Feb. 25, 1936. R. H. LAWSON ET AL 2,032,324

KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 1. FIG. 2. FIG. 3.

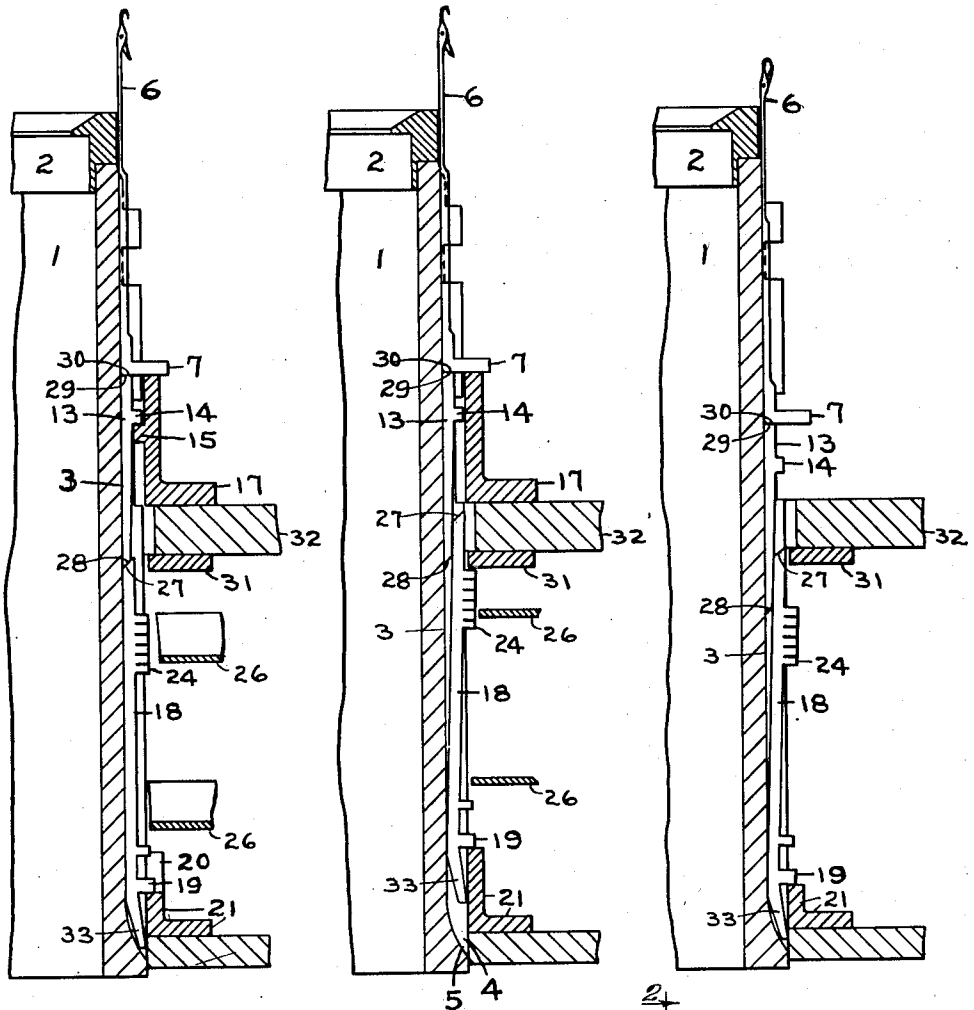
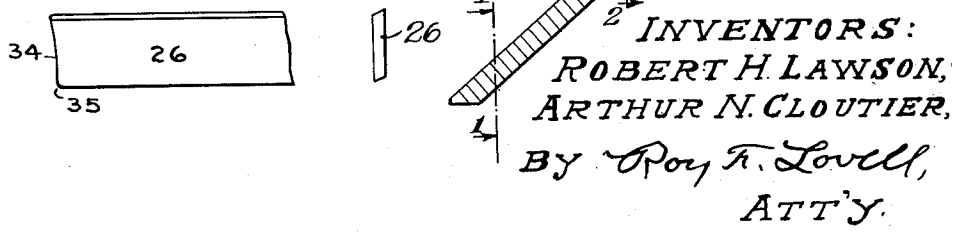


FIG. 9. FIG. 9a. FIG. 7a.



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FIG. 4. FIG. 5. FIG. 6.

