

May 21, 1946.

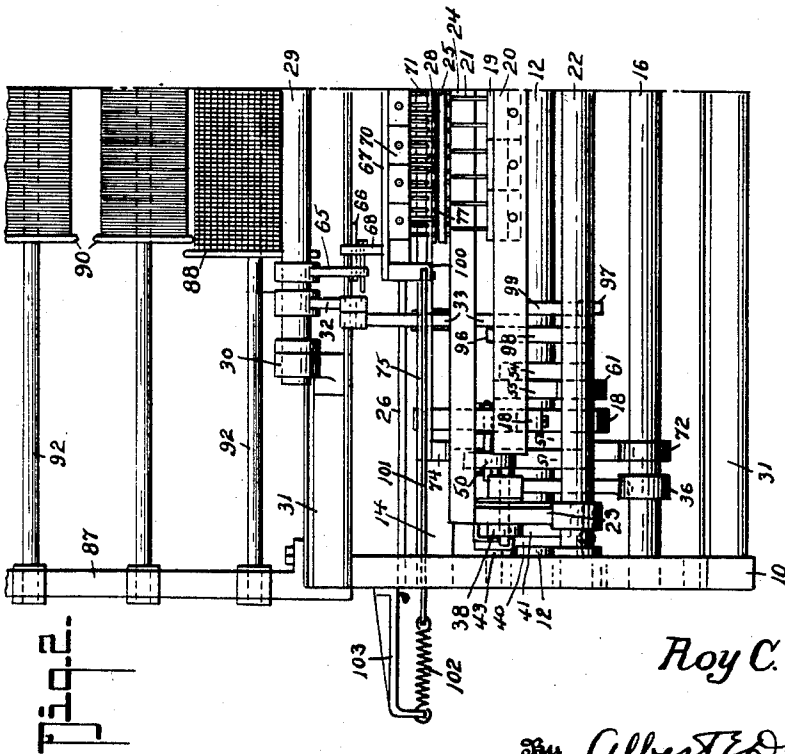
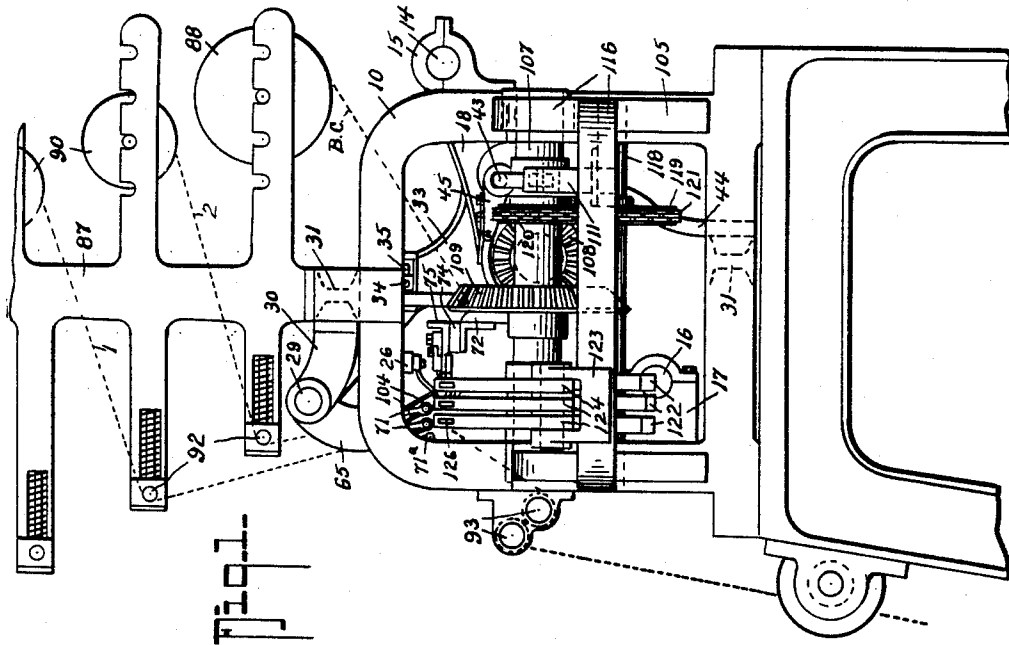
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 1



Inventor,  
Roy C. Amidon.

By Albert E. Dieterich

Attorney.

May 21, 1946.

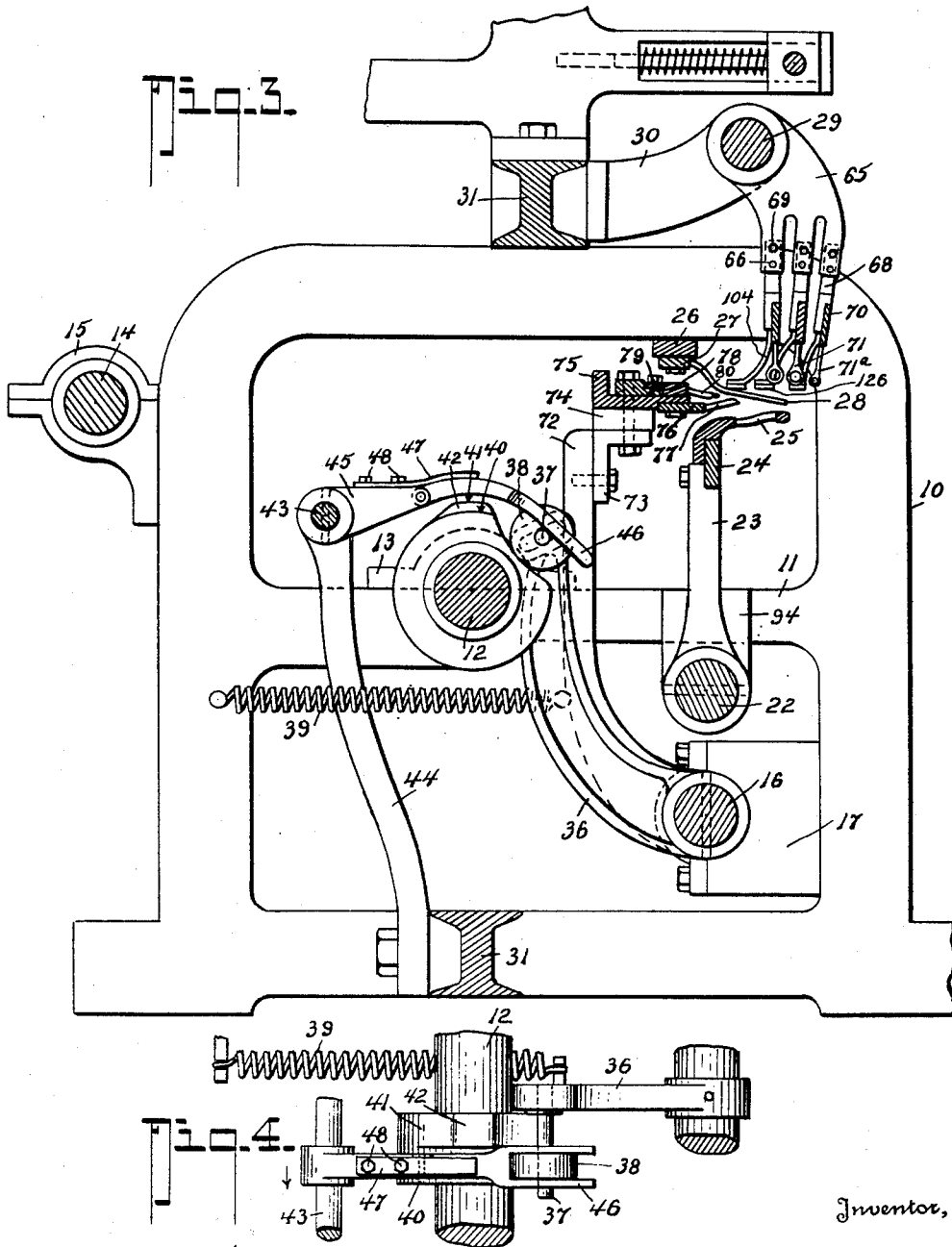
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 2



Inventor,

Roy C. Amidon,

By Albert E. Dieterichs,

Attorney.

May 21, 1946.

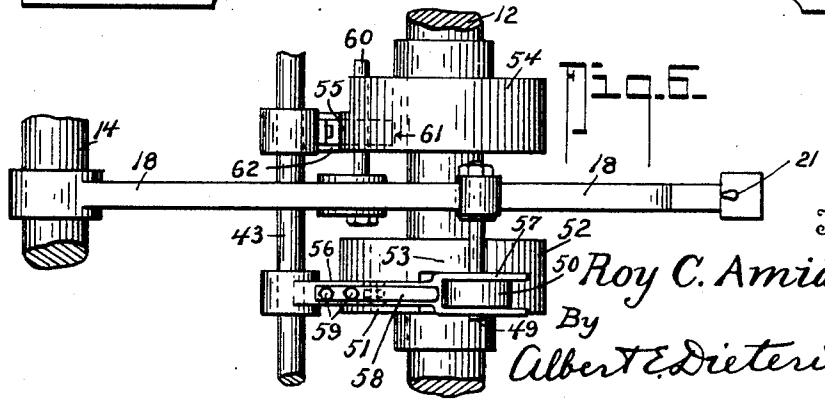
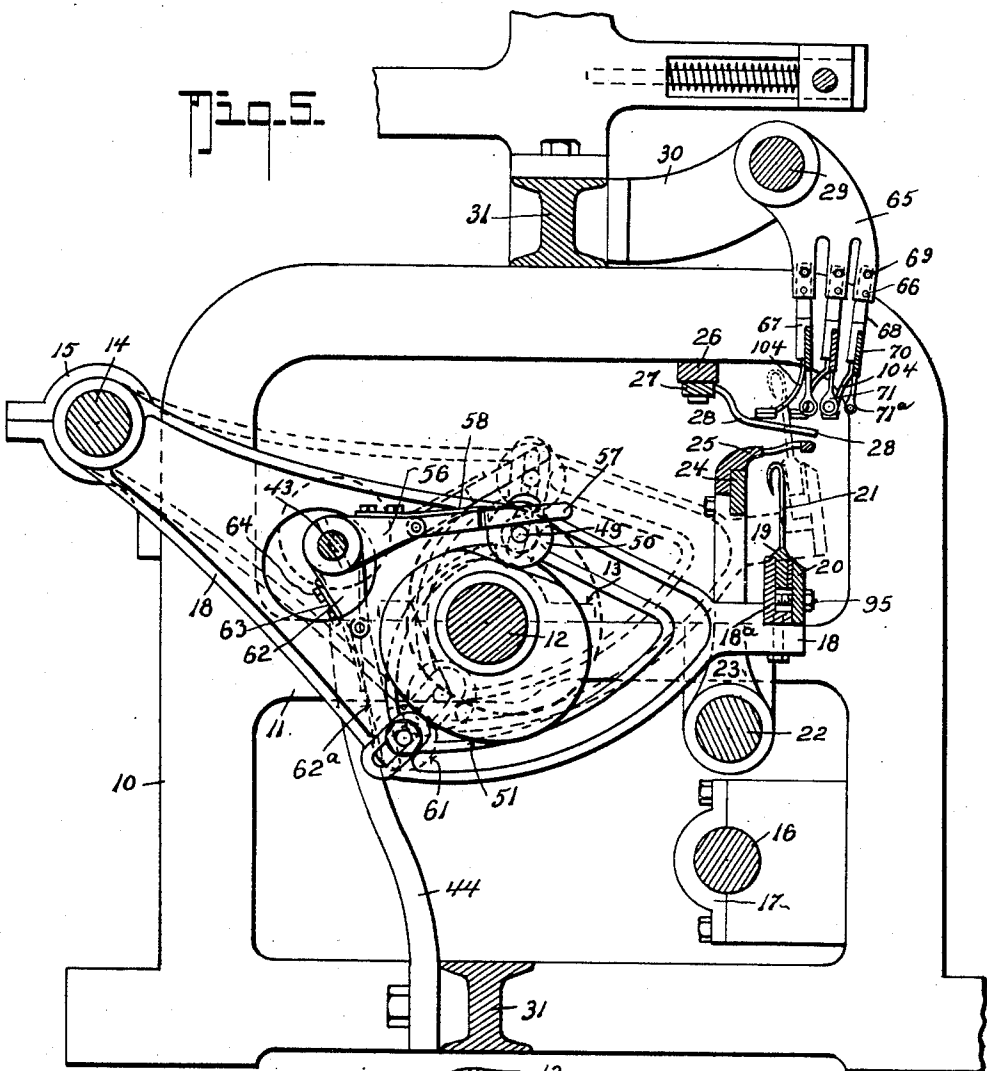
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 3



Inventor,  
*Roy C. Amidon.*  
 By  
*Albert E. Dieterich,*  
 Attorney.

