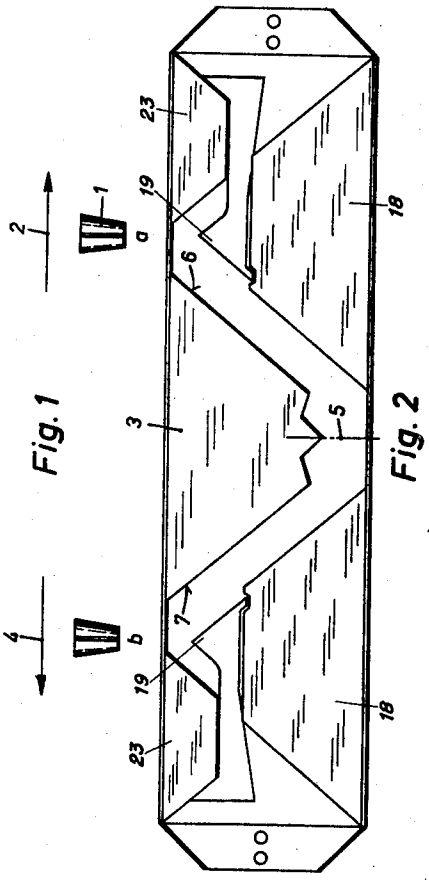
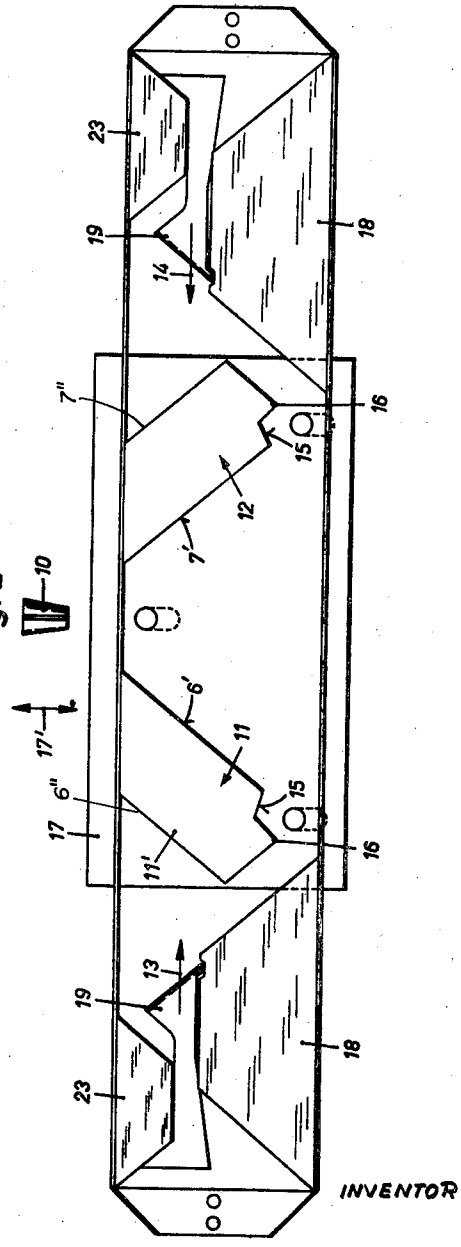
Nov. 13, 1962 H. SCHURICH 3,063,270

CAM ASSEMBLY FOR HAND KNITTING MACHINES

Filed Sept. 19, 1958 3 Sheets-Sheet 1





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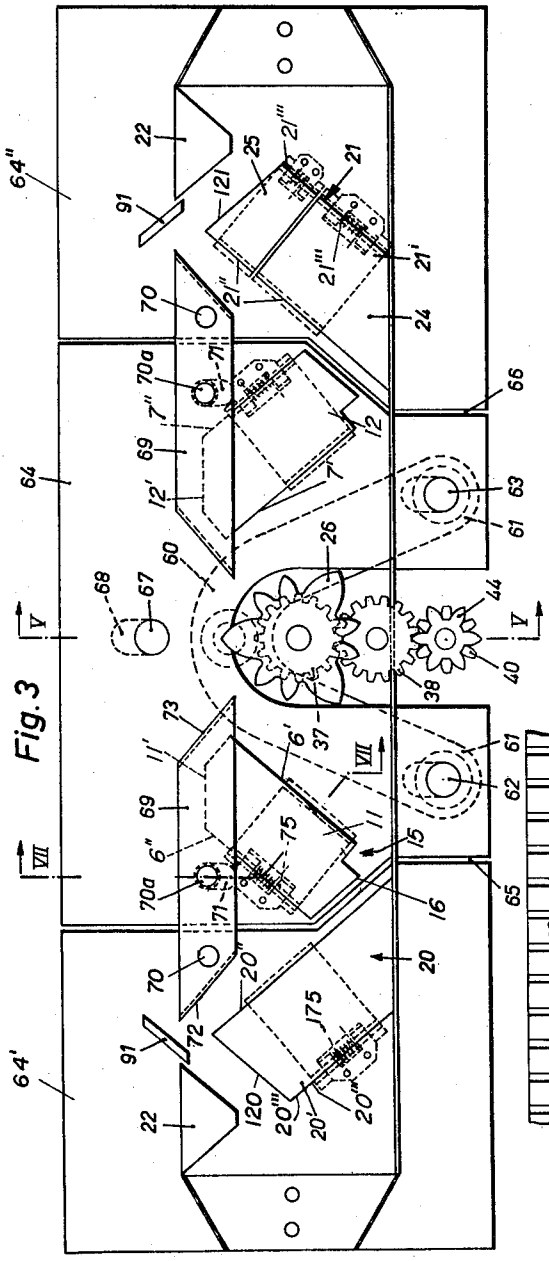