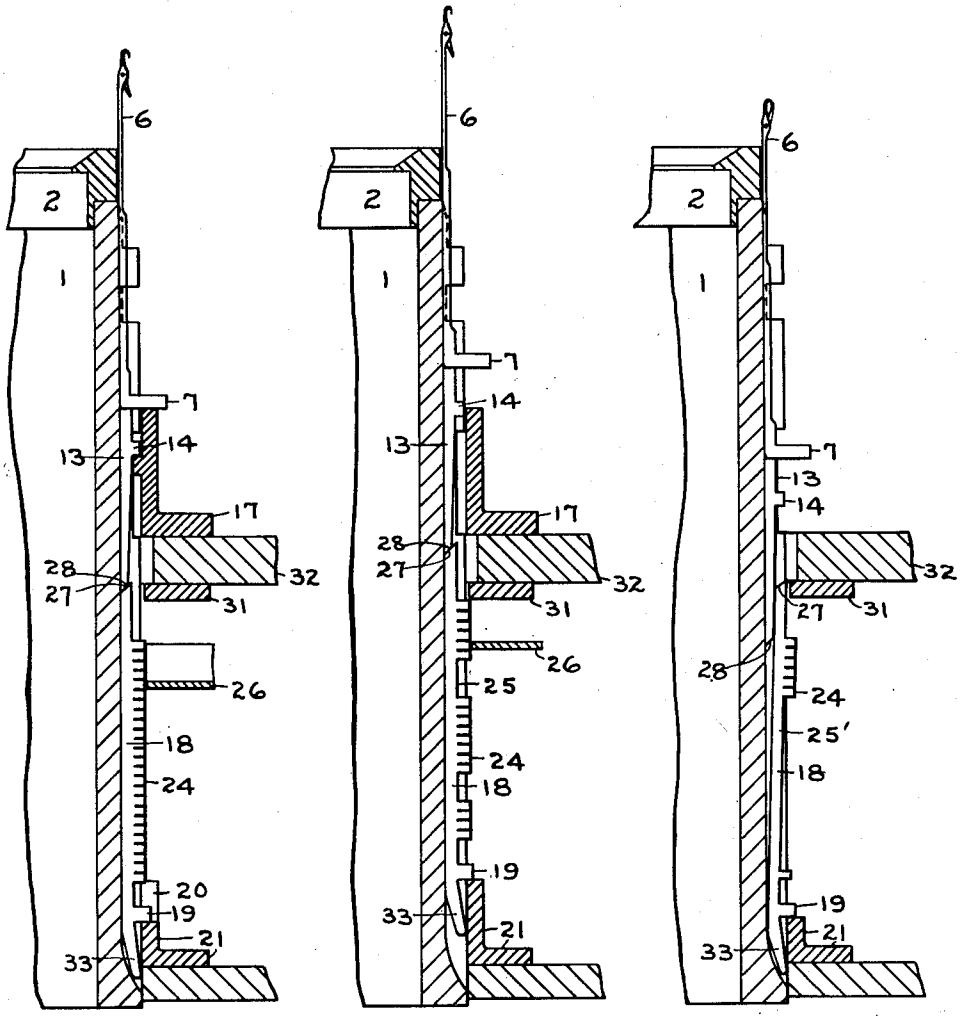


FIG. 19.

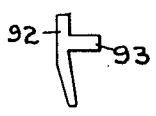
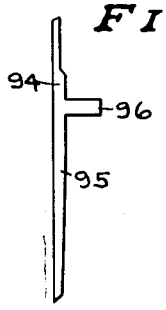


FIG. 20.



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FIG. 7.

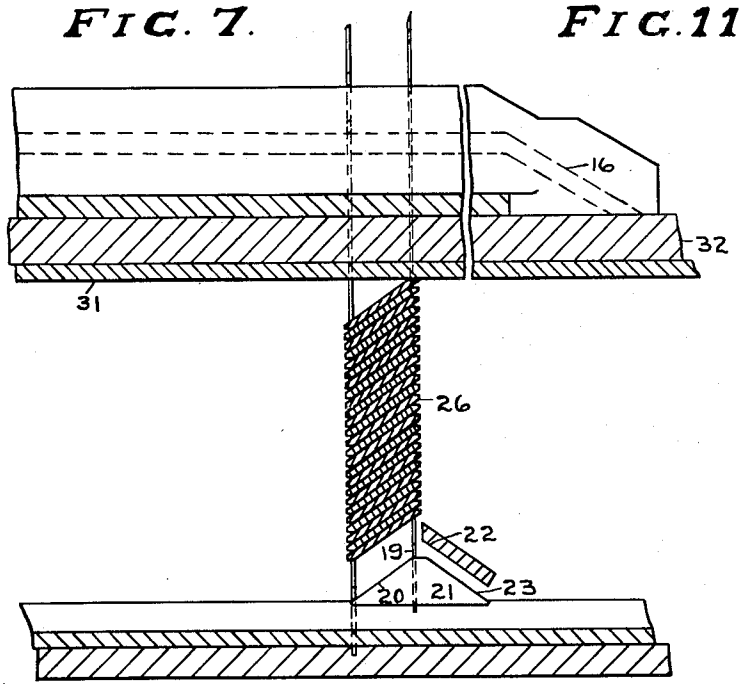


FIG. 11.

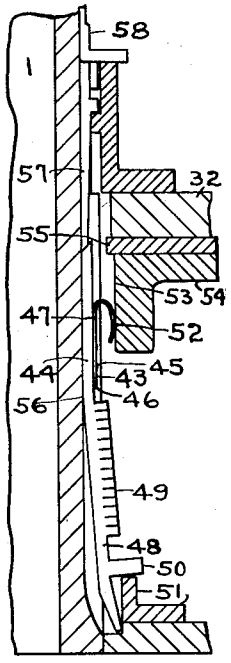


FIG. 8.

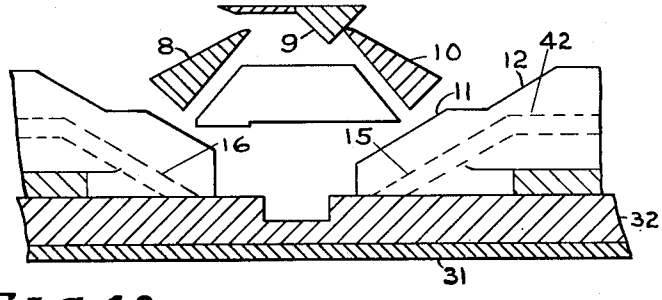


FIG. 12.

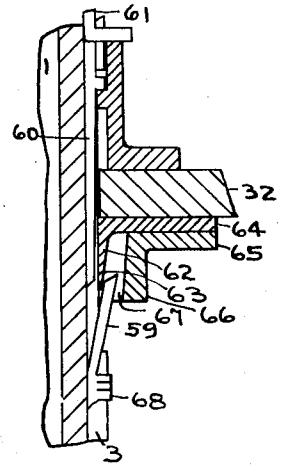
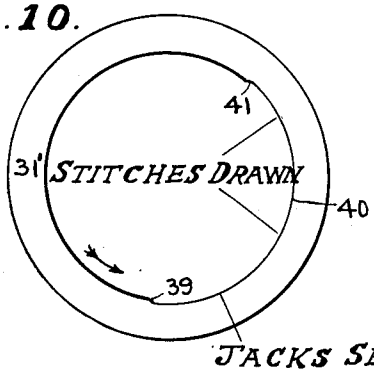


FIG. 10.



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FIG. 13.

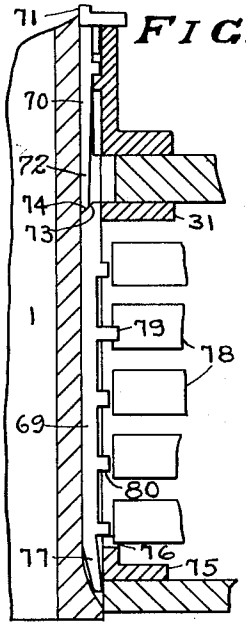


FIG. 14.

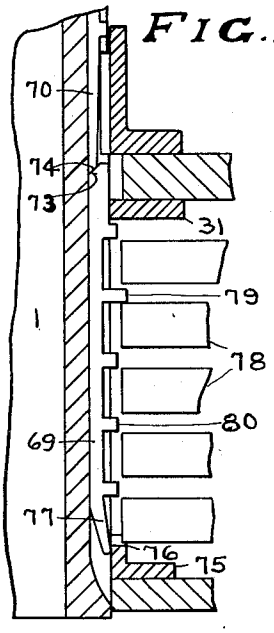


FIG. 15.