May 21, 1946.

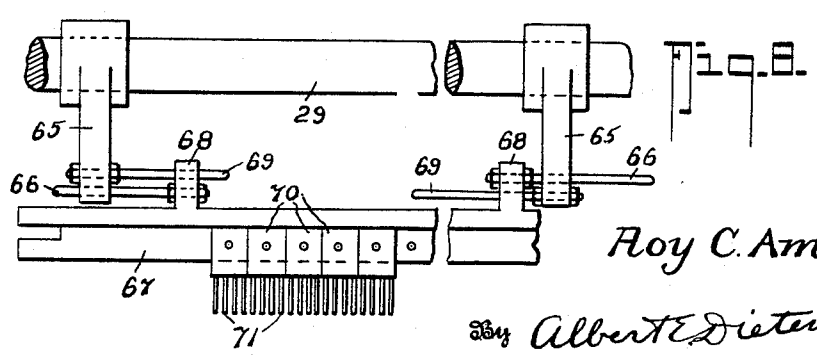
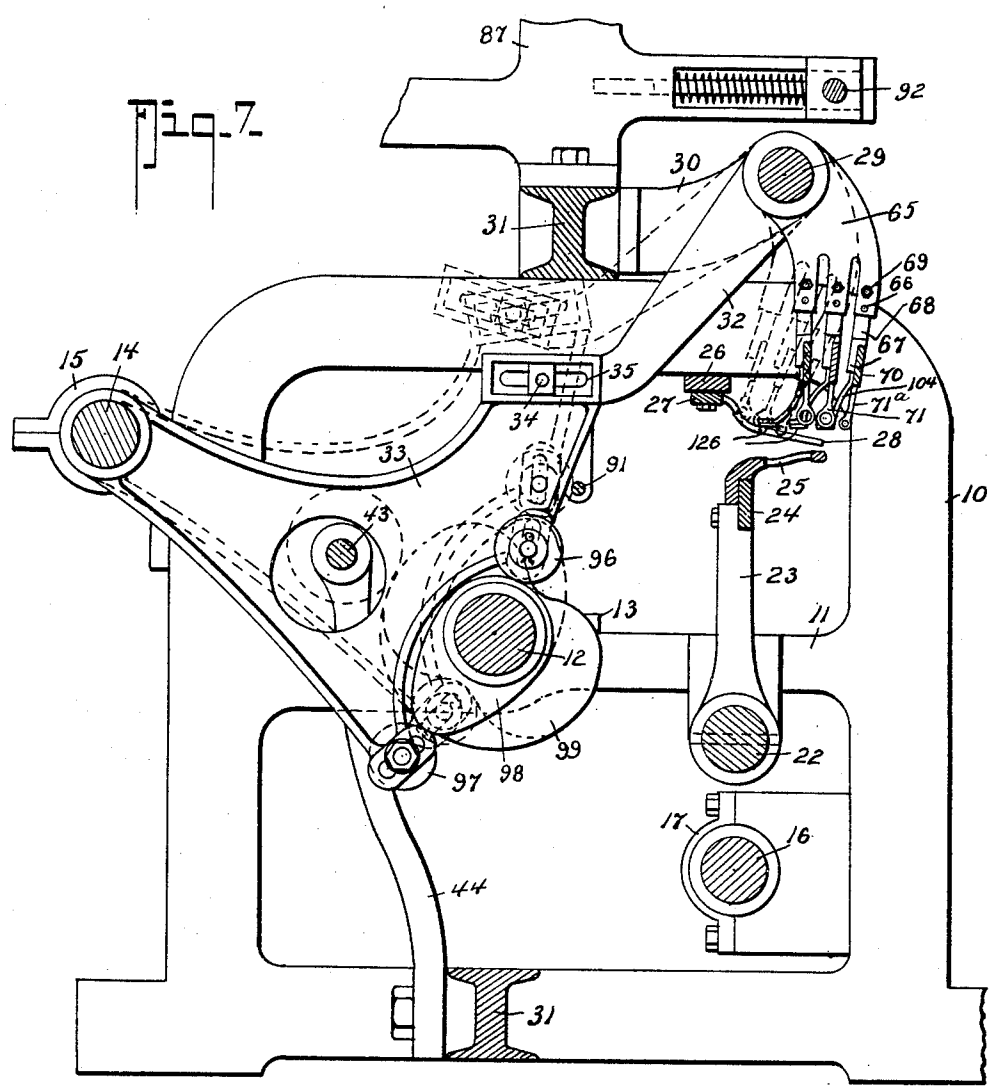
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 4



Inventor,

Roy C. Amidon,

by Albert E. Dietrich,

Attorney.

May 21, 1946.

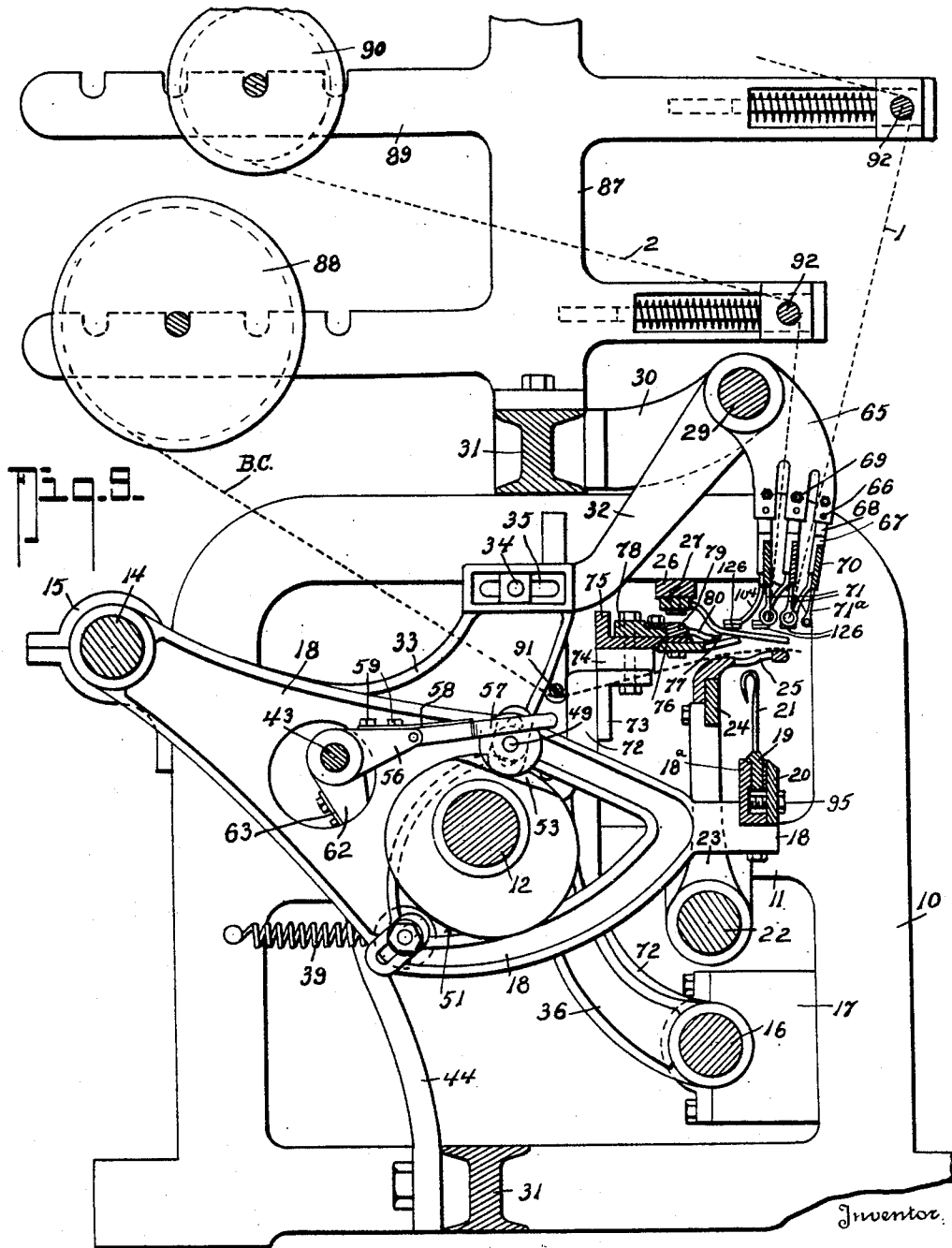
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 5



Inventor.

*Roy C. Amidon,*  
*Albert E. Dieterich,*  
 Attorney.



May 21, 1946.

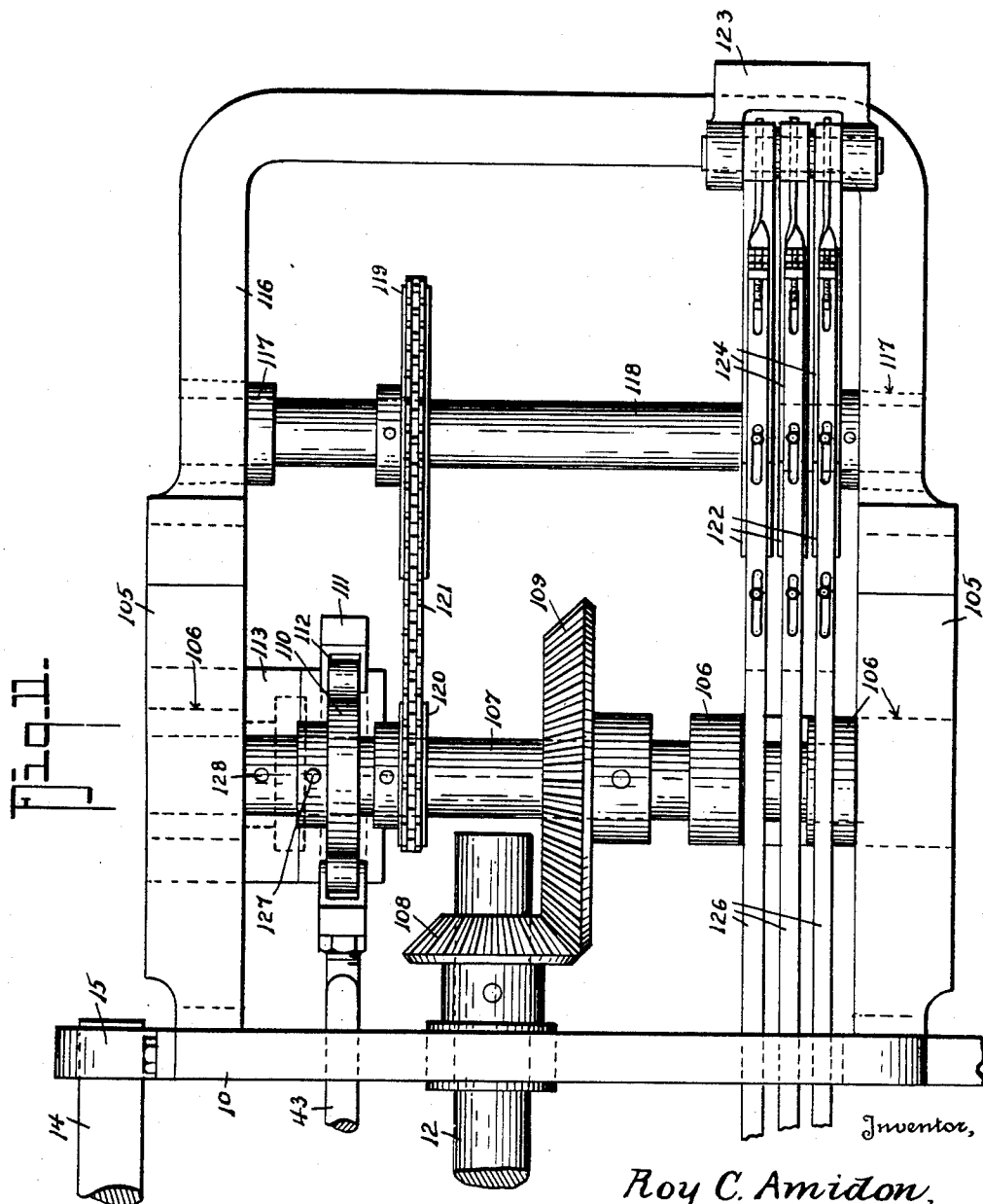
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 7



Inventor,

Roy C. Amidon,

By Albert E. Dieterich

Attorney

May 21, 1946.

