July 25, 1939. F. C. GOOD 2,167,478

CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

Filed May 7, 1935 7 Sheets-Sheet 1

Fig. 1.

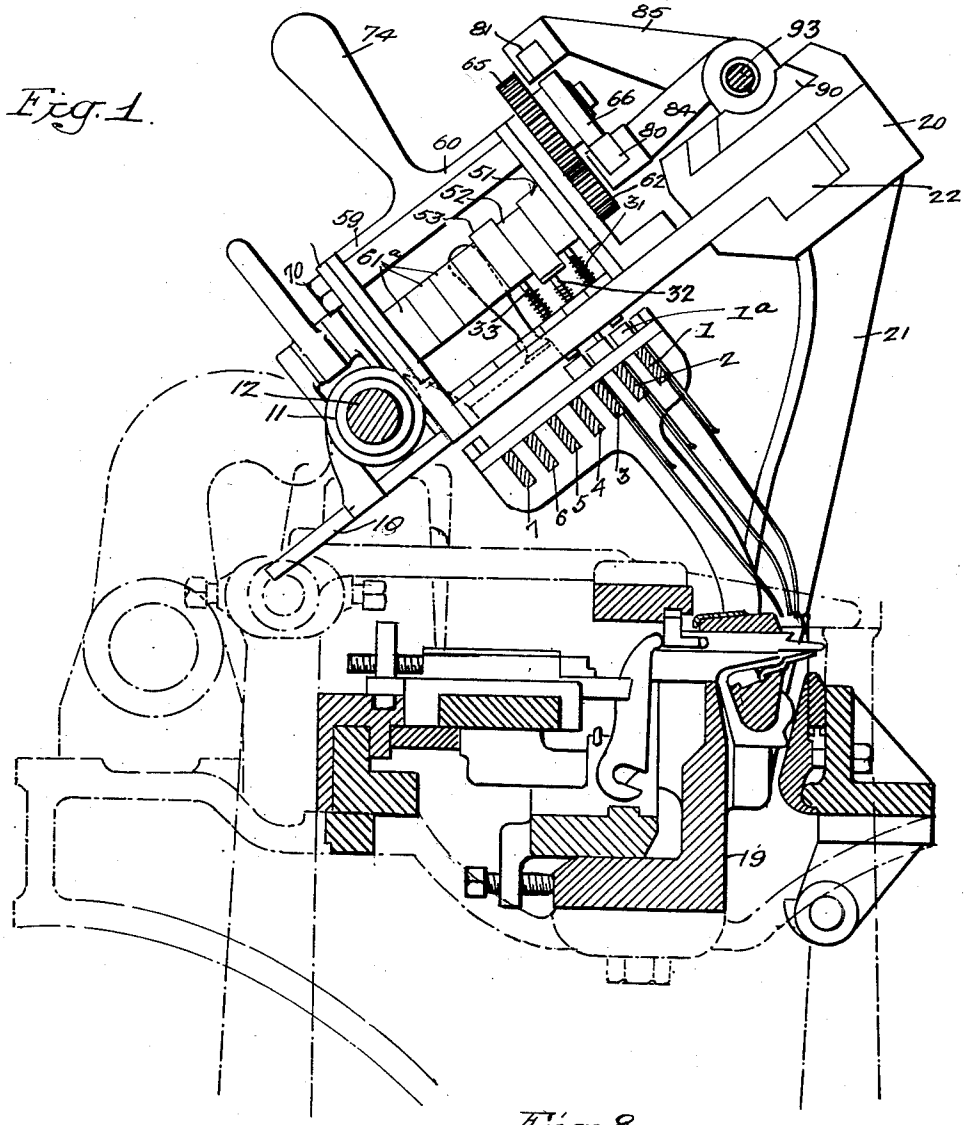
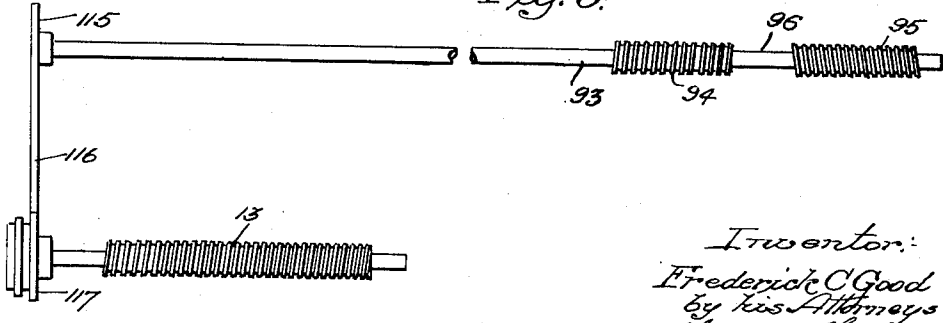


Fig. 8.



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CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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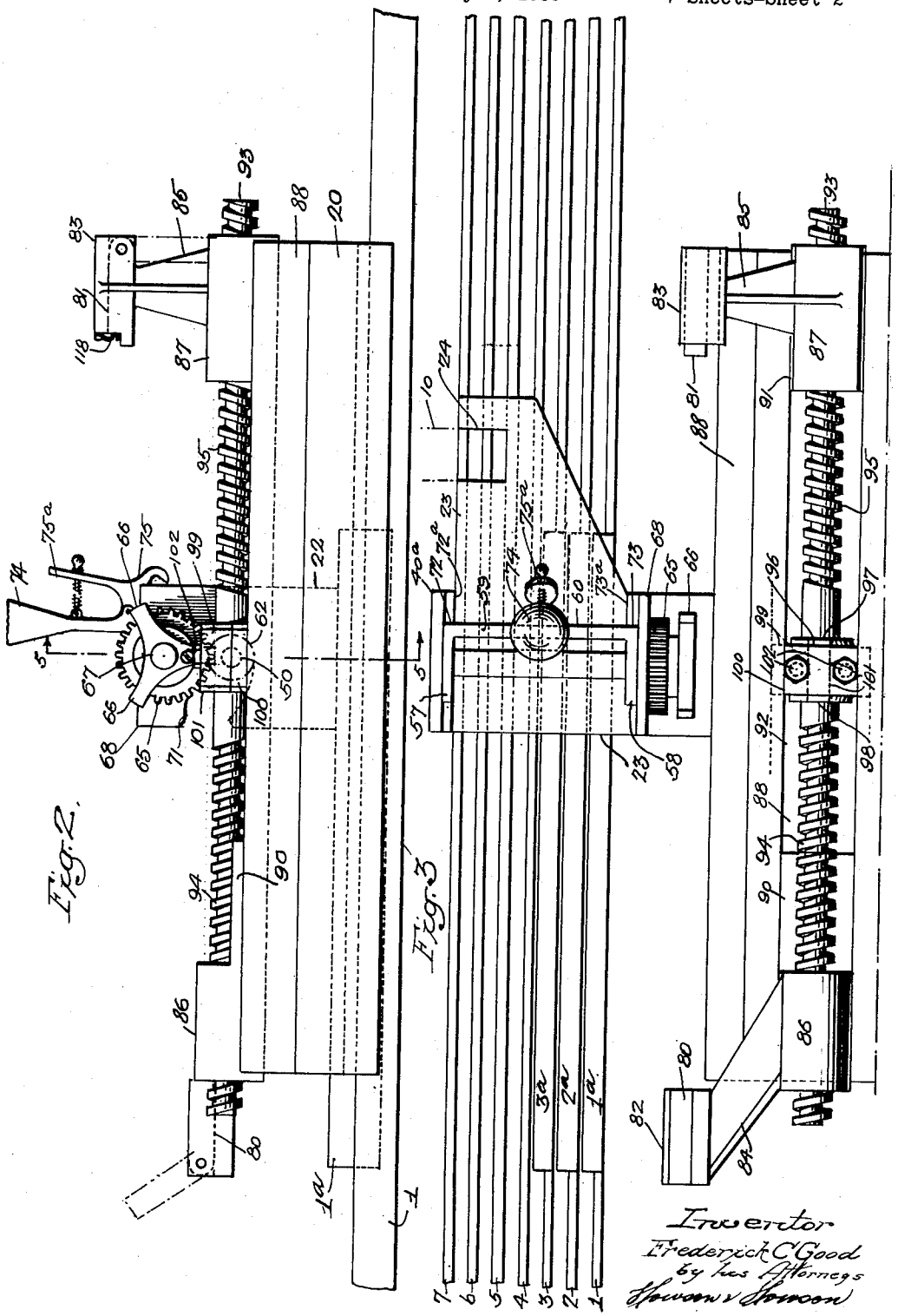


Fig. 2.

Fig. 3

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CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 4.

