Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

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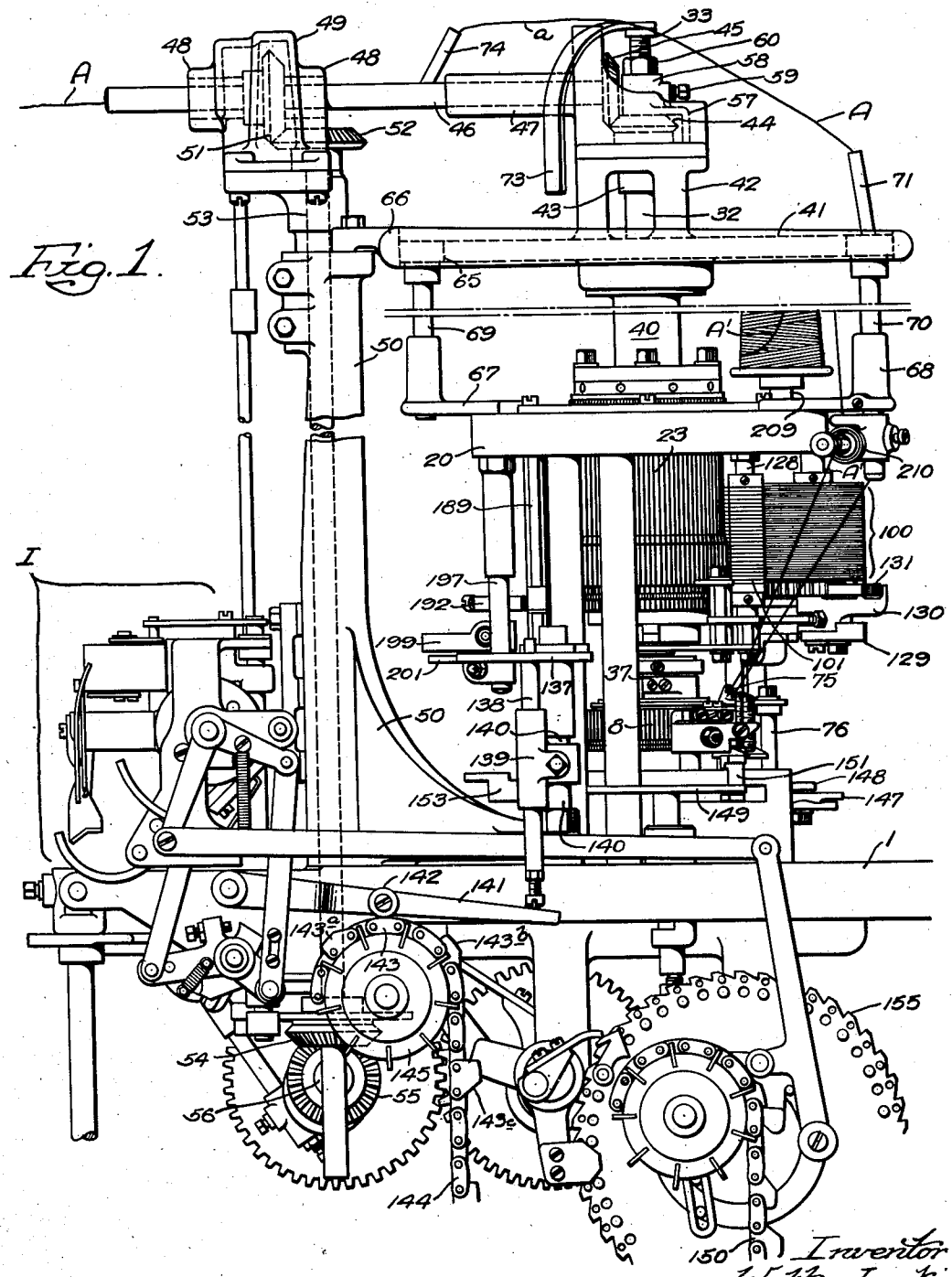


Fig. 1.

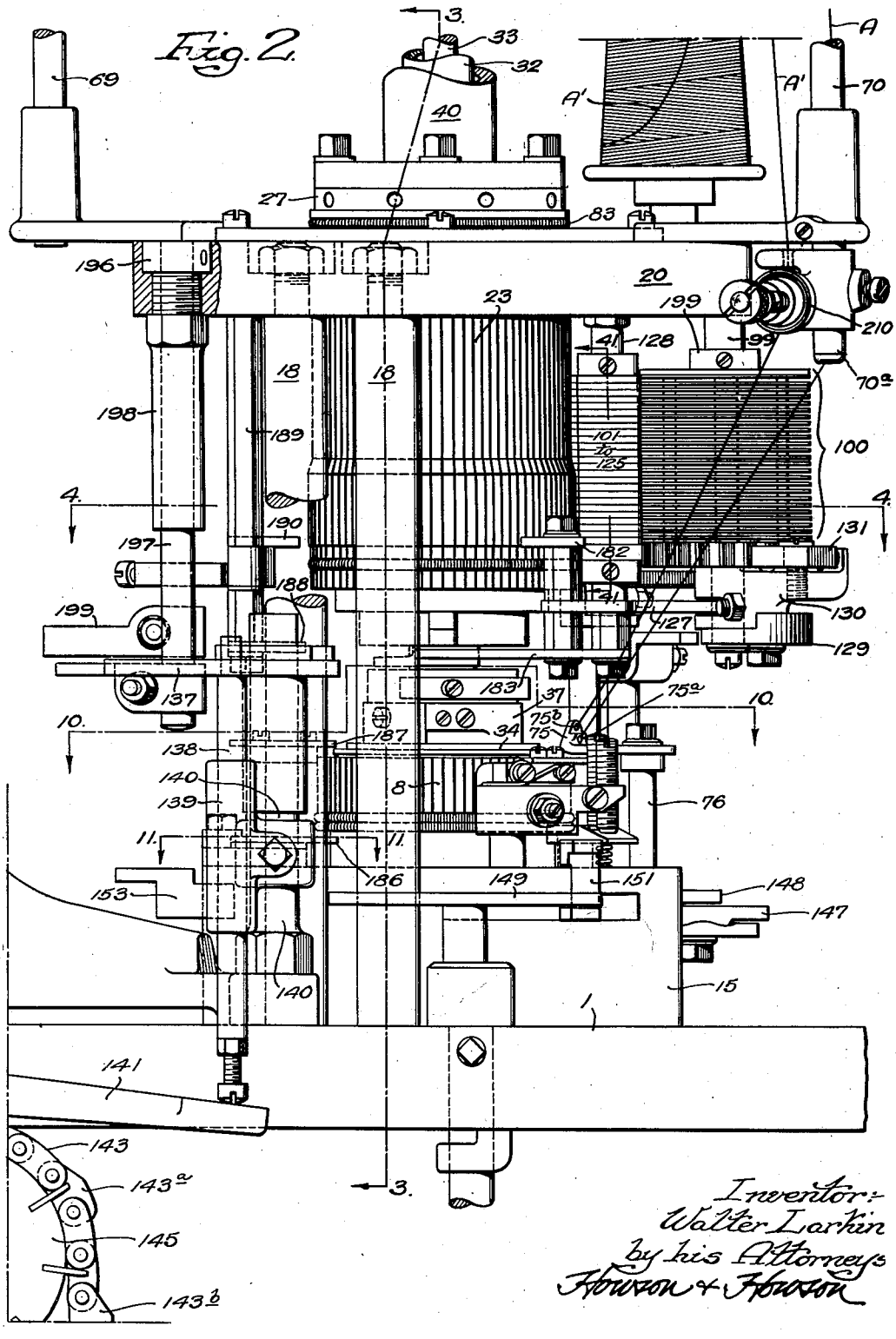
Inventor
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Howson & Howson

Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 2

Fig. 2.



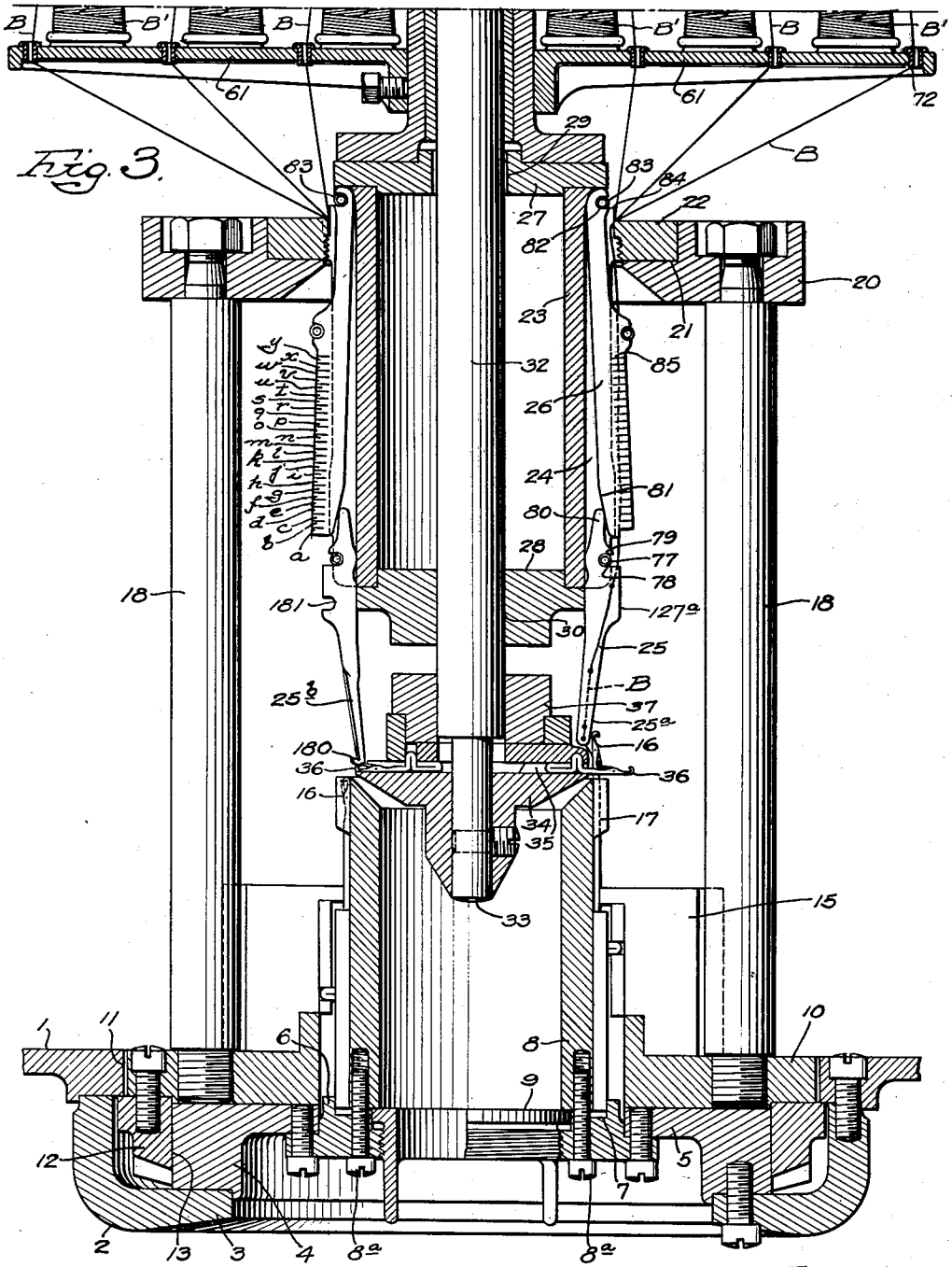
Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 3

Fig. 3.



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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 4

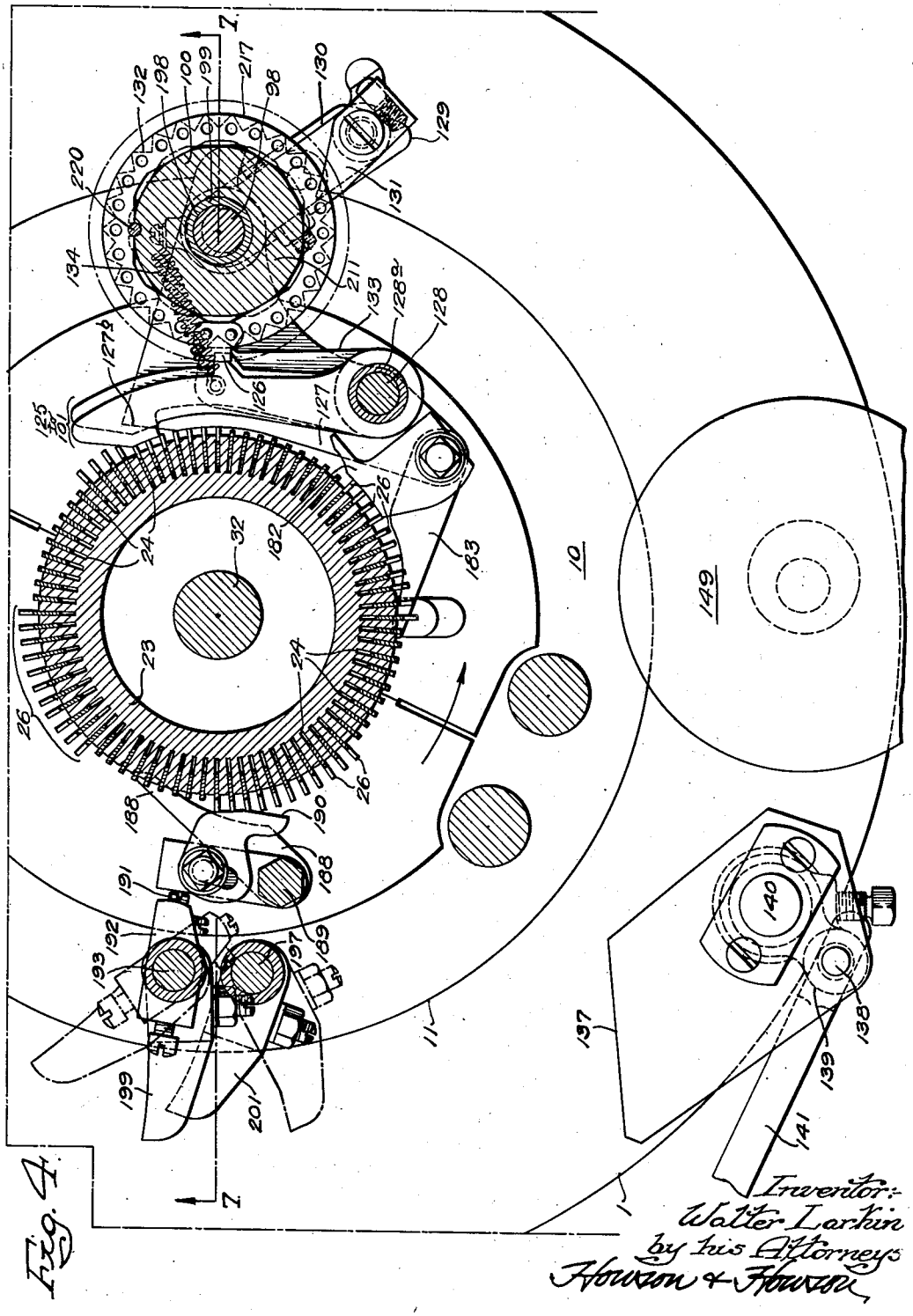


Fig. 4.

Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 5

Fig. 18.

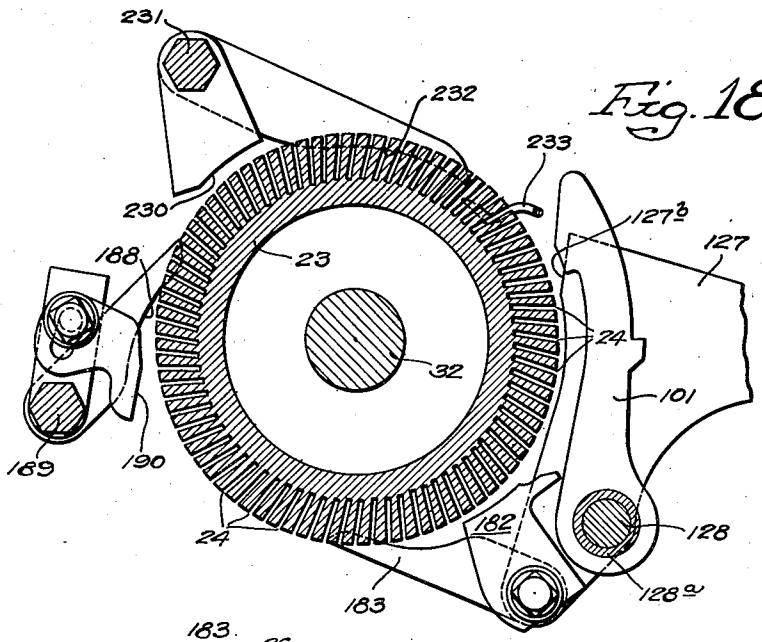


Fig. 5.