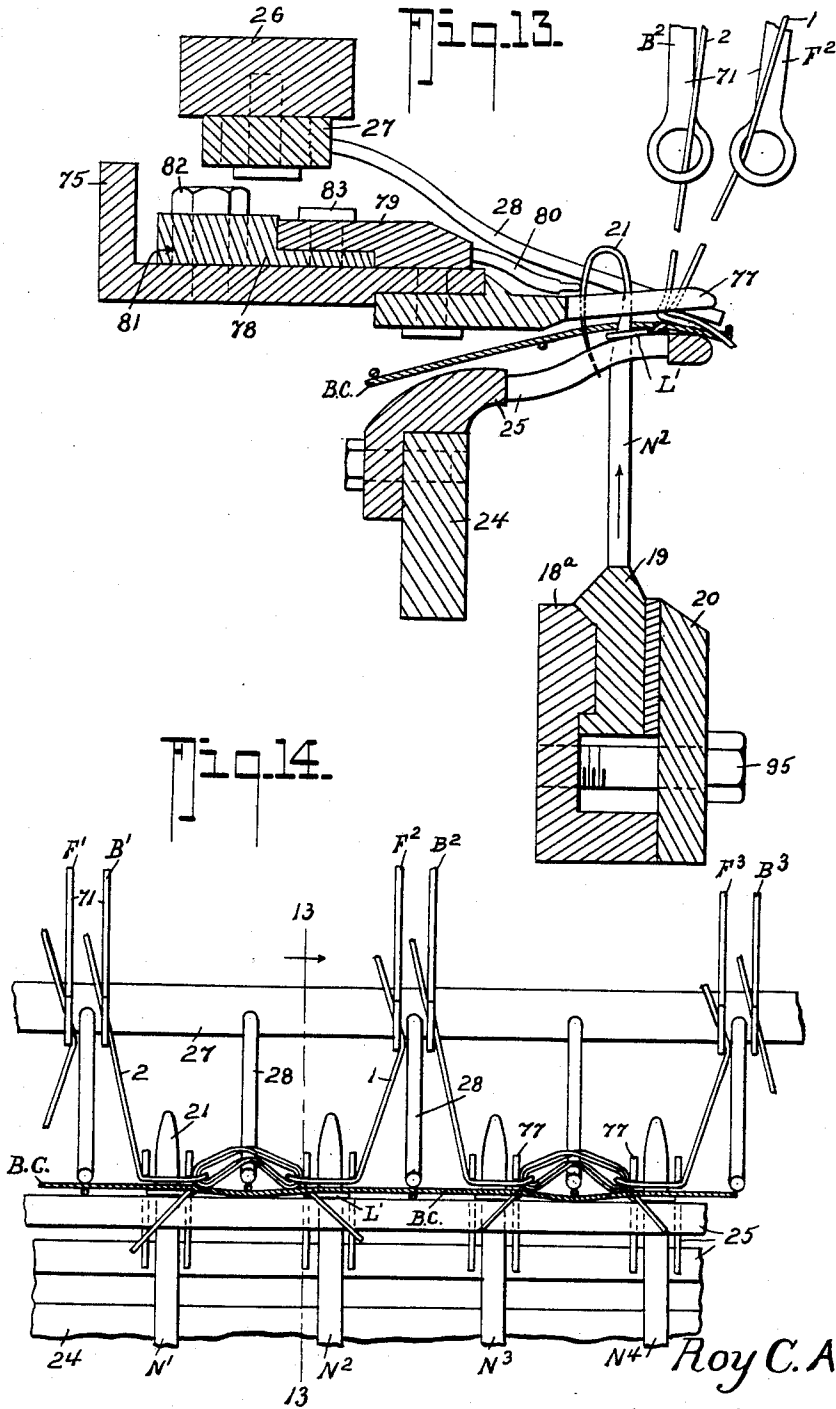
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 8



Inventor,

Roy C. Amidon,

By Albert E. Dieterich

Attorney.



May 21, 1946.

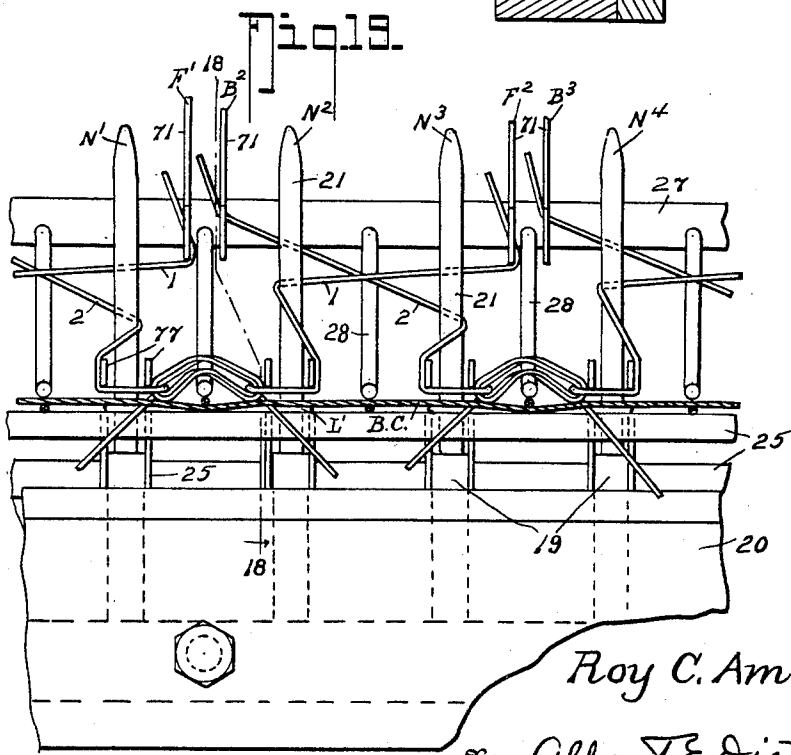
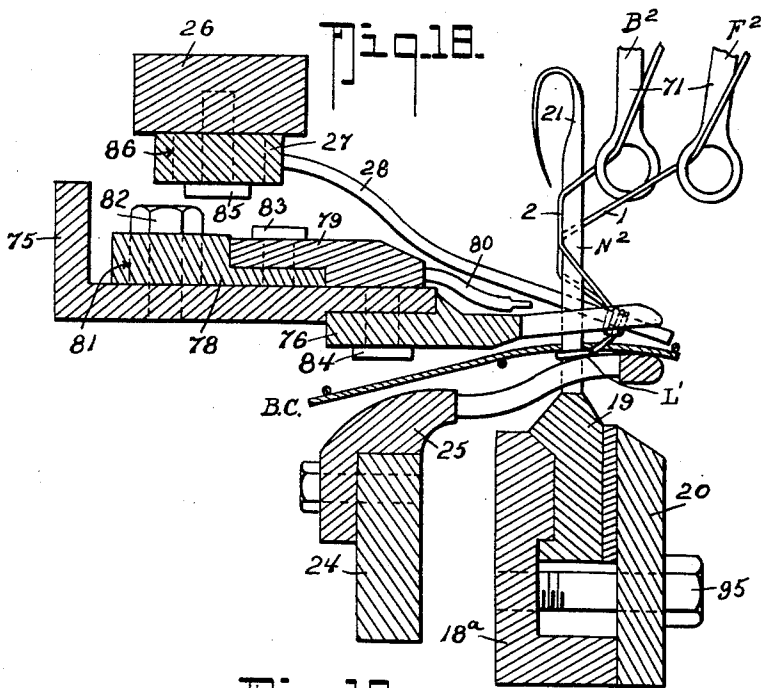
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 10



Inventor,

Roy C. Amidon,

334y Albert E. Dieterich,

Attorney.

May 21, 1946.

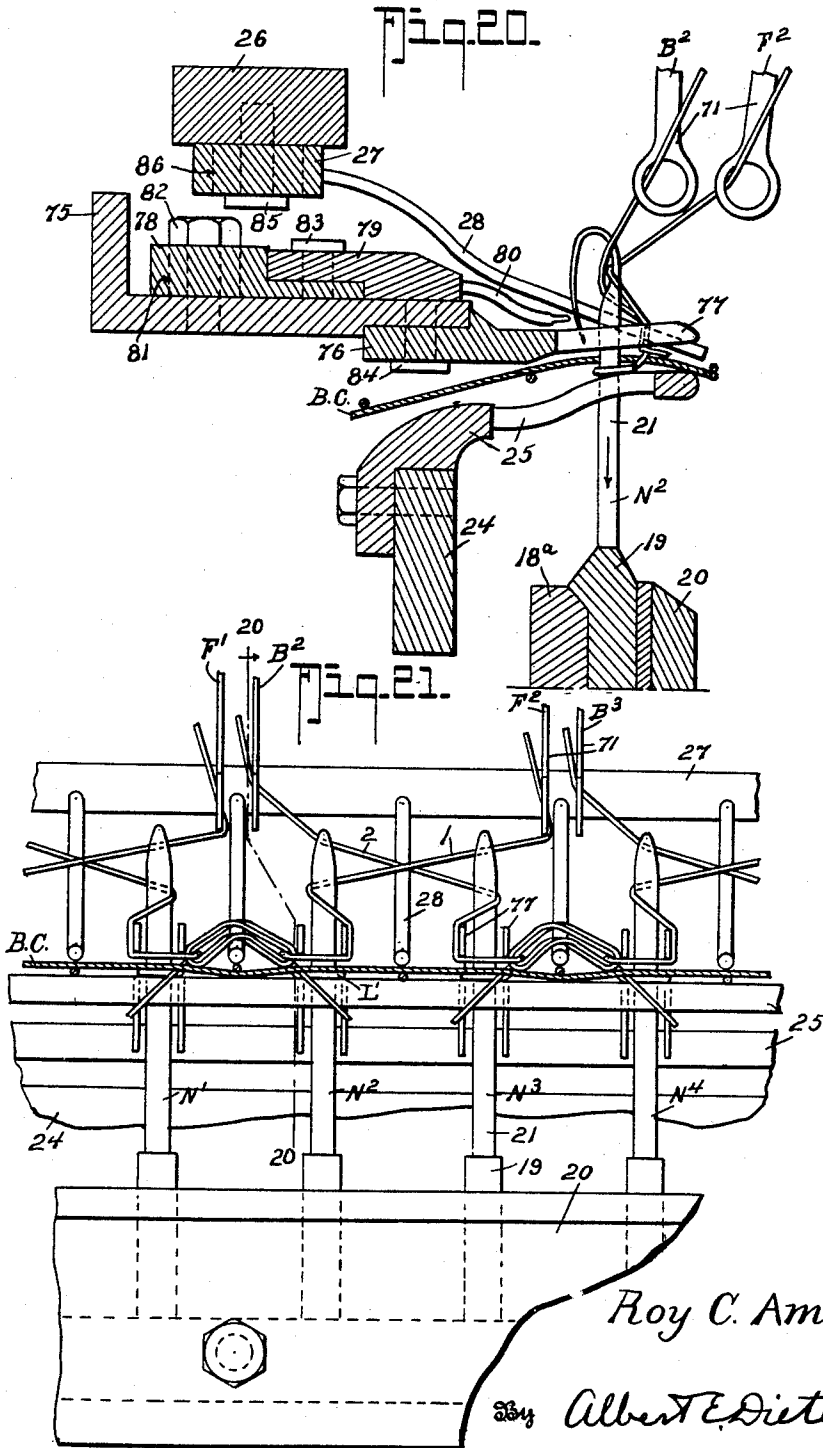
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 11



Inventor,  
 Roy C. Amidon,  
 Albert E. Dieterich,  
 Attorney.

May 21, 1946.