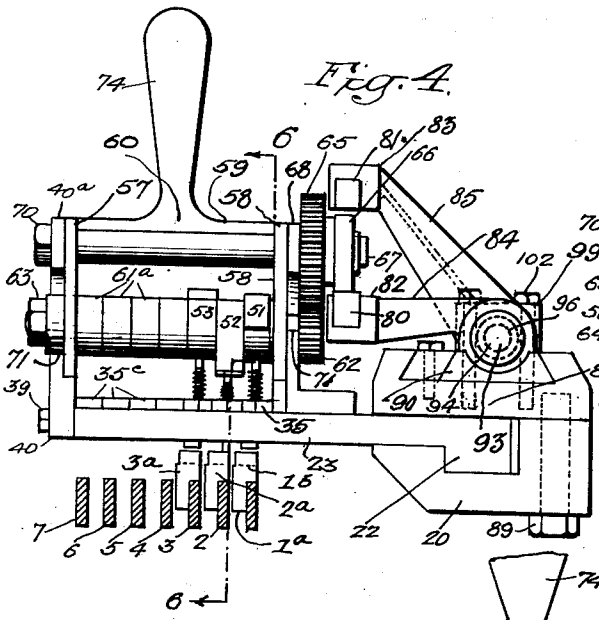


Fig. 5.

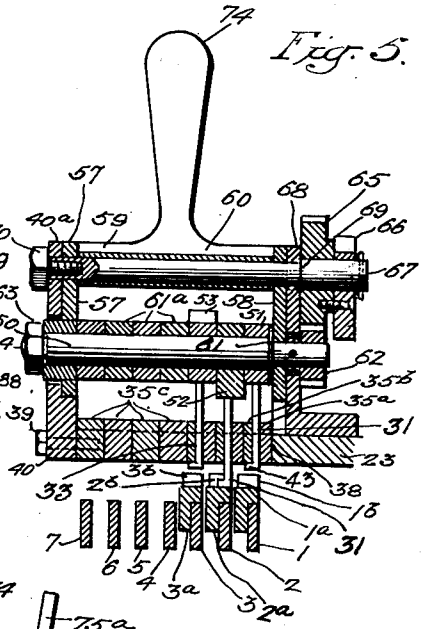
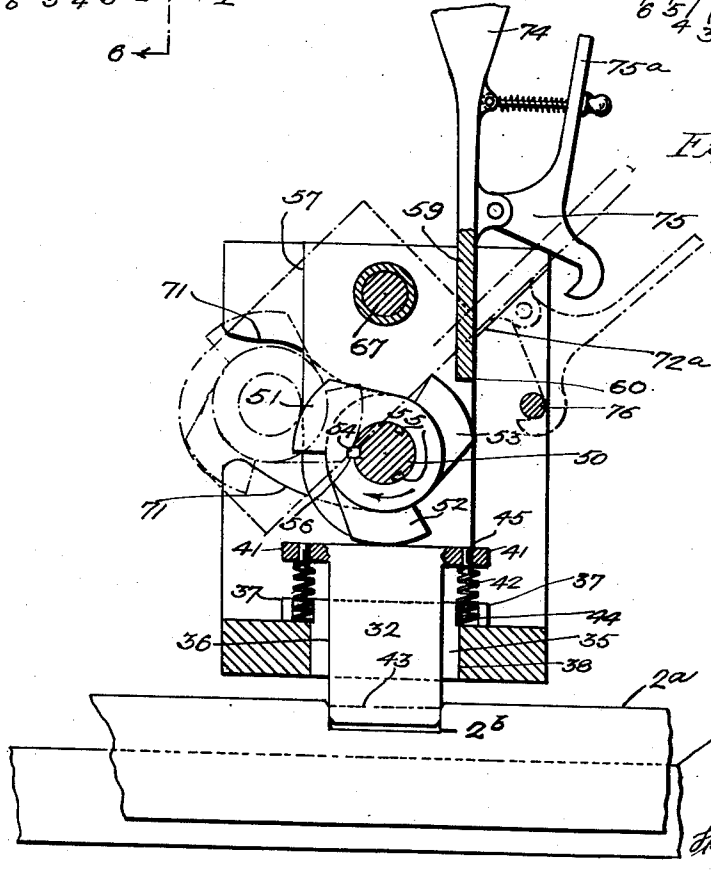


Fig. 6.



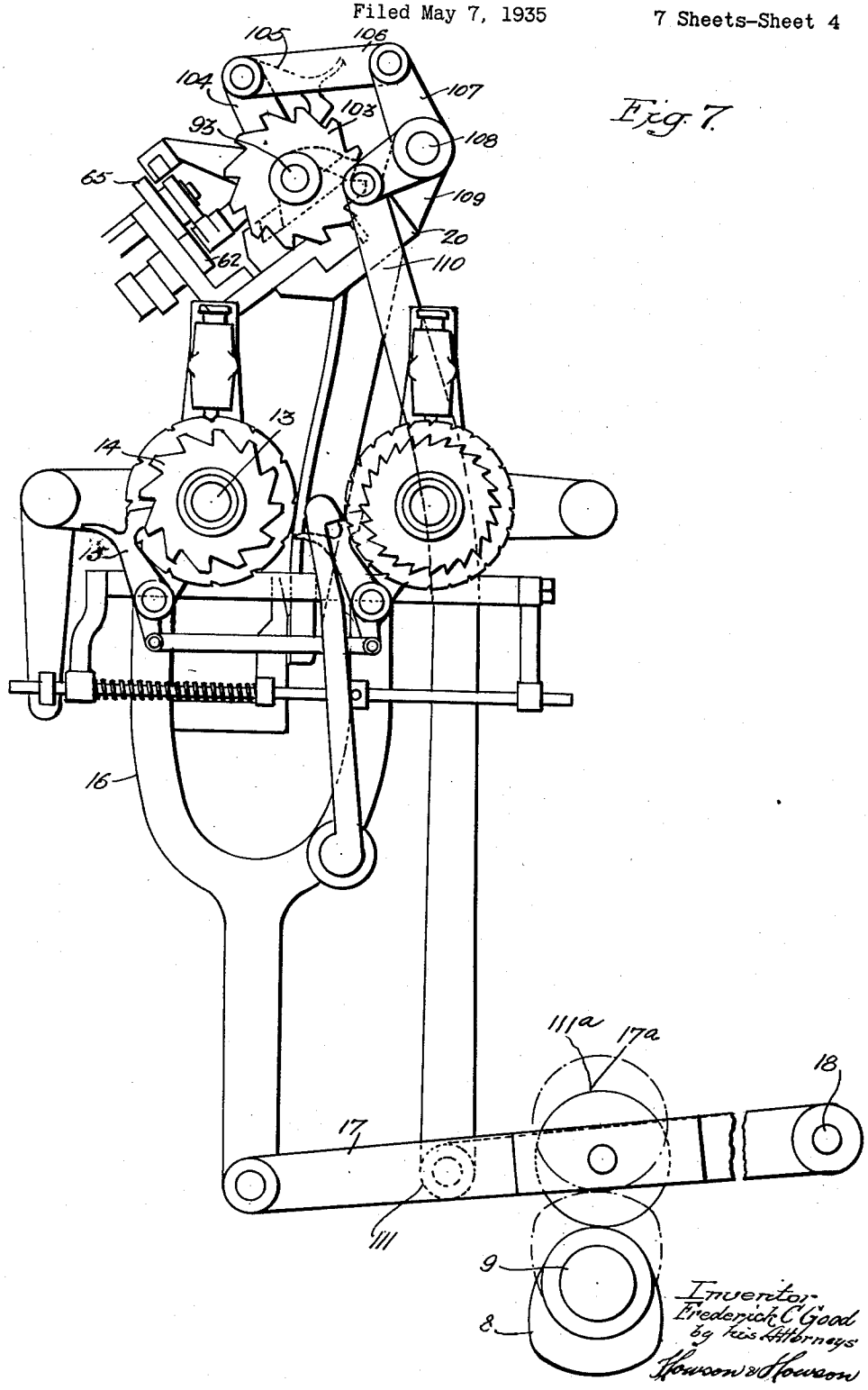
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CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 7.



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CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig. 9.

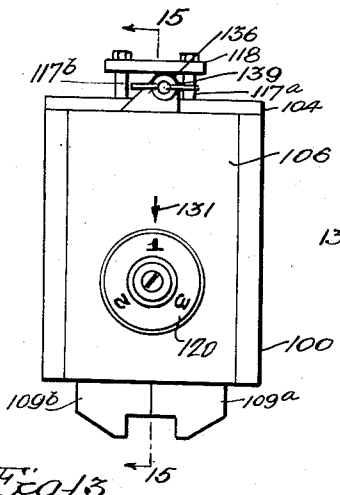


Fig. 11.

