a partial enlarged view on the line 31 of Fig. 9;

Fig. 32 is a section on the line 32—32 of Fig. 31;

Fig. 33 is a view on the line 33 of Fig. 4, showing one of the adjustable guides for the book;

Figs. 34, 35, 36 and 37 are details of the cams shown in Fig. 9; and Figure 38, a broken view in elevation of the drilling mechanism showing the drills forced into the book to the maximum distance.

The embodiment illustrated comprises a book sewing machine the principal units of which are the feeding conveyor A, the drill head B, the sewing mechanism C, the mechanism D for advancing the book from the drilling mechanism of the stitching mechanism, and the conveyor E for carrying away the stitched books.

It will be observed at this point that the machine as a whole is tilted to one side, as clearly shown in Fig. 9, so as to place the book somewhat at an angle as though it were lying in a trough. For convenience, however, many of the views have been turned so as to view the various parts of the mechanism at an angle as shown by the line 1—1 of Fig. 2.

The feeding conveyor A as shown in Figs. 3 and 4 and 14 to 17 comprises a chain 38 having laterally projecting pins 39 which pass around suitable sprockets 40 which are driven by means of gears 41 and 41[a] from a shaft 42 which in turn is driven by means of sprockets over which runs the chain 43 from the longitudinal shaft 44 which is driven by a motor as will later be explained.

The books F to be sewed are placed upon the inclined table 45 (Figs. 4 and 14), the back of the book resting against the guide 46. As the pins 39 advance they push the book forward along the table 45 and finally leave the book upon the adjustable guides 47 (Fig. 4) as the pin reaches the end of its movement and returns. This adjustable bracket is shown in Fig. 33 and is carried upon a member 48 which is adjustably secured to the rod 49 by means of a screw 50.

Thus it will be seen that the positioning of the book upon the adjustable guides 47 is dependent upon the point at which the pins 39 turn when nearest to the guides 47. The conveyor is, as shown in Fig. 4, at substantially its outermost point and is adjustable toward the cutting head by means of the shaft 42 which is provided with a key-way so as to be slidable through the sprocket which is driven by the chain 43 and the conveyor is secured in any adjustable position by means of the bolt 42[a] (Fig. 16) in the slot 42[b]. The adjustable guides 47 may be pushed back, after loosening the screws 50, to permit the conveyor A to be moved toward the machine so as to position the book at the desired point.

From this point on the adjustable guides 47, the book is picked up by the advancing mechanism D and carried to the proper position beneath the drill head B. At the same time the forward end of this advancing mechanism picks up the book which has just been drilled and carries it forward and deposits it in position to be gripped by the conveyor, shown in Fig. 18, which carries the book beneath the sewing head. This consists of an arm 51 (Figs. 8 and 9) which is mounted in a suitable guide 52 in the frame. To this is pivoted an upper arm 53 by means of hinge pins 54. The arm 51 lies just beneath the plate 55 upon which the book F rests. This arm has a projection 51[a] which lies just below the upper surface of the plate 55 so as to be able to grasp the book F. The upper arm 53 carries a member 56 pivotally connected at its outer end, which is guided by means of a link 57 so as to hold the member 56 substantially vertical at all points. The yieldable finger 58 is slidably mounted in the member 56 and is pressed by a spring 59, as shown in Fig. 8[a].

The outer ends of the upper arms 53 carry a longitudinal rod 60 which engages the roller 61 which is carried by the arm 62, which is pivotally mounted at 63. This arm is operated by means of a chain 64 which is connected to the bell-crank 65, as shown in Fig. 34. This bell-crank is pivotally mounted on the rod 66 which is common to the several bell-cranks, as shown in Figs. 34 to 37, inclusive. The other arm of the bell-crank 65 carries a cam follower 67, which bears upon the cam 68 which is keyed on the cam shaft 69.

Thus it will be seen that the cam 68 which is driven in timed relation to the conveyor mechanism, as will later be explained, holds the arms 51, 53 open for the greater portion of the revolution but permits the arm 53 to drop under the action of the tension spring 53[a] during the time when it is desired for the gripping fingers 58 to grip the book.

While so gripped the book is then brought forward by the mechanism which will now be described. The carriage, of which the lower arm 51 forms a part, is connected by means of a link 70 (Fig. 5) with a rocker arm 71 which is pivotally connected at its lower end to the main frame by means of a pin 72. This rocker arm has a longitudinal guide-way 73 therein (Fig. 71) in which rolls the roller 74 which is carried on the crank 75 which in turn is carried on the outer

end of the cam shaft 69. As the cam shaft 69 revolves at a uniform rate the roller 64 requires nearly two-thirds of a revolution of the cam shaft to move the rocker arm 71 from the full line position of Fig. 5 to the dotted line position, and the remainder of the revolution to return it again to the full line position. The result is that the rocker arm 71 and the arms 51, 53 move slowly to the right at the time when the book is not held and then after gripping the books move the books rapidly to the left.