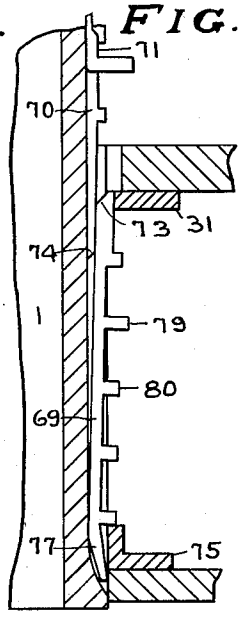


FIG. 16.

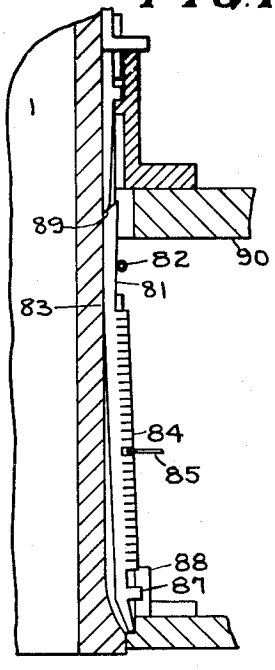


FIG. 17.

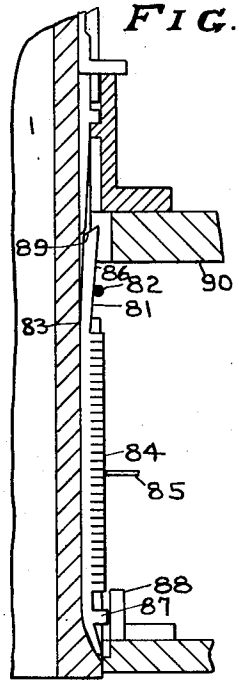
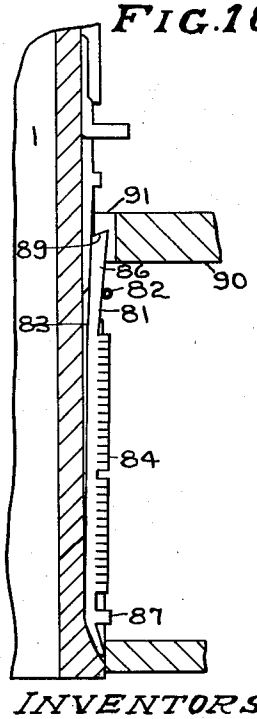


FIG. 18.



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UNITED STATES PATENT OFFICE

2,032,324

KNITTING MACHINE AND METHOD OF KNITTING

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Application May 28, 1931, Serial No. 540,774

18 Claims. (Cl. 66—50)

This invention relates to a new and improved mechanism for the selection of needles in a knitting machine, herein disclosed as a so-called circular knitting machine having a rotary needle cylinder, although the invention in its broad aspects is not necessarily limited to circular knitting machines nor to circular knitting machines having rotary needle cylinders.

In the drawings:

Fig. 1 is a sectional view of a needle cylinder showing a needle, a jack, and a sub-jack as well as cams or plungers for selectively controlling the movements of the needles through the jacks, the portion of the view relating to the cams or plungers being taken along the line 1—1, Fig. 7a, looking in the direction of the arrows;

Fig. 2 is a view similar to Fig. 1, but showing a sub-jack having been moved a short distance without, however, affecting the needle or its jack, the portion of the view relating to the cams or plungers being taken along the line 2—2, Fig. 7a, and looking in the direction of the arrows;

Fig. 3 is a view similar to Figs. 1 and 2, but at a later stage in the knitting cycle and showing a needle in a relatively lowered position after the same has been depressed by cams;

Figs. 4, 5 and 6 are views corresponding respectively to Figs. 1, 2 and 3, but showing the sub-jacks being so operated or controlled as to select their upper jacks and their needles, the said figures showing different sub-jacks although the sub-jack shown in Fig. 4, when operated, would assume the positions shown in Figs. 5 and 6;

Fig. 7 is a sectional view in elevation showing the sub-jacks and means for controlling the same, the parts being shown as they would be seen from the front of the machine if certain of the parts were broken away, the jacks being movable from the left to the right.

Fig. 7a is an enlarged view of one of the plungers on cams shown in Fig. 7;

Fig. 8 is a view showing the cams carried by the cam block for operating the needles (not shown) of the knitting machine, the parts being shown as they would be seen from the front of the machine if certain of the parts were broken away, the needles being movable from the left to the right.

Fig. 9 is a detail fragmentary plan view of one of the selecting cams;

Fig. 9a is an edge view of the plunger on cam shown in Fig. 9.

Fig. 10 is a detail view of a cam ring for controlling the radial positions of the sub-jacks;

Fig. 11 is a fragmentary view corresponding to Fig. 4, but showing a modification;

Fig. 12 is a fragmentary view in section showing a still further modification;

Figs. 13, 14 and 15 are sectional views corresponding to Figs. 4, 5 and 6 but showing a modified form of sub-jack;

Figs. 16, 17 and 18 are sectional views corresponding to views shown in Figs. 1, 2 and 3, but showing a still further modification.

Fig. 19 is a detail plan view showing a long butt sub-jack; and

Fig. 20 is a detail fragmentary view showing a needle provided with a tail-piece which takes the place of the upper jacks shown in Figs. 1–6 inclusive.

The needle bed herein shown as a needle cylinder 1 is or may be provided with the usual stitch ring 2 and in the needle cylinder are tricks or grooves 3 which are defined by adjacent needle walls 4. The base portions of the needle tricks or grooves 3 adjacent to their lower extremities terminate in curved or inclined walls 5.

Needles such as 6 are mounted to slide within the tricks or grooves 3 and are provided with customary butts 7 which butts are engaged and actuated by cams 8, 9, 10, 11 and 12.

Jacks 13 are provided, one being directly beneath each needle and in the needle trick or groove 3 within which the companion needle slides. Each jack 13 is provided with a butt 14 engageable, to be elevated, by cams such as 15 during circular knitting and by cams 15 and 16 during reciprocatory knitting, the cams being carried by and forming part of a cam ring 17.