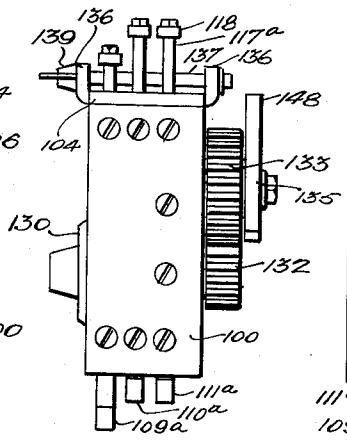


Fig. 10.

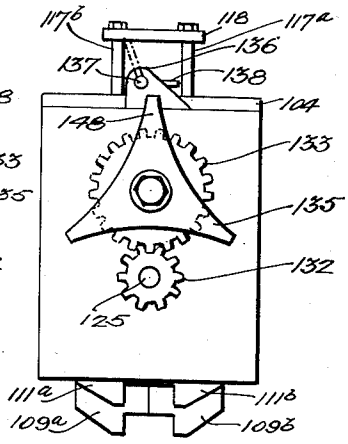


Fig. 13.

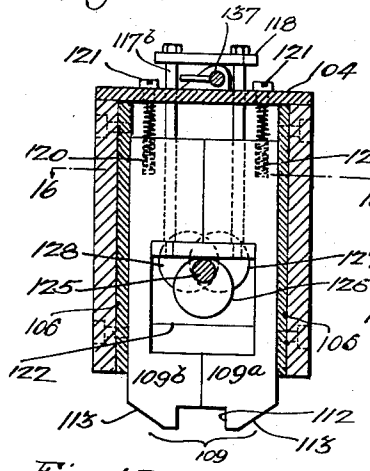


Fig. 15.

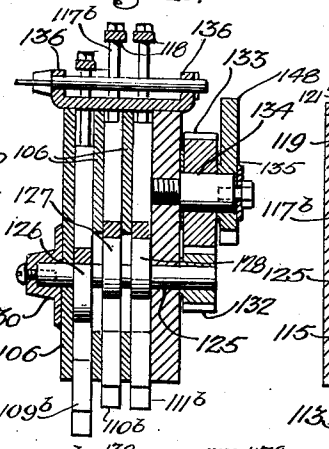


Fig. 14.

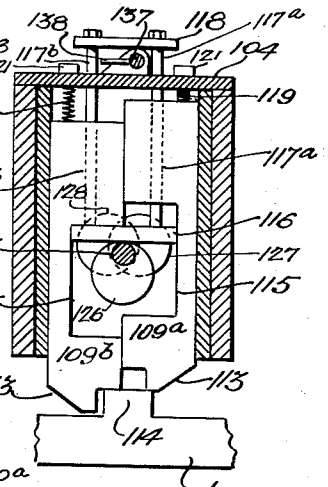


Fig. 12.

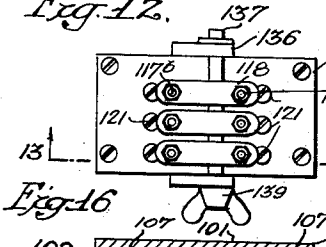


Fig. 16.

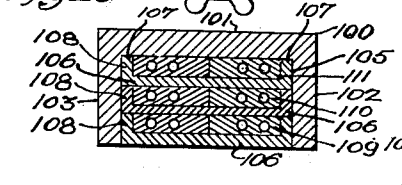
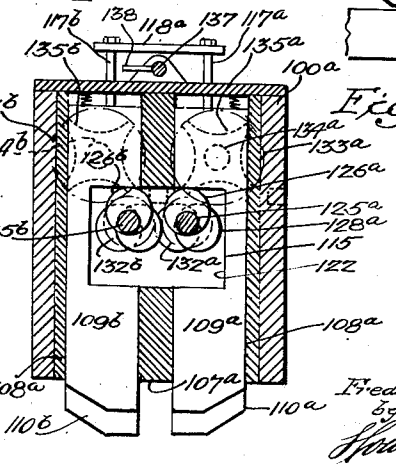


Fig. 17.



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CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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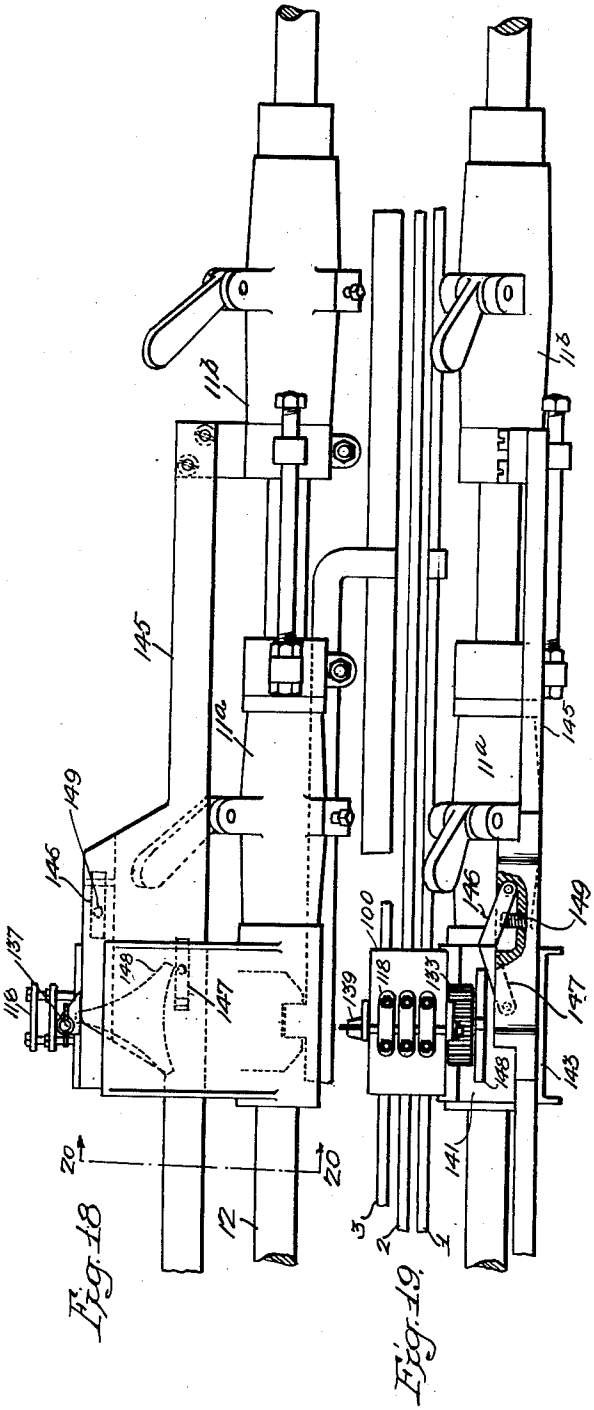


Fig. 18

Fig. 19

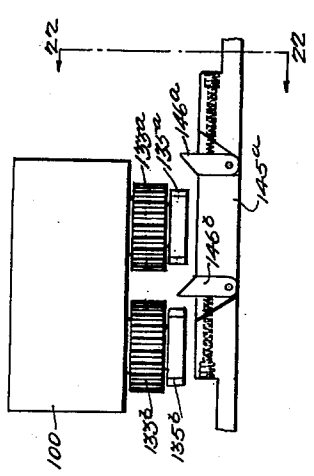


Fig. 21

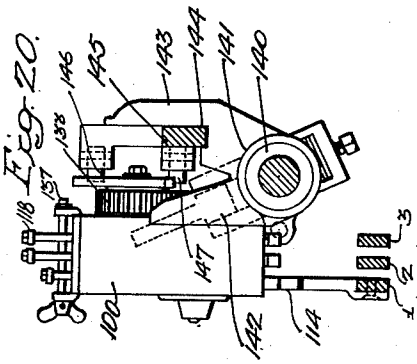


Fig. 20

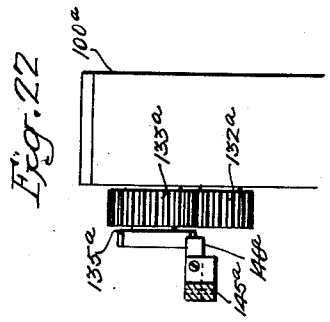


Fig. 22

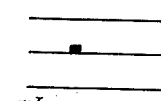
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CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

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Fig 23



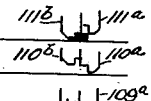


Fig. 24

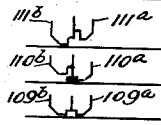


Fig. 25.

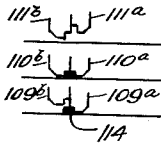


Fig. 26

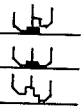


Fig. 27.

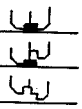


Fig. 28.

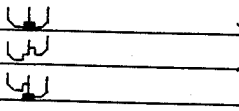


Fig. 29

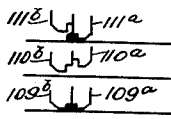
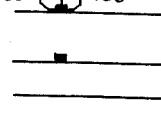


Fig. 30.