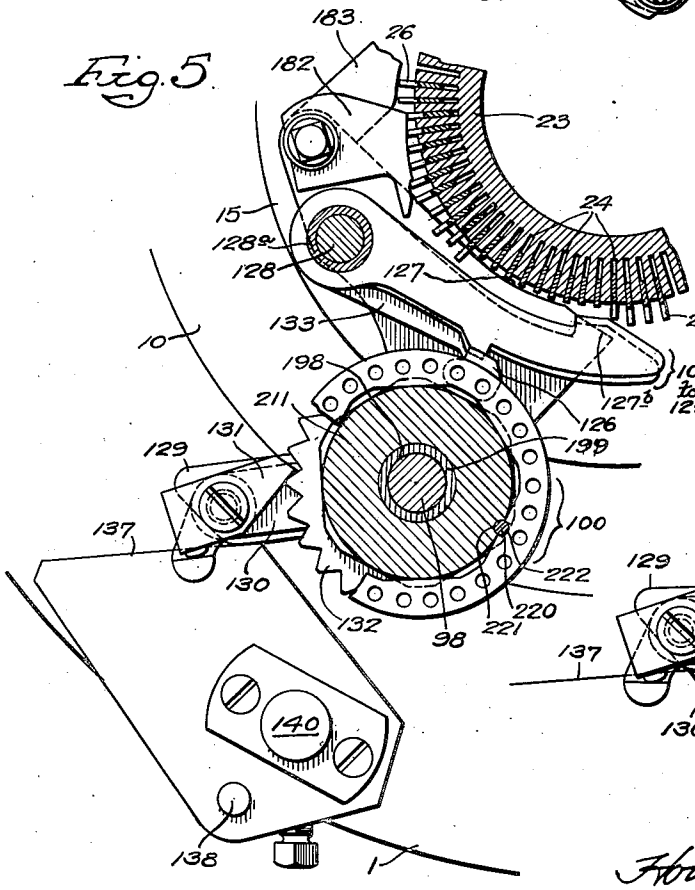
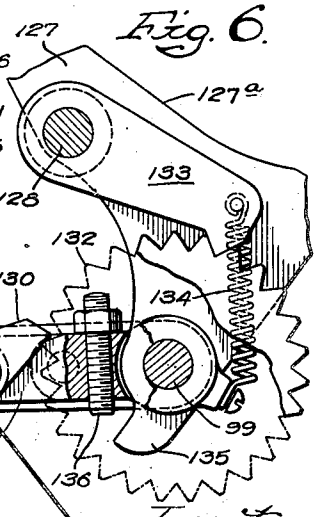


Fig. 6.



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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 6

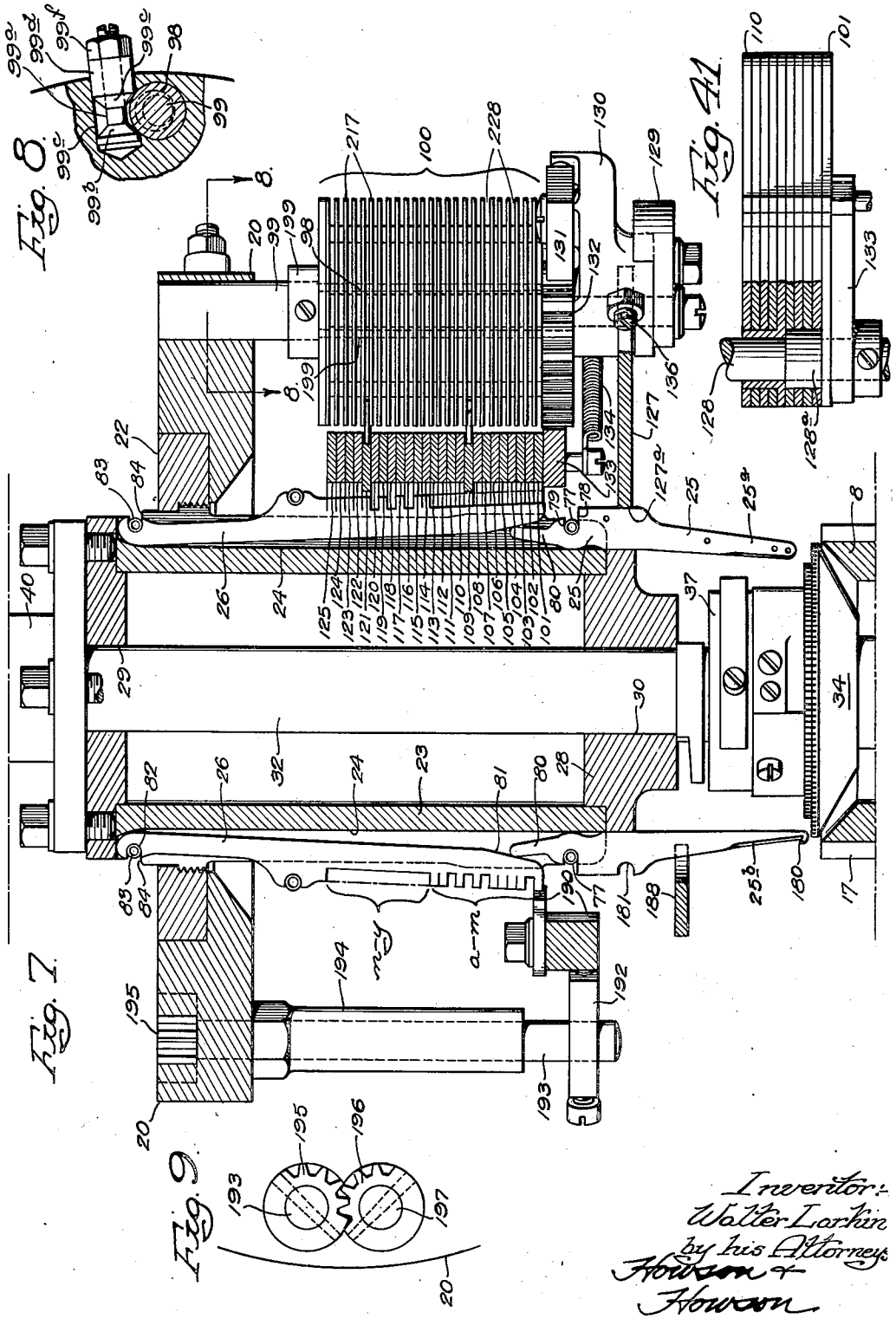


Fig. 8.

Fig. 41

Fig. 7

Fig. 9

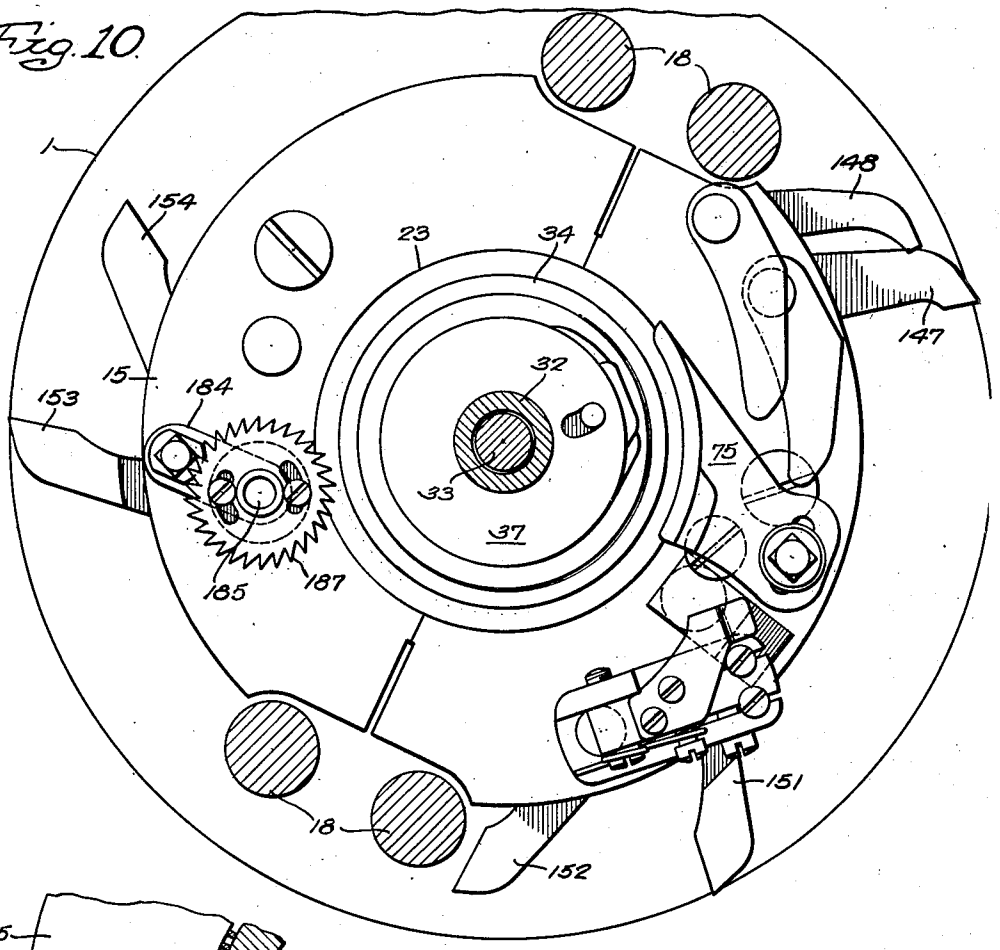
Inventor:
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by his Attorneys
Howson & Howson

Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 7

Fig. 10.



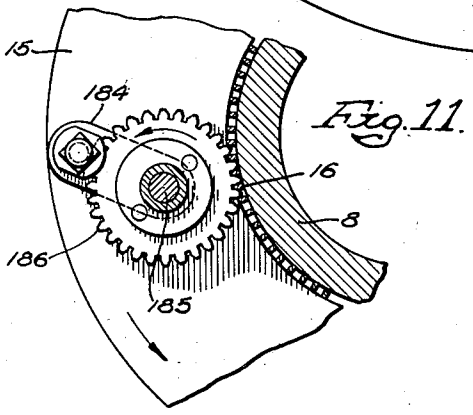


Fig. 11.

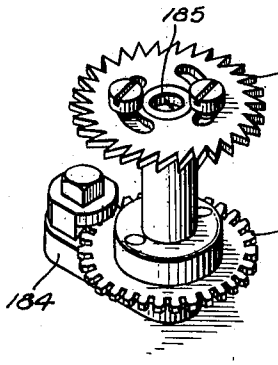


Fig. 12.

Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 8

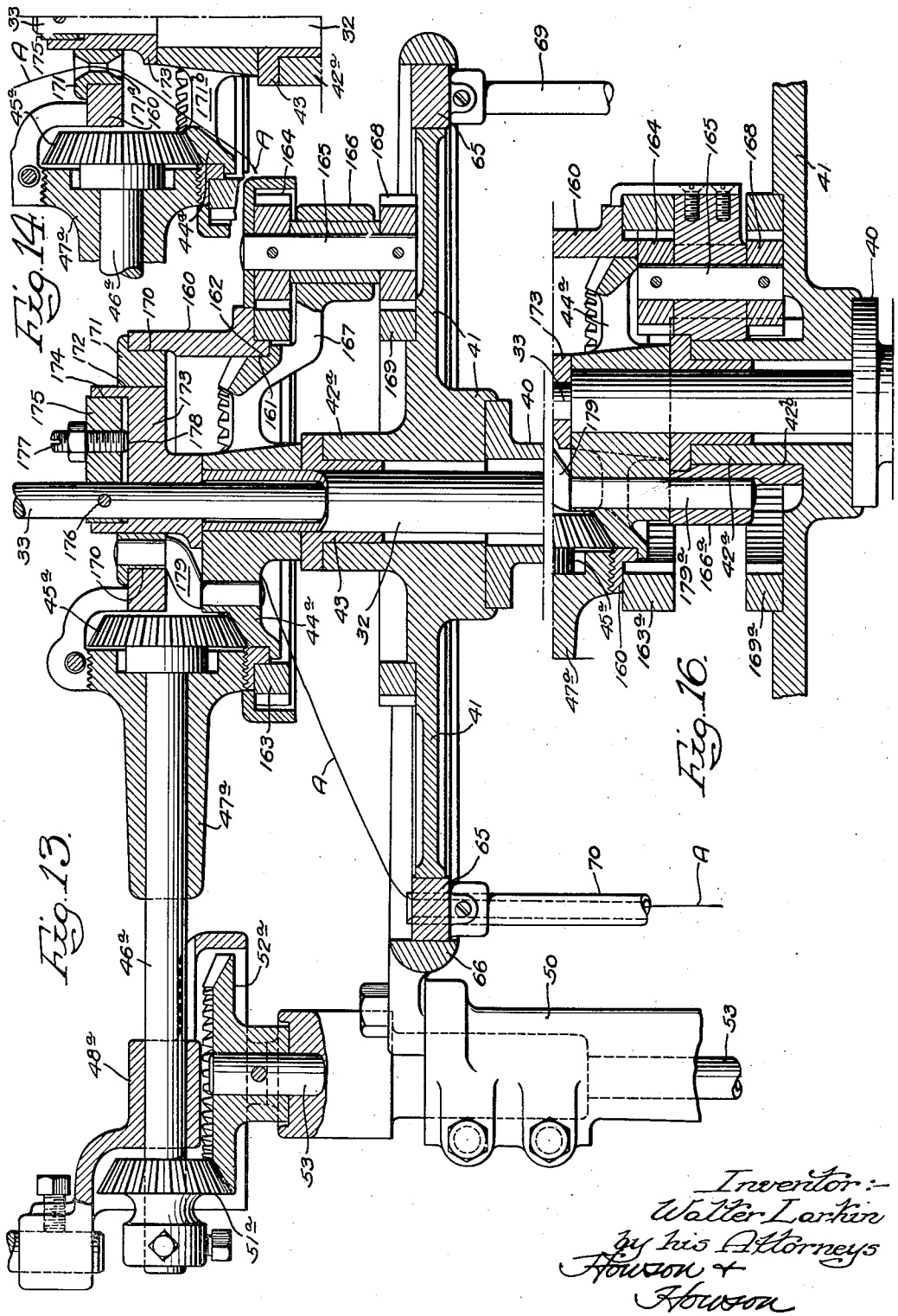


Fig. 14.

Fig. 16.

Fig. 13.

Inventor:-
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 9

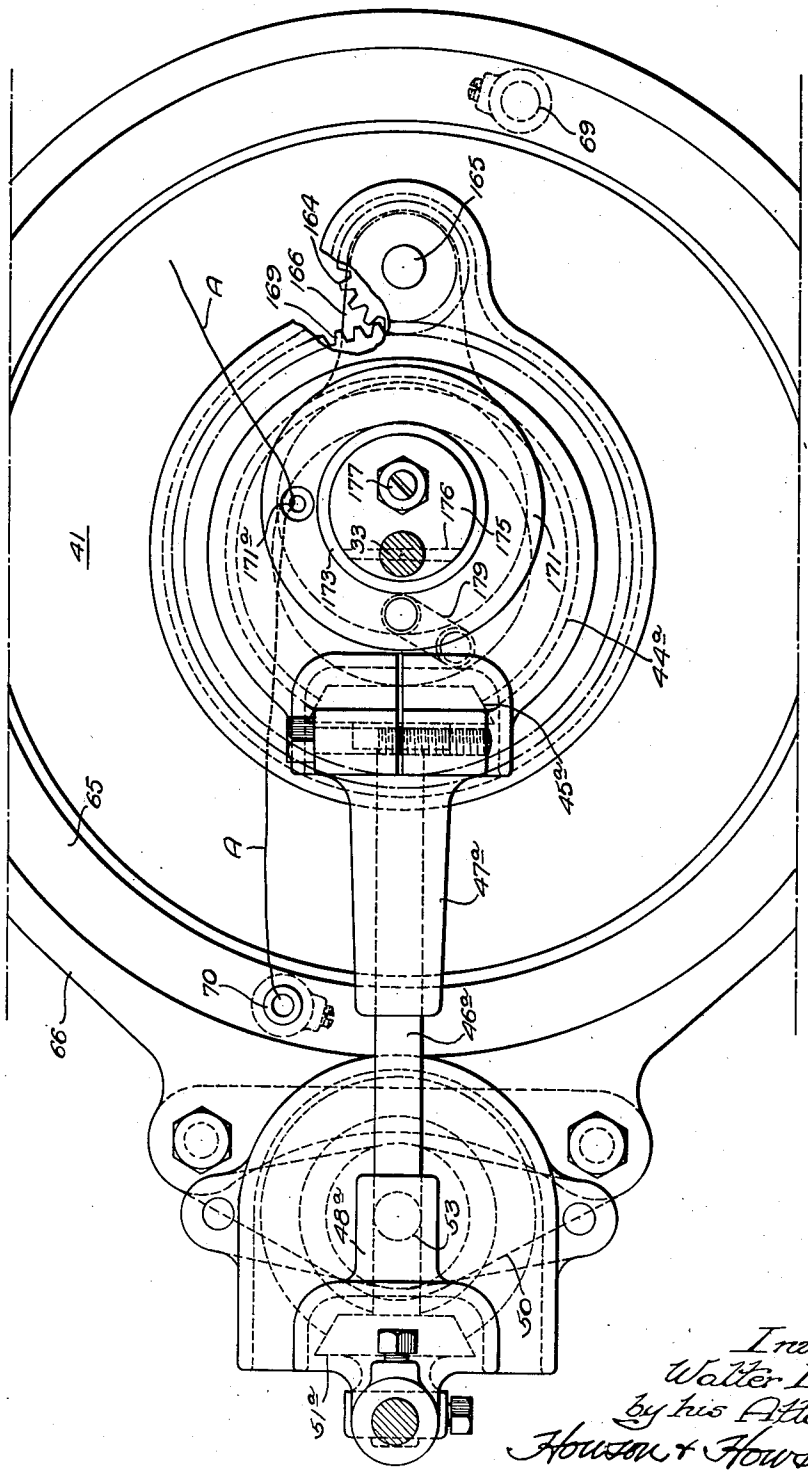


Fig. 15.