Fig. 3

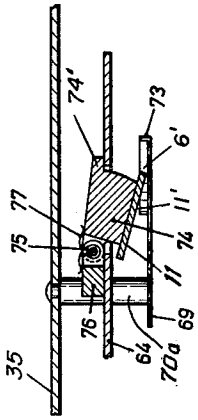


Fig. 7

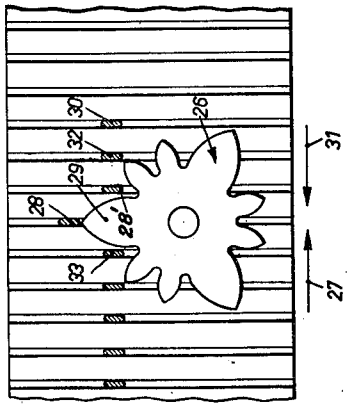


Fig. 4

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Fig. 5

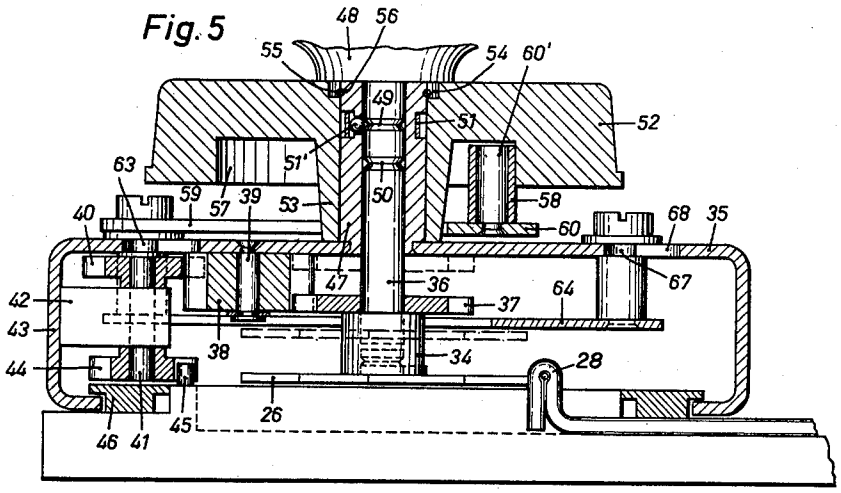


Fig. 8

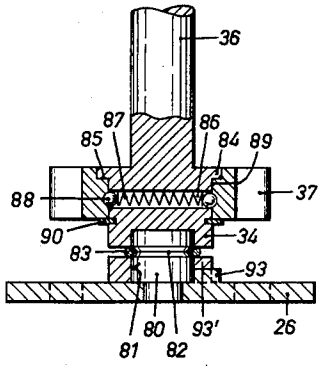


Fig. 6

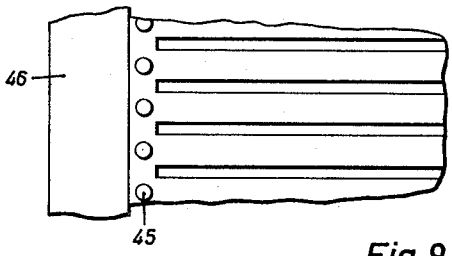
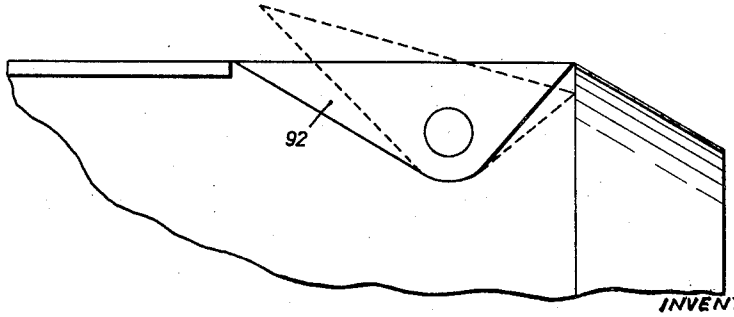


Fig. 9



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CAM ASSEMBLY FOR HAND KNITTING MACHINES

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Filed Sept. 19, 1958, Ser. No. 761,969
Claims priority, application Germany Sept. 30, 1957
19 Claims. (Cl. 66—78)

Hand knitting machines are recently being built which allow the thread to be introduced into the open eyes of the needles not only by hand but also, if desired, by means of a guide for the thread. In the case of hand-knitting machines so designed that after each complete movement of the cam box all the needles are in the laying-in position, in which the eyes of the needles lie outside the comb plates or stitch sinkers as the case may be, it is necessary to make the needle guide lead the cam plates, at the delivery point of the thread in order to facilitate the insertion of the thread into the opened needle hooks.