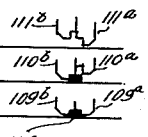


Fig. 31

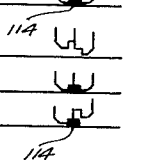
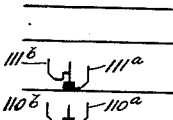


Fig. 32



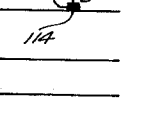


Fig. 33

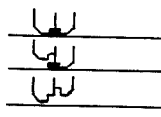
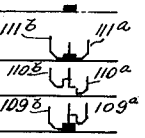


Fig 34.



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Patented July 25, 1939

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UNITED STATES PATENT OFFICE

2,167,478

CARRIER OPERATING MECHANISM FOR FLAT KNITTING MACHINES

Frederick C. Good, Philadelphia, Pa.

Application May 7, 1935, Serial No. 20,282

20 Claims. (Cl. 66—127)

The present application constitutes a continuation in part of my prior application Serial No. 735,081, filed July 13, 1934.

This invention relates to flat knitting machines which are provided with a multiplicity of independently operable thread carrier bars; and particularly to a simple and efficient attachment for selecting and operating, singly and in predetermined order or succession, a plurality of said bars, whereby the bars will respectively control and lay to the needles of the knitting machine a plurality of separate threads drawn from separate cones of the same kind, color and texture of yarn to be knit into successive courses of stitches with no two immediately succeeding courses composed of thread drawn from the same cone, in order to reduce to a minimum, especially in men's, women's and children's silk hosiery or in other sheer silk knitted fabrics, the formation of the objectionable rings or shadows which are frequently produced by reason of immediately succeeding courses being composed of a single thread having a relatively thick portion of sufficient continuous length to produce two or more courses of stitches in succession.

The attachment constituting the subject matter of the present invention is applicable to any of the well-known makes of full fashioned hosiery knitting machines of the "Cotton" type, including the "Reading" and other domestic and foreign machines.

In the accompanying drawings:

Fig. 1 is a transverse sectional elevation through a sufficient portion of a "Reading" machine to illustrate the attachment of the present invention as applied thereto;

Fig. 2 is a front elevation of the attachment and the thread carrier bars;

Fig. 3 is a plan view;

Fig. 4 is an end elevation showing the thread bars in section;

Fig. 5 is a transverse sectional elevation taken on the line 5—5, Fig. 2;

Fig. 6 is a longitudinal sectional elevation taken on the line 6—6, Fig. 4;

Fig. 7 is an end elevation of the narrowing mechanism of the knitting machine showing means for synchronizing certain elements of the mechanism of the attachment with the narrowing mechanism;

Fig. 8 is a diagrammatic front elevation of another form of mechanism for effecting synchronization of the devices;

Fig. 9 is a front elevation of a modified form of plunger head;

Fig. 10 is a rear elevation of the head shown in Fig. 9;

Fig. 11 is a side elevation of the head shown in Fig. 9;

Fig. 12 is a plan view of the head shown in Fig. 9;

Fig. 13 is a longitudinal sectional elevation taken on the line 13—13, Fig. 12;

Fig. 14 is a view similar to Fig. 13 with the two portions of one of the twin plungers in relatively different positions;

Fig. 15 is a transverse sectional elevation taken on the line 15—15, Fig. 9;

Fig. 16 is a sectional plan view taken on the line 16—16, Fig. 13;

Fig. 17 is a sectional elevation of another modified form of plunger head with twin plungers therein and separate means for operating the twin plungers independently;

Fig. 18 is a front elevation of a modified form of selector head-operating mechanism;

Fig. 19 is a plan view of the mechanism shown in Fig. 18;

Fig. 20 is a section on the line 20—20, Fig. 18;

Fig. 21 is a fragmentary view illustrating the mechanism for operating the pawls for the double star wheels shown in Fig. 17;

Fig. 22 is a sectional view taken on the line 22—22, Fig. 21; and

Figs. 23 to 34 inclusive are diagrammatic views illustrating the operation of that form of head shown in Fig. 17.

The attachment, as shown in Figs. 1 to 6 inclusive, comprises a main guide-bar, track, or slideway 20 which is adapted to be secured to any suitable and convenient rigid portion of a flat knitting machine, such for example as the center bed of a "Reading" machine, indicated at 19 on Fig. 1.

As shown in Fig. 1, the guide 20 is supported from the bed 19 by a bracket or brackets 21 which may be formed integral with the guide or secured in any suitable manner thereto. The guide 20 is mounted in substantially parallel relation to the bed 19 and to the multiplicity of thread carrier bars of the machine, which are indicated at 1 to 7 inclusive.

Slidably mounted in the guide 20 is a cross head 22. The cross head 22 is provided with a lateral extension 23 which overhangs the carrier bars 1 to 7, as clearly illustrated in Figs. 1, 4 and 5.

The bars 1, 2, 3, etc. are normally provided with operating dogs 1a, 2a, 3a respectively, each dog having a notch or recess 1b, 2b, 3b, etc., for the reception of one end of a slide 10 which is car-

ried by the ordinary friction box 11. The box 11 frictionally grips and moves with the ordinary friction box drive rod 12. The drive rod 12 forms part of the Coulier motion of the machine and receives a uniform axial movement.

The longitudinal movement of the carrier bars 1 to 7 is normally less than that of the drive rod and is controlled by stops at the opposite ends respectively of the machine. The end stops are movable toward and away from each other, to widen or narrow and thereby shape the fabric, through the medium of a narrowing screw 13 at each end of the machine.

Each narrowing screw 13 is provided with a ratchet wheel 14 operable by a pawl 15 which is pivotally mounted on a link 16, the link 16 in turn being pivotally connected to one end of an arm 17 which is pivotally mounted at 18 to a fixed portion of the frame of the machine.

The arm 17, in each case, receives an oscillating motion from the main cam shaft 9, when the cam shaft is shogged axially in the usual manner at such time as the fabric is to be shaped at its edges, by a cam 8 fixed to said cam shaft and engaging a cam follower 17a rotatably mounted on the arm 17.

In the present instance, instead of manually connecting each carrier bar to a separate friction box 11, as required in the ordinary knitting, a single friction box 11 with its connecting slide 10 is connected to the cross head 22 for operating any one of the carrier bars 1 to 7 which may be selected in accordance with the principles of the present invention.

The connection between the friction box 11 and the cross head 12 may be made in any suitable manner, according to the particular machine to which the attachment may be applied. In the present instance, in applying the attachment to the "Reading" type of machine, the connection between the friction box 11 and the cross head 22 may conveniently be made by providing in the overhanging extension 23 of the cross head 22 a suitable recess 24 for the reception of the one end of the connecting slide 10, said recess being clearly illustrated in Fig. 3.

From the above, it will be obvious that with the carrier-bar end stops set in predetermined relation to each other at the opposite ends of the machine and with the drive rod 12 receiving longitudinal reciprocation in the usual manner any one of the carrier bars, 1 to 7, which may be attached to the cross head 22 will receive a longitudinal movement in accordance with the setting of the end stops of the machine, surplus movement of the drive rod 12 being taken up by said drive rod sliding through the friction box 11 in the usual manner.

The present invention particularly concerns the mechanism by which the carrier bars are selectively connected to the cross head 22 and for this purpose the cross head 22 is provided with a series of longitudinally slidable plungers 31, 32, 33, etc., which are adapted to have their lower ends respectively and selectively projected into the recesses 1b, 2b, 3b, etc. of the carrier bars 1, 2, 3, etc., in a predetermined sequence.

While any suitable number of the carrier bars 1 to 7 may be employed for laying separate threads to the needles for knitting immediate succeeding courses in a predetermined order, it has been found that "ringless" or "shadowless" knitting may be accomplished by the use of but three separate threads, therefore, the following description will be directed to the use of the first three thread carrier bars of the machine, namely 1, 2 and 3 respectively.

The plungers 31, 32 and 33 which respectively connect the bars 1, 2 and 3 with the cross head 22 are slidably mounted in split bearings 35, 35, respectively. Each split bearing 35 is composed of two identical portions or halves 35a and 35b and each of such sections is preferably provided with a groove 36 which, when the two halves 35a and 35b are placed together, with their grooves facing each other, form a guide for slidably supporting the plunger 31, 32 or 33 as the case may be for longitudinal movement perpendicular to the thread carrier bar with which the plunger is associated.

Each bearing 35 is provided with laterally extending lugs or ears 37 which rest on the upper surface of the cross head extension 23, the lower portions of the bearings 35 fitting snugly within a slot or recess 38 formed in said extension.