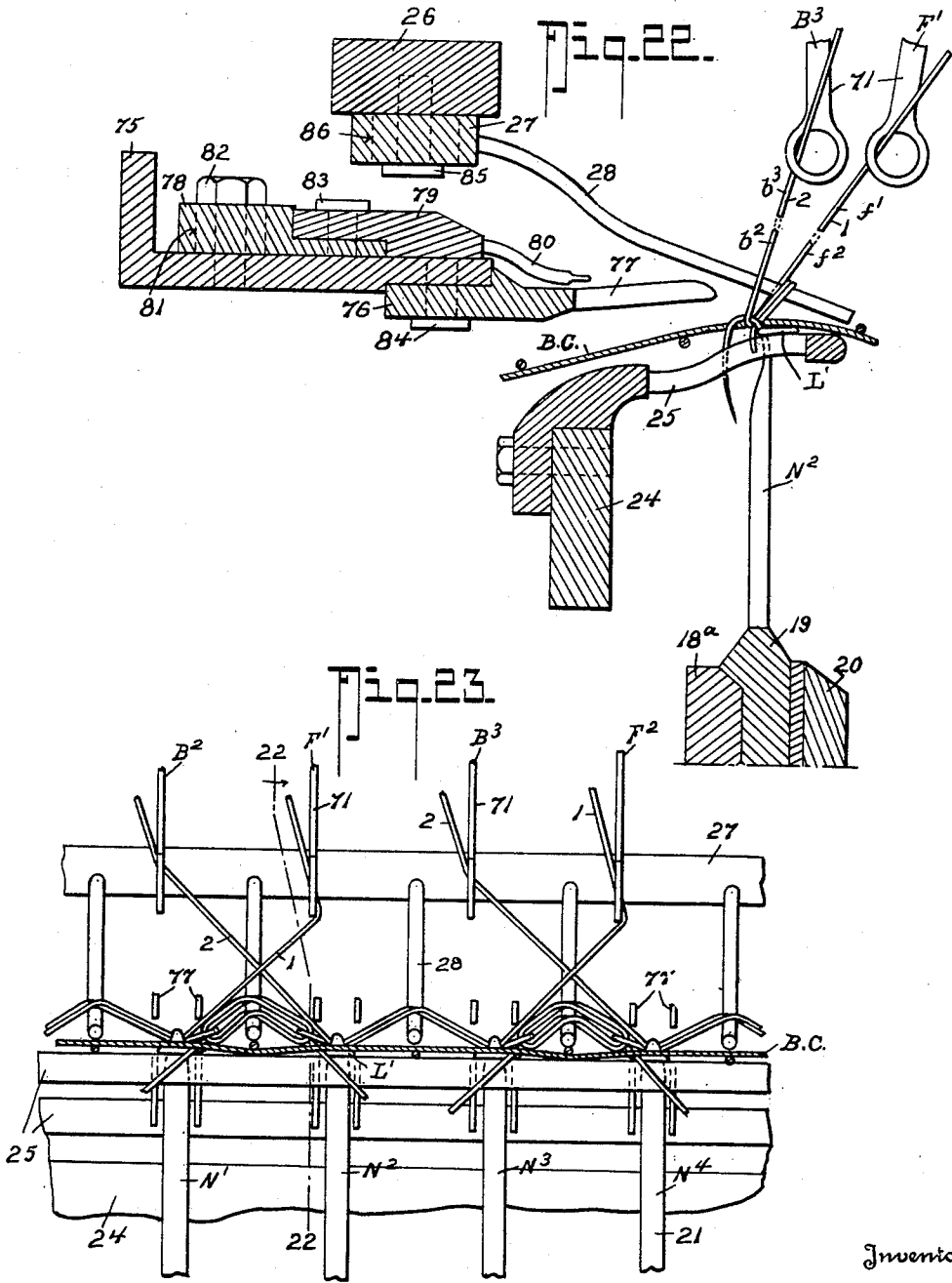
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 12



Inventor,  
*Roy C. Amidon,*  
 by *Albert E. Dieterich,*  
 Attorney.

May 21, 1946.

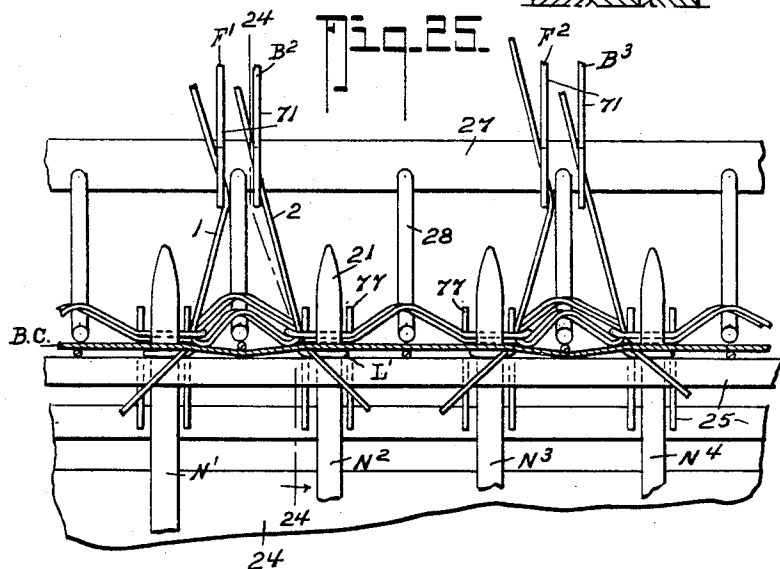
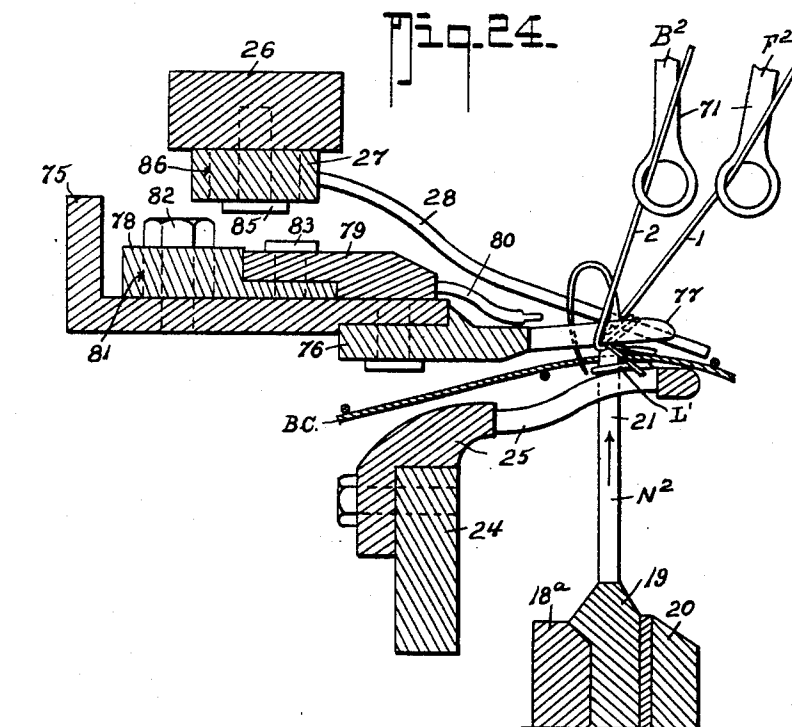
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets—Sheet 13



Inventor,  
*Roy C. Amidon,*  
 by *Albert Editerich,*  
 Attorney.

May 21, 1946.

R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 14

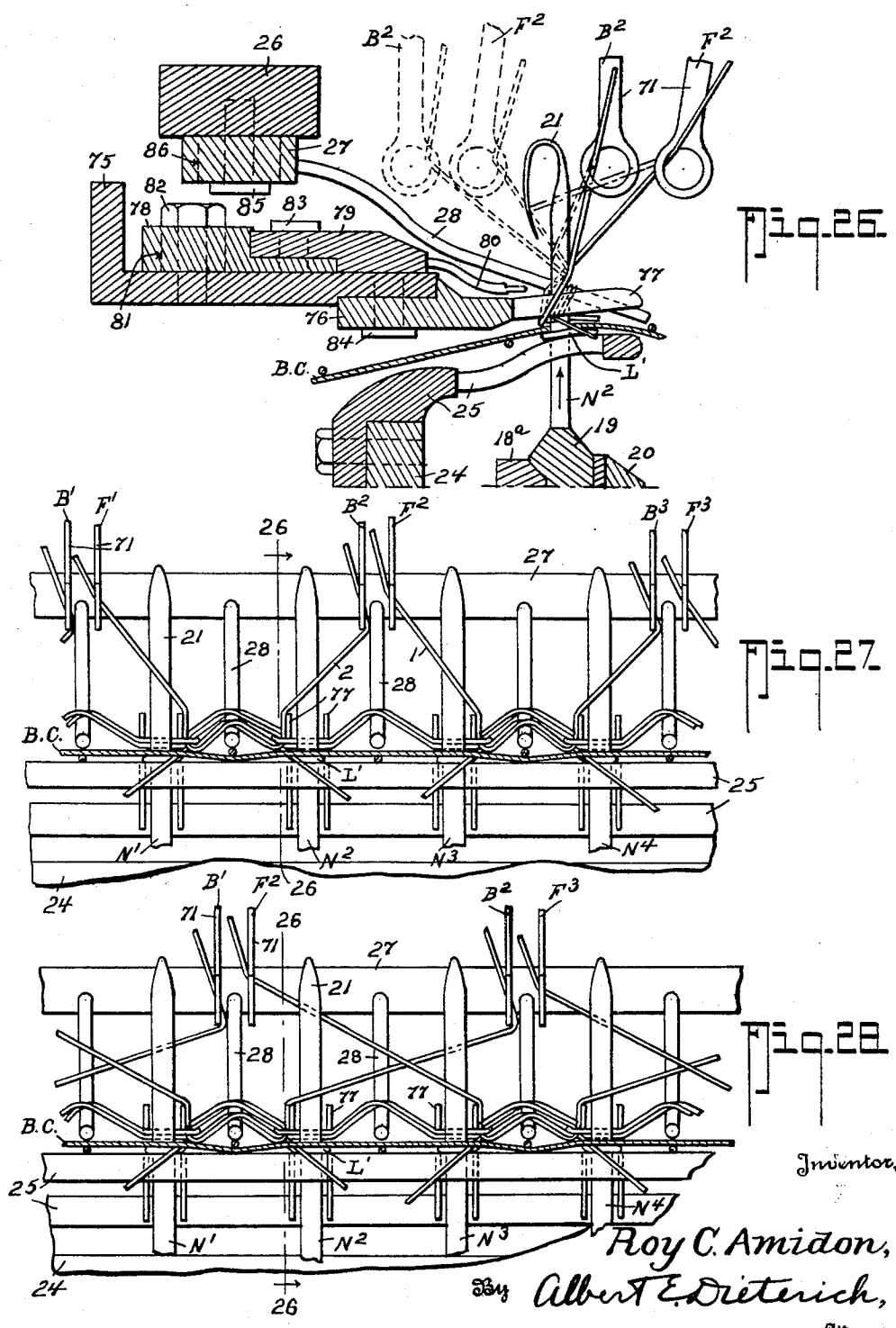


Fig. 26

Fig. 27

Fig. 28

Inventor,

Roy C. Amidon,

Albert E. Dieterich,

Attorney.



May 21, 1946.

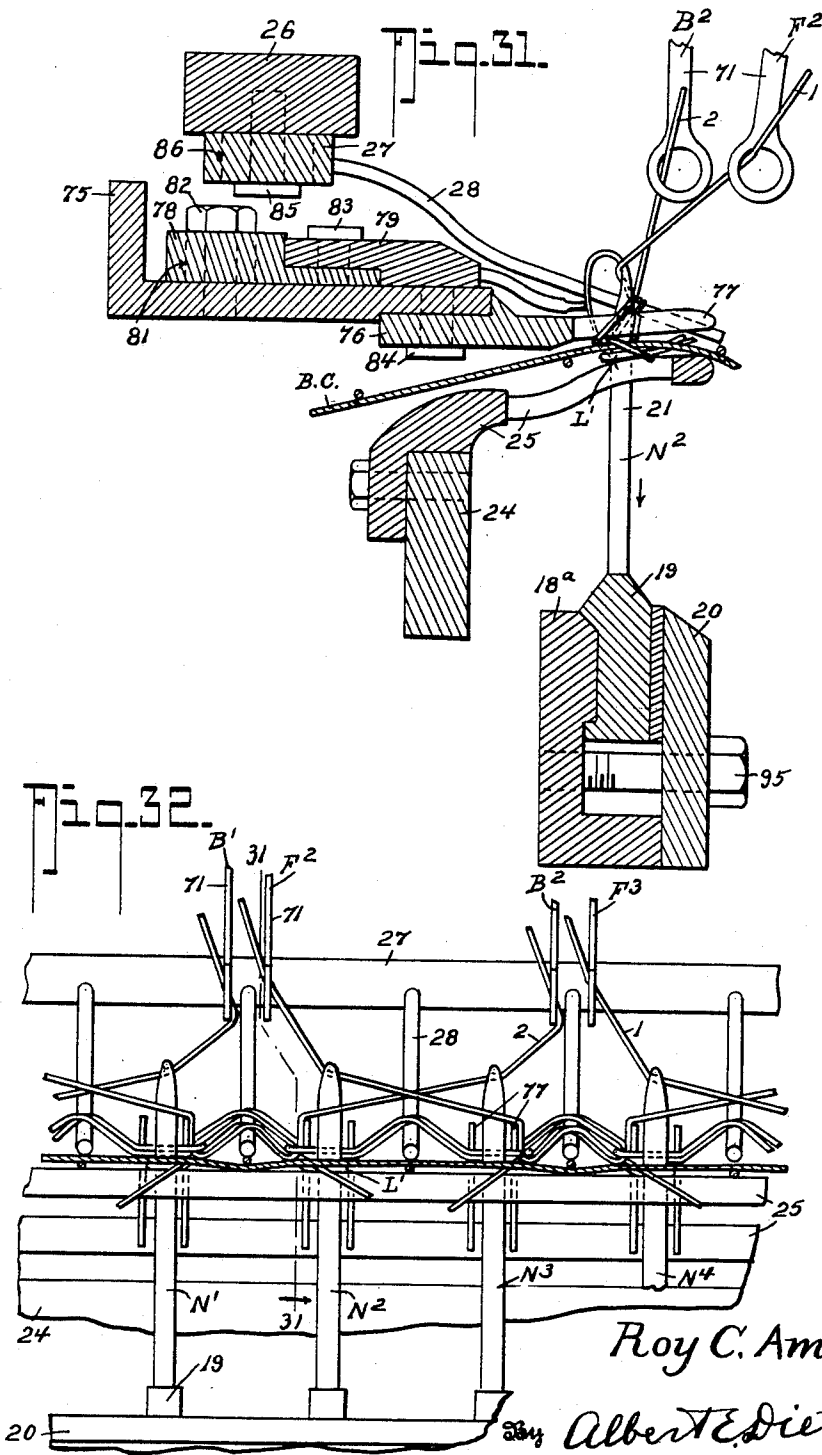
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 16



Inventor,  
 Roy C. Amidon,  
 Albert E. Dieterich,  
 Attorney.