Directly beneath the jacks 13 and slidable in the tricks therewith, are sub-jacks 18 which sub-jacks are provided with lower butts 19 which butts are engaged during each course of knitting by means of an incline or cam 20 which forms one face of the cam 21, the cam face or incline 20 by engaging the butts 19 elevating them to the positions shown in Figs. 2 and 5. After the sub-jacks have been elevated, the butts 19 are engaged by a cam 22 which restores the said sub-jacks to the position shown in Figs. 1, 3, 4 and 6. During reciprocating knitting such as during the knitting of heels and toes, the cam face 20 raises the jacks during the forward strokes of the needle cylinder, while the cam face 23 raises such jacks during the reverse strokes; however, during the knitting of heels and toes, the sub-jacks are idle and are depressed by means of the cam 22 as in straight-away knitting while during reverse strokes of heel

and toe or other knitting the sub-jacks 18 ride up the cam face 23 and stay at an elevated, inactive, level until the needle cylinder reverses and moves in a forward or counter-clockwise direction, whereupon cam 22 again engages the butts 19 and depresses the inactive, elevated sub-jacks. If the cam 22 were not provided, the inactive jacks once raised to the position shown in Fig. 2 by the cam face 20 or cam 21, would remain in such elevated position and would not thereafter be in a position to be again selected for another course of knitting.

Referring now to Figs. 4, 5 and 6, jacks 18 are shown as being provided with a plurality of additional butts 24, the jack in Fig. 4 being shown as having a full complement of such butts, while the jack in Fig. 5 is shown with some of the butts removed as at 25, and the jack in Fig. 6 is shown with others of its butts removed as at 25'. For this purpose the butts 24 are frangible and the jacks are thereby readily prepared and arranged within the tricks of the needle cylinder to knit any desired design or special form of fabric. In Figs. 4 and 5 the jacks 18 are shown as having a butt 24 opposite a cam or thrust plate 26, there being as many cams 26 as there are butts 24, one such cam 26 being positioned directly opposite a set of companion butts 24, i. e., at the levels or in the planes of movements of the sets of butts 24. In other words, the cams 26, as will be seen from inspection of Fig. 7, are arranged at the same angle with respect to the horizontal as the butt engaging cam surface 20 on the cam 21, whereby elevation of a jack 18 by means of the cam surface 20 engaging the butt 19, will not cause such butt to leave its position opposite the companion cam or plate 26. By such a construction, a jack 18, such as that shown in Figs. 4 and 5, when it is raised by the cam face 20 from the position shown in Fig. 4 to a position such as that shown in Fig. 5, has a butt which is maintained directly opposite a cam or plate 26, whereby such cam or plate 26 prevents an outward movement or springing of the jack 18. The failure of the sub-jack 18 to move or spring outwardly from the position shown in Figs. 4 and 5, maintains an inclined end 27 of such sub-jack in engagement with a correspondingly shaped end 28 of the companion and upper jack 13, whereby sub-jack 18, as it is elevated by the cam face 20 engaging the butt 19, causes the upper jack 13 to move from the position shown in Fig. 4 to that shown in Fig. 5, which movement of the jack 13 causes its upper face or edge 29, which has been in engagement with the heel 30 of the needle 6, to raise the said needle from the position shown in Fig. 4 to that shown in Fig. 5, whereupon the said needle may take an additional or other yarn, or may cast off its previous stitch if the needles are normally moved to a tuck position only and the said needle tucked during the knitting of the preceding course; in other words, the jack arrangement herein shown may be used for the purpose of selecting needles for any well known or other purpose.

When the jacks 18 are in their lowermost positions (Figs. 1, 3, 4 and 6) the said jacks are retained within the tricks of the needle cylinder by means of an annular plate or ring 31 which is attached to and carried by the cam plate 32, the said ring 31 overlying or overlapping the upper ends of the jacks 18, whereby the said jacks are prevented from falling out of the needle tricks or grooves 3. At the lower ends the jacks 18 are provided with tails or extensions 33 which are beveled or tapered to fit the correspondingly shaped ends of the needle grooves 3, the tails being of such a length that, when the jacks 18 are in the upper position shown in Figs. 2 and 5, there is no possibility of the lower ends of the jacks moving outwardly and the jacks 18 falling out of the needle cylinder, the cam plate 21 overlapping such tails or extensions 33 of the jacks.

Whenever a jack is not to be selected, that is, when the needle thereabove is not to be selected, the jacks 18 are controlled in a manner indicated in Figs. 1, 2 and 3, wherein is disclosed in Fig. 1, a sub-jack 18 in its lowermost position and an upper cam or plate 26 in a retracted, inactive position, while a lower cam or plate 26 is shown in an operative position adjacent to the needle cylinder; however, there being no butt 24 adjacent to, or at the level of, the lower cam or plate 26, the jack 18 is not affected thereby and consequently may tilt or may move from the position shown in Fig. 1 to that shown in Fig. 2, upon being raised by engagement of its butt 19 with the cam face 20 of the cam plate 21; and furthermore, the upper cam or plate 26 being in a retracted position, the butt 24 companion thereto is not engaged by the said cam or plate 26 and consequently such jack 18 may tilt or move from a position shown in Fig. 1 to that shown in Fig. 2 regardless of the presence of the upper cam or plate 26. However, had the upper cam or plate 26 been in its inner position adjacent to the needle cylinder—such as that shown in Figs. 4 and 5—the jack 18 would have been retained in its innermost position shown in Fig. 1, whereupon elevation thereof would have elevated its needle 6.

Referring again to Figs. 1, 2 and 3, the aforesaid engagement of the butt 19 by the cam face 20, causes such jack to move from the position shown in Fig. 1 to the position shown in Fig. 2, whereupon the resulting engagement of the upper, inclined edge 27 of the jack 18 and the correspondingly shaped lower edge 28 of the companion jack 13, causes the said jack 18 to be cammed outwardly from the position shown in Fig. 1 so that upon continued upward movement of jack 18, which is effected by the engagement of the butt 19 with the cam face 20, the said jack 18 finally arrives at the position shown in Fig. 2, there being no spring band to retain the jack in its innermost position adjacent to the inner wall of the needle cylinder. As a consequence of the tilting of the jack 18, the jack 13 and its needle 6 is not raised or selected and such needle therefore will not take an additional or other yarn, as hereinbefore described with respect to the action of the jacks and needles (Figs. 4, 5 and 6), nor, when knitting tuck stitches, will the said needle clear its latch of the previously drawn stitch.