Above each of the carrier bars which is not to be selected for operation is a solid filler block 35c, or, if desired, the bearings 35 without plungers therein may be inserted in the slot 38 to fill the length of the slot, whereby all the bearings or the bearings and the filler blocks combined may be rigidly clamped in the extension 23 by an outer plate 40 which is secured to the outer edge of the extension 23 by means of clamp bolts or screws 39 (see Fig. 5).

Each plunger 31, 32, 33 is provided with ears or lugs 41 in superposed relation to the ears or lugs 37 of the bearing 35 and between the lugs 37 and 41 are compression springs 42 which normally tend to raise the plungers in their respective bearings to an elevation, clear of the operating dogs 1a, 2a, 3a, wherein a rib 43, formed on and projecting laterally from the lower end of each plunger, engages the under side of the bearing 35 in which the plunger is mounted. Obviously, any form of spring or other resilient means may be provided for normally raising these plungers. In the present instance, each of the compression springs 42 has its lower end seated in a recess 44 formed in a bearing lug 37. The upper end of each spring encircles a pin 45 which is secured in and projects from and below each plunger lug 41 whereby lateral displacement of the springs is prevented.

The plungers 31, 32, 33 are adapted to be moved downwardly against the action of the springs 42 by cams 51, 52 and 53 respectively. The cams 51, 52 and 53, in the present instance, are set at 120° apart on a drive shaft 50, whereby, as said shaft is rotated, for example in the direction of the arrow in Fig. 6, the plungers 31, 32 and 33 will be operated in the order named, to connect and disconnect the carrier bars 1, 2 and 3 respectively to and from the cross head 22 in said predetermined sequence.

In order to set the cams for operating the plungers in any other desired order, each cam is provided with a single keyway 54 while the shaft 50 is provided with three keyways 55 set 120° apart, said keyways being adapted to receive a key 56 individual to each of the cams whereby the cams are interchangeable longitudinally and circumferentially of the shaft.

The shaft 50 is rotatably mounted, in the present instance, in legs 57 and 58 of a substantially U-shaped frame 60, said legs being connected by a back plate 59. Adjacent one side of the leg 58 of the frame 60 the shaft 50 is provided with an integral collar 61 and secured to the shaft 50 at the opposite side of the leg 58 is a

gear 62 which is pinned or otherwise secured to said shaft, whereby axial movement of the shaft 50 in the frame 60 is prevented and whereby the cams 51, 52 and 53 are normally maintained in operating alignment with the plungers 31, 32 and 33 respectively.

Mounted on the shaft 50 between the last of the cams thereon and a clamp nut 63, which is threaded onto a reduced end 64 of the shaft, is a series of filler collars 61a which are interchangeable with the cams in the same manner as the cams are interchangeable one with another so that the cams may be selectively placed in operating alignment with any desired ones of the carrier bars 1 to 7 inclusive.

Meshing with the gear 62 is a gear 65 and secured to the gear 65 is a star wheel 66. In the present instance the star wheel 66 has three arms, in accordance with the three cams 51, 52 and 53. However, in instances where more than three cams are to be attached the star wheel 66 will correspondingly be provided with the same number of arms as there are operating cams on the shaft 50.

Intermittent rotation of the star wheel 66 will effect intermittent rotation of the shaft 50 and the cams thereon as will be more fully described hereinafter.

The gear wheel 65 and the star wheel 66 are loosely mounted on one end of a shaft 67 which has one of its ends mounted in the upper portion 40a of the clamp plate 40 and its opposite end mounted in the upper end of a bracket 68 which is secured to the cross head extension 23 in parallel relation to the clamp plate 40.

The shaft 67, adjacent one of its ends, is shouldered at 69 to bear against the outer side of the bracket 68 and at its opposite side is provided with a clamp screw 70 bearing against the opposite outer side of the bracket portion 40a of the clamp plate 40, to prevent axial movement of the shaft 67 in the said brackets.

The shaft 67 functions as a pivot for the U-shaped frame 60, said frame being pivotally mounted for the purpose of swinging the cams 51, 52, 53 to an inoperative position relative to the plungers 31, 32, 33 to permit normal operation of the carrier bars 1 to 7 inclusive when desired. The brackets 40 and 68 are provided with arcuate slots 71 to permit swinging movement of the frame 60 in one direction, swinging movement of said frame in the opposite direction being prevented by shoulders or abutments 72 and 73 (see Fig. 3) formed in the brackets 40 and 68 respectively.

In order to move and maintain the frame 60 into and in the above noted inoperative position, the frame 60 is provided with a handle 74 and pivotally connected to said handle is a spring-pressed latch 75 which is adapted to engage a transversely extending stud or rod 76 carried by either of or extending between the brackets 40 and 68.

In order to permit the tilting of the frame 60 the abutment shoulders 72 and 73 are cut away at an angle at their upper ends as indicated at 72a and 73a respectively.

The latch 75 is provided with a finger-release portion 75a adjacent the handle 74, as clearly illustrated in Figs. 2 and 6, for quick release of the latch.

Intermittent rotation of the star wheel 66 is effected by means of abutments or trips 80 and 81 which are disposed respectively adjacent the opposite ends of the reciprocatory movement of the cross head 22, whereby, as the cross head moves to the left for example (see Fig. 2) and as the carrier bar which is connected to the cross head approaches the ordinary end stop at the left end of the machine, the lower leg of the star wheel will engage the left hand trip or abutment 80, thereby turning the star wheel 66 to the extent of 60°. Due to a two-to-one ratio of the gears 62 and 65, in the present instance, the shaft 50 with the cams 51, 52 and 53 thereon will receive a partial rotation of 120°, thereby releasing the one plunger from the one bar and effecting engagement of another of the plungers with another of the carrier bars, in accordance with the order of selection determined by the positioning of the cams on the shaft. Such 60° movement of the star wheel 66 will cause one of the arms thereof to project vertically upward and, upon movement of the cross head 22 in the opposite direction, as the bar then connected thereto approaches the ordinary end stop at the right hand side of the machine, the then upwardly projecting arm of the star wheel will engage the trip or abutment 81, thereby effecting a second 60° movement of the star wheel 66 and a corresponding 120° movement of the shaft 50, to release the lastly operated bar from the cross head and to connect another of the bars to said cross head. Such 60° movement of the star wheel again moves one of the arms thereof into the vertical downwardly extending position, to be engaged by the abutment stop 80 when the cross head again moves to the left.

The abutments 80 and 81 are pivotally mounted in guide blocks 82 and 83 respectively which in turn are carried by brackets 84 and 85 which extend laterally from control nuts 86 and 87 respectively. The control nuts 86 and 87 are slidably mounted, in the present instance, in a plate 88 which forms a cover for the guideway 20 in which the cross head 22 is slidably mounted, said plate 88 being secured to the guide bar 20 by screws or bolts 89 as shown in Fig. 4.

The nuts 86 and 87 are respectively provided with outwardly flaring bases or feet 90 and 91 which fit and are slidably mounted in a dove-tailed groove 92 formed in the upper side of the plate 88. The nuts 86 and 87 are provided with axially aligned bores threaded "right" and "left" respectively, for the reception of right and left threaded portions 94 and 95 respectively of a control shaft 93.

The control shaft 93 is reduced in diameter, as indicated at 96 in Fig. 3, providing shoulders 97 and 98 which bear against the opposite sides of an anchor bearing 99. The bearing 99 is of the split block type having a flared foot portion 100 fitting the dove-tailed groove 92 and a cap 101 secured to the foot 100 by bolts or screws 102 which pass completely through the cap 101 and foot 100 and are threaded into openings drilled and tapped in the base of the groove 92, whereby free rotation of the screw shaft 93 is permitted while axial movement thereof is prevented.

As the ordinary narrowing stops of the machine are moved relative to each other to shape the fabric being knit on the machine the travel of the thread carrier bars is determined accordingly, and in order to operate the star wheel 66 for selecting the carrier bars under the present invention at the extreme limit of travel of the carrier bars as fixed by the positions of the ordinary end stops, it is necessary that the trip stops 80 and 81 be moved in accordance with the end stops of the machine, and for this reason rota-

tion of the screw shaft 93 is synchronized with the rotations of the ordinary narrowing screws of the machine. This may be accomplished in any desired manner such as illustrated in Figs. 7 and 8 respectively.