May 21, 1946.

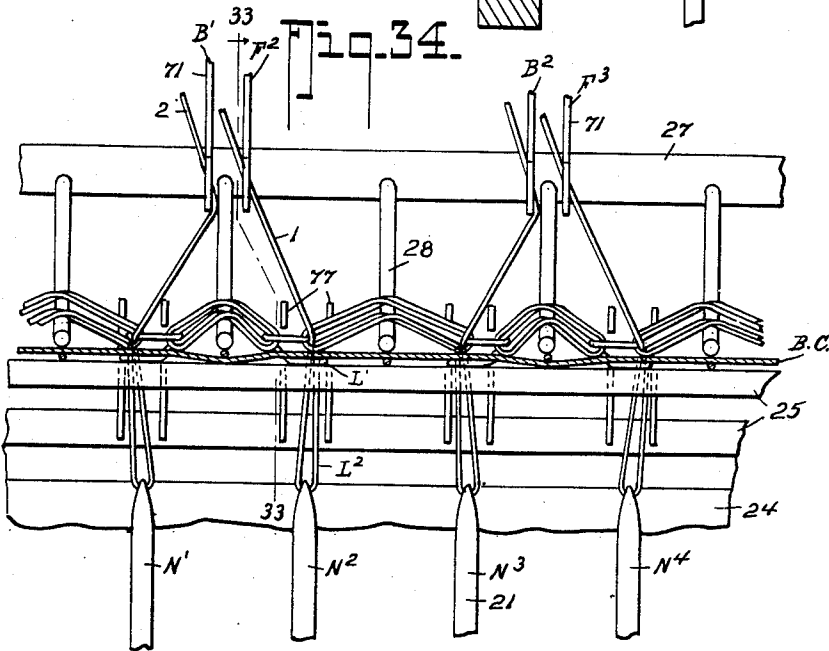
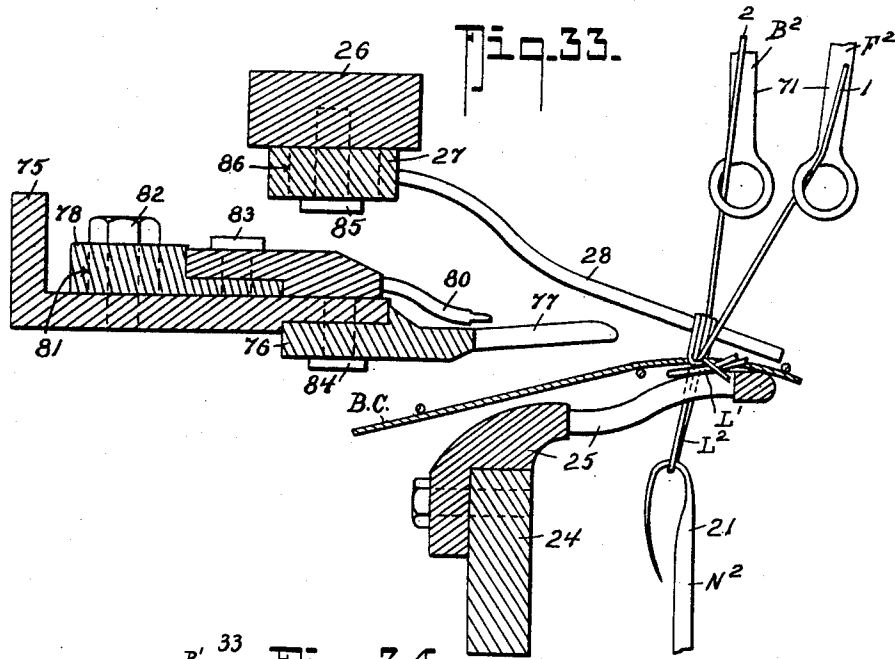
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 17



Inventor,

Roy C. Amidon,

By Albert Editerich,

Attorney.

May 21, 1946.

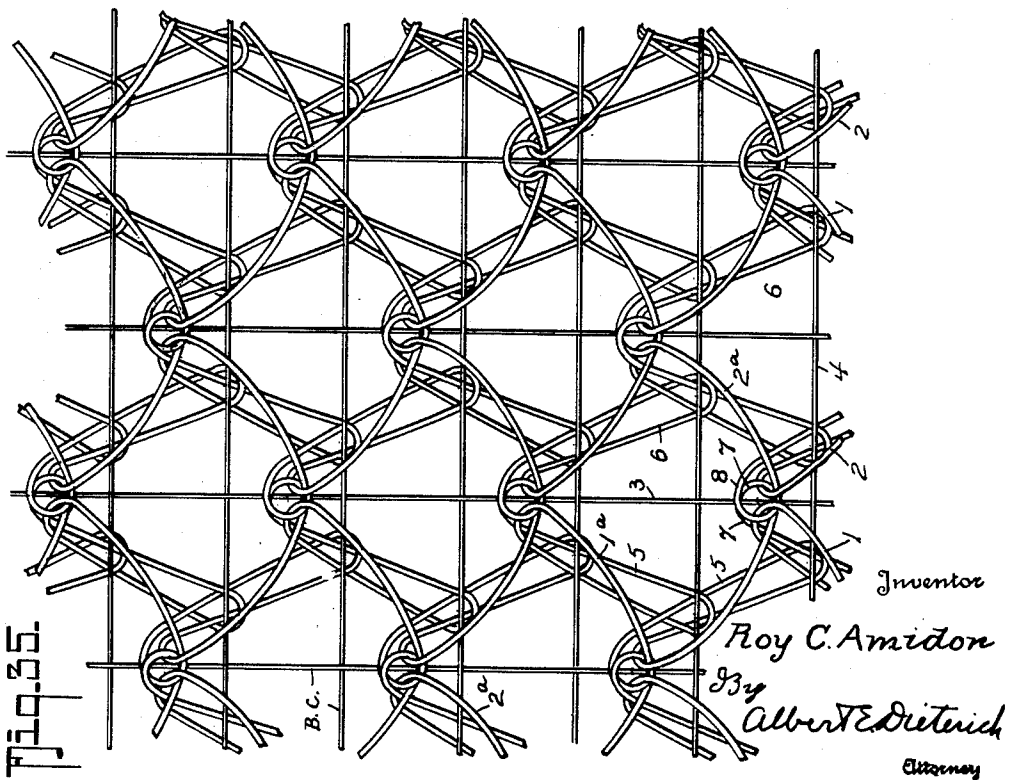
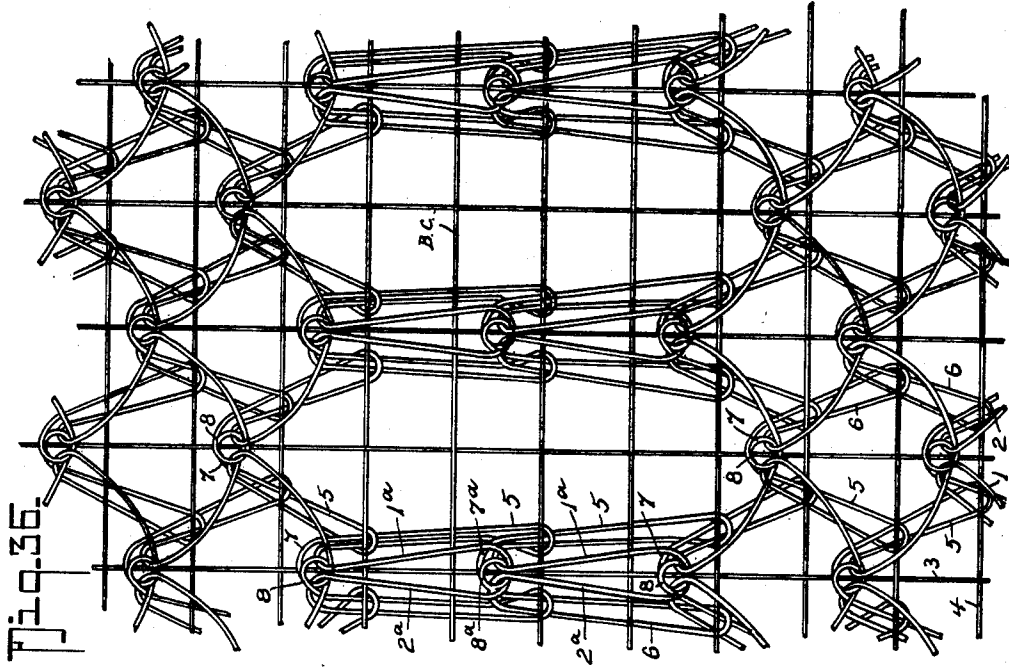
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 18



May 21, 1946.