It will be understood that two books are moved at a time. Thus the gripping member 56, shown to the right in dotted lines in Fig. 5, is gripping the books F^1 and F^2, after which they are both moved to the left by the mechanism which has been previously described, so that the book F^1 will then fall into the position of the book F^2 while the book F^2 will be moved into position to be caught by the conveyor which carries it under the stitching head, as will later be described. The throw of the gripping members 56 can be varied in different ways, as by varying the effective length of the crank 75.

Drilling mechanism.—The drilling mechanism B comprises a standard 76 (Fig. 8) on which are slidably mounted housings 77 and 78, which are shown in detail in Figs. 11, 12 and 13. Shafts 79 and 80 extend transversely through these housings and carry pulleys which are driven from belts 81 from motors 82, as shown in Fig. 8. These shafts have spiral gears 83 keyed thereon at intervals which mesh with spiral gears 84 on the spindles 85. Each spindle has at its lower end a chuck 86 by means of which it is adapted to hold a drill 87. These chucks are operated by means of knurled heads 88 and 89. Fig. 38 shows the drills forced into the book to a maximum depth.

It will be observed from Fig. 38 that the drills 87 do not all drill to the same depth and that each drill is in axial alignment with similar drills 87^a from the opposite side of the book. This arrangement permits of the holes being so staggered throughout the book that every sheet will have some holes which are undrilled through it so that the needle, as will latter be explained, will punch through the undrilled portions of the holes. The holes made by the needles are of course much firmer and grip the thread much more tightly. Consequently these holes which do tightly grip the thread prevent the sheet from latter becoming loosened. This results in a book which is much firmer and in which the leaves do not become loosened unequally.

Sewing mechanism.—The sewing mechanism C comprises a stitching head 90 which contains any well-known stitching mechanism (not shown in detail) and which is driven by means of a chain 91 (Fig. 2) from a shaft 92 which in turn is driven by a sprocket chain 93 from the main motor 94.

The shaft 92 carries at its inner end an eccentric pin 95 which operates a Geneva gear 96, as shown in Figs. 29 and 30. The Geneva gear is keyed on a shaft 97 and carries a gear 98 which meshes with a gear 99 on the shaft 100. The gear 98 also meshes with an idler 101 on the shaft 102 which meshes with a gear 103 on the sprocket shaft 104. The sprocket shafts 100 and 104 carry sprockets 105 and 106 which serve to drive the chains 107 and 108, as shown in Fig. 18. These sprockets are driven in timed relation to the sewing head 90 so that between each vertical movement of the sewing needle the chains 107 and 108 are advanced the predetermined distance between stitches. These chains are then held by means of the cut-away end of the shaft 92 cooperating with cut-out portions of the Geneva gear 96, so that the chains do not move during the time the stitching needle is moving into or out of the book. The distance these chains are moved forward at each actuation is also the distance between the holes drilled by the drilling mechanism, which has been explained, and the hole is so proportioned that the sewing needle registers with the hole which has been partly drilled so that the needle pierces the undrilled portion of each hole, forcing the thread through, where it is tied with the thread on the other side in any well-known manner.

As the book advances it is sewed, as shown in Fig. 28, with a looped portion between two adjacent books. The method of cutting this loop will later be explained.

Chain releasing mechanism.—In order to insert the book into the chains 107, 108 it is necessary to release these chains in some way. The lower chain, 108, operates upon a fixed track while the chain 107 is made so that the forward end of the chain can be released. Referring now to Figs 21 to 23, the chain links 107 slide upon plates 109 which are pressed by cups 110 which contain springs 111. The frame 112 which carries the upper chain, and whose mounting will later be explained, has a longitudinally disposed rocker shaft 113 mounted therein, as shown in Fig. 22. This rocker shaft carries a series of pins 114, each of which engages a hole in one of the cups 110. The shaft 113 has a laterally extending ear 115 which has an opening through which passes a headed rod 116. This rod is screwed into a tube 117 (Fig. 19) which is slidably mounted upon a link 118 and has an opening 119 through which extends a pin 120 from the link 118. A spring 121, connected at its opposite ends with the tube 117 and the pin 120, respectively, and acting in tension, normally holds the parts in the position shown in Fig. 19.