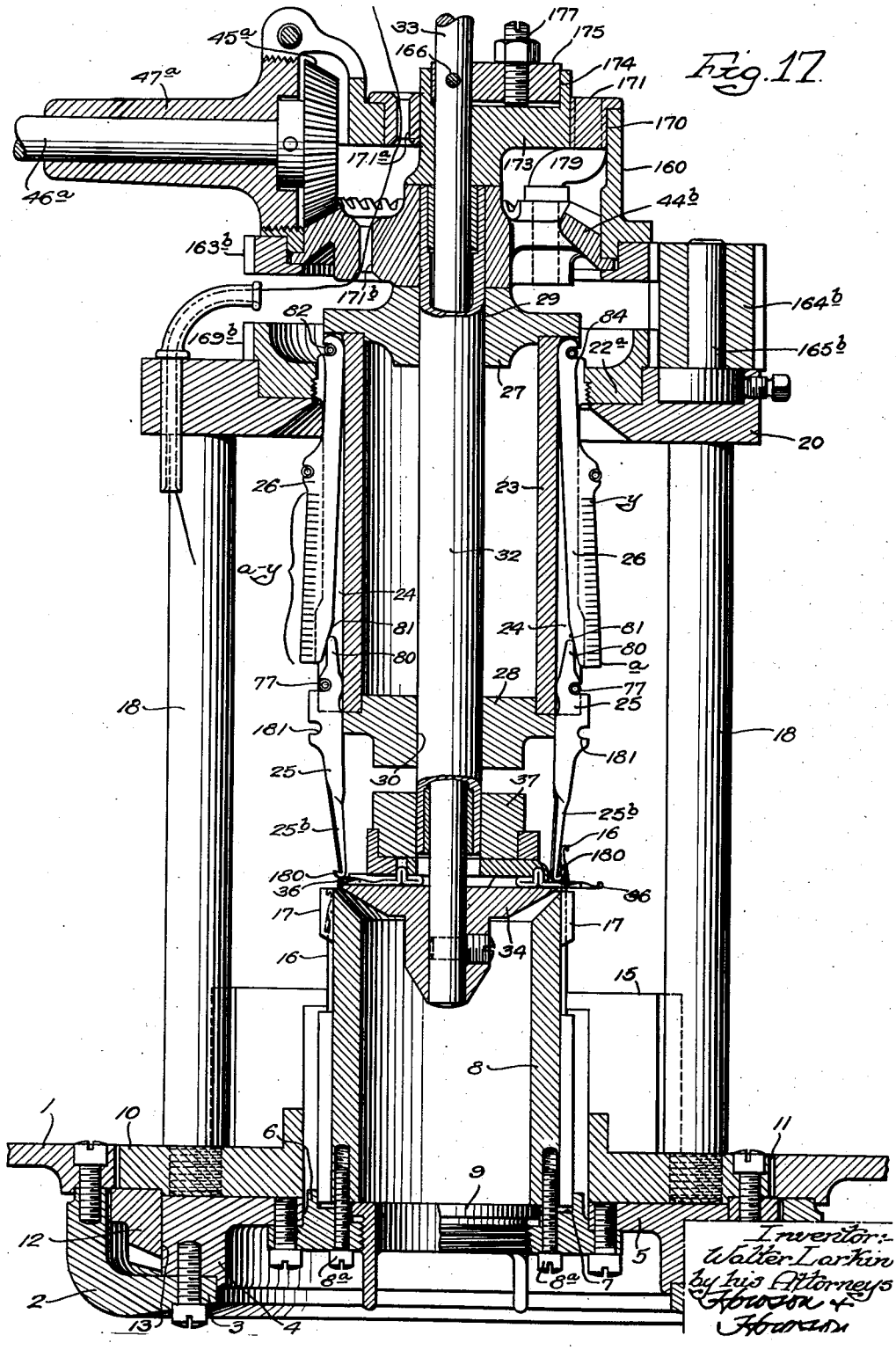
Inventor:-
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 10

Fig. 17.



Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 11

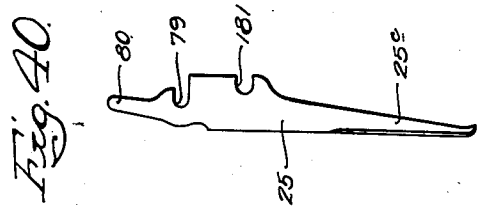


Fig. 40.

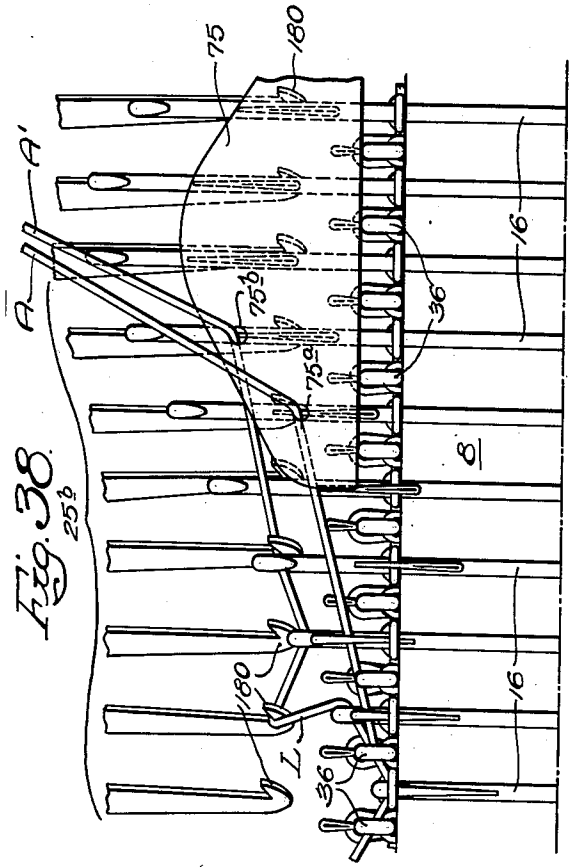


Fig. 38.

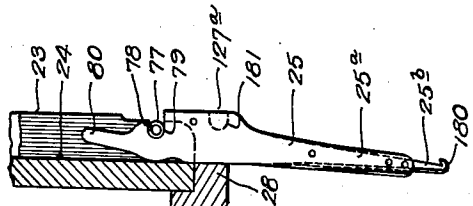


Fig. 36.

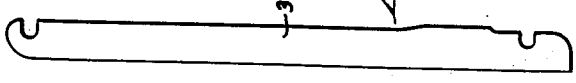


Fig. 42.

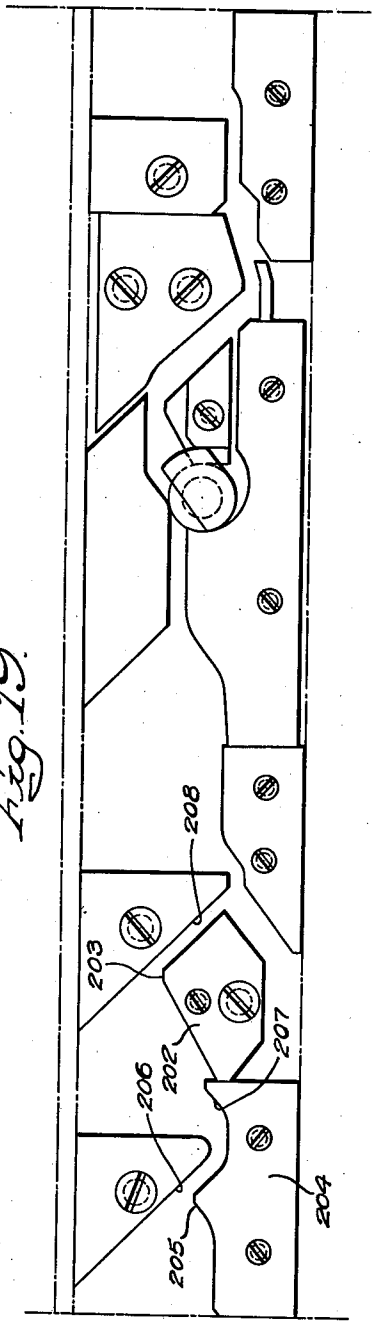


Fig. 19.

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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 12

Fig. 21.

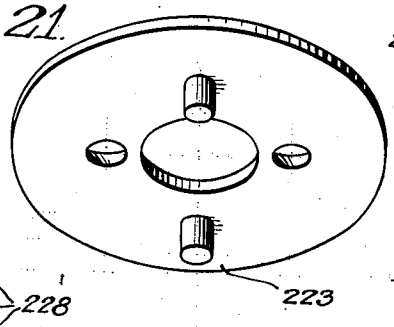


Fig. 23.



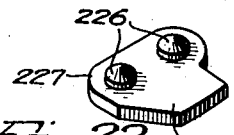


Fig. 22.

Fig. 25.

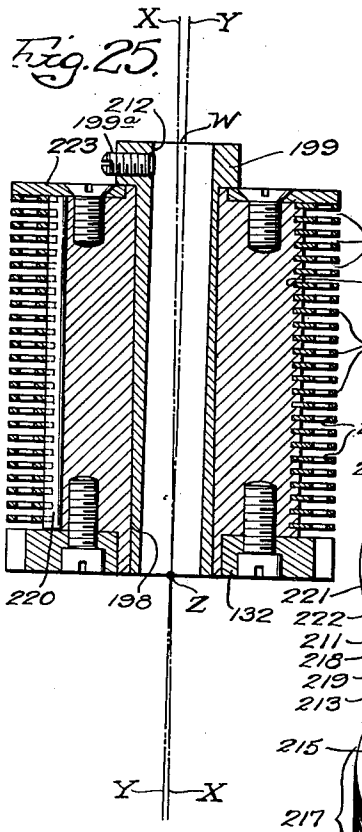


Fig. 20.

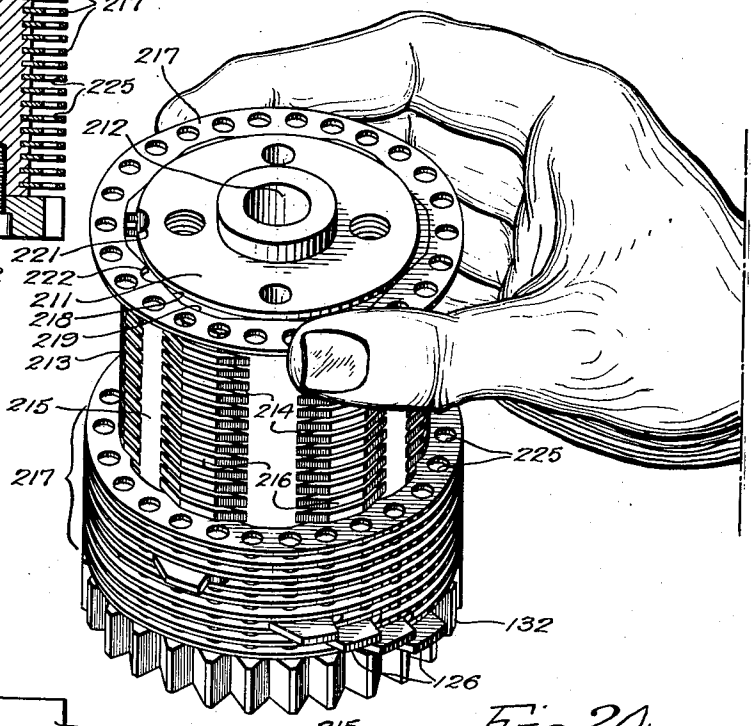


Fig. 26

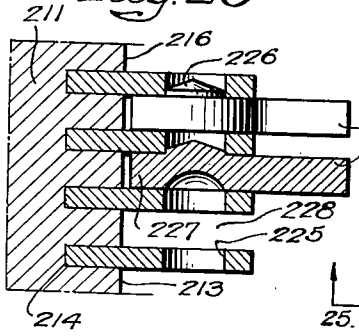
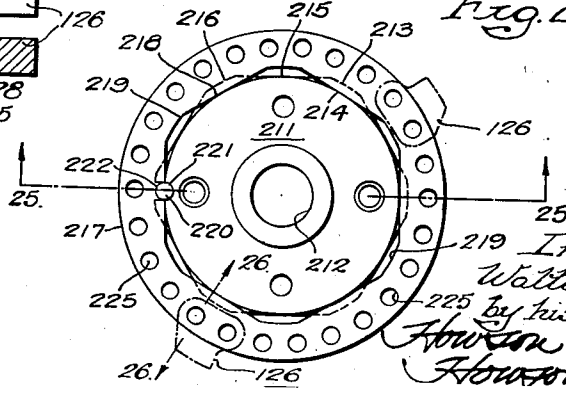


Fig. 24.



Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 13

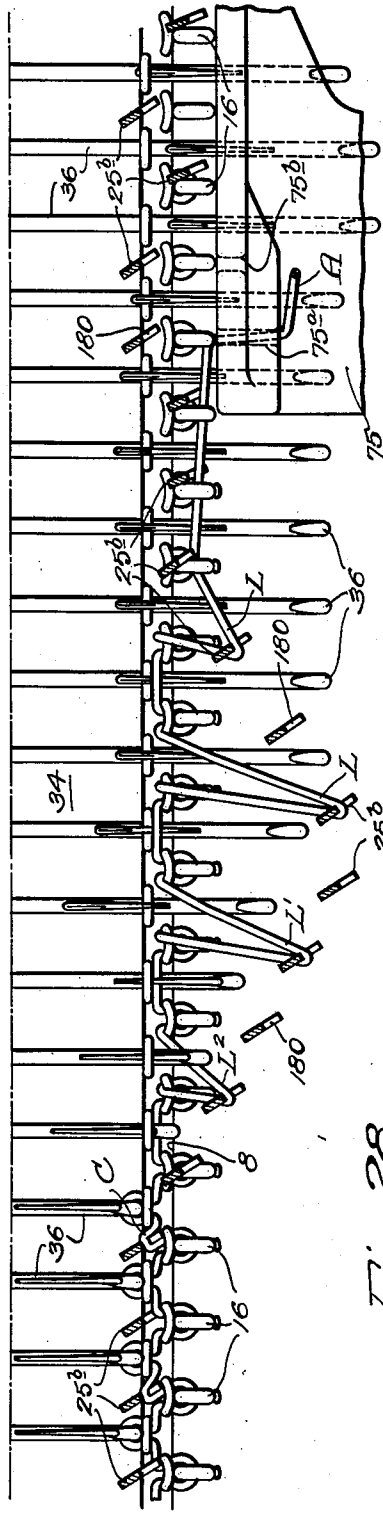


Fig. 27.

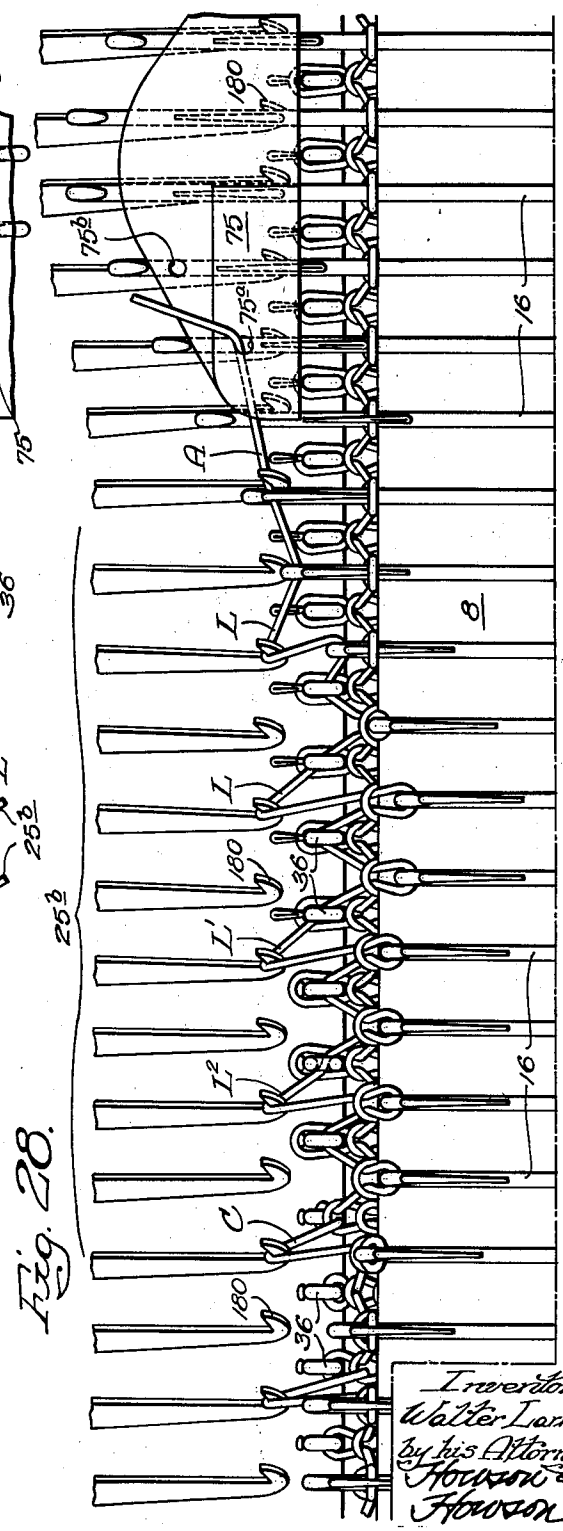


Fig. 28.

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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 14

Fig. 29.