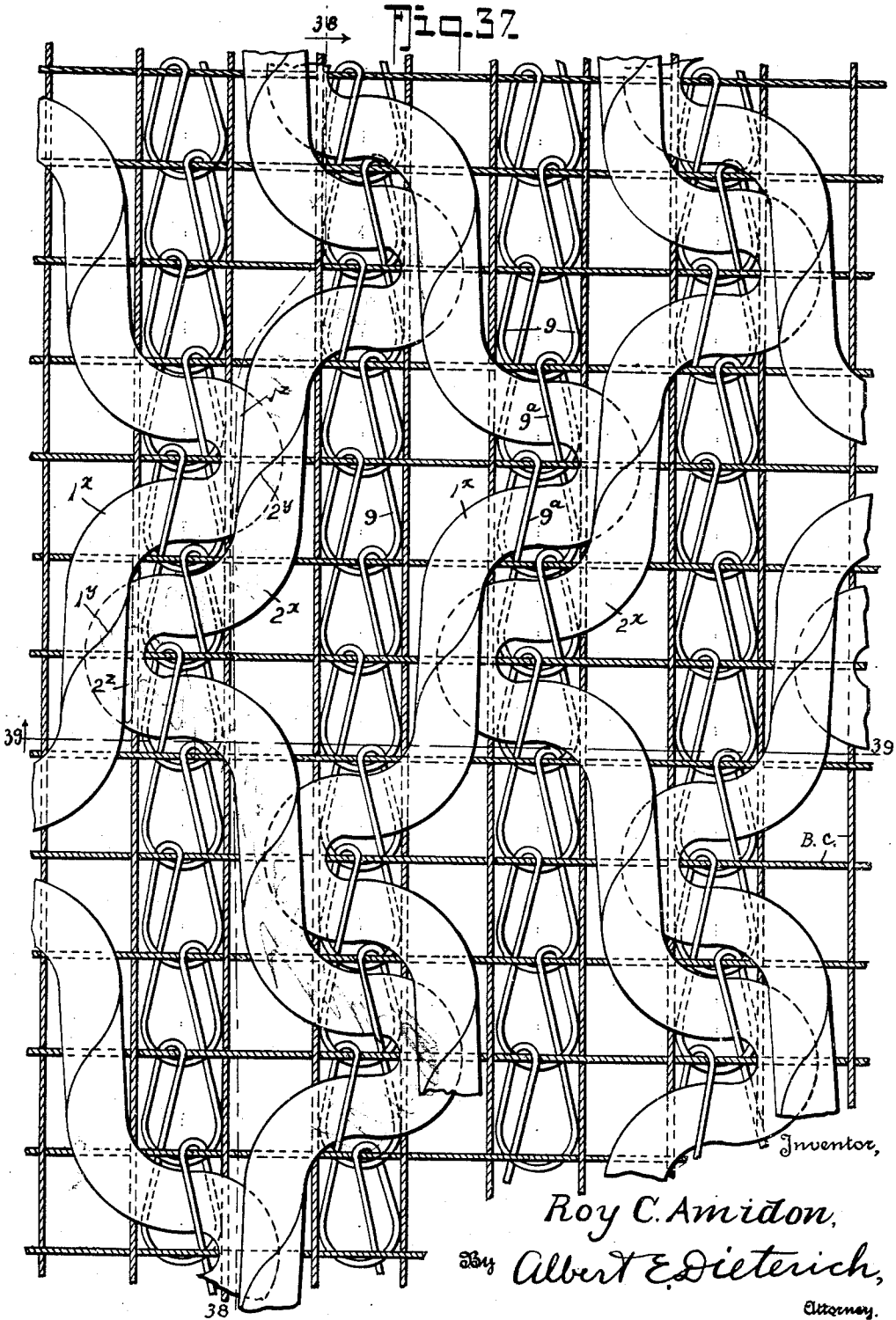
R. C. AMIDON

2,400,524

KNITTING MACHINE

Filed Dec. 10, 1943

20 Sheets-Sheet 19

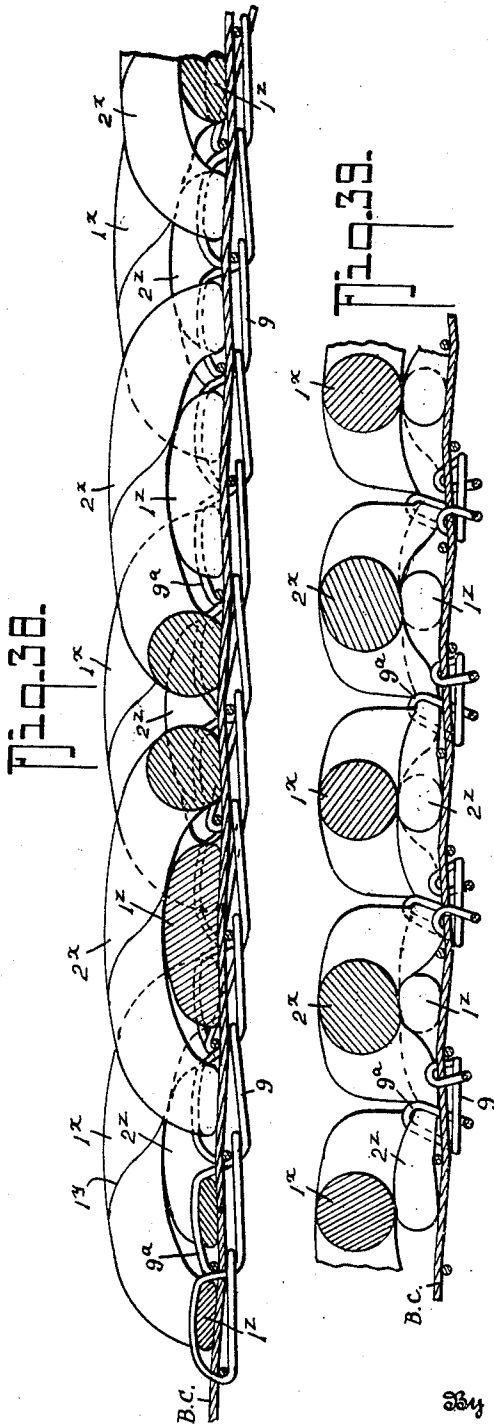


May 21, 1946.

R. C. AMIDON  
KNITTING MACHINE  
Filed Dec. 10, 1943

2,400,524

20 Sheets-Sheet 20



Inventor,  
Roy C. Amidon,

By Albert E. Dieterich,

Attorney.

Patented May 21, 1946

2,400,524

# UNITED STATES PATENT OFFICE

2,400,524

## KNITTING MACHINE

Roy C. Amidon, Reading, Pa., assignor to Vanity Fair Mills, Inc., a corporation of Pennsylvania

Application December 10, 1943, Serial No. 513,753

30 Claims. (Cl. 66—84)

My invention relates to the art of knitting and especially to knitting with machines of the tricot type.

The invention has for its object to provide a machine of the tricot type which, while especially devised for the manufacture of the cloth disclosed in my application for patent filed July 22, 1943, Serial Number 495,749, may be used to knit any other kind of cloth usually knit on tricot machines, as well as special cloths of my own design.

A further object is to provide a machine for knitting pile-type fabrics without the use of looper hooks or movable loop pullers, such for example as the loopers 23—25 of my Patent Number 2,313,725 issued March 16, 1943.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends the invention still further resides in the novel details of construction, combination and arrangement of parts, all of which will be first fully described in the following detailed description, and then be particularly pointed out in the appended claims, reference being had to the accompanying drawings in which:

Fig. 1 is an end elevation of a machine embodying the present invention.

Fig. 2 is a front elevation of a portion of the machine.

Fig. 3 is a vertical cross section of the machine showing in detail the sinker nib and beard presser operating mechanism, some of the other parts of the machine being omitted.

Fig. 4 is a detail top plan view of a portion of the mechanism shown in Fig. 3.

Fig. 5 is a view similar to Fig. 3 showing, in particular, the needle operating mechanism, some of the other parts of the machine being omitted.

Fig. 6 is a detailed top plan view of a portion of the mechanism shown in Fig. 5.

Fig. 7 is a view similar to Figs. 3 and 5 showing, in particular, the thread guide operating mechanism, some of the other parts of the machine being omitted.

Fig. 8 is a detail front elevation of the means for mounting the racking bars on the rock shaft arms.

Fig. 9 is a vertical cross section of the machine showing, particularly, the sinker nib operating mechanism, the needle operating mechanism, the thread guide operating mechanism, the sinker and its support and the finger means in place.

Fig. 10 is a detail side elevation of the end of the machine shown in Fig. 1.

Fig. 11 is a top plan view of the same.

Fig. 12 is a detail elevation (the shaft being shown in section) of the shifter cam and the slidable roller carriage that cooperates therewith to actuate the shifter rod.

Figs. 13 to 34, inclusive, are diagrammatic views hereinafter specifically referred to.

Fig. 35 is a diagrammatic view of one kind of cloth that can be knit on the present machine.

Fig. 36 is a diagrammatic view of a modification of the cloth shown in Fig. 35, that can also be knit on the present machine.

Fig. 37 is a diagrammatic view of an astrakhan type fabric that can be knit by the present machine.

Fig. 38 is a section on the line 38—38 of Fig. 37.

Fig. 39 is a section on the line 39—39 of Fig. 37.

In the drawings in which like numerals and letters of reference indicate like parts in all figures, 10 represents the end frames of the machine. These frames are rigidly connected together by I-beams 31. Each end frame (and intermediate frames when used in long machines) has a cross-bar 11 on which is a bearing 13 for a cam shaft 12.

Mounted in bearings 15 is a back rock shaft 14, while a lower rock shaft 16 is mounted in bearings 17 at the front of the machine and an upper rock shaft 29 is mounted in bearings on brackets 30 at the upper front portion of the machine. A fourth shaft 22 is stationarily held in brackets 94 which are attached to the cross-bars 11. On this fixed shaft 22 is mounted, immovably, arms 23 which carry a bar 24 to which the knock over sinkers 25 are attached.

Mounted above the sinkers are inclined fingers 28 whose base blocks 27 are adjustably secured by cap screws 85 passing through slots 86, in a bar 26 carried by the frames 10, of which fingers more will be said later.

Secured to the back rock shaft 14 are arms 18 which carry a needle bar 18<sup>a</sup> to which the needle blocks 19 are secured by a clamp plate 20 and cap screws 95. The needles are indicated at 21. The arms 18 serve also as roller carriages and each arm has a pair of rollers 50, 61 respectively. The roller 50 is journaled on a stub shaft 49, secured to the arm 18, and is slidable along the shaft, while roller 61 is similarly mounted on a stub shaft 60, the stub shafts 49 and 60 being carried by the arm 18 as best shown in Figs. 5 and 6. Each roller 50, 61 cooperates with a double cam.

The cam with which the roller 50 cooperates has a full-stroke cam surface 52 and a short-stroke cam face 51, while the cam which cooperates with the roller 61 also has a full-stroke cam surface

54 and a short-stroke cam surface 55. In Fig. 6, the numeral 53 indicates the node or high part of the cam surface 52. The cam 51—52 is the leader cam and the cam 54—55 is the follower cam for operating the needles in a manner later understood.

In order that the rollers 50 and 61 may be shifted from one cam surface of the respective cams to the other cam surface thereof, I provide a longitudinally shiftable rod 43 that is mounted in suitable supports 44. The rod 43, among other things, carries an articulated arm 56 having a fork 57 which lies on the stub shaft 49 and straddles the roller 50 (see Figs. 5 and 6). A spring 58 is secured, at 59 to part of the arm 56 and engages the other part thereof to make certain that the fork 57 shall remain in position while the machine is operating. Another articulated arm 62 is fastened on the rod 43 and has a fork 62<sup>a</sup> to straddle the roller 61. The fork 62<sup>a</sup> is held in position by a spring 63 that is secured, at 64, to one part of the arm 62 and engages the other part thereof.

Referring now to Fig. 7 it will be seen that an arm 32 is fastened on the shaft 29 and has a pin and slot slide connection 34, 35 with an arm 33 loosely mounted on the shaft 14, which shaft is preferably, stationarily mounted. The arm 33 also serves as a roller carriage on which is mounted two rollers 96 and 97 respectively to engage the leader and follower cams 98 and 99 that are, respectively, mounted on the cam shaft 12. Thus the shaft 29 is rocked through rotation of the cam shaft 12.

Secured to the rock shaft 29 are arms 65 which carry slide rods 69. A thread-guide carrying bar 67 has lugs 68 which are apertured to receive the slide rods 69 and themselves carry slide rods 66 that work in apertures in the arms 65 as clearly indicated in Fig. 8. Thread guides 71, mounted in blocks 70 are secured to the bar 67 in any suitable way.

Secured to the lower front rock shaft 16 is a roller carriage 36 having a stub shaft 37 on which a roller 38 is rotatably and slidably mounted (see Figs. 3 and 4). The roller 38 is held in contact with a double cam by a spring 39. The double cam has a short-throw surface 40 and a long-throw surface 41 the latter having a node 42. In order that the roller 38 may be shifted from one cam surface to the other in harmony with the shifting of the rollers 50 and 61 hereinbefore mentioned, a third articulated arm 45 is fastened to the rod 43 and has a fork 46 to straddle the roller 38 and rest on the shaft 37. A spring 47 secured, at 48, to one part of the arm 45 and engaging the other part thereof, serves to maintain the fork 46 in position with respect to the roller 38.

Arms 72 are fastened to the rock shaft 16 and carry brackets 73 on which a sinker-nib-carrying bar 75 is mounted, suitable spacers 74 being provided if necessary. Sinker nibs 77 are mounted, through the medium of their blocks 76 and cap screws 84, on the bar 75.

Longitudinally and laterally adjustably mounted on the bar 75 by means of slots 81 and cap screws 82 (see Fig. 13) is a beard-presser-carrying bar 78 to which beard presser blocks 79 are secured by cap screws 83. The beard pressers 80 extend forwardly over the sinker nibs in line with the needles.

Mounted on the upper beam 31 (see Fig. 1) are racks 87, having arms 89 for supporting the thread-carrying spools 90 and the base-cloth-

5 carrying spool 88. The base cloth B. C. passes under a guide rod 91 and between the sinkers 25 and nibs 77 (see Fig. 9). The threads 1 and 2 are passed over spring loaded tension rods 92 and through the eyes of the middle and back guides 71, respectively. The completed cloth passes to the cloth feed rolls 93 and from thence to the take up mechanism (not shown) which may be the same as that disclosed in my Patent #2,313,725 aforesaid if desired.

10 The mechanism by means of which the rod 43 is shifted longitudinally is best illustrated in Figs. 10, 11 and 12 by reference to which it will be seen that frames 105 are secured to an end frame 10. Mounted in suitable bearings 106, suitably secured to the frames 105, is a shaft 107 which is driven from shaft 12 by means of bevelled gears 108, 109 of, preferably, a one to two ratio, so that the shaft 107 turns only half as fast as shaft 12.