Referring to Fig. 9 it will be noted that the inner edge of each cam 26, i. e., the edge adjacent to the needle cylinder, is curved as at 34 thereby to accommodate the said cam to the shape of the needle cylinder. Each cam 26 furthermore is provided with a beveled or inclined, and preferably horizontally disposed, leading edge or face 35, whereby the butts 24 on outwardly disposed jacks, i. e., jacks that were in the inactive position shown in Fig. 2 during the knitting of the preceding course, are engaged by the leading inclined edges 35 of the cams 26 and pressed or moved backwardly into position ad-

jacent to the needle cylinder as shown in Fig. 1, the beveled edges 35 being, of course, adjacent to the lowermost corner or portion of the companion cams or plates 26, whereby the backward movements imparted to the jacks 18 will not cause the same to jam against the shanks of the upper jacks 13, but will permit the inclined edges 27 and 28 of respective jacks to assume the relative positions shown in Fig. 1.

The cams or thrust plates 26 may be selectively controlled in any desired manner, such as shown in British Patent 344,486, whereby they may be individually and selectively controlled so as to be moved inwardly to the position shown in Figs. 4 and 5 as described, that is, may be so controlled that any desired ones of such thrust plates may be moved adjacent to the needle cylinder (Figs. 4 and 5) for the knitting of one or more courses, or one or more partial courses, and the same or any other desired ones of the said thrust plates may be moved adjacent to the needle cylinders (Figs. 4 and 5) preparatory to the knitting of the next or succeeding course; whereby the needles may be selectively controlled in any desired order and such selection changed from course to course or as desired.

In Fig. 10 there is shown a modified form of ring 31' which may be used in substitution for the bevels 35 on the cams 26 or, may be used in conjunction therewith; both the ring 31' (Fig. 10) and the beveled ends 35 of the cams 26 functioning to cause the upper ends of the sub-jacks to be moved inwardly, i. e., towards the needle cylinder, to the position shown in Figs. 1 and 4, when the upper jacks are in the relative positions shown in said Figs. 1 and 4. As the needle cylinder rotates in the direction of the arrow, Fig. 10, and as the sub-jacks 18 are moved past the bevel 39 the said sub-jacks 18 are permitted—when they are raised from the position shown in Fig. 1 to that shown in Fig. 2—to be deflected radially outwards by the upper jacks 13 as indicated in Fig. 2, the recessing or cutting away of the ring 31' as at 40 permitting such outward movements of the upper ends of the sub-jacks. The bevel 39 which defines the leading end of the recess 40 may be variously located with relation to the selecting point of the sub-jacks but, preferably, the bevel 39 is situated at a place closely adjacent to the place where the selecting cams 26 are located. As hereinbefore described when the sub-jacks 18 have been selected, i. e., some of them retained in the position shown in Fig. 4 while others of them are free to be laterally deflected by the upper jacks as shown in Fig. 1, continued movement of the needle cylinder carries the sub-jacks 18 from the positions shown in Figs. 1 and 4 to the positions shown in Figs. 2 and 5 respectively; thereafter in the knitting cycle the needles are depressed to the extreme stitch drawing point as indicated in Figs. 3 and 6, whereupon, the upper jacks 13 are forced downwardly by their needles to the positions shown in Figs. 3 and 6. The outward deflection of the jacks theretofore retained adjacent to the needle cylinder (Fig. 5) is due to the fact that the sub-jacks have moved past the cams 26 and are consequently permitted to be deflected outwardly by the descending upper and companion jacks 13. Continued rotation of the needle cylinder causes the sub-jacks 18 to move along the recess 40 until they are again radially depressed by a cam 41 to a position adjacent to the needle cylinder (Figs. 1 and 4); the cam 41 necessarily being positioned at a place, with respect to the jack actuating cams, somewhere between the cams 9 and 10, Fig. 8, and the cams 26, Fig. 7. Cams 9 and 10 engage the butts 7 of the needles thereby causing the jacks to be moved from the positions shown in Figs. 2 and 5 to the positions shown in Figs. 3 and 6, respectively, the place in the horizontal portion of the raceway for the butts 14 which corresponds to the cam 41 being indicated by the numeral 42, Fig. 8; in other words, it is essential that the upper jacks 13 be in the upper positions shown in Fig. 4, when the sub-jacks 18 are engaged by the cam 41 and moved radially inwards to a position adjacent to the needle cylinder.

In the modification disclosed in Fig. 11, springs 43 are shown and are individual to sub-jacks 44, and are attached thereto at 45 as by means of solder, the said springs each having an arm or end 46 in engagement with the adjacent face of the upper arm 47 of the jack lever 44. Each jack lever 44 is formed of two angularly disposed arms, one 47 being the upper, and the other 48 being the lower arm, the arm 48 having a plurality of frangible butts 49 and also having a butt 50 to be engaged by a cam plate 51, which cam plate 51 corresponds in shape and function to the cam plate 21. The other end or arm of each spring 43 is bent over or curved as shown at 52, such curved end engaging against the inner, curved face 53 of an annular plate or ring 54 which plate 54 depends from and may be rigidly attached to the cam plate 32 or a supplemental plate 55 carried thereby and corresponding in function to the annular plate 31.

In the modification shown in Fig. 11, desired ones of the butts 49 may be broken off as hereinbefore described with respect to the butts 24, the remaining butts 49 being selectively engaged as by means of thrust plates 26, such engagement of a butt 49 by means of a plate 26 causing the jack 44 to rock upon its intermediate pivot point 56 and thereby move the upper end thereof from the position shown in Fig. 11 to a position corresponding to the position shown in Fig. 2, whereupon subsequent engagement of the butt 50 by the cam plate 51 will cause the sub-jack 44 to be elevated without raising its companion jack 57 and consequently the needle 58.

However, when the needle 58 companion to a particular jack 57 and sub-jack 44 is to be selected, none of the remaining butts 49 are engaged by forwardly positioned thrust plate 26 and as a consequence thereof the spring 43 maintains the upper arm 47 of the jack in the position shown in Fig. 11, whereupon subsequent engagement of the butt 50 by means of the cam plate 51 will cause the companion jack 57 and its needle 58 to be elevated for any one of the purposes hereinbefore described in connection with the description of the form of the invention disclosed in Figs. 1–8 inclusive.

The sub-jacks 44, jacks 57 and needles 58 are each maintained in their respective needle grooves, that is, each companion needle 58, jack 57 and sub-jack 44 is maintained in a needle groove in the same manner as hereinbefore described; and furthermore, the upper and lower portions of the sub-jacks 44 are additionally prevented from falling out of the cylinder grooves, by the ring 55 and cam plate 51 which respectively overlap the upper and lower portions of the sub-jacks in the same manner as hereinbefore described in connection with the description of the forms disclosed in Figs. 1–8 inclusive.