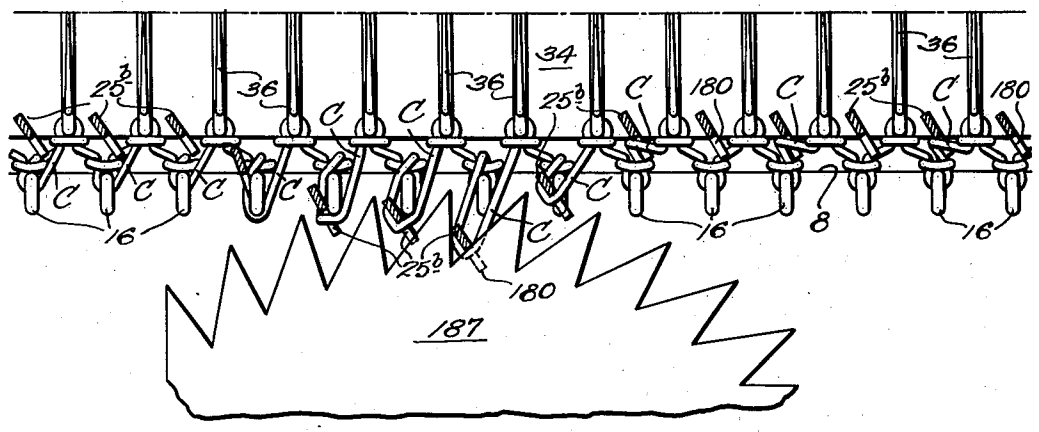
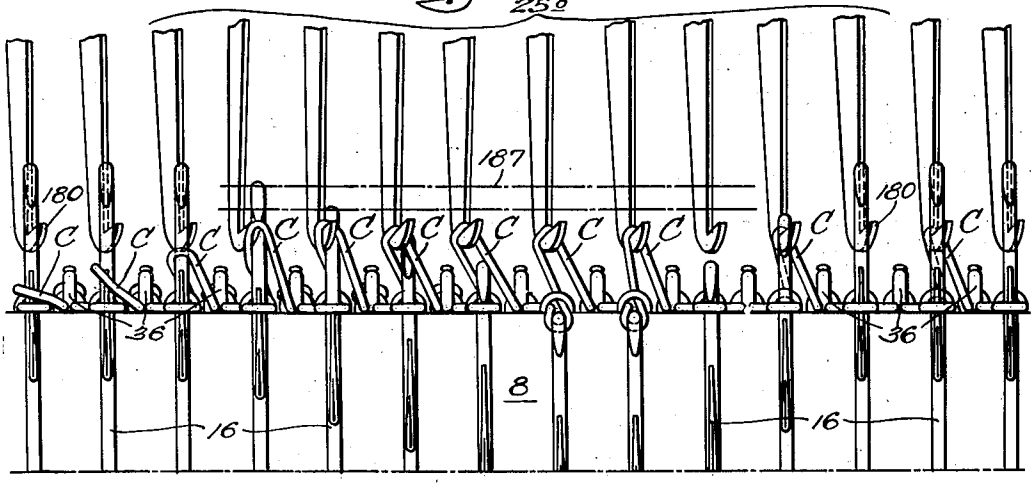


Fig. 30.



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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 15

Fig. 37.

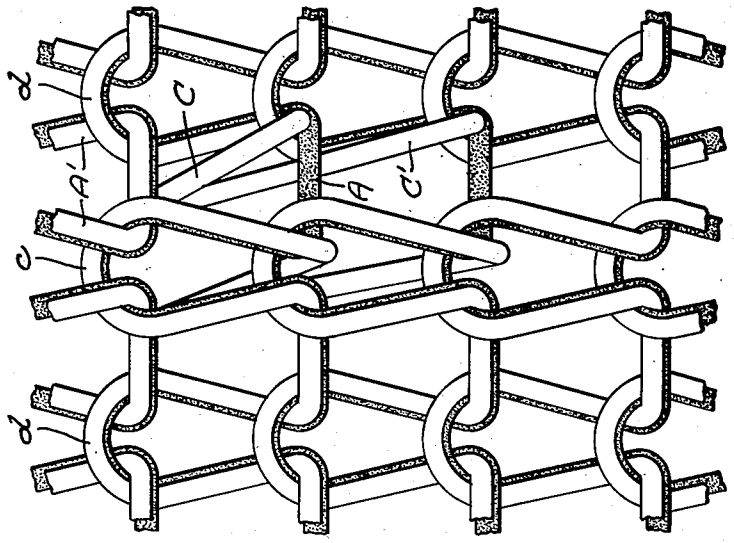


Fig. 31.

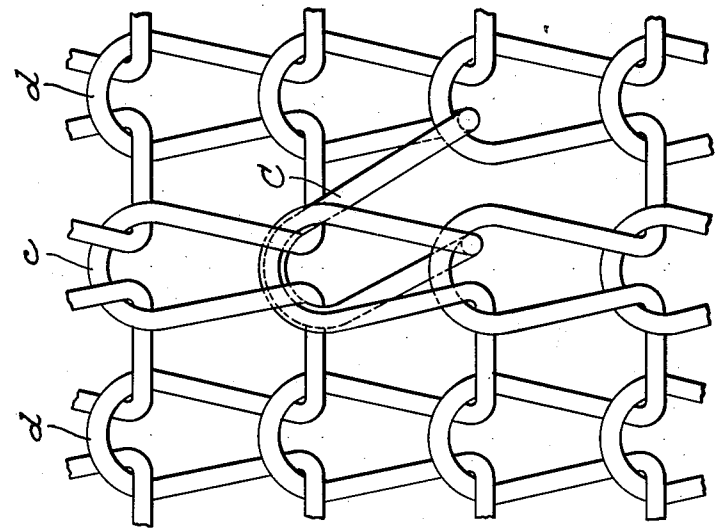
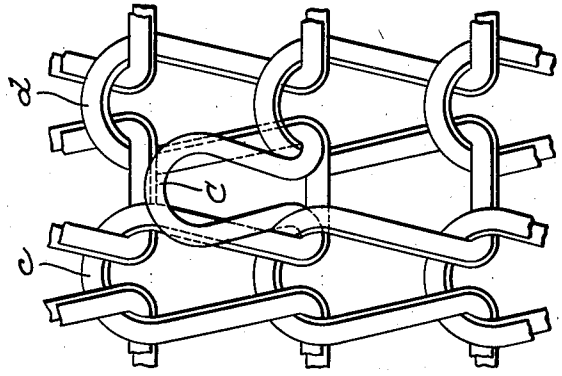


Fig. 39.



Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 16

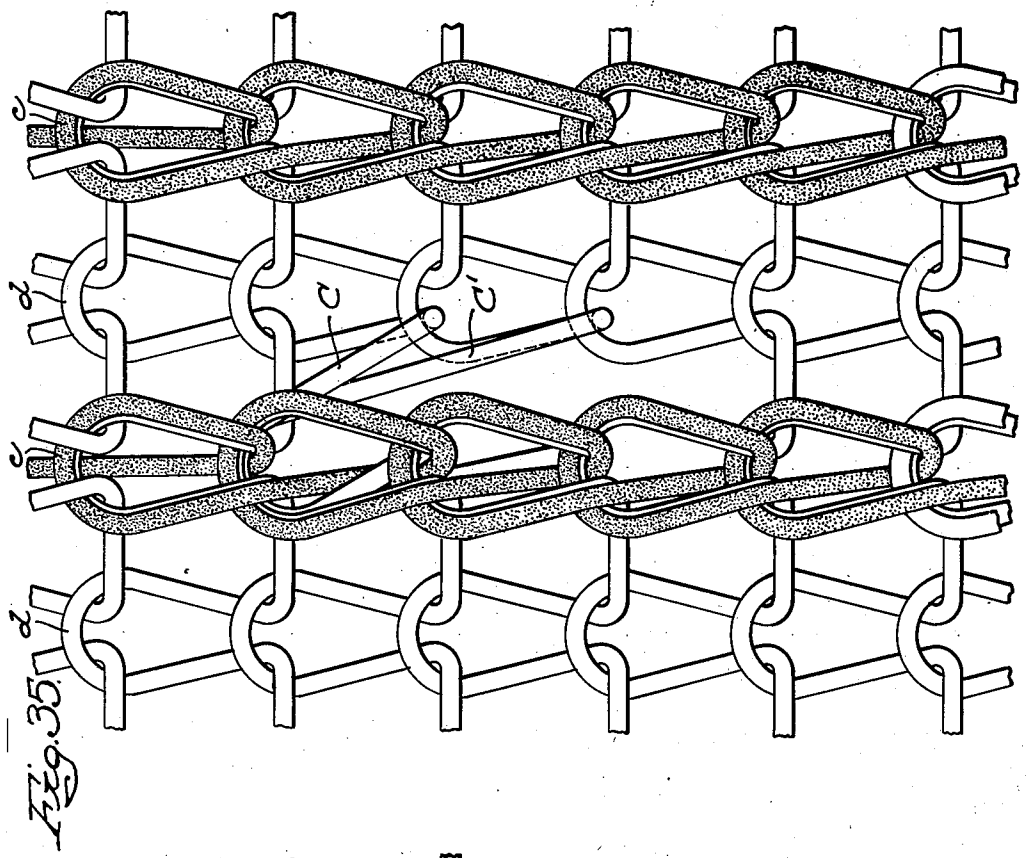


Fig. 35

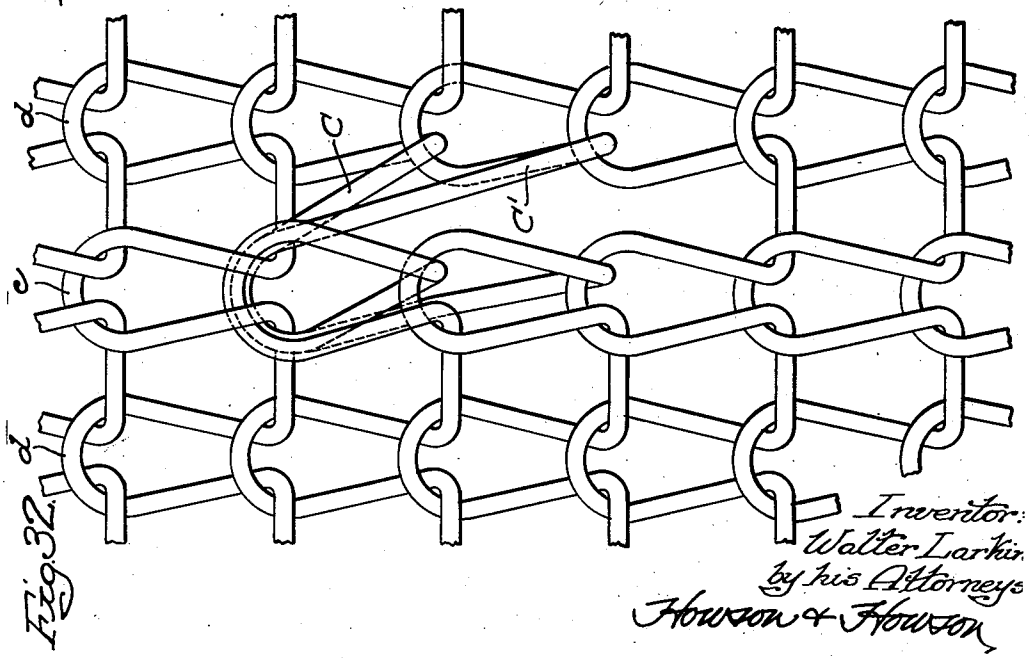


Fig. 32

Inventor:
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Aug. 18, 1936. W. LARKIN 2,051,724

KNITTING MACHINE

Filed May 28, 1932 17 Sheets-Sheet 17

Fig. 33.

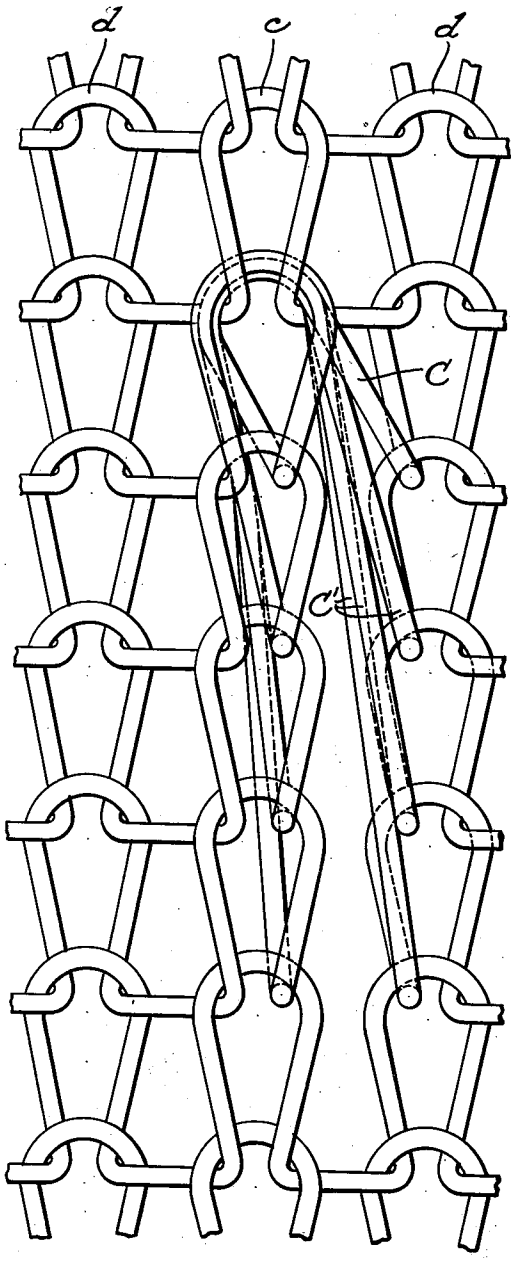
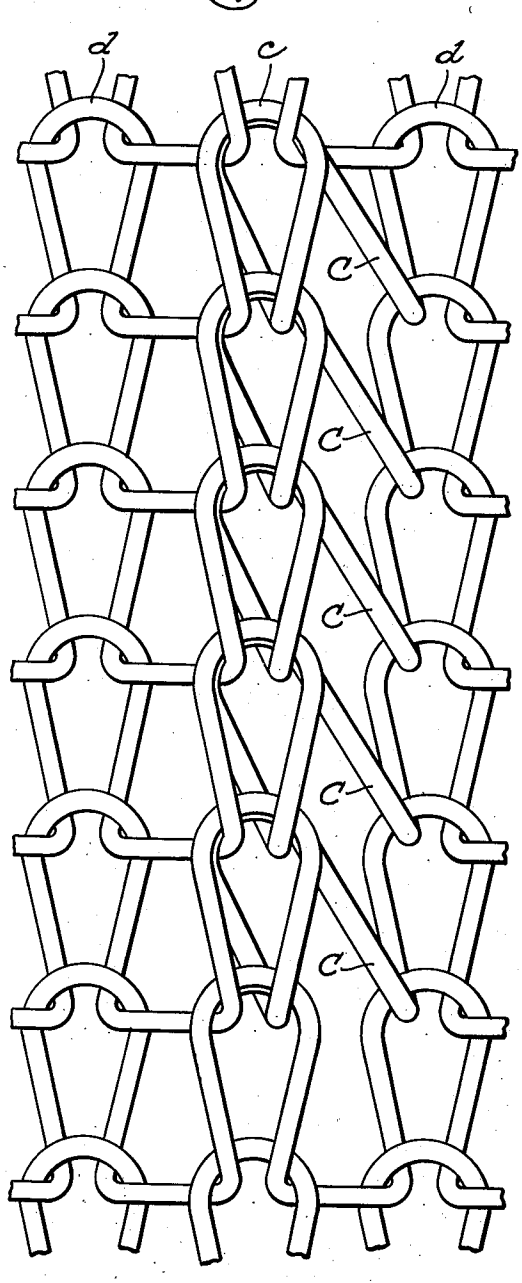


Fig. 34.



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by his Attorneys
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Patented Aug. 18, 1936

2,051,724

UNITED STATES PATENT OFFICE

2,051,724

KNITTING MACHINE

Walter Larkin, Norristown, Pa., assignor to Fidelity Machine Company, Wilmington, Del., a corporation of Delaware

Application May 28, 1932, Serial No. 614,216

47 Claims. (Cl. 66—25)

This invention relates to improvements in knitting machines of the type shown and described in the applicant's prior U. S. Letters Patent No. 1,841,249, dated January 12, 1932, which discloses a circular rib knitting machine provided with mechanism for selectively changing the yarn being fed to the cylinder and dial needles of the machine to produce a tubular seamless foundation fabric, whereby the foundation fabric may consist of a plurality of horizontal or coursewise stripes of desired widths and respectively composed of differently colored threads or threads of relatively different characters, and mechanism comprising thread-manipulating instrumentalities for selectively wrapping individual threads around predetermined cylinder needles respectively, to form vertical or walewise stripes in the fabric, in continuous or interrupted form, in immediately adjacent or laterally spaced outside wales of the fabric, for producing designs of desired configuration on the outer face of the fabric either independently of or coordinately with the coursewise stripes produced by the foundation yarn changes.

The object of the present invention is to construct the mechanism that controls the actuation of the thread-manipulating instrumentalities in such a manner as to increase the field of utility of the type of machine disclosed in the above-mentioned patent; whereby the possible range of design produced by needle wrapping alone, or by needle wrapping in combination with foundation yarn changing may be considerably increased; and whereby such mechanism, cooperating with various modified forms of thread-manipulating instrumentalities, may be utilized in the production of a foundation fabric having eyelets or other openings arranged separately or in predetermined relation to each other to form openwork areas or designs of predetermined contour directly in the foundation fabric; and whereby openwork designs and designs composed of needle wrapping may be produced in the same fabric in predetermined relation to each other, either independently of or coordinately with each other, to obtain predetermined effects, with or without changing of the foundation yarn as desired; and whereby designs or other areas may be produced in the foundation fabric which differ in character and appearance from the adjacent portions of the foundation fabric, such differentiating designs or areas to be composed of plain loops projecting outwardly from the foundation fabric to produce frieze effects, or wherein the projecting loops may be brushed or cut to produce fleece or pile effects, with the frieze, fleece, or pile effects covering the entire foundation fabric, or predetermined portions thereof, to depict various designs thereon as desired; and whereby the frieze, fleece, or pile areas may be employed in conjunction with openwork or plated areas in the production of a wide range of designs on the outer face of the foundation fabric.