20 Secured to the shaft 107 to turn with it but, preferably, movable along the shaft is a cam 110. When in use the cam is pinned at 127 to the shaft in the position shown in Fig. 11. When not in use the pin is removed and the cam slid back to the dotted position shown in Fig. 11 and the pin put through the cam and the hole 128. A bearing bracket 113 is secured to a frame 105 and has a slide way in which the yoke or U-frame 111 is slidably mounted. The yoke 111 carries two rollers 112 which engage the cam 110 at opposite sides (see Fig. 12). The yoke has a pin hole 114 and the bearing 113 has a pin hole 115. When the cam is moved back to the dotted position in Fig. 11 to be pinned there and the holes 114—115 are brought into alignment, a pin (not shown) can be inserted into holes 114—115 to hold the yoke from movement.

Referring now particularly to Figs. 1, 2, 10 and 11 it will be seen that at the end of the machine opposite that of Fig. 1 the racking bars 67 have arms 100 to each of which a rod 101 is pivoted. Each rod 101 is operated in one direction by a spring 102 that is attached to the rod 101 and is anchored to a bracket 103 that is secured to the end frame. The springs 102 continuously exert pulls on the bars 67 in a direction from right to left in Fig. 2. At the other end the racking bars 67 have arms 104 to which are connected in any suitable way, longitudinally extensibly adjustable rods 126. The rods 126 are pivoted to respective bell crank levers 124 which are independently pivoted to a bracket 123 that is secured to an extension frame 116 which, in turn, is suitably secured to the frames 105 as best shown in Figs. 10 and 11. Mounted in bearings 117 on the frames 105 is a pattern wheel shaft 118. The shaft 118 is driven from the shaft 107 by means of a sprocket and chain connection 119, 120, 121. Secured to the shaft 118 are the several pattern wheels 122, which are engaged by the bevelled lugs 125 on the respective bell crank levers 124. Since the springs 102 exert a constant tension on the bars 67 the levers 124 will be continuously held with their lugs 125 in continuous contact with the pattern wheels.

35 In Figs. 35 and 36 are diagrammatically illustrated special kind of fabrics for which the present machine was especially devised. These fabrics constitute the subject matters of my application for patent filed July 22, 1943, Serial Number 495,749. When the machine is used for knitting such fabrics, only two thread guides are used, say the second and third guides from the right in Fig. 3. The method of operating the machine to produce these fabrics is illustrated in

Figs. 13 to 34 inclusive, but before describing the operation with reference to those figures, a brief description of the fabrics is in order.

In Fig. 35, 1 and 2 designate the threads or yarns which are knit through the base fabric B. C. The base fabric is composed of warp threads 3 and weft threads 4 woven together, preferably, as an open mesh or net fabric. Each thread or yarn is so knit as to form a chain of loops 5, which loops all lie on the same side or face of the base fabric; each thread or yarn 2 is also knit to form a chain of loops 6, which loops all lie on the same side or face of the base fabric as do the loops 5. The courses of two adjacent threads or yarns are connected through the base fabric by interloops 7 and 8 which are spaced apart from one another longitudinally and transversely at predetermined distances. The interloops 7, 8 lie between adjacent chains 5 and 6 and are connected together by portions of the threads or yarns 1, 2 which lie on the same side of the base fabric as do the interloops 7 and 8. The interloops 7 and 8 are drawn together into the form of knots and shall be hereinafter referred to as knot-like elements. The drawing together of the loops 7 and 8 causes the chain loops 5 and 6 to assume inclinations which give the chains a zigzag appearance. As will be seen from an inspection of Fig. 35, the loops 5 and 6 of adjacent chains alternately converge and diverge. The inclination of the chain loops 5 and 6, together with the spacing of the interloops 7 and 8, provides substantial openings through the fabric for light, heat and air to pass. These openings are all of the same size and of quadrilateral form.

If desired, elongated holes may be formed in the fabric by not cross-connecting certain interloops, but effecting longitudinal connections only between interloops 7, 8 and 7<sup>a</sup>, 8<sup>a</sup> (see Fig. 36) by the thread portions 2<sup>a</sup>, 1<sup>a</sup>.

By referring now to Figs. 13 to 34 inclusive, the operation of the machine to produce the fabric of Fig. 35 (and by a slight change of the pattern wheel contours, the fabric of Fig. 36) will be understood. In these figures, for convenience of description, the front thread guides 71 are lettered F<sup>1</sup>, F<sup>2</sup>, F<sup>3</sup>; the rear thread guides 71 are lettered B<sup>1</sup>, B<sup>2</sup>, B<sup>3</sup>; and the needles are lettered N<sup>1</sup>, N<sup>2</sup>, N<sup>3</sup> and N<sup>4</sup>. The upper figure on each of Sheets 8 to 17 inclusive is a section taken on the similarly numbered section line or lines of the figure or figures below the same.

Starting with the parts in the position of Figs. 13 and 14, it will be seen that the sinker nib has advanced to a position where the needle will clear the beard presser; the needle is rising through a previously formed loop L<sup>1</sup>; the sinker is of course stationary as is also the finger 28 at this time, also, the rollers 38, 50, 61, are in engagement with the short-throw surfaces of their respective cams on shaft 12.

As the parts pass from the position of Figs. 13 and 14 to the position shown in full lines in Fig. 15, the thread guides 71 are racked in front of the needles from the position of Fig. 14 to the position of Fig. 16; the sinkers, sinker nibs, beard pressers and fingers remain stationary while the needles rise from the position of Figs. 13, 14 to the position of Figs. 15, 16, 17.

It should here be noted that throughout this specification when reference is made to the "front" of the machine the reference is to that part of the machine through which the completed fabric passes out.

As soon as the thread guides shall have racked

in front of the needles from the position of Fig. 14 to that of Fig. 16, they are swung back between the needles to the dotted line position of Fig. 15 and racked in back of the needles, as shown in Fig. 17, they are then swung forward between the needles to the full line position again in Fig. 15, thereby laying the threads about the needles as shown in dot and dash lines in Fig. 15.

The needles 21 continue to rise to the position shown in Figs. 18 and 19 allowing the threads to slip down over the beards to the shanks of the needles. Figs. 18 and 19 show the needles at the top of their strokes; the other parts shown in Figs. 18 and 19 remain stationary as in Fig. 17.

On passing from the position of Figs. 18, 19 to the position of Figs. 20, 21 the needles go down and hook both threads beneath the beards which remain open; as the needles go down from the position of Figs. 20, 21 to the position of Figs. 22, 23 the sinker-nibs and beard pressers are moved back to the position of Fig. 22 and the needles at that time have reached the bottom of their short stroke. The needles on this down stroke do not draw the threads through the loops L<sup>1</sup>. It will be noted that in passing from the position of Fig. 16 to that of Fig. 23 the threads 1 and 2 are crossed over fingers 28 to begin the formation of the inter-loops that comprise the knot like elements, 7, 8 of the fabric.

On passing from the position of Fig. 22 to that of Fig. 24, the sinker nibs 77 and beard pressers 80 move forwardly and the needles move upwardly. The nibs hold the threads down to clear the beards as the needles rise. On passing from the position of Figs. 22, 23 to the position of Figs. 24, 25, as soon as the sinker nibs have advanced far enough to hold down the hooked threads, the thread guides are racked in front of the needles from the position of Fig. 23, through the position of Fig. 25 to the position shown in full lines in Figs. 26 and 27.

As the needles rise from the position of Fig. 24 to that of Fig. 26 and after the racking in front of the needles has taken place as last above described, the thread guides 71 are swung back between the needles to the position shown in dotted lines in Fig. 26 and again racked to pass the threads again over the fingers 28 and in back of the needles as shown in Fig. 28. After having racked in back of the needles (Figs. 26, 28) the guides are swung forward again between the needles, thereby laying the threads about the needles as indicated in dot and dash lines in Fig. 26.

Passing from the position of Figs. 26, 28 to that of Fig. 29 the sinkers 77 and beard pressers 80 will have reached the ends of their long strokes forward so as to bring the beard pressers in line to close the beards as the needles come down. During this time thread 2 lies in front of the needles and thread 1 behind the needles. By the time position in Figs. 29, 30 has been reached the needles will have reached the upper limit of their strokes; sinker-nibs, beard pressers and sinkers will be stationary and remain so until after position in Figs. 31, 32 has been reached. As the needles continue downward to the position shown in Figs. 33, 34 they pull the threads through the loops L<sup>1</sup> to form the next loop L<sup>2</sup>. On passing from the position of Figs. 31, 32 to the position of Figs. 33, 34, and after the needles shall have passed the beard pressers and through the loops L<sup>1</sup>, the nibs 77 and beard pressers 80 are moved back until the needles move up again

to the position of Fig. 13, thus completing a full cycle of operation.

As soon as the parts reach the position of Figs. 33, 34 the cam engaging rollers are shifted back from the long throw faces of the cams on shaft 12 to the short throw faces thereof to begin another cycle of operation. Each complete cycle of operation involves two complete revolutions of the cam shaft 12. The first half of the cycle takes place while the cam engaging rollers on the carriages 18 and 36 are running on the low or short throw cam surfaces (positions Fig. 13 through Fig. 25). The second half of the cycle takes place while the rollers of the carriages 18 and 36 are on the high or long throw faces of the cams on shaft 12 (positions Figs. 26 through 34). The fingers 28 serve to keep the knot-forming, interloop, parts of the threads under even tension while the threads are being laid about the needles, drawn into loops and the loops passed through preceding loops and prevent the interloops being drawn into too tight knots. As the cloth of Figs. 35 and 36 is, in practice, knit with elastic yarn or worsted it is essential that no undue tension is placed on the same during the knitting function.

The presence of the fingers 28 in the machine is also of value in producing astrakhan cloth in making which thick worsted is employed. Such cloth is diagrammatically shown in Figs. 37, 38 and 39 of the drawings by reference to which it will be seen that parallel chains of thread 9 are knit through the base fabric B. C. and yarns 1<sup>x</sup>-2<sup>x</sup> are laid over the base fabric and through the base-fabric-overlying portions 9<sup>a</sup> of the chains. Each yarn 1<sup>x</sup>, 2<sup>x</sup> is alternately laid through two adjacent loops of a chain and then through two adjacent loops of an adjacent second chain, those portions of a yarn 1<sup>x</sup> which pass from one chain to the next adjacent chain lie over the portions of the yarn 2<sup>x</sup> which are looped through the first mentioned chain and vice versa, as at 2<sup>z</sup> and 1<sup>z</sup> in Figs. 37 to 39 inclusive. In knitting this fabric the yarns 1<sup>x</sup> and 2<sup>x</sup> in passing from one row of chains to the adjacent row may undergo a slight twist as at 1<sup>y</sup>, 2<sup>y</sup>. Those portions between chains, in the finished fabric, comprise the curls of the cloth which give to it the appearance of true or natural astrakhan.

In adjusting the machine to knit astrakhan cloth the cam 110 is set to the dotted position in Fig. 11 and held there, thus rendering the cam roller shifter 43 inoperative. The rod 43 is moved by hand to establish the rollers on the high or long throw faces of the cams on shaft 12 which control the needle and the sinker-nib and beard-presser operations which bring pin holes 114 and 115 into register. A pin is then placed in these holes to hold yoke 111 and rod 43 stationary. The first or small eye guides 71<sup>a</sup> are used for the chain-forming threads and the other guides 71 for the yarn or worsted. Pattern wheels of the required contours replace those shown in Fig. 10. The fingers 28 are adjusted to effect the proper sized loop or curl to the parts of the yarn that lies between adjacent rows of chains. The machine is then ready to function. A complete cycle of operation then takes place with each revolution of the cam shaft 12 instead of with each two revolutions as before.

With properly designed fingers 28 to give the required lift, and with pattern wheels designed accordingly the machine may also be used to make pile fabric.

What I claim is:

1. In a flat knitting machine employing, bearded needles, knock-over sinkers, sinker nibs and thread guides and thread racking means: the improvement which comprises fingers projecting between adjacent needle paths and over which the threads from the guides are racked.

2. In a flat knitting machine employing, bearded needles, knock-over sinkers, sinker nibs and thread guides and thread racking means: the improvement which comprises fingers projecting between adjacent needle paths and over which the threads from the guides are racked; means for imparting two actions to the needles during each cycle of operation; and means to operate the beard pressers to close the needle beards during one only of said actions per cycle.

3. In a flat knitting machine employing, bearded needles, knock-over sinkers, sinker nibs and thread guides and thread racking means: the improvement which comprises fingers projecting between adjacent needle paths and over which the threads from the guides are racked; means for imparting a short stroke and then a long stroke to the needles during each cycle of operation; and means to operate the beard pressers to close the beards of the needles during but one stroke per cycle.