A still further modification is disclosed in Fig.

12 wherein is shown a fragmentary view of the needle cylinder 1 having a slot or groove 3 therein within which are mounted for sliding movements, a sub-jack 59 and thereabove a companion jack 60 and needle 61. In Fig. 12 instead of the individual springs 43 disclosed in Fig. 11, a thin cam 62 is used which is provided with a knife edge 63, the said edge being curved to fit the needle cylinder and positioned closely adjacent thereto, the cam 62 being a depending portion of a plate 64 attached to or carried by the cam plate 32. Also formed integral with or attached to the plate 64 is a supplemental plate 65 which latter has a depending portion 66 opposite and adjacent to the depending cam 62, thereby providing therebetween a space 67 within which may be received the upper ends of deflected sub-jacks 59, all as shown in Fig. 12.

The sub-jacks 59 are otherwise substantially the same as the jacks 44 (Fig. 11) and are provided with frangible butts 68, the ones remaining on any particular jack being adapted to be engaged by selectively actuated thrust plates or cams 26 in such a manner that when a butt 68 is so engaged, the upper end of a jack 59 will be rocked to the position shown in Fig. 12, whereupon the knife edge 63 of the cam 62 immediately comes between—due to the rotation of the needle cylinder—the deflected jack and others not so deflected, which latter remain in a position adjacent to the needle cylinder such as that shown in Fig. 11, whereupon a cam plate similar to or identical with cam plate 51, engages a jack butt corresponding in posititon to the jack butt 58 and thereupon raises the companion upper jack 60 and its needle 61 for any one of the purposes hereinbefore mentioned with respect to the form of the invention shown in Figs. 1–8 inclusive.

In Figs. 13, 14 and 15 there is disclosed a further modification wherein although the sub-jacks 69 shown therein are not held adjacent to the needle cylinder for the purpose of elevating the upper jacks 70 and consequently their needles 71; nevertheless when the needles 71 and jacks 70 are moved from the position shown in Fig. 14 to the lowermost stitch drawing position shown in Fig. 15, the sub-jacks 69 are deflected laterally outward to the position shown in Fig. 15 by the lower portions or tails 74 of the jacks 70 engaging the upper ends of the sub-jacks 69, the jacks 69 and the upper jacks 72 having cooperating bevels 73 and 74 for the purpose of causing the lateral deflection of the sub-jacks 69 when the upper jacks 70 are moved to the position shown in Fig. 15 by their needles, all as hereinbefore described with respect to forms of the invention shown in Figs. 1–12 inclusive.

The cam ring 31 which overlaps the upper ends of the jacks 69 thereby to retain the same within the slots of the needle cylinder, may be of a shape similar to or identical to that shown in Fig. 10, or, may be slightly modified with respect thereto.

A plate 75 may be provided, said plate having an inclined edge or surface 76; and although the plate 75 corresponds in shape and position to the plate 21 hereinbefore described, nevertheless, the function of the plate 75 is merely to retain the jacks 69 within the slots of the needle cylinder as indicated in Figs. 13 and 14, where the tails 77 of the jacks are shown in two positions, in the upper of which (Fig. 14) the upper portion of the plate 75 defined by the incline 76 overlaps the extreme lower portions of the tails 77 thereby retaining the jacks 69 in position within the slots of the needle cylinder.

In this form of the invention a series of selectively actuated cams 78 are provided which may be selectively controlled to move radially so as to engage, first, long butts 79 and thereafter or at another time short butts 80 as well, it being understood that at each of the five butt levels shown in Figs. 13, 14 and 15 two or more lengths of butts may be used, i. e., some jacks at one butt level may have short butts while others have longer butts; and furthermore although two lengths of butts only are shown, the butts may be of two or more lengths.

In Figs. 16, 17 and 18 a still further modification of the invention is shown, wherein within the slots of the needle cylinder 1 sub-jacks 81 are mounted and are retained within the slots of the needle cylinder with usual spring bands such as 82. In this form of the invention the sub-jacks are elbow-shaped, rocking upon a fulcrum 83 from the position shown in Fig. 16 to that shown in Figs. 17 and 18 when any one of the frangible butts 84 are engaged by selectively controlled cams such as 85, such cams being movable radially from a position outwardly thereof to positions shown in Figs. 16 and 17. And whereas as shown in Fig. 17, cam 85 engages a butt 84 and rocks the sub-jack 81 upon its fulcrum 83 thereby causing the upper end 86 of the jack to be radially displaced to the position shown in Fig. 17 and the actuating butt 87, adjacent to the lower end of the jack, to be radially displaced inwards and to such a position as not to be engaged by the fixed cam 88; but as shown in Fig. 16 removal of a butt 84 at the level of the cam 85 renders such cam 85 inoperative upon that particular butt and therefore does not rock the sub-jack 81 to the positions shown in Figs. 17 and 18. Such of the jacks as are radially displaced to the position shown in Fig. 17 are not actuated by engagement of their butts 87 with the fixed cam 88; but the sub-jacks 81 (Fig. 16) not so rocked by a cam 85 are elevated when the cam 88 engages their butts, in which case, the resultant elevation of the jacks (Fig. 16) causes the said jacks to move upwardly from the position shown in Fig. 16 to a position corresponding to that shown in Fig. 5, whereby the needles companion to the elevated jacks are selectively raised for any one of the purposes hereinbefore with respect to the description of the form of the invention disclosed in Figs. 1–10 inclusive.

The upper portions or ends of the sub-jacks 81 are provided with bevels 89 which engage correspondingly shaped bevels provided upon the upper jacks or as hereinbefore described with respect to the form of the invention disclosed in Figs. 1–10 inclusive.

Although in the form of the invention disclosed in Figs. 16–18 inclusive spring bands such as 82 are used and consequently restrict the number of butts 84 that it is possible to use on a single jack, nevertheless when the needles are moved by suitable cams to their lowermost stitch drawing position shown in Fig. 18, the upper jacks engage the bevels 89 of the sub-jacks 81 and cause the said jacks to rock by deflecting the upper ends thereof as shown in Fig. 18, whereby the sub-jacks do not have to be moved (by the needles) to a position below the selecting level, with the result that many more butts 84 may be used than would otherwise be possible.