The link 118 is adapted to engage a pin 122 on the lever 123 which is pivotally mounted

at 124. The lever 123 carries a cam follower 125 which rolls upon the face of the cam 126 on the cam shaft 69.

Thus it will be seen that as the cam revolves the rod 116 will be drawn down, thereby lifting the cups 110 against the action of the springs 111 and releasing the forward end of the chain 107 from pressure. The book F^2 can consequently be inserted therein by the advancing mechanism, which has been previously described.

The upper arm carrying the conveyor chain 107 comprises a frame 127 which is pivotally mounted at its rear end on the shaft 100, as shown in Fig. 29, while the forward end has a bell-crank 128 pivotally connected thereto at 129. This bell-crank is pivotally connected to the main frame at 130. A similar bell-crank 131 (Figs. 18 and 29) is mounted on the shafts 97 and 100. The bell-cranks 128 and 131 are connected by means of a link 132. These bell-cranks have equal arms which are parallel so that they together with the link 132 and the frame 127 form a parallelogram. Journalled on the shaft 91 is a lever arm 133 which carries a bolt 134 which passes through the slot 135 in the adjusting link 136 which is pivotally connected at 137 to the main frame. A member 138, shown as integral with the bell crank 131, is also pivotally connected to the shafts 97 and 100 and has a pin 139 which is held against the lever 133 by means of a spring 140.

This provides a yieldable connection so that in case a book becomes wedged between the chains 107, 108, the chain 107 will be permitted to rise, forcing the member 138 down against the action of the spring 140. The distance between the chains 107 and 108 is regulated by means of the bolt 134 in the slot 135.

Thread cutting mechanism.—The thread cutting mechanism which was previously referred to in connection with the description of Fig. 28, is shown in Figs. 24 to 27, inclusive. This comprises two shearing elements 142 and 143 which are provided with shearing knife edges on the side adjacent the books. The knife 142 is provided with three angled slots 142^a and 142^b while the other member 143 is provided with three slots set at right angles thereto. Square pins 144 are secured to the main frame and serve as guides for these cutting members. Heads on these pins have longitudinal holes therethrough which serve as guides for parallel rods 145. These rods carry a central block 146 which has a square pin 146^a extending through the middle slot in both the members 142 and 143.

It will be understood from this construction that a movement of the member 146 will cause the shearing members 142 and 143 to move back and forth, at the same time giving them a motion across each other which will enable them to shear a thread which is placed in their path.

This movement is accomplished by means of a spring 147 which tends to force these shearing elements toward the book, and a chain 148 which connects the block 146 with the cam lever 149. This cam lever is pivotally mounted at 150 and has a cam follower 151 which operates upon the face of the cam 152 which is located on the shaft 92.

As long as the machine is in operation and there is no book in the machine the cam 152 will cause the shearing elements to move back and forth through their full stroke on each revolution of the cam. This, however, can be permitted only when no book is in front of the knives. To accomplish this purpose, a shoe 153 (Fig. 24) is mounted on a plunger 154 which is normally pressed out in the path of the book F by means of a spring 155. As the book advances, as shown in Fig 27, the book encounters the shoe 153 and forces it back against the action of the spring 155. In doing so the outer end of the plunger 154 (Figs. 24 and 26) rides over the end of the lever 149 when down, thereby preventing it from rising to its full height. This is so proportioned that when the lever 149 is thus held down the knives 142, 143 are held back out of the path of the book.

The shoe 153 rides along the back of the book during its passage under the stitching machine and drops off the rear end of the book as it passes. When this happens the next revolution of the cam 152 causes the knives 142, 143 to move in a full stroke, thereby encountering and severing the thread between the books, as shown in Fig. 28.

Driving mechanism.—The main motor 94 acting through the sprocket chain 93 drives the shaft 92 as previously explained. This shaft has a longitudinal key-way and carries a pinion 156 which has a key operating in the key-way and which meshes with a gear 157. The gears 156 and 157 are enclosed in a housing 158, the gear 157 extending through the side of the same and adapted to selectively mesh with any one of the gears of the stepped gear 159 which is keyed to a shaft 160. The last of these step gears meshes with a gear 161 on the cam shaft 69. This shaft has a spiral gear 162 meshing with a spiral gear 163 on the longitudinal shaft 44 (Fig. 9).