4. In a flat knitting machine employing, bearded needles, knock-over sinkers, sinker nibs and thread guides and thread racking means: the improvement which comprises fingers projecting between adjacent needle paths and over which the threads from the guides are racked; and means to operate said thread guides twice during each cycle of operation.

5. In a flat knitting machine employing, bearded needles, knock-over sinkers, sinker nibs and thread guides and thread racking means: the improvement which comprises fingers projecting between adjacent needle paths and over which the threads from the guides are racked; means for imparting two actions to the needles during each cycle of operation; and means to operate the beard pressers to close the needle beards during one only of said actions per cycle; and means to operate said thread guides twice during each cycle of operation.

6. In a flat knitting machine employing, bearded needles, knock-over sinkers, sinker nibs and thread guides and thread racking means: the improvement which comprises fingers projecting between adjacent needle paths and over which the threads from the guides are racked; means for imparting a short stroke and then a long stroke to the needles during each cycle of operation; and means to operate the beard pressers to close the beards of the needles during but one stroke per cycle; and means to operate said thread guides twice during each cycle of operation.

7. In a flat knitting machine: stationary sinkers; movable sinker nibs; reciprocable bearded needles; reciprocable beard pressers; thread guides; means for mounting the aforesaid elements in cooperative association for effecting knitting operations; stationary fingers projecting over the sinkers and sinker nibs between the positions of adjacent needles; and means for operating the sinker nibs, the needles, the beard pressers, and the thread guides to effect knitting operations and racking over said fingers for purposes described.

8. In a flat knitting machine: stationary sinkers; movable sinker nibs; reciprocable bearded needles; reciprocable beard pressers; thread

2,400,524

5

guides; means for mounting the aforesaid elements in cooperative association for effecting knitting operations; stationary fingers projecting over the sinkers and sinker nibs between the positions of adjacent needles; and means for operating the sinker nibs, the needles, the beard pressers, and the thread guides to effect knitting operations and racking over said fingers for purposes described, said operating means including a cam shaft, a cam on said shaft, a roller carriage for the sinker nibs and beard pressers, said carriage having a roller for cooperating with said cam to impart movement to said sinker nibs and said beard pressers in one direction and a spring for imparting movement to said sinker nibs and beard pressers in the opposite direction, said cam having a short-stroke effecting surface and a long-stroke effecting surface, and means to shift said roller back and forth from one of said surfaces to the other.

9. In a flat knitting machine: stationary sinkers; movable sinker nibs; reciprocable bearded needles; reciprocable beard pressers; thread guides; means for mounting the aforesaid elements in cooperative association for effecting knitting operations; stationary fingers projecting over the sinkers and sinker nibs between the positions of adjacent needles; and means for operating the sinker nibs, the needles, the beard pressers, and the thread guides to effect knitting operations and racking over said fingers for purposes described, said operating means including a pair of cams on said shaft, a needle carrying arm having a pair of rollers to engage said cams to effect operation of said needles, said cams each having a short-stroke effecting surface and a long-stroke effecting surface and means to shift said rollers back and forth from one cam-surface to the other.

10. In a flat knitting machine: stationary sinkers; movable sinker nibs; reciprocable bearded needles; reciprocable beard pressers; thread guides; means for mounting the aforesaid elements in cooperative association for effecting knitting operations; stationary fingers projecting over the sinkers and sinker nibs between the positions of adjacent needles; and means for operating the sinker nibs, the needles, the beard pressers, and the thread guides to effect knitting operations and racking over said fingers for purposes described, said operating means including a pair of cams on said shaft, a needle carrying arm having a pair of rollers to engage said cams to effect operation of said needles, said cams each having two operating surfaces, and means to shift said rollers back and forth from one of said operating surfaces to the other.

11. In a flat knitting machine: stationary sinkers; movable sinker nibs; reciprocable bearded needles; reciprocable beard pressers; thread guides; means for mounting the aforesaid elements in cooperative association for effecting knitting operations; stationary fingers projecting over the sinkers and sinker nibs between the positions of adjacent needles; and means for operating the sinker nibs, the needles, the beard pressers, and the thread guides to effect knitting operations and racking over said fingers for purposes described, said operating means including a cam shaft, a sinker nib and beard presser operating cam on said shaft, an operating connection, including a cam-engaging roller, between said shaft and said sinker nibs and beard pressers, said operating means also including a leader cam and a follower cam on said cam shaft, an

operating connection, including cam-engaging rollers, between said shaft and said needles, said leader and follower cams each having two different operating surfaces, and means for shifting said cam-engaging rollers back and forth from one cam surface to the other.

12. In a flat knitting machine: a frame; sinkers stationarily mounted on said frame; sinker nibs longitudinally movably mounted above said sinkers; means to operate said sinker nibs forwardly and backwardly over the sinkers; beard pressers; means to operate said beard pressers; bearded needles mounted for longitudinal reciprocation through said sinkers and sinker nibs; means to operate said needles; fingers held over said sinkers and spaced between adjacent needle positions; thread guides; means to operate said thread guides to lay threads over said fingers and around the needles; and means to co-ordinate the operations of all said means to effect knitting operations.

13. In a flat knitting machine: a frame; sinkers stationarily mounted on said frame; sinker nibs longitudinally movably mounted above said sinkers; means to operate said sinker nibs forwardly and backwardly over the sinkers; beard pressers; means to operate said beard pressers; bearded needles mounted for longitudinal reciprocation through said sinkers and sinker nibs; means to operate said needles; fingers held over said sinkers and spaced between adjacent needle positions; thread guides; means to operate said thread guides to lay threads over said fingers and around the needles; and means to co-ordinate the operations of all said means to effect knitting operations, said sinker nib, said beard presser and said needle operating and co-ordinating means including cam engaging rollers, a cam shaft with cams for engagement by said rollers, said cams each having a short and a long stroke-effecting surface, and means for shifting said rollers back and forth from one said surface to the other according to a definite pattern.

14. In a flat knitting machine employing stationary sinkers, movable sinker nibs and beard pressers, reciprocable needles, and thread guides; the improvement which includes means to effect two reciprocations of the needles to two of the sinker nibs and one operation of the beard presser.

15. In a flat knitting machine employing stationary sinkers, movable sinker nibs and beard pressers, reciprocable needles, and thread guides; the improvement which includes fingers projecting between adjacent needle paths and over which fingers the threads are laid; and means to effect two reciprocations of the needles to one effective action of the beard pressers.

16. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, said beard pressers and said thread guides to effect knitting operations and racking over said fingers.

17. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, and said beard pressers to provide two actions of the needles to one of said beard pressers.

18. In a flat knitting machine, wherein bearded

needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, and said beard pressers to provide two actions of the needles to one of said beard pressers and effect knitting operations in part over said fingers.

19. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, and said beard pressers to provide two actions of the needles to one of said beard pressers and effect knitting operations in part over said fingers, said operation means including a cam shaft with thread guide operating cams, a pivoted roller carriage with rollers engaging said cams, a rock shaft, an arm on said rock shaft having a pin and slot connection with said carriage, other arms on said rock shaft; at least one thread guide bar carried by said other arms; and means to rack said thread guide bar.

20. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, said beard pressers to provide two actions of the needles to one of said beard pressers and effect knitting operations in part over said fingers, said operating means including a cam shaft, needle actuating cams on said cam shaft, a needle carrier having cam engaging rollers cooperating with said needle actuating cams, said needle actuating cams each having a short stroke-effecting and a long-stroke effecting surface, sinker nib and beard presser actuating cams on said cam shaft, and means to shift said rollers in step back and forth from one cam surface of a cam to the other.

21. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, said beard pressers to provide two actions of the needles to one of said beard pressers and effect knitting operations in part over said fingers, said operating means including a cam shaft, needle actuating cams on said cam shaft, a needle carrier having cam engaging rollers cooperating with said needle actuating cams, said needle actuating cams each having a short stroke-effecting and a long-stroke effecting surface, sinker nib and beard presser actuating cams on said cam shaft, and means to shift said rollers in step back and forth from one cam surface of a cam to the other, said shifting means including a shifter shaft with shifting forks engaging the rollers to be shifted, and means to move said shifter shaft back and forth lengthwise.

22. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, said beard pressers to provide two actions of the needles to one of said beard pressers and effect knitting operations in part over said fingers, said operating means including a cam shaft, needle

actuating cams on said cam shaft, a needle carrier having cam engaging rollers cooperating with said needle actuating cams, said needle actuating cams each having a short stroke-effecting and a long-stroke effecting surface, sinker nib and beard presser actuating cams on said cam shaft, and means to shift said rollers in step back and forth from one cam surface of a cam to the other, said shifting means including a shifter shaft with shifting forks engaging the rollers to be shifted, a second cam shaft gear-connected to the first mentioned cam shaft, a cam on said second cam shaft, a yoke with rollers engaging said last named cam and connected to said shifter shaft.

23. In a flat knitting machine, wherein bearded needles, fixed sinkers, reciprocable sinker nibs, beard pressers, and thread guides are employed: fingers located above the sinkers and between adjacent needle paths; and means for effecting operation of said needles, said sinker nibs, said beard pressers to provide two actions of the needles to one of said beard pressers and effect knitting operations in part over said fingers, said operating means including a cam shaft, needle actuating cams on said cam shaft, a needle carrier having cam engaging rollers cooperating with said needle actuating cams, said needle actuating cams each having a short stroke-effecting and a long-stroke effecting surface, sinker nib and beard presser actuating cams on said cam shaft, and means to shift said rollers in step back and forth from one cam surface of a cam to the other, said shifting means including a shifter shaft with shifting forks engaging the rollers to be shifted, a second cam shaft gear connected to the first mentioned cam shaft, a cam on said second cam shaft, a yoke with rollers engaging said last named cam and connected to said shifter shaft, means to render said last named cam inoperative at will, and means to retain said shifter rod in a predetermined position when said last named cam shall have been rendered inoperative.

24. In a flat knitting machine employing bearded needles, stationary sinkers and movable sinker nibs: a sinker nib carrying bar; sinker nibs secured to said bar; a beard presser carrying bar adjustably mounted on said sinker nib carrying bar; beard pressers secured to said beard presser carrying bar; and means for advancing and retracting said sinker carrying bar and the parts carried thereby and mounted thereon.

25. In a flat knitting machine employing bearded needles, stationary sinkers and movable sinker nibs: a sinker nib carrying bar; sinker nibs secured to said bar; a beard presser carrying bar adjustably mounted on said sinker nib carrying bar; beard pressers secured to said beard presser carrying bar; and means for advancing and retracting said sinker carrying bar and the parts carried thereby and mounted thereon, said advancing and retracting means including means to give, alternately, short and long strokes to said sinker carrying bar by virtue of which said beard pressers are rendered operative on the needles once every two strokes of the needles.

26. In a flat knitting machine employing bearded needles, stationary sinkers and movable sinker nibs: a sinker nib carrying bar; sinker nibs secured to said bar; a beard presser carrying bar adjustably mounted on said sinker nib carrying bar; beard pressers secured to said beard presser carrying bar; and means for advancing and retracting said sinker carrying bar and the parts carried thereby and mounted thereon; and stationary held fingers cooperatively associated with

2,400,524

7

the aforesaid elements over which fingers the knitting threads are racked.

27. In a flat knitting machine embodying bearded needles, stationary sinkers and movable sinker nibs: a sinker nib carrying bar; sinker nibs secured to said bar; a beard presser carrying bar adjustably mounted on said sinker nib carrying bar; beard pressers secured to said beard presser bar; means for advancing and retracting said sinker carrying bar and the parts carried thereby and mounted thereon, said advancing and retracting means including means to give, alternately, short and long strokes to said sinker carrying bar by virtue of which said beard pressers are rendered operative on the needles once every two strokes of the needles; and stationarily held fingers cooperating with the aforesaid elements and over which fingers the knitting threads are racked.

28. In a flat knitting machine employing stationary sinkers, movable sinker nibs and beard pressers, reciprocable needles, and thread guides: the improvement which includes fingers projecting between adjacent needle paths and over which fingers the threads are laid; and means to effect two reciprocations of the needles to two reciprocations of said sinker nibs and one effective action of the beard pressers.

29. In a knitting machine wherein bearded knitting needles, sinkers, sinker nibs and beard pressers are employed, the improvement which comprises: stationary sinkers, sinker nibs movable to and fro over the sinkers, and beard pressers movable to and fro with the sinker nibs.

30. The improvement of claim 29 wherein a sinker nib carrier is provided on which the sinker nibs and the beard pressers are mounted.

ROY C. AMIDON.