In the form of the invention disclosed in Figs. 16, 17 and 18, the cam plate 31 may be dispensed with, the spring bands performing the functions thereof, that is, causing the sub-jacks to be retained in position within the slots of the needle

cylinder. The cam plate 80 is cut away or set back from the needle cylinder as at 81, whereby to permit the rocking of the upper ends of the sub-jacks 81, the circular base 80 overlapping the upper ends of the sub-jacks 81 and also thereby tending to maintain the sub-jacks 81 within the slots of the needle cylinder.

In Fig. 19 is shown a fragmentary view of a sub-jack 92 provided with a long butt 93; whereby by adjustably positioning the came plate 21, i. e., at different positions with respect to the needle cylinder, the long butts 93 of the jacks may be engaged and the jacks actuated and thereafter or at another time, others or all of the sub-jacks may be actuated by the cam face 20 engaging both the long butts 93 and the short butts 19. Although two lengths of butts only have been referred to, it is evident that any number of lengths of butts could be provided and the cam plate 21 controlled in its radial movements so as to engage some or all of the butts and thereby actuate and select different ones of the jacks; and while the arrangement shown in Fig. 19 could be for the purpose of knitting a plain sole and patterned instep, such use is cited by way of example only.

Whereas in the several figures of the drawings there are shown needles and independent jacks, in Fig. 20 there is shown a needle 94 having depending therefrom an integral tail or extension 95 which performs the functions of the upper jacks. The needle has the usual butt 96. Thus in Fig. 20 the jack or extension is an integral part of the needle and in the other figures the jack is shown as being a separate piece; although in each case, the separate jack or integral extension constitutes a part of the needle, the combined needle constituting, in each case, a knitting instrumentality.

In all the forms of the invention hereinbefore disclosed, the active sub-jacks are moved, which movements in turn raise needles, the method of raising the needles not differing, broadly, from the methods for the selective raising or control of needles now in common use; but, as hereinbefore disclosed, when the needles are retracted, the provision of the contacting and inclined edges on the adjacent ends of the upper and lower jacks, or upon the upper ends of the sub-jacks and the adjacent edges of tails or extensions of needles, permits the needles to continue their downward movements without, however, correspondingly depressing or moving the sub-jacks, due to the fact that the mentioned beveled or adjacent inclined edges permit the upper jacks or extensions on the needles, to force the upper ends of the sub-jacks outwardly, thereby permitting the upper jacks or extensions on the needles to move downwardly back of the sub-jacks.

Prior jack selecting methods used spring bands to retain the jacks within the grooves of the needle cylinder, and due to the fact that the jacks were moved downwardly by the needles when the needles moved to stitch drawing position, a certain length of the jacks moved past the spring band, and consequently it was not possible to place butts on said portion of the jack; and furthermore in all prior jack and needle selecting methods, it has not been possible to move the selected or active jacks by means of a fixed or other cam, from a point adjacent to the lower end of the needle cylinder for the reason that the needles as they consequently descended to knitting position, moved the jacks to a position below the selecting position or level; whereas by the methods hereinbefore disclosed, the jack butts such as 19 are engaged by a cam such as 20 adjacent to the lowermost portions of the needle cylinder.

The differences in the present and past methods, as recited in the preceding paragraphs, are very important in that they permit the use of a greater number of butts in a given length of jack, thereby greatly increasing the scope and patterning possibilities of jacks.

The so-called sub-jacks, the construction and operation of which has been hereinbefore specifically disclosed, all consist of relatively elongated thin metal strips each having butts along one edge thereof and having beveled upper edges, each bevel extending downwardly from the edge having the butts to the opposite edge; the upper jacks or other parts movable with the needles having cooperating beveled formations for engagement with and by the aforesaid bevels constituting the upper edges of the sub-jacks. In other words, the sub-jacks and other jacks or parts movable with the needles, have cooperating cam formations whereby lateral deflection of the sub-jacks is effected.

Although the needles and jacks have been hereinbefore referred to as being raised or lowered and as being moved inward and outward; nevertheless the invention is equally applicable to other types of knitting machines, e. g., flat machines, machines having dial or conical needle beds.

Although as hereinbefore disclosed, the jacks are within the tracks or slots of an integral extension of the needle bed, such integral construction is not essential.

Although as hereinbefore disclosed the cam or cam surface 20 is integral with the cam plate 21, the portion of the cam plate 21 carrying the cam or cam surface 20 may be radially movable with respect to the needles so that, during the knitting of heels and toes or at other desired times, the said cam 20 may be rendered inoperative with respect to the jacks.

There is no intention of limiting the invention, excepting as required by the scope of the appended claims, to the means hereinbefore disclosed for laterally deflecting, or permitting lateral deflection of, the sub-jacks; nor is there any intention of limiting the invention to the use of sub-jacks as distinguished from ordinary jacks, in other words, the selectively controlled jacks may act directly upon needles.

We claim:

1. In a knitting machine including a needle bed, means for selecting needles including jacks mounted within the slots of the needle bed, said jacks adapted to be laterally displaced whereby the needles, companion to the jacks laterally displaced, are not selected, while the needles companion to the jacks not laterally deflected are selected, means movable with each needle, and cooperating means formed on each jack, one of the two means last mentioned having a cam formation whereby the jacks are laterally displaced upon relative movements of the two last mentioned means.

2. In a knitting machine including a needle bed, means for selecting needles including jacks mounted within the slots of the needle bed, said jacks adjacent to their upper ends being beveled downwardly and inwardly, in combination with jacks each movable with a needle and companion thereto, said jacks last named having cooperating bevels at their lower ends adapted to engage the

bevels on the jacks first mentioned and thereby cause lateral deflection of the jacks first mentioned.

3. A knitting machine having therein independently movable needles and jacks, the said jacks being mounted below the needles, means for selectively controlling the jacks in any desired order, the operative connections between the jacks and needles being such as to cause some of the jacks as a result of selection to move their needles, the jacks, when so moving their companion needles, moving with the needles, the needles and jacks having portions cooperating so that the said jacks will not move with the needles when the said needles move in a direction opposite to that first mentioned.

4. A circular knitting machine of the independent needle type including a needle cylinder, needles and companion jacks for selectively controlling the same, the jacks having provisions for actuating the needles when in one radial position, said jacks not being adapted to actuate the needles when in another radial position, means for selectively controlling the radial positions of the jacks, and means for uniformly advancing all of the jacks regardless of their radial positions.