In the accompanying drawings:

Fig. 1 is a side elevation of the machine embodying the improved features of the present invention;

Fig. 2 is an enlarged side elevation of that portion of the machine shown in Fig. 1 that immediately concerns the present invention;

Fig. 3 is a sectional elevation taken on the line 3—3, Fig 2;

Fig. 4 is a sectional plan view taken on the line 4—4, Fig. 2;

Figs. 5 and 6 are fragmentary sectional plan views, similar to Fig. 4, showing various elements of the machine in different operating positions from those shown in Fig. 4;

Fig. 7 is a sectional elevation taken on the line 7—7, Fig. 4;

Fig. 8 is a fragmentary sectional plan view taken on the line 8—8, Fig. 7;

Fig. 9 is a fragmentary plan view of a portion of the mechanism shown in Fig. 7;

Fig. 10 is a sectional plan view taken on the line 10—10, Fig. 2;

Fig 11 is a sectional plan view taken on the line 11—11, Fig. 2;

Fig. 12 is a perspective view of the needle and loop former aligning wheel shown in Figs. 2, 10 and 11;

Figs. 13 and 14 are sectional elevations of a preferred form of dogless mechanism for holding the needle dial and carrier stationary and for feeding the foundation yarn to the needles of the machine;

Fig. 15 is a plan view of the mechanism shown in Figs. 13 and 14;

Fig. 16 is a sectional elevation of a modified form of dogless mechanism;

Fig. 17 is a sectional elevation similar to Fig. 3 showing the mechanism arranged to produce openwork without needle wrapping;

Fig. 18 is a diagrammatic plan view of the cams associated with the thread-manipulating instrumentalities;

Fig. 19 is a diagrammatic flat development of the cams in the cylinder cam ring;

Fig. 20 is a perspective view of the trick wheel in course of assembling;

Fig. 21 is a perspective view of the trick wheel cap plate;

Fig. 22 is a perspective view of one form of trick wheel lug;

Fig. 23 is a perspective view of another form of trick wheel lug;

Fig. 24 is a plan view of the trick wheel with the cap plate removed;

Fig. 25 is a sectional elevation of the trick wheel taken on the line 25—25, Fig. 24;

Fig. 26 is an enlarged fragmentary sectional elevation taken on the line 26—26, Fig. 24;

Figs. 27 and 28 are respectively flat plan and elevation developments of the cylinder and dial needles and thread-manipulating instrumentalities, illustrating previously selected thread-manipulating elements as taking thread and forming loops in conjunction with the cylinder and dial needles;

Figs. 29 and 30 are similar views illustrating the thread-manipulating instrumentalities as transferring their hooked loops to adjacent cylinder needles;

Fig. 31 is a stitch diagram showing a single hooked loop in a single wale and single course displaced laterally to provide a small eyelet in the fabric in accordance with the illustration of Figs. 27 to 30 inclusive;

Fig. 32 illustrates a larger eyelet comprising a pair of hooked loops in successive courses in a single wale displaced laterally in a manner similar to the single hooked loop in Fig. 31;

Fig. 33 illustrates a still larger opening composed of a plurality of hooked loops held by a single instrumentality for a plurality of courses and subsequently transferred laterally to a single cylinder needle;

Fig. 34 shows a plurality of single looped loops respectively transferred in successive courses in a single wale;

Fig. 35 illustrates a medium sized opening surrounded by plating on adjacent cylinder needle wales;

Fig. 36 illustrates the arrangement of hook and wrapping instrumentalities to produce the fabric shown in Fig. 35;

Fig. 37 illustrates the use of two threads in the foundation fabric simultaneously with one of the threads hook-looped and transferred laterally to provide an opening through which the other of the foundation threads appears as a background;

Fig. 38 illustrates the relation of the cylinder needles, dial needles, hooks and thread guides to produce the fabric shown in Fig. 37;

Fig. 39 illustrates loops projecting outwardly from the face of the fabric without transfer and produced by the mechanism shown in Fig. 38;

Fig. 40 illustrates a thread-manipulating instrumentality for producing the non-transferred loops of Fig. 39;

Fig. 41 is a sectional elevation taken on the line 41—41, Fig. 2; and

Fig. 42 is a detail view of a separator between the two instrumentalities shown in Fig. 36.

The machine comprises a base plate 1, to which is secured a hollow annular element 2 having a flange 3 on which is secured a base ring 4. The base ring 4 is provided with a flange 5 to which is secured a cylinder-carrying ring 6 having a counterbore 7 in which is adjustably mounted the lower end of the needle cylinder 8 secured to the ring 6 by screws 8a.

The cylinder 8 rests on an adjusting ring 9, which is threaded into the ring 6, as shown in Figs. 3 and 17, for purposes hereinafter described.

Resting on the base ring 4 and mounted for rotation within a circular opening 11 in the base plate 1, is a cylinder cam plate 10 adapted to be rotated by a ring gear 12 secured thereto with its peripheral edge projecting under the circular edge of the opening 11, said ring gear 12 snugly fitting and rotating about the outer peripheral surface 13 of the base ring 4.

Carried by the cylinder cam plate 10 is a cylinder cam ring 15 provided with the usual assortment of cams for operating the cylinder needles 16, 16, respectively mounted in grooves 17, 17 in the peripheral surface of the cylinder 8.

Secured to the rotating cylinder cam plate 10 are vertical posts 18, 18 which support a ring 20 for rotation with the cylinder cam plate 10. The ring 20 is counterbored at 21 to receive and support a relatively stationary flange 22 of a stationary cylindrical carrier 23.

The carrier 23 is vertically grooved at 24, 24 in substantially vertical alignment with the needle cylinder grooves 17, 17 respectively. Pivotally mounted in the lower end of each groove 24 is one or more thread-manipulating instrumentalities 25, which will be more specifically referred to hereinafter, and above and cooperating with the thread-manipulating instrumentalities 25 in said groove is one or more actuating jacks 26, which will be more specifically referred to hereinafter.

The stationary carrier 23 is provided with a fixed upper head 27 and a fixed lower head 28 providing bearings 29 and 30 respectively for a rotatable tubular shaft 32, within which is mounted a relatively stationary dial post 33.

To the lower end of the stationary dial post 33 is secured the usual needle dial 34 having radial grooves 35 in which are operatively mounted the dial needles 36. The dial needles 36, as usual, are adapted to alternate with and project outwardly between the cylinder needles, 16, 16 for producing a foundation circular knit ribbed fabric in the usual manner.

Secured to the lower end of the rotatable tubular shaft 32 is a dial cam plate 37 provided with the usual assortment of cams arranged to operate the dial needles 36 coordinately with the cylinder needles 16 to produce the circular knit ribbed fabric and to provide ordinary welt, selvedge, and loose courses in the string of tubular fabric being produced on the machine.

In the machine shown in Figs. 1, 2, 3, 7 and 13, the upper head 27 of the carrier 23 rigidly supports a hollow column 40 which rigidly supports at its upper end a circular top plate 41. Projecting above and rigidly secured to the fixed plate 41 is a bracket 42 having a bearing 43 for the upper end of the rotatable tubular shaft 32.

Secured to the upper end of the tubular shaft 32 is a beveled gear 44 which meshes with a beveled gear 45 secured to the inner end of a horizontal tubular shaft 46. The inner end of the shaft 46 is rotatably mounted in a bearing 47 rigidly secured to the fixed bracket 42. The opposite end of the tubular shaft 46 is rotatably mounted in bearings 48, 48 formed in a housing 49 which is rigidly secured to the upper end of a fixed standard 50 that is secured to the base plate 1 of the machine. Intermediate the bearings 48, 48 of the tubular shaft 46 is secured a beveled gear 51 which meshes with a beveled gear 52 secured to the upper end of a vertical shaft 53 journaled in the standard 50. On the lower end of the shaft 53 is secured a beveled gear 54 mesh-

ing with a corresponding beveled gear 55 that is secured to a horizontal shaft 56.

The shaft 56 and the ring gear 12 are geared to the main operating shaft (not shown) of the machine, to effect one complete revolution of the tubular shaft 32, and consequently the dial cam plate 37 carried thereby, for each complete revolution of the cylinder cam plate 10, the cylinder cam ring 15 and the carrier-supporting ring 20 carried thereby.

Secured to the fixed bracket 42 is a bracket 57 provided with a boss 58 in which the upper end of the dial post 33 is non-rotatably secured, by means of a set screw 59, a lock nut 60 being threaded on the upper end of the post 33 above the boss 58 for supporting the weight thereof in a vertical direction and providing for vertical adjustment of the dial 34 with respect to the upper end of the needle cylinder 8.

Secured to the central hollow column 40 intermediate the stationary carrier 23 and the stationary top plate 41 is a series of shelves 61 arranged to support bobbins containing the threads which are fed downwardly to the thread-manipulating instrumentalities 25, when such instrumentalities take on the form of needle-wrapping fingers, to produce plating on the outside wales of the fabric formed by the cylinder needles 16, 16 respectively.

In order to feed a foundation thread A to the cylinder and dial needles of the machine, that form of the machine illustrated in Figs. 1, 2, 3 and 7 is provided with a thread-carrying ring 65 which encircles and rotates about the peripheral edge of the stationary top plate 41 within a fixed annular stabilizing guide 66 that is secured to the upper end of the standard 50.

Secured to the rotating carrier-supporting ring 20 are brackets 67 and 68, which respectively support the lower ends of vertical rods 69 and 70 having their upper ends secured in the ring 65. One of said rods, as for instance the rod 70, is of hollow construction and projects above the plate 41, as indicated at 71, for the reception of the foundation thread A as it passes upwardly from the main thread guide 75 through the hollow rod 70 and into a hollow laterally extending arm 74 of the tubular horizontal shaft 46, the foundation thread A then passing through the outer end of the tubular shaft 46 to the stop motion of the machine, as disclosed in the above-mentioned patent, and thence to the foundation yarn-changing mechanism generally illustrated at I, which functions in the same manner as disclosed in the above-mentioned patent to tie different foundation thread units together end to end for feeding to the cylinder and dial needles of the machine as a single continuous thread.

The main thread guide 75 is secured to the cylinder cam ring 15, by a post 76, and as the cylinder cam ring 15, the carrier-supporting ring 20, the thread carrier ring 65 and the horizontal shaft 46 rotate in unison, in one-to-one ratio with respect to each other, the foundation thread A is carried around those stationary portions of the machine that are centrally located above the cylinder 8, the thread A being guided over the bracket 42 and the elements carried thereby by laterally extending arms 73, 73 secured to the upper end of the stationary dial post 33.

The individual wrapping threads B pass upwardly from the bobbins B^1, carried by the shelves 61, through suitable guides and tensioning means (not shown), thence downwardly through suitable eyes 72 in said shelves and into the upper ends of the grooves 24, in which the jacks 26 and thread-manipulating elements 25 are mounted, thence down through the ring 20 and along one side of the respective jacks to and through thread eyes in the lower end 25*a* of the thread-manipulating element 25 in the lower end of said slot, as clearly shown in Fig. 3 to be selectively wrapped about the needle 16 with which the lower end 25*a* of the thread-manipulating element is arranged to cooperate.

In other instances the lower ends of the thread-manipulating instrumentalities 25 take on the form of a hook as illustrated at 25*b* in Figs. 3, 7 and 17, and in other instances the lower ends of the elements 25 take the form of pickers or loop formers as illustrated at 25*c* in Fig. 40 for purposes that will be fully disclosed hereinafter.

In each instance the thread-manipulating elements 25 are pivotally mounted upon an annular element 77 seated in a groove 78 formed circumferentially of and in the peripheral surface of the carrier 23 adjacent the lower end thereof, each of the thread-manipulating elements 25 being notched as at 79 to receive the annular pivot element 77, whereby each of the thread-manipulating elements 25 may be rocked about the pivot 77.

Projecting above the pivot 77 and formed integral with each of the thread-manipulating elements 25 is an arm 80, the upper end of which is engaged by the rear edge 81 of a cooperating jack 26.

Each of the jacks 26 is notched at its upper end as indicated at 82 for the reception of a pivot element 83, which is in the form of a ring seated in a circumferentially extending groove 84 formed in the peripheral surface of the carrier 23 adjacent the upper end thereof.

Along the outer edge of each jack 26, upwardly from the lower end thereof, the said jack is slitted inwardly as indicated at 85, to provide a series of frangible butts *a* to *y* inclusive as indicated in Fig. 3, which are adapted to be broken out as desired in laying out a pattern or design to be depicted on the outer surface of the fabric by selective actuation of the thread-manipulating elements 25.

Arranged to cooperate with the butts *a* to *y* respectively is a series of selector arms 101 to 125 respectively, as shown in Fig. 7, each of which is adapted to be actuated by one or more of a series of lugs 126 interchangeably carried by a trick wheel 100 which is rotatably mounted on a bearing sleeve 199 circularly adjustable on and secured to an eccentric portion 98 of a depending stud 99 which is axially and rotatably adjustable in and carried by the rotary plate 20, the axial and circular adjustment of the stud 99 and the circular adjustment of the bearing sleeve 199 relative to the eccentric portion 98 of the stud 99 providing for operative alignment of the lugs, disposed in various elevations on the periphery of the trick wheel, with the selector arms 101 to 125 respectively.

The lower end of the stud 99 passes through and supports a horizontal plate 127 which is also supported by a second stud 128 having its upper end secured in the ring 20 and its lower end secured in said plate 127. The selector arms 101 to 125 are pivotally mounted in superposed parallel relation to each other on the stud 128.

Pivotally mounted on a concentric portion of the stud 99 above and below the plate 127 are relatively spaced portions of a bifurcated hub of a pawl arm 130 (see Figs. 1, 2, 4, 6 and 7). On the outer end of the arm 130 is pivotally mounted a

spring-pressed pawl 131 that is adapted to engage the teeth of a ratchet wheel 132 secured to the lower side of the trick wheel 100, for intermittently rotating the trick wheel 100 step-by-step to bring single or vertically aligned rows of the lugs 126 of the trick wheel into engagement with predetermined selector arms of the series 101 to 125 inclusive.

A detent 133 is pivotally mounted on the stud 128 and engages the teeth of the ratchet wheel 132 to maintain the trick wheel 100 in the position to which it is moved by the pawl arm 130. A spring 134 tends to keep the detent 133 in cooperative relation to the ratchet wheel 132 and at the same time to return the arm 130 to a normal position determined by a fixed stop 135 carried by the plate 127 and an adjustable stop 136 carried by the arm 130.

The arm 130 is adapted to be rocked about the stud 99, as the cylinder cam plate 10 and ring 20 rotates, by a vertically movable pawling cam 137 arranged to engage a wiper plate 129 carried by the arm 130. The pawling cam 137 is provided with a hub that is slidably mounted on a vertical post 140, the said pawling cam resting on the upper end of a stem 138 which is slidably mounted in a bearing 139 secured to the post 140 that projects upwardly from and is rigidly secured in the base plate 1.

The lower end of the stem 138 overlies the outer end of a positioning lever 141 pivotally mounted on the base plate 1 (see Figs. 1, 2 and 4), and provided with a roller 142 arranged to be engaged by graded heighth links 143, 143*a*, 143*b* and 143*c*, of a pattern chain 144, which rides on and with the peripheral surface of a drum 145, which is intermittently rotated to bring the links 143*a*, 143*b* and 143*c* into cooperative relation with the stem 138 to raise and lower the pawling cam 137 as desired.

The entire machine, as in the above mentioned patent, is controlled by the primary pattern chain 150, which controls the actuation of the control wheel 155 that governs the positioning of the bob disc 149 for engagement with the arms 148 and 147, that control the welt-forming cams in the dial cap 37, and two other sets of arms 151—152 and 153—154 that control the cylinder needles to form the selvedge welt and loose courses respectively. The wheel 155 also controls the intermittent actuation of the pattern chain 144, as above noted, and the primary pattern chain 150 also controls the actuation of the yarn-changing device I in the same manner as disclosed in the above mentioned patent.

The operation of the machine to produce plated or needle wrapped designs on the outer face of the foundation fabric independent of or in combination with foundation yarn changes is as follows:

In the present illustration each of the jacks 26 for the thread-manipulating instrumentalities 25 is provided with twenty-five frangible butts, *a* to *y* inclusive, arranged in parallel horizontal planes. There is a corresponding number of selector arms 101 to 125 inclusive arranged in horizontal planes coinciding respectively with the planes of the butts. There is also a corresponding number of horizontal grooves in the trick wheel 100 for reception of the selector arm actuating lugs 126 in planes coinciding with those of the selector arms and butts; and there is at least twenty-five, though preferably twenty-six, teeth on the ratchet wheel 132 of the trick wheel 100.

By breaking out predetermined butts on the jacks and leaving others intact and by arranging the lugs 126 in a predetermined order on the trick wheel 100, any desired form of design, having a desired width extending coursewise across a predetermined number of the outside wales of the tubular fabric and a heighth including all or any part of twenty-five successive courses, without repeat in any of said courses, may be produced.

The trick wheel 100 is adapted to be intermittently rotated one step for each course of stitches, thereby bringing a new vertically aligned series of lugs 126 into cooperative relation with the selector arms 101—125, to move the arms selectively inward to press against retained butts of the jacks 26, for rocking the cooperating needle-wrapping elements 25*a* outwardly to wrap their individual plating threads around the cylinder needles 16 with which the elements 25*a* are respectively aligned, upon each revolution of the cam plate 10, the ring 20 and the trick wheel 100 and the selector arms 101 to 125 carried thereby, in an orbicular path around the stationary carrier 23 and the jacks 26 and thread-manipulating elements 25 supported by the carrier.

The pawling cam 137 is arranged to be moved vertically into and out of the orbicular path of the pawl arm 130 so that any desired part of the design may be repeated for any desired number of successive courses, as determined by the arrangement of the high links 143*c* of the pattern chain 144.