In Fig. 7, for example, the screw shaft 93 is provided with a ratchet wheel 103. A pawl-carrying arm 104 is loosely mounted on the screw shaft 93 adjacent said ratchet wheel and carries a pawl 105 adapted to engage the teeth of the ratchet wheel. The pawl arm 104 is operatively connected by a link 106, to one arm 107 of a bell-crank lever mechanism which, in the present instance, is pivotally mounted onto a bracket 109 formed on or secured to the guide 20. The second arm of the bell-crank lever 107 is connected by a link 110 to an arm 111 which is pivotally mounted to a fixed portion of the machine in line with the pivot 18 of the arm 17 by which operation of the narrowing screw 13 is effected. The arm 111 is provided with a roller 111a corresponding to and axially aligned with the roller 17a on the arm 17 for engagement with a cam corresponding to and aligned with the cam on the main cam shaft 9 of the machine. Therefore, when the cam shaft 9 is shogged axially to effect narrowing and thereby effect operation of the ordinary narrowing screw 13 the levers 17 and 111 will be oscillated simultaneously to operate the ordinary narrowing screw 13 and the screw shaft 93 respectively, whereby the ordinary narrowing nuts of the machine and the trip stops 80 and 81 of the attachment are simultaneously moved toward each other.

In the arrangement shown in Fig. 8, the screw shaft 93 is provided with an axial extension which in turn is provided at its outer end with a sprocket wheel 115. The sprocket wheel 115 is connected by a sprocket chain 116 with a sprocket wheel 117 mounted on the end of the ordinary narrowing screw 13 at one end of the machine, in order that, as the narrowing screw 13 is operated to reduce the travel of the thread bars, the screw shaft 93 is similarly operated to move the trip stops 80 and 81 inwardly accordingly.

If for any reason it should be desirable to knit successive courses of stitches with any one single thread, the trip stops 80 and 81 may be thrown out of operation into inoperative positions shown in broken lines in Fig. 2, whereby the last selected carrier bar will continue to lay its thread to the needles until the stops are again placed in operating positions. As shown in Fig. 2, the stop 80 swings upwardly into its inoperative position while the stop 81 swings downwardly.

In order to maintain the stop 81 in its operating position within the groove in the block 83 in which the stop is mounted a spring-pressed latch 118 is provided to bear against the end of the stop or to fit into a notch formed in said end. The stop 80, resting in the base of the groove of the block 82 in which it is mounted, requires no other means for maintaining it in its operating position.

With the present set-up of cams 51, 52 and 53, let it be assumed that the carrier bars 1 and 3 are in the extreme right position with the carrier bar 2 in the extreme left position and that the cam 51 has depressed plunger 31 to connect the bar 1 with the cross head 22. The drive rod 12 by moving to the left will carry the bar 1 therewith into the extreme left position, whereupon the shaft 50 by turning 120° will release the rod 1 and effect connection of the rod 2 with the cross head 22. The drive rod 12 by then moving to the right will carry the rod 2 in the same direction to the extreme right position, whereupon the shaft 50 by making another 120° rotation will release the rod 2 and effect connection of the rod 3 to the cross head 22. The drive rod 12 by then moving to the left will carry the rod 3 into the extreme left position, whereupon the rod 3 will be disconnected from the cross head 22 and the bar 1 will be reconnected to the cross head for reverse movement to a starting position at the extreme right. The drive rod 12 by again moving to the right will carry the rod 1 into the extreme right position, wherein the bar 1 will be released and connection will be made with the rod 2. Movement of the drive rod 12 to the left then carries the bar 2 into the extreme left position, whereupon the bar 2 is disconnected and the bar 3 is again connected to be moved to the right by the next movement of the drive rod 12, to complete one cycle of operation of the attachment, wherein thread has been laid to the needles of the machine for the formation of six courses of stitches and wherein the thread controlled by each bar has been laid to the needles only for the formation of each third course of stitches.

A modified form of the invention shown in Figs. 9 to 16 inclusive and in Figs. 18 and 19 comprises a head 100, which in the present instance consists of the back wall, side walls and top plate 101, 102, 103 and 104 respectively and which provide the cavity 105 for the reception of a series of partition plates 106.

The partition plates 106 are each provided with longitudinal flanges 107 for spacing the partitions with respect to each other and with respect to the back wall 101, to provide vertical guideways 108, for a plurality of twin plungers 109, 110 and 111. Each of the twin plungers includes a right hand section 109a, 110a, 111a as the case may be, and a left hand section 109b, 110b and 111b as the case may be. Each twin plunger is provided with a centralized recess in its lower edge indicated at 112, formed half in one of the sections and half in the other of the sections, in each instance.

The opposite lower corner edge of each section is beveled or inclined as illustrated at 113, in Fig. 13, the centralized recess 112 being adapted to receive a dog 114 on one of the thread bars 1, 2, 3, etc., with which the twin plungers are respectively aligned vertically, the beveled corners 113 being provided to permit the one section to engage and ride up over the top of the thread bar dog, as illustrated in Fig. 14, whereby the vertical wall of the recess 112 in the other of the plunger sections may engage one of the vertical walls of the dog 114, after which the previously raised section of the plunger will descend at the opposite side of the thread bar dog to confine said dog within the recess 112 for locking the thread bar to the head 100.

Each twin plunger is provided with a rectangular opening 115 formed half in one of the plunger sections and half in the other plunger section, in each instance.

Normally disposed in the opening 115 is a cross bar 116 extending from side to side of the opening 115. Each cross bar 116 is provided with a pair of vertical rods 117a, 117b which pass upwardly through openings formed in the *a* and *b* sections of each twin plunger respectively and through the top plate 104.

Above the top plate 104, the rods 117a—117b are connected by a second cross bar 118. Each of the twin plunger sections is provided with a spring 119 having one end seated in a bore 120 formed in the upper end of the plunger section and its opposite end seated against a shouldered screw 121 threaded into and through the top plate 104, whereby the plunger sections are independently urged to move downwardly at all times.

Extending transversely through the openings 115 in the several twin plungers and through corresponding openings formed in the two inner partitions 106 and journaled in the back plate 101 and in the outermost partition 106 is a shaft 125 on which is mounted or formed integral therewith a series of cams or eccentrics 126, 127 and 128 which are disposed in the planes of the plungers 109, 110 and 111 respectively, said cams being disposed at 120° apart about the axis of the shaft 125. These cams are adapted to engage the undersides of the cross bars 116 within the recess 115 of the plungers 109, 110 and 111 respectively.

Rotation of the shaft 125 in intermittent steps of 120° each will cause the cams thereon to lower the plungers 109, 110 and 111 in succession for locking the thread bars 1, 2 and 3 successively to the head 100, it being noted that there is but one plunger in the lowered thread bar engaging position at any one time, the other two plungers being maintained in an inactive raised position.

Rotation of the shaft 125 may be effected manually as in setting the device at the beginning of a cycle of its operation by a dial 120 secured to the shaft 125 adjacent the outermost partition plate 106, said dial being provided with numbers corresponding to the thread bars 1, 2 and 3 respectively and arranged to index with a pointer 131 on the outer partition plate 106 for indicating which of the plungers is in its lowered bar-engaging position.

After setting, the shaft 125 is adapted to be mechanically driven and automatically rotated by means of a pinion 132 secured to or formed on the end of the shaft 125 outside the back wall 101 of the head 100. The pinion 132 intermeshes with a gear 133 which is rotatably mounted on a stud 134 fixed to and projecting laterally from the back wall 101. Freely rotatable on the stud 134 and secured to the gear 133 is a three-point star wheel 135 which is adapted to be rotated in intermittent steps of 60° each as and by mechanism hereinafter described.

In order to raise all of the plungers to an inoperative position, the top plate 104 is provided with lugs 136, 136 which provide bearings for a transversely extending shaft 137, said shaft being provided with a lateral extension 138 which, when said plungers are operating, is turned to a horizontal position by rotation of the shaft 137, but which, when it is desired to raise said plungers to an inoperative position, is turned to a substantially vertical position illustrated in broken lines in Fig. 10, and whereby the outer edge of the blade or lateral extension 138 engages the undersides of the cross bars 116 and through the rods 117a, 117b and lower cross bars 116 raises and maintains all of the plungers in an upper inoperative position. Turning of the shaft 137 is effected through means of the knob or butterfly nut 139 formed on or secured to one end of the shaft 137.

The head 100 may be mounted on the slide 23 illustrated in Fig. 4, but is preferably mounted on one end of one of the ordinary friction boxes 11 which are slidably mounted on and arranged to frictionally grip the friction box drive rod 12 of the machine.

In the present instance, as illustrated in Figs. 18, 19 and 20, a friction box 11a is provided at one side with an elongated hub 140 on and to which is secured a sleeve 141. Formed integral with the sleeve 141 is a bracket 142 to which the back wall 101 of the head 100 may be secured in any suitable manner. Also formed on the sleeve 141 is a bracket 143 provided with a guideway 144 for a slide bar 145. The slide bar 145 is connected at one of its ends to a second friction box 11b which, like the friction box 11a, is slidably mounted on the rod 12 and adapted to frictionally engage the same in the usual manner.

The slide bar 145 is provided with upper and lower pawls 146 and 147 which project laterally from said slide bar and arranged to engage the points 148 of the star wheel 135 at opposite sides, that is, above and below the center of the stud 134, said pawls being so arranged and resiliently pressed outwardly by springs 149 that reciprocation of the bar 145 relative to the head 100 will effect intermittent rotation of the star wheel in one direction.