The cam shaft 69 also carries cams 164, 165 and 166 which control the operation of the drilling heads 77, 78 and of the pressure foot 167, is shown in Fig. 11. These cams are shown in elevation in Figs. 35, 36 and 37. The cam 164 which controls the upper drilling head has a cam follower 168 which is carried upon the bell-crank 169 which is pivotally connected to a rod 170 which in turn is pivotally connected at its upper end (Figs. 10 and 11) to a lever 171 which is adjust-

able endwise through a member 172 by means of a nut 173. The member 172 is connected to a gear 174 which is carried by the shaft 175 which is journaled in the standard 76. The gear 174 meshes with a rack 176 which is carried by the upper drilling head 78.

As the rod 170 is raised by the action of the spring 177 which tends to keep the follower 168 against the cam 164, the gear 174 is turned so as to lower the drilling head 78, thereby forcing the drills into the book F^2.

The cam 165 has a similar follower 178 which is carried by a bell-crank 179 on the rod 66. This is connected to a link 180 which is pivotally connected to a lever 181 which passes through a yoke 182 and is adjustable therein by means of a nut 183. The member 182 is connected to gear 184 which is carried by a shaft which is suitably journaled in the standard 76. The gear 184 meshes with a rack 185 which is carried by the lower drilling head 77. The weight of this drilling head tends to keep the follower 178 against its cam 165. As the shaft 69 revolves it causes the drilling head 77 to rise, thereby causing the drills 87^a to enter the lower portion of the book F^2. For this purpose a combined support and drill guide 186 is carried by the standard 76.

Immediately over the support 186 is the pressure foot 167 which likewise is provided with holes through which the drills 87 pass. The pressure foot 167 is carried in guides on the standards 76 and is provided at the back with a rack 187 which meshes with a gear 188 which is rotatably mounted on the standard 76. A second rack 189 engages the opposite side of the gear 188 and is suitably guided in the standard 76. The rack 189 carries a rod 190 which is connected to a bell-crank 191 (Fig. 35) which is also loosely mounted on the rod 66. This bell-crank carries a cam follower 192 which engages the face of the cam 166 and is pressed against it by means of the tension spring 193 which is attached to rack 189, as shown in Fig. 11. The cam 166 acts in advance of the drilling heads to force the pressure foot 167 down, thereby firmly clamping the book F^2 which is to be drilled.

Thus it will be seen that the books placed between pins of the feeding conveyor A are carried forward and deposited on the adjustable supports 47 where they are picked up by the fingers 56 of the advancing mechanism D, as shown in Fig. 5. From here the book F^1 is advanced to the position F^2 where it is held between the drilling heads 77 and 78 by means of the pressure foot 167, as shown in Fig. 11.

The drilling is done by moving the drilling heads 77 and 78 towards each other. This may be done at the same time or, as indicated by the positions of the cams, may be staggered somewhat. All of the holes on each side of the book thus are drilled at the same time, after which the drill heads return to the position as shown in Fig. 11, and the pressure foot 167 is released. The fingers 56 of the advancing mechanism D again move forward to the dotted line position of Fig. 5, grasping the two books F^1 and F^2 simultaneously and then while still holding them, advancing them to the positions F^2 and F^3, respectively. During the time the book is being advanced from the position F^2 to that of F^3 the shaft 113 of Fig. 20 is turned so as to relieve the pressure on the upper chain 107 of the conveyor which intermittently feeds the book beneath the stitching head.

The cam 126 then operates to cause the chains 107, 108 to grip the book and the Geneva gear 96 causes the conveyor chains 107 and 108 to advance the book in timed relation to the stitching needle, which then sews through the holes made by the drills 87.

As the sewed book passes the cam shoe 153 of the thread cutting mechanism, as shown in Figs. 24 and 27, the cutters 142 and 143 move forward between the books, the knives severing the thread.

As the completed and severed book then passes out between the chains 107 and 108 it drops into the chute 194, as shown in Fig. 7, and is picked up by the conveyor 195 which is driven by the longitudinal shaft 44 by means of a sprocket 196 and chain 197. The book then falls upon the rack 198, where it is forced forward by the reciprocating fingers 199 which are moved back and forth by means of a crank 200 on the shaft 44.

The books F shown are assumed to be quite thick and hence the staggering of the undrilled portions is accomplished by using drills of a number of lengths. It will be understood, however, that for books of less thickness, where the drilling is less than half way through the books, it will be sufficient to drill holes alternately from each side. In this case, the holes are not in axial alignment. When stitched, this arrangement provides tight leaves throughout, due to the fact that each sheet is tightly held by at least each alternate stitch.

While I have shown and described but a single embodiment of this invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and operation may be made which do not depart from the spirit and scope of the invention as disclosed in the appended claims, in which it is my intention to claim all the novelty inherent in the invention as broadly as possible in view of the prior art.