By providing teeth on the ratchet wheel 132 in excess of the number of butts and selector arms, for example twenty-six teeth and twenty-five butts, and by leaving out the lugs 126 in a vertical line on the periphery of the trick wheel 100 in line with the twenty-sixth tooth and then by effecting one step movement of the trick wheel for each revolution of the cam ring 15 a non-plated course may be produced between repeats of the twenty-five course design as none of the jacks would be operated in that course of knitting when the empty part of the trick wheel moves into cooperating alignment with the selector arms 101—125, and by leaving out other vertically aligned rows of the trick wheel lugs 126 non-plated courses may be formed wherever desired, as for example between small designs each covering relatively few courses in a direction walewise of the fabric.

Obviously, the foundation yarn changer, I, may be operated at and for any desired course or number of courses to provide circumferential or horizontal strips that may coordinate with the plated areas, to form a single design, or the horizontal strips may be provided in courses having no plating as above noted but which will form a design coordinately with plated areas above and below the horizontal stripe or stripes.

The thread-carrying ends 25*a*, of the thread manipulating elements 25, after being moved outwardly between the cylinder needles 16 from a position inside the circle of cylinder needles to a position outside said circle of needles, to carry their individual threads out in front of the needles with which they are respectively aligned, are immediately returned to normal position inside the circle of needles, to complete the wrapping of their individual threads around the needles, by engagement of a portion 127*a* of the outer edge of the lower portions 25*a*, below the pivot notch 78 of the elements 25, with a cam

edge 127b on the orbicularly movable plate 127, which returns the cooperating jacks 26 to their outer normal position in the carrier 23.

In the preferred form of the machine the foundation thread A is fed to the hollow tube 70 which carries the thread around the stationary elements centrally located above the needle cylinder 8 by mechanism shown in Figs. 13, 14 and 15, by an improved dogless mechanism, wherein the horizontal shaft 46a is of solid construction and is journaled at its outer end in a bearing 48a which is secured to the upper end of the standard 50.

The inner end of the shaft 46a is journaled in the bearing 47a that projects laterally from one side of a circular housing 160 disposed concentric with the stationary dial post 33 and with the encircling tubular shaft 32, which latter is journaled in the bearing 43 formed in the boss 42a on the stationary top plate 41.

Secured to the upper end of the tubular shaft 32 is a beveled gear 44a which meshes with a beveled gear 45a on the inner end of the shaft 46a, the outer end of the shaft 46a being provided with the beveled gear 51a meshing with the beveled gear 52a on the upper end of the driving shaft 53. The beveled gear 44a is provided with a peripheral annular shouldered bearing surface 161 in rotatable engagement with a corresponding bearing surface 162 in the housing 160.

Secured to the housing 160 is a non-rotatable gear ring 163 which meshes with a planetary pinion 164 secured to the upper end of a short shaft 165 that is rotatably mounted in a bearing 166 carried by an arm 167 projecting radially from the beveled gear 44a. To the lower end of the shaft 165 is secured a planetary pinion 168 which meshes with a stationary gear ring 169 secured to the stationary top plate 41.

The beveled gear 44a is rotated within the housing 160 through the horizontal shaft 46a, but the housing 160 is prevented from rotating with the gear 44a by reason of the outer end of the shaft 46a being rotatably secured in the bearing 48a that is secured to the fixed standard 50. As the gear 44a rotates the pinions 164 and 168 are walked around the gear rings 163 and 169 respectively and as the gear ring 163 is secured to the non-rotatable housing 160 the gear ring 169 and consequently the top plate 41 to which the gear ring 169 is secured are held against rotation about the axis of the shaft 32, which is rotated with respect to the plate 41 and dial post 33 by the rotation of the gear 44a.

The upper end of the housing 160 is provided with an eccentric bearing surface 170 in which is rotatably mounted a ring 171 that is provided with an inner circular bearing surface 172, concentric with the outer bearing surface of the ring 171 and which are each eccentric with respect to the axis of the shaft 32 and dial post 33. In the eccentric bearing surface 172 is mounted a supporting block 173 having a cup-shaped cavity having a bearing surface 174 concentric with the bearing surface 172 of the ring 171 and adapted for the reception of the block 175 secured to the upper end of the dial post 33 in eccentric relation thereto as by a pin 176. The eccentric block 175 is vertically adjustable in the cup-shaped cavity of the support 173 and supports the dial post 33 by means of adjusting screw 177 passing through the eccentric 175 and bearing on the base surface 178 of the cup cavity of the support 173.

The ring 171 is rotated in unison with, but eccentrically with respect to, the gear 44a by means of a link 179, and is provided with an opening or eye 171a (see Figs. 14 and 15), through which the foundation thread passes from the sweep arm of the stop motion to the machine or other guide located above the machine, the foundation thread passing from the opening 171a in the ring 171 through a corresponding opening 171b formed in the gear 44a, the thread then passing to the upper end of and through the tubular guide 70 carried by the ring 65 and thence to the thread guide 75 as above described.

As a modification of this arrangement, and as shown in Fig. 16, the housing 160 and the top plate 41 may be provided with internal gear rings 163a and 169a respectively, and the shaft 165 on which the planetary pinions 164 and 168 are secured may be journaled in a ring 166a rotatably mounted on a bearing surface 42b formed on the outer surface of the boss 42a, the ring 166a being secured to the beveled gear 44a by a downwardly extending portion 179a of the link 179, whereby the two will rotate in unison to carry the shaft 165 around the boss 42a with the pinions 164 and 168 respectively meshing with and walking around the internal gear rings 163a and 169a which are respectively secured to the housing 160 and top plate 41 to prevent a relative rotation between these normally fixed elements as the gear 44a revolves.

In that form of the machine shown in Fig. 17, the column 40 is eliminated and the gear 44b bears directly on the upper end of the bearing 29 on the upper head 27 of the carrier 23. The flange or ring 22a of the carrier 23 is provided with a fixed gear ring 169b, the teeth of which mesh with the teeth at the lower end of a pinion 164b that is rotatably mounted on a stud 165b secured in the rotating ring 20. The teeth at the upper end of the pinion 164b mesh with the teeth of the ring gear 163b, that is non-rotatably secured to the fixed housing 160.

With either of the dogless constructions above noted, the eccentric relation of the ring 171 and the dial post supporting element 173 with respect to the fixed housing 160 and the dial post 33 prevents rotation of the dial post 33 and consequently the needle dial 34 at the lower end thereof, as the tubular shaft 32, which drives the dial cap 37, is rotated; and the planetary gearing connecting the fixed housing 160 with the top plate 41, or the carrier 23 as the case may be, prevents rotation of the top plate 41, and carrier 23 and permits feeding of the foundation thread A around these fixed elements without interfering therewith.

In that form of the machine illustrated in Fig. 17 the lower ends 25b of the thread-manipulating instrumentalities 25 are in the form of hooks as illustrated at 180. These hook-like instrumentalities are operated in the same manner, by the same form of jacks and from the same trick wheel as the thread-manipulating instrumentalities that comprise the needle-wrapping lower ends 25a. The hook ends 180 of the elements 25b, like the thread-carrying ends of the needle-wrapping elements 25a, are normally disposed within the circle defined by the cylinder needles 16 and are arranged to be moved outwardly between adjacent cylinder needles 16, each in a plane intermediate a cylinder needle and adjacent dial needle 36 (see Figs. 27 and 28), and in so doing to catch that portion of the foundation thread that nor-

mally connects the lower portion of the stitch formed on the cylinder needle with the lower portion of the stitch formed on the dial needle next adjacent thereto, and which for the purpose of description will be hereinafter referred to as the "connecting loop".

As the cylinder cam ring 15 and the trick wheel 100 revolve about the needle cylinder 8 and carrier 23 the jacks 26 are operated selectively to move predetermined hooks 180 outwardly into the circular plane of the circle of cylinder needles, which have previously been raised to clear their latches for receiving the foundation thread to form a new course of stitches, the dial needles 36 being simultaneously moved outwardly for the same reasons.

The foundation thread A passes at an angle from the lower eye 75a in the thread guide 75 to the cylinder needles 16 crossing the needles 16 below their hooks and above their latches in the usual manner as the cylinder needles 16 descend to draw the thread for their respective stitches. In the present case the thread A (see the right hand end of Figs. 27 and 28) is laid in the selected hooks 180 at the same time as it is laid to the cylinder needles 16, and as the cylinder needles successively descend to a position wherein the thread A is caught behind the points of the cylinder needles all the hooks 180 are moved outwardly beyond the circle of cylinder needles, by the lower butts *a* on the jacks 26 that control the hooks 180 engaging the fixed cam 182. By the time the hooks 180 are moved outwardly by the cam 182 the cylinder needles have descended sufficiently and carried the thread A with them to such an extent that the hooks 180 that had not been previously selected by the trick wheel 100 do not engage the thread A while the previously selected hooks which have already engaged the thread A draw out the thread to form a long loop L between adjacent cylinder needles. The cylinder needles at this time cast their previous stitches and remain in low position.

The dial needle then begins to recede to catch and draw thread for their respective stitches, and at the same time the hooks 180 recede in time with the dial needles, by engagement with a fixed cam 183 which engages the element 25b below their pivots 77, and in so doing carry the thread at one side of the long loop L across the dial needle to be engaged by the hook thereof, as illustrated at L^1. As the dial needles 36 and hooks 180 recede in unison the dial needles draw thread for their respective stitches from the long loops as illustrated at L^2 which are still held by the hooks 180 and then cast their previous stitches, leaving the hooks 180 holding the thread that connects the lower ends of the cylinder stitches with the lower ends of the adjacent dial stitches respectively in the form of connecting loops C.

The selecting outward movement of the hooks 180 occurs at the same time as the selecting outward movement of the needle-wrapping elements 25a, but the hooks 180 are not immediately returned to the position within the needle circle as are the needle-wrapping elements 25a, the elements 25b with the hooks 180 thereon each being provided with a notch 181 in line with the wrapping element retracting cam 127b, so that the hooks 180 remain in the outer selected position for further movement to the positions outside the needle circle as above noted. The lower butt *a* on the jack 26 aligned with each of the thread-manipulating elements 25 that have a hook 180 at the lower end 25b thereof is permitted to remain in each instance to be engaged by the connecting loop-forming cam 182 which is carried by the plate 127.

In order to form openwork in the foundation fabric the connecting loops C held by the selected hooks 180 are subsequently transferred on to the cylinder needles with which the hooks 180 are respectively aligned.

In order to effect transfer of the connecting loops C onto the cylinder needles 16 the elements 25b, on which the hooks 180 are formed, are moved outwardly beyond the circle of cylinder needles and the cylinder needles are then raised behind the hooks 180 through the connecting loops held thereby (see Figs. 29 and 30), the cylinder needle and the cooperating hook being aligned for transfer of the connecting loop from the hook to the needle by the following mechanism:

Secured to the upper surface of the cylinder cam ring 15 is a bracket 184 which carries a vertically extending stud 185 on which is rotatably mounted a transfer wheel comprising a lower toothed flange or disc 186 arranged to mesh with the cylinder needles 16 of the cylinder 8. On the upper end of the transfer wheel is a toothed flange or disk 187, the openings between the teeth of which are in vertical alignment with the openings between the teeth in the lower flange or disk 186, the openings in the disk 187 being arranged to receive the lower hooked ends 180 of the thread-manipulating elements 25b and to move any of said hooks that have for any reason been deflected out of transfer registry with the underlying needles to be moved into such registry so as to open the connecting loop held thereby in order that the cylinder needle may be raised through the said connecting loop.

For effecting the transferring operation the hooks 180 are moved outwardly from their positions within the circle of cylinder needles to the transfer position outside the circle of needles and are held out in firm contact with the aligning wheel 187 by a cam 190 (see Fig. 4), which is rotatably mounted on a post 189 carried by and depending from the ring 20 with the cam 190 in position to engage the lower butt *a* of the jack controlling the hook 180 in order to effect and insure entrance of the aligned cylinder needle into the connecting loop C held by the hook.

The cylinder needles 16 are first raised to a position to lower their retained stitches down on the cheeks of the needles to insure their latches being open, by an elevation 205 of a cam 204 in the cylinder cam ring 15 (see Fig. 19), and are lowered by a cam 206 to permit the hooks 180 to move outwardly without engaging the needles 16. The needles are thereafter raised through the connecting loops C by a second elevation 207 in the cam 204 and by the cam 202.

While the needle is being raised by the cam 202 and the top of the needle is within and passing upwardly through the connecting loop C the hook 180 is retracted to a normal position within the needle circle, releasing the hook from and leaving the connecting loop C formerly held thereby on the cylinder needle 16 which is subsequently lowered to a rest position by a cam 208 in the ring 15 ready for the next knitting cycle.

The hooks 180 are returned to their normal position within the needle circle by a fixed cam 188 secured to the post 189 depending from the rotary ring 20, the cam 188 engaging the thread-manip-

ulating elements **25b** below the pivot notch **78** thereof.

In cases where a larger opening or eyelet is to be formed in the foundation fabric the connecting loops C caught by the hooks **180** are held for a number of successive courses, in which case transferring of the several connecting loops C, C^1 held on the hook is not effected until such a number of courses of stitches have been produced as will provide the size eyelet desired, whereupon the hook holding the several connecting loops C, C^1 will be brought into alignment with the cylinder needle with which the hook cooperates and the whole number of connecting loops transferred to the cylinder needle at one time in substantially the same manner as the transferring of the single sinker loop above noted.

When the hooks **180** are to hold the connecting loops C during the formation of two or more courses the cam **190** is thrown out of action. The cam **190** is freely rotatable on the stud **189** and tends to swing to an inoperative position at all times by centrifugal force, being stopped in its rotation about the stud **189** by contact with an abutment **191** on an arm **192** which is secured to the lowered end of a shaft **193** depending from the rotating ring **20** and rotatably mounted in a bearing **194** carried by said ring **20**.

On the upper end of the shaft **193** is a gear segment **195** meshing with a similar gear segment **196** secured to the upper end of a shaft **197** which is mounted in a depending bearing **198** carried by the ring **20**. On the lower end of the shaft **193** is a wiper arm **199** arranged to engage the cam **137** when the said cam is raised by one of the intermediate high links **143a** or **143b** on the pattern chain **144** to rock the shaft **193** and the arm **192** carried thereby to the inoperative position shown in Fig. 4, whereby the cam **190** is free to swing outwardly to clear the butts *a* of the jacks **26**.

The cam **190** is adapted to be swung about the stud **189** to its inner operative position to engage the lower butts *a* of the jacks **26** for moving the hooks **180** outwardly into transferring relation with respect to the cylinder needles by turning the shaft **197**, the lower end of which is provided with a wiper arm **201** also arranged to engage the cam **137** when said cam is in its normal low position as determined by the low links **143** of the chain **144**, which rocks the shaft **193** through the gear segments **196** and **195** to swing the cam **190** to its operative position against the abutment **191** of the arm **192**.

Obviously, one portion of the outer surface of the fabric may include designs formed by needle wrapping effected by the thread-manipulating instrumentalities **25a** and in another portion of the outer surface of the fabric openwork designs may be formed in the same piece of fabric by the thread-manipulating instrumentalities **25b** having the hooks **180** at their lower ends, in which case and for the purpose of more conveniently laying out the various designs one group of the butts in the jacks **26** may be reserved for the openwork designs, for example the butts *a* to *m* inclusive while the remaining butts *n* to *y* inclusive may be reserved for the plated designs, as clearly indicated in Figs. 3 and 7, wherein the carrier **23** is provided with thread-manipulating instrumentalities including both the needle-wrapping ends **25a** and the ends **25b** having the hooks **180**.

In other instances it may be desirable to form an openwork design and plating on the same cylinder needles, in which case it is within the scope of the present invention to place a thread-manipulating instrumentality having a needle-wrapping end **25a** and an instrumentality having an end **25b** provided with a hook **180** in the same groove **24** of the carrier **23**, in which case two jacks **26** would be inserted in the same groove **24** for cooperation with the elements **25a** and **25b** respectively, as illustrated in Fig. 36, the butts *a* to *m* of the jack cooperating with the element **25b** being reserved for the designs to be produced by cooperation of the element **25b** with the cylinder needle **16** vertically aligned therewith while the butts *n* to *y* inclusive of the second jack cooperating with the needle-wrapping element **25a** would be reserved for the designs to be produced by the said needle-wrapping element on the same cylinder needle, the resultant fabric being diagrammatically disclosed in Fig. 35.

In other instances it may be desirable to form designs wherein the connecting loops above referred to are not transferred to the adjacent cylinder needle but are permitted to project outwardly from the outer face of the fabric (see Fig. 39), in which case a third form of thread-manipulating instrumentality is provided and which takes the form of a picker **25c** as illustrated in Fig. 40, which is substantially the same as the element **25b** with the exception that the shoulder on the hook **180** is considerably less pronounced, the picker element **25c** being merely bent outwardly slightly at its lower end sufficient to hold the thread of the connecting loop while it and the adjacent cylinder and dial needles are drawing sufficient of the thread to produce the respective loops. The instrumentality **25c**, like the instrumentality **25b**, is arranged to engage the loop-drawing cam **182** and to be retracted to cast the loops by the fixed cam **188**, the transferring cam **190** at such times being inoperative.

When forming loops by the instrumentalities **25c** and in order to retain the loops it is necessary to feed a second thread A^1 to the needles together with the foundation thread A, in which case one of said threads, for example the thread A, is fed to the cylinder and dial needles through the lower thread eye **75a** in the thread guide **75** while the second thread A^1 is fed to the needles through a relatively elevated thread eye **75b** in the guide **75** (see Fig. 38), the pickers **25c** in such cases engaging only one, for example the thread A^1, while the thread A is fed to the cylinder and dial needles in the usual manner to form regular foundation fabric, in which case the threads A and A^1 throughout the knitting are in a normal plating relation to each other, for example the thread A^1 being on the outside of the stitches formed by the cylinder needles and this thread is the one engaged by the pickers **25c** for the formation of the loops on the outer face of the fabric.