In operation, assuming that the twin plunger 109 is engaging the dog 114 of the thread carrier rod 1 to lock said thread carrier rod to the head 100, movement of the rod 12 axially to the left will cause the head 100 and the rod 1 to move correspondingly until the end of the carrier rod 1 engages one of the end stops of the machine, whereupon further movement of the head 100 will be arrested, the rod 12 thereafter sliding through the friction box 11a. However, the friction box 11b is still frictionally locked to and moving with the actuating rod 12 and causing a relative longitudinal movement of the slide bar 145 with respect to the head 100, whereby the pawl 146 is caused to engage the vertically projecting point 148 of the star wheel 135, such relative movement causing a 60° rotation of the star wheel 135 and gear wheel 133 which provides a 120° rotation of the pinion 132 and the shaft 125. Such rotation of the shaft 125 will cause a corresponding movement of the cams 126, 127 and 128 thereon. Such movement of the cam or eccentric 126 raises the twin plunger 109 through the medium of its cross bar 116 and causes the cam 127 to move into the position formerly occupied by the cam 126, whereby the twin plunger 110 is lowered into position to grip the dog 114 of the thread carrier rod 2, locking the same to the head 100 while the raising of the plunger 109 disconnects the thread bar 1 from the head 100.

The above noted 60° movement of the star wheel 135 causes one of the points 148 thereof to project vertically downward. As the bar 12 then moves in the opposite direction, it carries the thread bar 2 along with it until said bar engages the end stop at the right hand side of the machine which arrests the head 100 and friction box 11a against further movement while the friction box 11b and slide bar 145 continue to travel with the actuating rod 12 which produces a relative movement between the slide bar 145 and the head 100 in a direction opposite to that formerly noted and causing the lower pawl 147 to engage the then downwardly projecting point of the star wheel, causing said star wheel to turn to the extent of 60° by which the plunger 110 is raised to release the thread bar 2 and the plunger 111 is lowered to engage the thread bar

3, the plunger 109 at the same time being retained in its upper inactive position.

The thread bar 3 on the next movement of the actuating rod 12 to the left is carried along with said actuating bar until it engages the left end stop of the machine, whereupon the star wheel is again actuated, causing a release of the thread bar 3 and a locking of the thread bar 1 to the head 100 for a return to its position at the right hand side of the machine. These operations carry on in this order throughout the knitting operation, bringing the thread bars 1, 2 and 3 successively into operation for laying the threads controlled thereby to the needles of the knitting machine.

In that form of the invention shown in Figs. 17 and 21 to 34 inclusive, the sections 109a, 109b; 110a, 110b; 111a, and 111b are spread apart to an extent substantially equal to the width of the dogs 114 on the thread bars 1, 2 and 3, and each of the partition plates 106 is provided with a central rib 107a extending from the lower edge of the plate to the lower edge of the opening 122 in the plate and from the top edge of said opening to the top edge of said plate, whereby each of the twin plunger sections is mounted in an individual guideway 108a. In this instance, the head 100a is provided with a pair of transversely extending shafts passing through the openings 122 in the partition plates and the openings 115 in the plunger sections, said shafts being indicated at 125a and 125b. Each shaft is provided with three cams 126a, 127a, 128a and 126b, 127b and 128b. Said shafts are respectively provided with pinions 132a and 132b which mesh with gears 133a and 133b respectively mounted on independent studs 134a and 134b respectively.

Secured to the gears 133a and 133b are star wheels 135a and 135b respectively. In this case, the vertical rods 117a and 117b are secured to the twin plunger half sections respectively and are arranged to slide freely through cross bar 118a which extends across the shaft 137, whereby as the shaft is turned all of the plunger sections are simultaneously raised to an inoperative position. In this case, as above described, the plunger sections are urged downwardly by the springs 119. The star wheels 135a and 135b are adapted to be turned in opposite directions by resilient pawls 146a and 146b arranged in a common plane adjacent the lower edges of the star wheels 135a, 135b, said pawls being carried by the slide bar 145a and so arranged that when the slide bar moves to the left relative to the head 100a, the pawl 146b will turn the star wheel 133b 90° in one direction and through the gearing 133b—132b turn the shaft 125b to the extent of 120° for operating the series of plunger sections 109b, 110b, 111b.

When the slide bar 145a moves to the right relative to the head 100a, the pawl 146a will engage the star wheel 135a, giving it a 90° turn, and through the gearing 133a—132a rotating the shaft 125a to the extent of 120° for operating the series of plunger sections 109a, 110a, 111a.

Referring now to the diagrams in Figs. 23 to 34, assuming that No. 1 bar and No. 3 bar have been moved into contact with the end stops at the right hand side of the machine and No. 2 bar has been moved into contact with the end stop at the left hand side of the machine and that it is desired to move the bars in 1—2—3 order, the plunger sections 109a, 109b are in locking engagement with the dog 114 on the thread bar 1. The friction box actuating rod 12 would then move to the left, carrying with it the head 100a and the thread bar 1.

When the thread bar 1 engages the left end stop of the machine, the shaft 125b is rotated 120° to raise the plunger section 109b and to lower the plunger section 110b against the left hand side of the dog 114 on the thread bar 2, the plunger section 110a having been previously lowered by a former operation of the shaft 125a. The friction box actuating rod 12 and the head 100a then moves to the right, as illustrated in Fig. 25, carrying with it the thread bar 2.

As the thread bar 2 engages the right hand end stop, the shaft 125a is actuated to raise the plunger section 110a and to lower the plunger section 111a into engagement with the right hand side of the dog 114 on the thread bar 3. The plunger section 111b having been previously lowered by a former rotation of the shaft 125b, the bar 12 and head 100a then move to the left, as illustrated in Fig. 27, carrying with it the thread bar 3 until said thread bar engages the left hand end stop of the machine, whereupon the shaft 125b is rotated to raise the plunger section 111b and to lower the plunger section 109b into engagement with the left side of the dog 114 on the bar 1.

Movement to the right of the head 100a carries the thread bar 1 into its starting position and causes a rotation of the shaft 125a to release the plunger section 109a from the dog 114 of the bar 1 and to lower the plunger section 110a into engagement with the right side of the dog 114 on the bar 2, as shown in Fig. 31.

Movement of the head 100a to the left then carries the bar 2 to its starting position and causes the shaft 125b to be rotated to raise the plunger section 110b out of engagement with the dog of the bar 2 and to lower the plunger section 111b into engagement with the left side of the dog on the thread bar 3, as illustrated in Fig. 33. The next stroke of the friction box actuating rod 12 and the head 100a to the right brings the thread bar 3 into its original starting position, as shown in Fig. 34 and causes the plunger section 111a to be raised to release the dog of the bar 3 and the plunger section 109a to be lowered to engage the dog of the bar 1, as illustrated in Fig. 23 for the start of a repeat of the complete cycle just described.

The advantage of this form of the invention resides in the fact that in each direction of movement of the head 100a the bar moved by such movement of the head and the bar to be moved by the return stroke of the head are held firmly in engagement with the end stops of the machine preventing rebound of the one bar or creeping movement of the other bar while the slur cock is completing its sinker-projecting movement and during the stitch-forming operations of the machine and up until such time as the slur cock and thread guides begin a reverse movement relative to the bank of needles, which insures that the thread guides will not be accidently moved into positions causing damage to needles or sinkers and further insuring that each bar in succession will be in the right position to be picked up by the reciprocating head 100a in its proper turn.

I claim:

1. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be

reciprocated by said frictionally driven means parallel to said bars, a series of twin plungers each comprising a pair of independently movable sections slidably mounted in said head perpendicular to said bars respectively, and means on said head for projecting and retracting said plunger sections to and from driving engagement with said bars in predetermined sequence.

2. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of twin plungers each comprising a pair of independently movable sections slidably mounted in said head perpendicular to said bars respectively, resilient means on said head for projecting said sections independently into driving engagement with said bars, and positive acting means on said head for retracting and withholding said sections from said driving engagement.

3. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of twin plungers each comprising a pair of independently movable sections slidably mounted in said head perpendicular to said bars respectively, resilient means on said head for projecting said sections independently into driving engagement with said bars, and cam means on the head for retracting and withholding said sections from said driving engagement in predetermined sequence.

4. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of twin plungers each comprising a pair of opposed sections independently and slidably mounted in said head perpendicular to said bars respectively, a pair of shafts rotatably mounted on said head adjacent the two series of plunger sections respectively, and a series of cams on each shaft for projecting said opposed plunger sections into driving engagement with said bars respectively and in predetermined sequence.

5. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of plungers slidably mounted in said head perpendicular to said bars respectively, a shaft rotatably mounted on said head adjacent said series of plungers, a series of cams on said shaft, and trip means including a star wheel on the head and a pair of abutments respectively cooperating with said star wheel adjacent the limits of reciprocation of the head for intermittently rotating said cam shaft for projecting said plungers into driving engagement with said bars respectively and in predetermined sequence.

6. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of twin plungers each comprising a pair of independent sections slidably mounted in said head perpendicular to said bars respectively, a shaft rotatably mounted on said head adjacent said series of plungers, a series of cams on said shaft, and trip means including a star wheel on the head and a pair of abutments respectively cooperating with said star wheel adjacent the limits of reciprocation of the head for intermittently rotating said cam shaft for projecting said plungers into driving engagement with said bars respectively and in predetermined sequence.

7. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of twin plungers each comprising a pair of opposed independently operable sections slidably mounted in said head perpendicular to said bars respectively, a pair of shafts rotatably mounted on said head adjacent said each series of plunger sections, a series of cams on each shaft, a pair of star wheels on the head and operatively connected to said shafts respectively, and trip means including a pair of abutments respectively cooperating with said star wheels adjacent the limits of reciprocation of the head for intermittently rotating said cam shafts for projecting said plunger sections into driving engagement with said bars respectively and in predetermined sequence.

8. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, means carried by said head for selectively connecting said bars thereto in predetermined sequence, trip means adjacent the limits of reciprocation of said head for actuating said selecting means, and means for setting said trip means in accordance with the setting of said end stops.

9. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, means carried by said head for selectively connecting said bars thereto in predetermined sequence, trip means adjacent the limits of reciprocation of said head for actuating said selecting means, means for setting said trip means in accordance with the setting of said end stops, and means for synchronizing the setting movements of said trip means and the end stops.

10. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of plungers slidably mounted in said head perpendicular to said bars respectively, a shaft rotatably mounted on said head adjacent said series of plungers, a series of cams on said shaft, trip means including a

star wheel on the head and a pair of abutments respectively positioned adjacent the limits of reciprocation of the head for intermittently rotating said cam shaft for projecting said plungers into driving engagement with said bars respectively and in predetermined sequence, and means for moving said abutments toward and away from each other parallel to the path of reciprocatory movement of the star wheel in accordance with the relative positions of said end stops.

11. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops, said attachment comprising a slideway adapted to be positioned adjacent and parallel to said bars, a head slidably mounted in said slideway and overhanging said bars, means for operatively connecting said head to said frictionally driven means, a series of plungers slidably mounted in the overhanging portion of the head perpendicular to said bars respectively, a shaft rotatably mounted in said head above said plungers, cams on said shaft for respectively projecting said plungers into driving engagement with said bars in predetermined sequence, and means operable adjacent the limits of reciprocation of said head for intermittently rotating said cam shaft.

12. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, a friction box drive rod axially reciprocable parallel to said bars, a pair of friction boxes mounted on said rod, a head carried by one of said friction boxes and overhanging said bars, a series of plungers slidably mounted in said head perpendicular to said bars respectively, means on the head for projecting and retracting said plungers to and from driving engagement with said bars, and means carried by the second of said friction boxes for actuating said plunger-operating means upon engagement of a driven bar with one of said end stops producing relative movement between said friction boxes on said drive rod.

13. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, frictionally driven means for reciprocating the bars between the end stops including an axially reciprocable drive rod adjacent and parallel to said bars, a pair of friction boxes mounted on said drive rod, a head carried by and slidably mounted on one of said friction boxes and overhanging said bars, a series of plungers slidably mounted in the head perpendicular to said bars respectively, a shaft rotatably mounted in said head above said plungers, cams on said shaft for respectively projecting said plungers into driving engagement with said bars in predetermined sequence, a star wheel rotatably mounted on said head and operatively connected to said cam shaft, and a pair of relatively spaced abutments carried by the second of said friction boxes and operable adjacent the limits of reciprocation of said head for alternately engaging the star wheel to effect intermittent rotation of the cam shaft by relative movement between said friction boxes on said drive rod.

14. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops, said attachment comprising a slideway adapted to be positioned adjacent and parallel to said bars, a head slidably mounted in said slideway and overhanging said bars, means for operatively connecting said head to said frictionally driven means, a series of plungers slidably mounted in the overhanging portion of the head perpendicular to said bars respectively, a shaft rotatably mounted in said head above said plungers, cams on said shaft for respectively projecting said plungers into driving engagement with said bars in predetermined sequence, a star wheel rotatably mounted on said head and operatively connected to said cam shaft, a pair of relatively adjustable abutments adjacent the limits of reciprocation of said head for alternately engaging the star wheel to effect intermittent rotation of the cam shaft, a guideway for slidably supporting said abutments, a shaft having oppositely pitched screw portions threaded into said abutments respectively, and means for rotating the screw shaft for moving the abutments in accordance with relative adjustments of said end stops.

15. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops, said attachment comprising a slideway adapted to be positioned adjacent and parallel to said bars, a head slidably mounted in said slideway and overhanging said bars, means for operatively connecting said head to said frictionally driven means, a series of plungers slidably mounted in the overhanging portion of the head perpendicular to said bars respectively, a shaft rotatably mounted in said head above said plungers, cams on said shaft for respectively projecting said plungers into driving engagement with said bars in predetermined sequence, a star wheel rotatably mounted on said head and operatively connected to said cam shaft, a pair of relatively adjustable abutments adjacent the limits of reciprocation of said head for alternately engaging the star wheel to effect intermittent rotation of the cam shaft, and means for supporting said abutments in a manner providing for movement of the abutments to inoperative positions respectively and independently relative to the path of reciprocation of the star wheel.

16. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops, said attachment comprising a slideway adapted to be positioned adjacent and parallel to said bars, a head slidably mounted in said slideway and overhanging said bars, means for operatively connecting said head to said frictionally driven means, a series of plungers slidably mounted in the overhanging portion of the head perpendicular to said bars respectively, a frame pivotally mounted on said head, a shaft rotatably mounted in said frame, cams on said shaft for respectively projecting the plungers into driving engagement with said bars in predetermined sequence, means adjacent the limits of reciprocation of the head for intermittently rotating the cam shaft, and means for swinging said frame in said head to move said cams to an inoperative position relative to said plungers.

17. An attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops, said attachment comprising a slideway adapted to be positioned adjacent and parallel to said bars, a head slidably mounted in said slideway and overhanging said bars, means for operatively

connecting said head to said frictionally driven means, a series of plungers slidably mounted in the overhanging portion of the head perpendicular to said bars respectively, a frame pivotally mounted on said head, a shaft rotatably mounted in said frame, cams on said shaft for respectively projecting the plungers into driving engagement with said bars in predetermined sequence, means adjacent the limits of reciprocation of the head for intermittently rotating the cam shaft, means for swinging said frame in said head to move said cams to an inoperative position relative to said plungers, a star wheel loosely mounted on the frame pivot, a gear wheel rigidly secured to the star wheel, a gear on the cam shaft meshing with said star wheel gear, and a pair of relatively movable abutments adjacent the limits of reciprocation of the star wheel respectively for intermittently rotating the cam shaft.

18. In an attachment for a knitting machine having a multiplicity of thread bars, adjustable end stops, and frictionally driven means for reciprocating the bars between the end stops; said attachment comprising a head adapted to be reciprocated by said frictionally driven means parallel to said bars, a series of plungers slidably mounted in said head perpendicular to said bars respectively, a series of bearings for said plungers and a series of filler blocks interchangeable with said bearings in said head, a shaft rotatably mounted on said head adjacent said series of plungers, a series of cams on said shaft for projecting said plungers into driving engagement with said bars respectively and in predetermined sequence, and a series of spacer collars interchangeable with said cams on said shaft.

19. In a flat hosiery knitting machine provided with a reciprocable friction rod and a multiplicity of carrier rods, carrier rod driving mechanism comprising a friction device frictionally engaged with said friction rod, carrier rod driving means carried by said friction device and including a series of twin plungers each including a pair of independently movable sections, means upon each carrier rod for establishing a driving connection with said plunger sections of the driving means, selector cams adapted to move with said friction device and operated from a power member of the knitting machine, for selectively engaging and disengaging the plunger sections of said carrier rod driving means from the connecting means on the several carrier rods.

20. In a flat knitting machine provided with a reciprocable friction rod and carrier rods, carrier rod driving mechanism comprising a friction device frictionally engaged with said friction rod, a multiplicity of carrier rod driving means carried by said friction device, each of which is associated with a different carrier rod and includes independently movable plunger sections engageable with said associated carrier rod, means upon each carrier rod for establishing a driving connection with the plunger sections of the respective driving means, and means adapted to move with said friction device for independently engaging and disengaging each of said carrier rod driving means for moving the plunger sections thereof from the connecting means on the associated carrier rod.

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