5. A circular knitting machine of the independent needle type including a needle cylinder, needles and companion jacks for selectively controlling the same, the jacks having provisions for actuating the needles when in one radial position, said jacks not being adapted to actuate the needles when in another radial position, means for selectively controlling the radial positions of the jacks, and means for constantly actuating all of the jacks, cam means adapted to retain all of the jacks adjacent to the needle cylinder throughout a portion of the knitting cycle but not adapted to retain the jacks in position adjacent to the needle cylinder throughout the remaining portions of the knitting cycle, and other means adapted during the last named portion of the knitting cycle selectively to maintain some of the jacks in position adjacent to the needle cylinder while permitting others of the jacks to move radially with respect to the needle cylinder.

6. A knitting machine having independent needles and jacks for selectively controlling the same, said jacks being movable in the direction of movements of the needles and being provided with selective means, the said selective means being located at different points in the directions of movements of the jacks, in combination with selectively controlled cams angularly disposed with respect to the directions of movements of the jacks and at such angles that when movements are imparted to the jacks causing such jack selective means to be angularly displaced, such angular displacements are coincident with the angles assumed by the cams, whereby during selective movements of the jacks at least one of the aforesaid selective means on some of the jacks remains directly opposite at least one of the aforesaid cams so that the cams will prevent radial displacement of the jacks during selective movements thereof.

7. In a knitting machine needles and jacks for selectively controlling the same, said jacks having butts adjacent to the lower ends thereof and selective means between the aforesaid butts and needles, whereby the jacks may be rocked so that ends thereof which selectively control the needles shall be laterally displaced to an inoperative position with relation to the needles, spring means constantly acting upon the last named portions of the jacks and in such a manner as to urge the jacks into active, needle selecting position.

8. In a knitting machine needles and jacks for selectively controlling the same, said jacks having butts adjacent to the lower ends thereof and selective means between the aforesaid butts and needles, whereby the jacks may be rocked so that ends thereof which selectively control the needles shall be laterally displaced to an inoperative position with relation to the needles, spring means constantly acting upon the last named portions of the jacks and in such a manner as to urge the jacks into active, needle selecting position, a cam for constantly engaging the butts on the jacks during the knitting of a plurality of courses.

9. In a knitting machine, needles and jacks for selectively controlling the same, said jacks having butts adjacent to the lower ends thereof and selective means between the aforesaid butts and needles, whereby the jacks may be rocked so that ends thereof which selectively control the needles shall be laterally displaced to an inoperative position with relation to the needles, spring means constantly acting upon the last named portions of the jacks and in such a manner as to urge the jacks into active, needle selecting position, a cam for normally engaging the butts on all of the jacks and means for laterally deflecting the jacks so that the butts are not engaged by the said cam.

10. A knitting machine having needles and jacks independently mounted therein, the said jacks being adapted selectively to control the needles, the jacks adjacent one end thereof being movable from a position where they control the needles to a position where they do not control the needles, and a member for dividing the jacks whereby subsequent longitudinal movements imparted to all of the jacks moves them the same distance and causes some of the jacks only to actuate their needles.

11. A knitting machine, a needle bed having mounted therein needles and jacks for selectively controlling the needles, said needles being moved lengthwise by their companion jacks a series of cams operatively positioned intermediate the ends of the jacks for selectively controlling the jacks in such a manner that when the jacks are actuated by other cam means the needles companion to the jacks are likewise actuated, provisions being made so that when the needles move to their lowermost, stitch drawing positions the jacks are not correspondingly moved.

12. In a knitting machine including a needle bed, means for selecting needles including jacks mounted within the slots of the needle bed, said jacks adapted to be laterally displaced whereby the needles, companion to the jacks laterally displaced, are not selected, while the needles companion to the jacks not laterally deflected are selected, in combination with means for moving all the jacks the same distance in the direction of their companion needles throughout the knitting of a plurality of courses.

13. A method of knitting consisting in selecting needles by advancing all of the jacks the same distance but correspondingly moving only such of the needles as are companion to selected jacks and continuing the knitting by moving the needles in a direction opposite to the direction of move-

ments of the jacks and needles first mentioned without correspondingly moving the jacks.

14. A circular knitting machine of the independent needle type including a needle cylinder, needles and companion jacks for selectively controlling the same, cam means adapted to retain all of the jacks adjacent to the needle cylinder throughout a portion of the knitting cycle but not adapted to retain the jacks in position adjacent to the needle cylinder throughout the remaining portions of the knitting cycle, and other means adapted during the last named portion of the knitting cycle selectively to maintain some of the jacks in position adjacent to the needle cylinder while permitting others of the jacks to move outwardly from the needle cylinder.

15. A knitting machine having companion needles and jacks, means acting upon the said jacks adapted to move all of the said jacks the same direction lengthwise of and independently of their companion needles, and means selectively acting upon the said jacks as to cause engagement of their companion needles by the selected jacks, the engagement of the needles and jacks being such as to cause the needles to move with their companion jacks.

16. A knitting machine having companion knitting instrumentalities, and jacks for cooperation with the said knitting instrumentalities, means acting upon the said jacks adapted to move all of the jacks the same direction lengthwise of their companion knitting instrumentalities, and means so acting upon the said jacks selectively as to cause said jacks to engage their companion knitting instrumentalities which thereafter move with their companion and selected jacks when the jacks are moved by the means first mentioned, the non-selected jacks moving independently of their companion knitting instrumentalities and without correspondingly moving the said knitting instrumentalities.

17. A knitting machine having a slotted needle bed and cooperating instrumentalities and jacks mounted therein, companion knitting instrumentalities and jacks being mounted in the same slots in the needle bed, means acting upon all of the said jacks to move them the same distance lengthwise of and independently of their companion knitting instrumentalities, and other means adapted selectively to act upon the jacks at various points along the lengths thereof and when so acting adapted to cause effective engagement of knitting instrumentalities by their companion and selected jacks, the effective engagement of the knitting instrumentalities and jacks being such as to cause the knitting instrumentalities which are companion to the selected jacks to move with the said jacks when the said jacks are moved longitudinally of the slots in the needle bed.

18. A method of knitting including the controlling of needles by instrumentalities by moving all of the said instrumentalities lengthwise of the needles the same distance, selecting some of the instrumentalities so that the lengthwise movements imparted to the selected instrumentalities are communicated directly to the companion needles, thereafter causing the needles to be retracted without correspondingly retracting the companion instrumentalities.

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