In order to prevent the pickers drawing both threads into the outstanding loops the needle cylinder **8** is lowered by rotating the ring **9** which supports the cylinder in the ring **6** and by tightening up the screws **8a** which secure the ring **6**, the ring **9** and the cylinder **8** in rigid relation to each other, and the dial **34** is lowered by adjusting the screw **177** or the nut **60** that supports the dial post **33** at the top of the machine. Lowering of the cylinder **8** and dial **34** throws the thread A to a position below the ends of the pickers at the point where the thread is fed to the needles while the second thread A^1 being fed to the needles through the upper eye **75b** in the guide **75** is held

at such an angle with respect to the thread A and the lower ends of the pickers 25c that it will be engaged by the ends of the pickers and drawn into the loops while the said pickers miss the thread A and which accordingly produces regular rib knit fabric while the thread A^1 is formed into loops that project outwardly from the outer surface of the fabric but which are tied into the fabric by the thread A^1 being interknit on one side with the cylinder stitch of the foundation fabric and on the opposite side by the rib stitch in the same course of the said ribbed fabric.

These loops may be subsequently brushed to produce a fleecy effect throughout the area composed of said outwardly projecting loops or the loops may be left plain to produce a frieze effect. If desired, the outwardly projecting loops may be cut, thus producing a pile effect on the outer surface of the fabric.

In other instances, it may be desirable to form openwork designs in the fabric of one color wherein a different color will appear through the openwork, in which case two threads, such as the threads A and A^1 of relatively different colors are fed to the needles simultaneously as above described, in which case the hooks 180 will catch only the uppermost thread, for example the thread A^1 while the other thread will continue to knit ordinary ribbed fabric as above noted. The loops held by the hooks 180 are subsequently transferred in the same manner as above described, making the openwork in the fabric through which the color of the other thread will appear as diagrammatically illustrated in Fig. 37.

With the mechanism above described any of the above-mentioned effects may be produced independently or in any desired combinations in a single piece of fabric independently of or coordinately with yarn changing for the foundation thread.

Where the two threads are fed simultaneously to the needles one thread will be under control of the thread-changing mechanism, I, while the second thread will be fed from a bobbin carried by a suitable part of the mechanism, such for example, the post 209 carried by the ring 20 (see Fig. 1), or the fixed dial post 33 may be extended as illustrated in Figs. 13 and 17, and provided with any suitable bobbin-supporting element (not shown) and from either of which the thread may be fed to the upper eye 75b in the thread guide 75 through a suitable tensioning device 210 carried by the ring 20 or other correspondingly rotating portion of the mechanism.

In cases where the two threads are fed to the needles which are to be plated by the individual plating threads B, the threads A and A^1 may be simultaneously fed through the tube 70 and through the openings 181 and 180 formed in the gear 44a and thread-carrying ring 171 respectively, the thread A^1 coming from a bobbin carried on the upper end of the fixed dial post 33 while the thread A comes from the sweep arm of the stop motion preferably in direct line above the center of the post 33.

The trick wheel employed is of novel construction, comprising a main hub section 211 having a bore 212 to receive the eccentric portion 98 of the stud 99. The hub 211 is of cylindrical form having a peripheral surface 213 in which is formed a series of grooves 214, the bases of which are of complete circular form while the peripheral surface 213 of the hub is flattened hexagonally, as illustrated at 215, tangent to the bases of the grooves 214, leaving vertical ribs 216 on the outer surface of the hub 211 in which the horizontal grooves 214 are present.

Arranged to fit in the grooves 214 are rings 217, the inner surface of each of which is of hexagonal form corresponding with a hexagonal outer surface of the hub 211, the said inner surface of the ring having flat portions 218 similar to the flattened portions 215 of the hub 211 and between which are segmental portions 219 corresponding to the outer segmental surface of the vertical ribs 216 of the hub 211.

In assembling the rings 217 on the hub 211 the inner edge of each ring is registered with the correspondingly shaped portions of the outer surface of the hub 211 so that the ring can be dropped on to the hub for movement axially thereof to an elevation coincident with the groove 214 in which the ring is to be positioned, whereupon the ring is turned about the hub 211 until the flat portions 218 on the inner edge of the ring enter the grooves 214 in the vertical ribs 216 of the outer face of the hub 211.

After the rings have been assembled on the hub in this manner, all the rings are locked against further rotation with respect to the hub 211 by a key 220 entering a groove 221 formed in one of the vertical ribs 216 and a notch 222 formed in each of the rings 217. The key 220 is held against longitudinal displacement by the ratchet wheel 132, which is secured to a shouldered portion of the hub 211 at one end thereof, and by a cap plate 223 which is secured to a correspondingly shouldered portion of the hub at the opposite end thereof.

Each of the rings 217 is provided with a series of holes 225 adapted to receive tits 226 pressed up from the body 227 of each of the trick wheel lugs 126 when the body portion 227 of the lug is forced into one of the grooves 228 formed between each pair of superimposed rings 217, the rings being composed of metal sufficiently resilient to permit the passage of the tits 226 therebetween when inserting and removing the lugs 126, and to snap back into position in contact with the body 227 of the lug when the tits 226 are respectively brought into alignment with a pair of the openings 225 in one of the rings 217. In this way the lugs 126 are made readily interchangeable for setting up any desired pattern.

In order to provide a continuous lug on the trick wheel for continuously pressing any one jack 26 for a full revolution or any desired segmental portion thereof of the trick wheel 100, lugs of the character shown in Fig. 23 may be employed, which are relatively narrow, being confined in width to planes extending radially from the center of the hub through two adjacent holes 225 in the rings 217. The narrow lugs 126a are each provided with one tit 226 and are held against rotation around the tit by a shoulder 227a arranged to bear against the peripheral edge of one of the rings 217 between which the lugs 126a are placed, whereby the peripheral edge of any desired number of the lugs 126a placed side by side in a single groove 228 of the trick wheel will form a continuous bearing surface for the selector lever that controls the jack which is to be continuously pressed.

In order to keep the relatively thin selector levers 101—125 from sagging at their outer ends as a result of insufficient bearing surface with the pivot stud 128, the levers are divided into groups, for example five groups of five levers each. The lower lever of each group is provided with an

integral elongated hub 128a having a length equal to the thickness of the five levers of the group and the other four levers of the group are pivoted on the peripheral surface of the said elongated hub of the lower lever, as shown in Fig. 41.

In order to relieve the tension on the connecting loops C that are held by the hooks 180 during the formation of a plurality of courses of stitches, a cam 230 is provided on the lower end of a stud 231 rigidly secured in and depending from the ring 20. The cam 230 is arranged to press against the lower butt a of each jack 26 that controls a thread-manipulating instrumentality 25 having a hook 180 at the lower end 25b thereof, whereby the hooks are moved out to a position close to the rear edge of the circle of cylinder needles 16, thus relieving the strain on the thread held by the hooks 180.

In order to prevent any of the thread-manipulating instrumentalities 25 from moving out to a position where their lower ends would strike the latch opener 233 (see Fig. 18), a cam 232 is provided on the stud 231 and arranged to bear against the elements 25 below the pivots thereof, to hold these elements in position until the latch opener is reached, the latch opener being positioned immediately ahead of the point of selection of the elements 25 that are to function in the course of stitches about to be formed.

While the grooves 24 in the carrier 23 are shown in Fig. 4 of the drawings as being strictly radially disposed with respect to the axis of the carrier, it is obvious that in order to present the jacks and thread-manipulating instrumentalities as nearly as possible in perpendicular relation to the actuating cams and selector arms with which they contact during relative rotation between such actuating elements and the carrier, the grooves 24 may be cut at an angle to the said strictly radial plane as shown in Fig. 18 of the drawings and thus present the edges of the jacks 26 and instrumentalities 25 flatly to said actuating elements to reduce wear therebetween.

The bearing sleeve 199 about which the trick wheel 100 rotates is bored, as illustrated at 198, at an angle to the axis X—X of the trick wheel 100, the axis Y—Y of the bore 198 and the axis X—X of the trick wheel 100 coinciding at the lower end of the trick wheel as illustrated at Z while the axes X—X and Y—Y are spaced apart a predetermined distance as illustrated at W at the upper end of the trick wheel.

To properly align the lugs 126 of the trick wheel with the arms 101—125, the stud 99 is rotated until the lowermost lugs on the trick wheel are in proper operating relation to the lowermost arm 101. The stud 99 is then securely locked in the ring 20. The bearing sleeve 199 is then rotated about the eccentric portion 98 of the stud 99 which moves the top part of the trick wheel 100 toward the arm 125 so that the uppermost lugs of the trick wheel 100 are in the same relation to the arm 125 as the lowermost lug is to the arm 101, the arms and trick wheel being slightly inclined to the vertical in the same manner as and substantially parallel to the outer edges of the jacks 26 when the adjustment is complete. The sleeve 199 is then secured to the eccentric portion 98 of the stud 99 by a set screw 199a.

The stud 99 is secured in fixed relation to the ring 20 by a clamp including a bolt 99a having a beveled head 99b mounted at one side of the stud 99 in a bore 99c in the ring 20, in which is also mounted, at the opposite side of the stud 99, a sleeve 99d having a beveled end 99e between which the upper end of the stud 99 is gripped and held against rotation when the hub 99b is pulled up tightly on the bolt 99a.

The jacks 26 being separate from and cooperating with the needle-wrapping instrumentalities 25 facilitates the changing of patterns and eliminates re-threading of the wrapping fingers 25a when the pattern is changed, as the jacks 26 may be readily removed from and replaced in the carrier 23 without removing the wrapping fingers 25, and if differently colored threads are required in the fingers the new threads are knitted to the threads already threaded through the eyes in the fingers 25 and the old thread pulled down until the new thread is drawn through the eyes and beyond the liner ends of the fingers to a position for wrapping the needles.

Where a wrapping finger 25a and a hook instrumentality 25b or a picker instrumentality 25c are used in the same groove of the carrier, as in Fig. 36, a separator, such as that shown at 326 in Fig. 42 is placed between the two instrumentalities to permit each instrumentality and its individual controlling jack 26 to operate independently without interfering one with the other.

I claim:

1. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier above the dial, a plurality of thread-manipulating instrumentalities supported by the carrier in operative relation to said needles, a trick wheel arranged to travel around the outside of the carrier for selecting thread-manipulating instrumentalities for cooperation with predetermined needles, operating jacks supported by the carrier for and in cooperative relation to the thread-manipulating instrumentalities respectively, and means intermediate the jacks and the trick wheel for conveying the selections of the trick wheel to the operating jacks.

2. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier above the dial, a plurality of thread-manipulating instrumentalities supported by the carrier in operative relation to said needles, a trick wheel arranged to travel around the outside of the carrier for selecting thread-manipulating instrumentalities for cooperation with predetermined needles, operating jacks supported by the carrier for and in cooperative relation to the thread-manipulating instrumentalities respectively, means intermediate the jacks and the trick wheel for conveying the selections of the trick wheel to the operating jacks, and interchangeable lugs carried by the trick wheel for actuating the said intermediate means.

3. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier above the dial, a plurality of thread-manipulating instrumentalities supported by the carrier in operative relation to said needles, a trick wheel arranged to travel around the outside of the carrier for selecting thread-manipulating instrumentalities for cooperation with predetermined needles, operating jacks supported by the carrier for and in cooperative relation to the thread-manipulating instrumentalities respectively, means intermediate the jacks and the trick wheel for conveying the selections of the trick wheel to the operating jacks, selectively arranged butts on

the jacks for engagement by said intermediate means respectively, and selectively arranged interchangeable lugs on the trick wheel for selectively operating said intermediate means.

4. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier above the dial, a plurality of thread-manipulating instrumentalities supported by the carrier in operative relation to said needles, a trick wheel arranged to travel around the outside of the carrier for selecting thread-manipulating instrumentalities for cooperation with predetermined needles, operating jacks supported by the carrier for and in cooperative relation to the thread-manipulating instrumentalities respectively, means intermediate the jacks and the trick wheel for conveying the selections of the trick wheel to the operating jacks, selectively arranged butts on the jacks for engagement by said intermediate means respectively, selectively arranged interchangeable lugs on the trick wheel for selectively operating said intermediate means, and means for selectively rotating the trick wheel to bring predetermined combinations of the lugs into cooperative relation to said intermediate means.

5. The combination in a circular rib knitting machine, of a needle cylinder, a circle of needles in said cylinder, a needle dial, needles in the dial in alternating relation to the cylinder needles, dial cams for projecting and retracting the dial needles between the cylinder needles, a carrier above the dial, thread-manipulating instrumentalities supported by the carrier with their lower ends within the circle defined by the cylinder needles, a shaft rotating within the carrier for actuating the dial cams, a trick wheel arranged to travel around the carrier in advance of the dial needle retracting cam to select and press predetermined instrumentalities outwardly in planes between those of adjacent cylinder and dial needles, and cam means following said trick wheel for returning the lower ends of the instrumentalities to normal position within the circle of needles substantially with the retraction of the dial needles.

6. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the dial and cylinder respectively in alternating relation to each other, means for feeding a foundation thread to the cylinder and dial needles, a plurality of thread-manipulating instrumentalities pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles with a predetermined number of said instrumentalities arranged to engage said foundation thread between the cylinder and dial needles, means for selectively rocking predetermined instrumentalities about their respective pivots for said engagement with the foundation thread to draw said thread into loops connecting stitches formed by the cylinder and dial needles respectively and means for casting said loops from said instrumentalities.

7. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the dial and cylinder respectively in alternating relation to each other, means for feeding a foundation thread to the cylinder and dial needles, a plurality of thread-manipulating instrumentalities operable in planes intermediate those of adjacent cylinder and dial needles with a predetermined number of said instrumentalities arranged to engage said foundation thread between the cylinder and dial needles to draw said thread into connecting loops between stitches formed respectively by said needles, and a predetermined number of said thread-manipulating instrumentalities arranged to wrap individual threads around predetermined cylinder needles, means for selectively operating said thread-manipulating instrumentalities for coordinately effecting their said purposes in the production of tubular ribbed fabric on said machine, and means for casting said loops from said loop-forming instrumentalities.

8. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the dial and cylinder respectively in alternating relation to each other, means for feeding a foundation thread to the cylinder and dial needles, a plurality of thread-manipulating instrumentalities operable in planes intermediate those of adjacent cylinder and dial needles with a predetermined number of said instrumentalities arranged to engage said foundation thread between the cylinder and dial needles to draw said thread into connecting loops between stitches formed respectively by said needles, and a predetermined number of said thread-manipulating instrumentalities arranged to wrap individual threads around predetermined cylinder needles, means for selectively operating said thread-manipulating instrumentalities for coordinately effecting their said purposes in the production of tubular ribbed fabric on said machine, and means for transferring predetermined connecting loops produced by said foundation thread-engaging instrumentalities to adjacent needles respectively.

9. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the dial and cylinder respectively in alternating relation to each other, means for feeding a foundation thread to the cylinder and dial needles, a plurality of thread-manipulating instrumentalities operable in planes intermediate those of adjacent cylinder and dial needles with a predetermined number of said instrumentalities arranged to engage said foundation thread between the cylinder and dial needles to draw said thread into connecting loops between stitches formed respectively by said needles, and a predetermined number of said thread-manipulating instrumentalities arranged to wrap individual threads around predetermined cylinder needles, means for selectively operating said thread-manipulating instrumentalities for coordinately effecting their said purposes in the production of tubular ribbed fabric on said machine, means for transferring predetermined connecting loops produced by said foundation thread-engaging instrumentalities to adjacent needles respectively, and means for selectively changing the foundation thread being fed to the needles to produce predetermined effects in the fabric coordinately with the selective operation of said thread-manipulating instrumentalities.

10. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities pivotally mounted adjacent said needles for swinging movement respectively in planes intermediate those of adjacent needles for engaging and drawing said thread into loops connecting stitches produced by the said needles respectively, means for selectively rocking said thread-manipulating instrumentalities about their re-

spective pivots to engage said thread, and means for actuating predetermined thread-manipulating instrumentalities to transfer the connecting loops held thereby onto needles adjacent thereto respectively.

11. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities pivotally mounted adjacent said needles for swinging movement respectively in planes intermediate those of adjacent needles for engaging and drawing said thread into loops connecting stitches produced by the said needles respectively, means for selectively rocking said thread-manipulating instrumentalities about their respective pivots to engage said thread, means for actuating predetermined thread-manipulating instrumentalities to transfer the connecting loops held thereby onto needles adjacent thereto respectively, and means for aligning said predetermined loop-holding instrumentalities with the needles receiving said loops to effect said transfer.

12. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities pivotally mounted adjacent said needles for swinging movement in planes intermediate adjacent needles, means for rocking predetermined instrumentalities about their respective pivots to engage, draw and hold said thread in loops connecting stitches produced by adjacent needles respectively, and means for actuating predetermined loop-holding intrumentalities to transfer their loops to adjacent needles respectively.

13. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities pivotally mounted adjacent said needles for swinging movement in planes intermediate adjacent needles, means for rocking predetermined instrumentalities about their respective pivots to engage, draw and hold said thread in loops connecting stitches produced by adjacent needles respectively, and means for casting the loops from the loop-holding instrumentalities.

14. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities pivotally mounted adjacent said needles for swinging movement in planes intermediate adjacent needles, means for rocking predetermined instrumentalities about their respective pivots to engage, draw and hold said thread in loops connecting stitches produced by adjacent needles respectively, means for actuating predetermined loop-holding instrumentalities to transfer their loops to adjacent needles respectively, and means for casting the loops from the loop-holding instrumentalities.

15. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles, means for returning a group of the selected instrumentalities to said normal position to wrap supplemental threads about predetermined needles, means for rocking a second group of said selected instrumentalities to an extreme position outside the said circle of needles to engage, draw and hold said thread in loops connecting stitches produced on adjacent needles respectively, and means for casting said loops from said instrumentalities.

16. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles, means for returning a group of the selected instrumentalities to said normal position to wrap supplemental threads about predetermined needles, means for rocking a second group of said selected instrumentalities to an extreme position outside the said circle of needles to engage, draw and hold said thread in loops connecting stitches produced on adjacent needles respectively, means for actuating predetermined ones of said loop-holding instrumentalities to transfer their loops on needles adjacent thereto, and means for casting said loops for said loop-holding instrumentalities.

17. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles, means for returning a group of the selected instrumentalities to said normal position to wrap supplemental threads about predetermined needles, means for rocking a second group of said selected instrumentalities to an extreme position outside the said circle of needles to engage, draw and hold said thread in loops connecting stitches produced on adjacent needles respectively, and means for returning the said second group of instrumentalities to said normal position.

18. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles, means for returning a group of the selected instrumentalities to said normal position to wrap supplemental threads about predetermined needles, means for rocking a second group of said selected instrumentalities to an extreme position outside the said circle of needles to engage, draw and hold said thread in loops connecting stitches produced on adjacent needles respectively, means for returning the said second group of instrumentalities to said normal position, and means for subsequently actuating said second group to transfer the connecting loops held thereby to needles adjacent thereto.

19. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles, means for returning a group of the selected instrumentalities to said normal position to wrap supplemental threads about predetermined needles, means for rocking a second group of said selected instrumentalities to an extreme position outside the said circle of needles to engage, draw and hold said thread in loops connecting stitches produced on adjacent needles respectively, means for returning the said second group of instrumentalities to said normal position, means for subsequently actuating said second group to transfer the connecting loops held thereby to needles adjacent thereto, and means for moving said second group of instrumentalities to an intermediate position to relieve strain on the thread of said connecting loops held thereby.

20. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles to engage, draw and hold said thread in loops connecting stitches produced by adjacent needles respectively, means for returning said loop-holding instrumentalities to said normal position while holding their respective loops and means for casting said loops from said instrumentalities.

21. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles to engage, draw and hold said thread in loops connecting stitches produced by adjacent needles respectively, means for returning said loop-holding instrumentalities to said normal position while holding their respective loops, and means for subsequently actuating said loop-holding instrumentalities to transfer their loops to needles adjacent thereto.

22. In a circular rib knitting machine, the combination of alternating cylinder and dial needles, means for feeding thread to said needles, thread-manipulating instrumentalities normally within a circle defined by the cylinder needles and pivotally mounted adjacent said needles for swinging movement in planes intermediate those of adjacent cylinder and dial needles, means for selectively rocking said instrumentalities about their respective pivots outwardly between the needles to engage, draw and hold said thread in loops connecting stitches produced by adjacent needles respectively, means for returning said loop-holding instrumentalities to said normal position while holding their respective loops, means for subsequently actuating said loop-holding instrumentalities to transfer their loops to needles adjacent thereto, and means for moving said loop-holding instrumentalities to an intermediate position to relieve strain on the loops held thereby between the forming and transferring of said loops.

23. The combination in a circular rib knitting machine of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, thread-manipulating instrumentalities operable between said needles, a thread guide in predetermined relation to the needles for feeding a thread to the needles and thread-manipulating instrumentalities simultaneously and means for varying the relation of the needle cylinder relative to the thread guide to cause the thread-manipulating instrumentalities to clear said thread whereby said thread will be formed into a course of stitches by the needles, and means adjacent the thread guide for said thread arranged to feed a second thread to the needles and the thread-manipulating instrumentalities simultaneously with and in predetermined relation to the first said thread to be engaged by said thread-manipulating instrumentalities, means for actuating said instrumentalities in a manner to draw and hold loops of said second thread intermediate predetermined dial and cylinder needles, and means for actuating said instrumentalities to transfer said held loops to adjacent needles respectively to expose the first of said foundation threads in the openings formed by said transfer.

24. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, and means for engaging said butts to actuate the said instrumentalities upon relative rotation between said means and said carrier.

25. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, and means for selectively engaging said selector arms to actuate the instrumentalities upon relative rotation between said means and said carrier.

26. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, nee-

dles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, and a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable selectively arranged lugs on the periphery of the trick wheel in substantially horizontal alignment with the said selector arms, for actuating the said manipulating instrumentalities upon relative rotation between the carrier and the trick wheel about the axis of the carrier.

27. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier and interchangeable selectively arranged lugs on the periphery of the trick wheel in substantially horizontal alignment with the said selector arms, for actuating the said manipulating instrumentalities upon relative rotation between the carrier and the trick wheel about the axis of the carrier, and means for rotating the trick wheel in intermittent steps about its own axis during said relative rotation between the trick wheel and carrier around the axis of the carrier.

28. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier and interchangeable selectively arranged lugs on the periphery of the trick wheel in substantially horizontal alignment with the said selector arms, for actuating the said manipulating instrumentalities upon relative rotation between the carrier and the trick wheel about the axis of the carrier, a cam in fixed spaced relation to the trick wheel circumferentially of the carrier for returning one group of said instrumentalities to normal position relative to said needles while another group of said instrumentalities are apertured to avoid said cam, and a second cam in fixed relation to the trick wheel circumferentially of the carrier and arranged to return the second said group to said normal position subsequent to the return of the first said group.

29. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier and interchangeable selectively arranged lugs on the periphery of the trick wheel in substantially horizontal alignment with the said selector arms, for actuating the said manipulating instrumentalities upon relative rotation between the carrier and the trick wheel about the axis of the carrier, a cam in fixed spaced relation to the trick wheel circumferentially of the carrier for returning one group of said instrumentalities to normal position relative to said needles while another group of said instrumentalities are apertured to avoid said cam, a second cam in fixed relation to the trick wheel circumferentially of the carrier and arranged to return the second said group to said normal position subsequent to the return of the first said group, and a cam intermediate the two said returning cams and arranged to engage a predetermined butt on each of the jacks of the second group of instrumentalities to move said instrumentalities to an extreme operative position subsequent to the return of the first said group.

30. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier and interchangeable selectively arranged lugs on the periphery of the trick wheel in sub-

stantially horizontal alignment with the said selector arms, for actuating the said manipulating instrumentalities upon relative rotation between the carrier and the trick wheel about the axis of the carrier, a cam in fixed spaced relation to the trick wheel circumferentially of the carrier for returning one group of said instrumentalities to normal position relative to said needles while another group of said instrumentalities are apertured to avoid said cam, a second cam in fixed relation to the trick wheel circumferentially of the carrier and arranged to return the second said group to said normal position subsequent to the return of the first said group, a cam intermediate the two said returning cams and arranged to engage a predetermined butt on each of the jacks of the second group of instrumentalities to move said instrumentalities to an extreme operative position subsequent to the return of the first said group, and a cam for subsequent engagement with the said predetermined butts of said second group to move said second group of instrumentalities to a position intermediate said operative and said normal positions.

31. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, a carrier mounted above and axially aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves respectively with their lower ends in cooperative relation to said needles, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontally superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with the butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier and interchangeable selectively arranged lugs on the periphery of the trick wheel in substantially horizontal alignment with the said selector arms, for actuating the said manipulating instrumentalities upon relative rotation between the carrier and the trick wheel about the axis of the carrier, a cam in fixed spaced relation to the trick wheel circumferentially of the carrier for returning one group of said instrumentalities to normal position relative to said needles while another group of said instrumentalities are apertured to avoid said cam, a second cam in fixed relation to the trick wheel circumferentially of the carrier and arranged to return the second said group to said normal position subsequent to the return of the first said group, a cam intermediate the two said returning cams and arranged to engage a predetermined butt on each of the jacks of the second group of instrumentalities to move said instrumentalities to an extreme operative position subsequent to the return of the first said group, a selectively operable cam arranged subsequently to engage the said predetermined butts on the jacks of the second said group of instrumentalities to operate said instrumentalities a second time from said normal position, and a cooperating cam for again returning said second group to said normal position.

32. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, means for engaging said butts to actuate said thread-engaging instrumentalities to form said thread into loops between adjacent cylinder and dial needles, and means for casting said loops from said instrumentalities.

33. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, means for selectively engaging said selector arms to actuate the thread-engaging instrumentalities to draw said thread into loops between adjacent cylinder and dial needles, and means for casting said loops from said instrumentalities.

34. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable lugs on the periphery of the trick wheel in substantially horizontal alignment with said selector arms, for moving said instrumentalities selectively from a normal position behind said cylinder needles into circular alignment with said cylinder needles to receive the thread simultaneously with said needles, a loop-drawing cam arranged to engage a predetermined butt on each of the jacks to cause said instrumentalities to draw said thread into loops between adjacent cylinder needles, a cam in fixed relation to said trick wheel cicrumferentially of the carrier to return the instrumentalities to said normal posi-

tion to permit said dial needles to take said thread, and means for casting said loops from said instrumentalities.

35. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable lugs on the periphery of the trick wheel in substantially horizontal alignment with said selector arms, for moving said instrumentalities selectively from a normal position behind said cylinder needles into circular alignment with said cylinder needles to receive the thread simultaneously with said needles, a loop-drawing cam arranged to engage a predetermined butt on each of the jacks to cause said instrumentalities to draw said thread into loops between adjacent cylinder needles, a cam in fixed relation to said trick wheel circumferentially of the carrier to return the instrumentalities to said normal position to permit said dial needles to take said thread, a cam arranged to engage said predetermined butt to move said instrumentalities to a position intermediate said normal and said thread-drawing positions to relieve the thread of the loops held by said instrumentalities, and means for casting said loops from said instrumentalities.

36. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable lugs on the periphery of the trick wheel in substantially horizontal alignment with said selector arms, for moving said instrumentalities selectively from a normal position behind said cylinder needles into circular alignment with said cylinder needles to receive the thread simultaneously with said needles, a loop-drawing cam arranged to engage a predetermined butt on each of the jacks to cause said instrumentalities to draw said thread into loops between adjacent cylinder needles, a cam in fixed relation to said trick wheel circumferentially of the carrier to return the instrumentalities to said normal position to permit said dial needles to take said thread, a cam arranged to engage said predetermined butt to move said instrumentalities to a position intermediate said normal and said thread-drawing positions to relieve the thread of the loops held by said instrumentalities, and a selectively operable transfer cam arranged to engage said predetermined butts to move said instrumentalities into loop-transferring position with respect to said cylinder needles.

37. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable lugs on the periphery of the trick wheel in substantially horizontal alignment with said selector arms, for moving said instrumentalities selectively from a normal position behind said cylinder needles into circular alignment with said cylinder needles to receive the thread simultaneously with said needles, a loop-drawing cam arranged to engage a predetermined butt on each of the jacks to cause said instrumentalities to draw said thread into loops between adjacent cylinder needles, a cam in fixed relation to said trick wheel circumferentially of the carrier to return the instrumentalities to said normal position to permit said dial needles to take said thread, a cam arranged to engage said predetermined butt to move said instrumentalities to a position intermediate said normal and said thread-drawing positions to relieve the thread of the loops held by said instrumentalities, a selectively operable transfer cam arranged to engage said predetermined butts to move said instrumentalities into loop-transferring position with respect to said cylinder needles, and selectively operable element for actuating said transfer cam into and out of transfer position.

38. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable lugs on the

periphery of the trick wheel in substantially horizontal alignment with said selector arms, for moving said instrumentalities selectively from a normal position behind said cylinder needles into circular alignment with said cylinder needles to receive the thread simultaneously with said needles, a loop-drawing cam arranged to engage a predetermined butt on each of the jacks to cause said instrumentalities to draw said thread into loops between adjacent cylinder needles, a cam in fixed relation to said trick wheel circumferentially of the carrier to return the instrumentalities to said normal position to permit said dial needles to take said thread, a cam arranged to engage said predetermined butt to move said instrumentalities to a position intermediate said normal and said thread-drawing positions to relieve the thread of the loops held by said instrumentalities, a selectively operable transfer cam arranged to engage said predetermined butts to move said instrumentalities into loop-transferring position with respect to said cylinder needles, and a common selectively operable element for actuating said transfer cam into and out of transfer position and for rotating said trick wheel relative to said selector arms.

39. The combination in a circular rib knitting machine, of a needle cylinder, a needle dial, needles in the cylinder and dial respectively, means for feeding thread to said needles, a carrier above and aligned with the cylinder and dial and provided with vertical grooves in its peripheral surface in substantially vertical alignment with the cylinder needles respectively, a series of thread-manipulating instrumentalities pivotally mounted in the lower ends of said grooves with their lower ends arranged to engage said thread, a series of jacks pivotally mounted in said grooves in cooperative relation to said instrumentalities, a series of horizontal superposed butts selectively arranged on each jack, a series of selector arms arranged in horizontal superposed relation adjacent to and aligned with said butts respectively, a trick wheel rotatably mounted about an axis substantially parallel to the axis of the carrier, and interchangeable lugs on the periphery of the trick wheel in substantially horizontal alignment with said selector arms, for moving said instrumentalities selectively from a normal position behind said cylinder needles into circular alignment with said cylinder needles to receive the thread simultaneously with said needles, a loop-drawing cam arranged to engage a predetermined butt on each of the jacks to cause said instrumentalities to draw said thread into loops between adjacent cylinder needles, a cam in fixed relation to said trick wheel circumferentially of the carrier to return the instrumentalities to said normal position to permit said dial needles to take said thread, a cam arranged to engage said predetermined butt to move said instrumentalities to a position intermediate said normal and said thread-drawing positions to relieve the thread of the loops held by said instrumentalities, a selectively operable transfer cam arranged to engage said predetermined butts to move said instrumentalities into loop-transferring position with respect to said cylinder needles, and a return cam following said transfer cam for returning said instrumentalities to said normal position.

40. The combination of a trick wheel having selectively arranged lugs on its peripheral surface, and a series of selector arms pivoted about a common axis substantially parallel to the axis of said trick wheel for cooperation with the lugs thereon, one of said arms having an elongated hub concentric to said common axis and forming the pivot for another of said arms in movement about said common axis.

41. The combination of a trick wheel having selectively arranged lugs on its peripheral surface, and a series of selector arms pivoted about a common axis substantially parallel to the axis of said trick wheel for cooperation with the lugs thereon, said arms being arranged in groups with one arm of each group provided with an elongated hub concentric to said common axis and forming the pivot for the remaining arms of the group in movement about said common axis.

42. The combination of a carrier, thread-manipulating instrumentalities operatively mounted in the carrier, butts extending outwardly from the carrier for actuating said instrumentalities, a trick wheel, lugs on the trick wheel for operating said butts, a carrier for the trick wheel in unalterable relation to the first said carrier, a stud supporting the trick wheel from the last said carrier and mounted for axial adjustment relative thereto for bringing the lugs and butts into substantially coinciding operating planes, said stud having an eccentric portion about which the trick wheel revolves, said stud being rotatably adjustable relative to its carrier for swinging the eccentric portion of the stud and the trick wheel to move the lugs in said planes to or from the butts.

43. The combination of a carrier, thread-manipulating instrumentalities operatively mounted in the carrier, butts extending outwardly from the carrier for actuating said instrumentalities, a trick wheel, lugs on the trick wheel for operating said butts, a carrier for the trick wheel in unalterable relation to the first said carrier, a stud supporting the trick wheel from the last said carrier and mounted for axial adjustment relative thereto for bringing the lugs and butts into substantially coinciding operating planes, said stud having an eccentric portion about which the trick wheel revolves, said stud being rotatably adjustable relative to its carrier for swinging the eccentric portion of the stud and the trick wheel to move the lugs in said planes to or from the butts, and a bearing sleeve for the trick wheel rotatably adjustable on the eccentric portion of the stud and having one end eccentric to the axis of the eccentric portion of the stud for tilting the trick wheel to bring the lugs into substantially parallel relation to the butts.

44. The combination of a carrier, thread-manipulating instrumentalities operatively mounted in the carrier, butts extending outwardly from the carrier for actuating said instrumentalities, a trick wheel, lugs on the trick wheel for operating said butts, a carrier for the trick wheel in unalterable relation to the first said carrier, a stud supporting the trick wheel from the last said carrier and mounted for axial adjustment relative thereto for bringing the lugs and butts into substantially coinciding operating planes, said stud having an eccentric portion about which the trick wheel revolves, said stud being rotatably adjustable relative to its carrier for swinging the eccentric portion of the stud and the trick wheel to move the lugs in said planes to or from the butts, a bearing sleeve for the trick wheel rotatably adjustable on the eccentric portion of the stud and having one end eccentric to the axis of the eccentric portion of the stud for

tilting the trick wheel to bring the lugs into substantially parallel relation to the butts, and means for rotating one of said carriers relative to the other of said carriers to effect successive operation of the butts by the lugs on the trick wheel.

45. The combination of a carrier, thread-manipulating fingers operatively mounted in grooves in the carrier, and an operating jack in each groove for each instrumentality therein, said jacks being removable from the carrier independent of the instrumentalities.

46. The combination of a carrier, thread-manipulating fingers operatively mounted in grooves in the carrier, and an operating jack in each groove for each instrumentality therein, said jacks and said instrumentalities being independently removable from the carrier.

47. The combination of a carrier, thread-manipulating instrumentalities operatively mounted in grooves in the carrier, predetermined grooves being provided with a pair of instrumentalities in parallel relation to each other, an operating jack in each groove for each instrumentality therein, and a readily removable separator blade between each pair of instrumentalities and operating jacks thereof in each groove containing such pair of instrumentalities.

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