I claim:

1. A book sewing machine comprising means for forming in a book holes which extend only part way therethrough to cause certain of the leaves of the book in line with

certain of said holes to be imperforate, means for sewing through said holes and the portions of the leaves of the book in line with said holes, and means in timed relation to said sewing means for advancing the book as it is being sewed.

2. A book sewing machine comprising means disposed at opposite sides of a book for drilling holes part way through opposite sides thereof to cause certain of the leaves of the book in line with certain of said holes to be imperforate, means for sewing through said holes and the portions of the leaves, of the book in line with said holes, and means in timed relation to said sewing means for advancing the book as it is being sewed.

3. A book sewing machine comprising means disposed at opposite sides of a book for drilling holes part way through opposite sides thereof to cause certain of the leaves of the book in line with certain of said holes to be imperforate, means for sewing through said holes and the portions of the leaves of the book in line with said holes, means in timed relation to said sewing means for advancing the book as it is being sewed, and means for moving the book from the drilling means to said advancing means.

4. A book sewing machine comprising means disposed at opposite sides of the book for simultaneously drilling holes part way through opposite sides thereof to cause certain of the leaves of the book in line with certain of said holes to be imperforate, means for sewing through said holes and the portions of the leaves of the book in line with said holes, and means in timed relation to said sewing means for advancing the book as it is being sewed.

5. A book sewing machine comprising means disposed at opposite sides of a book for drilling holes through opposite sides thereof to different depths at different points to cause each leaf of the book to present an imperforate portion in line with the perforate portion of an adjacent sheet, means for sewing through said drilled holes and said imperforate portions, and means in timed relation to said sewing means for advancing the book as it is being sewed.

6. A book sewing machine comprising drills located at opposite sides of the book, certain of said drills being axially alined and arranged to, together, drill alined holes of a combined depth less than the thickness of the book, means for sewing through said drilled holes, and means in timed relation to said sewing means for advancing the book as it is being sewed.

7. A book sewing machine comprising drills at opposite sides of a book, the ends of adjacent ones of which project different distances for drilling part way only through the book to cause certain of the leaves of the book to present an imperforate portion in line with the perforate portion of an adjacent sheet, means for sewing through said drilled holes, and means in timed relation to said sewing means for advancing the book as it is being sewed.

8. A book sewing machine comprising means for drilling holes partly through opposite sides of a book, means for sewing through said drilled holes, means in timed relation to said sewing means for advancing said book as it is being sewed, and means, the operation of which is controlled by said books, for cutting the thread between them.

9. In a machine for sewing books and the like, a sewing head, two spaced conveyors intermittently driven at the same speeds, in timed relation to the sewing head, means for exerting pressure between said conveyors, and means for releasing the pressure between said conveyors after a predetermined number of stitches have been made by said sewing head so as to permit the insertion of another book.

10. In a machine for sewing books and the like, a sewing head, two spaced conveyors intermittenly driven at the same speeds, in timed relation to the sewing head, means for yieldably exerting pressure between said conveyors, and means for releasing the pressure between said conveyors after a predetermined number of stitches have been made by said sewing head so as to permit the insertion of another book.

11. In a machine for sewing books and the like, a sewing head, two spaced conveyors intermittently driven at the same speeds in timed relation to the sewing head, one of said conveyors being firmly backed, the other conveyor having at its entering end a spring-pressed backing, and means in timed relation to the passage of said books for relieving the pressure on said springs so that a book may be inserted.

12. In a machine for sewing books and the like, a sewing head, two spaced conveyors intermittently driven at the same speeds in timed relation to the sewing head, one of said conveyors being firmly backed, the other conveyor having means for alternately applying pressure thereto and for relieving pressure thereon so that a new book may be inserted while relieved and then gripped so as to be advanced by the conveyor.

13. In a machine for sewing books and the like, a sewing head, two spaced conveyors intermittently driven at the same speeds in timed relation to the sewing head, one of said conveyors being firmly backed, the other conveyor having a chain backed by a series of hollow members, springs within said members for forcing the chain toward the other conveyor, and means for retracting said members against the action of said springs so that a book may be inserted.

14. In a machine for sewing books and the like, a sewing head, two spaced conveyors in-

termittently driven at the same speeds in timed relation to the sewing head, one of said conveyors being firmly backed, the other conveyor having at its entering end a spring-pressed backing, means in timed relation to the passage of said books for relieving the pressure on said springs so that a book may be inserted, and yieldable means for permitting said conveyors to separate when more than a predetermined pressure is exerted tending to separate them.

RAYMOND E. ACKLEY.