For the thread guide to lead requires a relatively complicated arrangement, because, in the positions of return of the cam box, the thread guide has to be switched from being in the lead in one direction of being in the lead in the opposite direction. For this purpose the lever of the thread guide is so fitted to the carriage that the rear end of the thread guide works together with a brake rail extending lengthwise of the needle bed.

An object of my present invention is to provide, in a hand knitting machine, a cam assembly so designed as to avoid the need for periodic relocation of a thread guide.

Another object of this invention is to provide, in such cam assembly, means for varying the patterns produced by the machine through a selective withdrawal of certain needles from knitting position.

The foregoing objects are realized, in accordance with my present invention, through the provision of a cam carrier having an elongated cam-supporting surface on which there are positioned, at opposite sides of a transverse plane of symmetry, a pair of main needle-lowering stitch cams, a pair of lifting cams bracketing the stitch cams and a pair of auxiliary needle-lowering cams between the needle lifters and adjacent thereto; the main stitch cams, as preferably also the needle lifters referred to, are pivotally mounted for swingable movement about axes parallel to the cam-supporting surface of the carrier and inclined to the plane of symmetry thereof, the cams being normally urged into a position in which they project from the carrier surface so that their sloping operative edges intercept the butts of needles guided for movement parallel to the aforementioned plane. These needles are withdrawable from an active or knitting position in the direction of convergence of the inclined operative edges of the two main stitch cams and, according to a further feature of the invention, can be displaced into their withdrawn positions by a selector wheel provided with peripheral projections and intervening peripheral gaps. The projections, in a preferred embodiment, are constituted by relatively large teeth while the gaps are formed by substantially smaller teeth receiving the butts of the operatively positioned needles between them. Advantageously, for reasons explained hereinafter, the selector wheel is positively driven during reciprocations of the cam carrier in its longitudinal direction, e.g. by means of a gear train meshing with rack teeth disposed along a stationary support for the cam carrier.

The above and other objects and features of my invention will become more fully apparent from the following description, reference being made to the accompanying drawing in which:

FIGURE 1 shows a view from below of a cam box of a hand knitting machine with a leading thread guide represented diagrammatically;

FIGURE 2 shows from below a cam box altered according to the invention with a thread guide fixed to it;

FIGURE 3 shows another embodiment of the cam box according to the invention, with a built-in needle-selector star wheel for automatic pattern formation;

FIGURE 4 shows an enlarged partial view of the back of the cam box of FIGURE 3 at the site of the star wheel;

FIGURE 5 shows an enlarged cross-section of the cam box of FIGURE 3, taken along the line V—V thereof;

FIGURE 6 shows a view from above the needle-bed of the hand knitting machine according to the invention, with studs fitted near the ends of the grooves to turn a toothed wheel operatively connected to the star wheel;

FIGURE 7 shows a partial cross-section of the cam box of FIGURE 3, taken along the line VII—VII thereof;

FIGURE 8 shows an enlarged partial axial section of the star wheel and its shaft as shown in FIGURE 5; and

FIGURE 9 is an enlarged view, partly from below, of part of a modified cam box, showing a form of auxiliary stitch cam different from that of FIGURE 3.

FIGURE 1 diagrammatically illustrates a cam box of a known kind, comprising a centrally disposed main stitch cam 3 with operative edges 6 and 7, two main needle lifters 18 disposed outwardly of the main stitch cams, a respective auxiliary needle-lowering draw cam 23 disposed adjacent to each main needle lifter 18, and a respective latch 19 disposed between each main needle lifter and the adjacent auxiliary stitch cam. A thread guide 1 is attached to the cam box and is movable, with respect to the cam box, between positions *a* and *b*.

In order to facilitate the understanding of the invention, the joint working of the thread-guide motion and of the cam-plate motion using the principle of a cam plate pursuant to commonly assigned U.S. Patent No. 2,759,343 will first be described: It can be seen from FIGURE 1 how, during a movement of the cam box in the direction of the arrow 2, the thread guide 1 in the position *a* leads in relation to the middle 5 of the stitch cam 3, this lead being a distance which is greater than half the width of the stitch cam. Upon reversal of the movement of the cam box, from the direction 2 to the direction of the arrow 4, the thread guide 1 must be brought from position *a* into position *b* by a horizontal swing of the arm of the thread guide, so that the thread guide during the movement of the cam plate in the direction of the arrow 4 again attains its necessary lead.

In order to avoid this complicated and hence disadvantageous movement of the thread guide, the present invention replaces the single stitch cam 3 by two main needle-lowering stitch cams 11 and 12 each having a single operative edge 6′ and 7′, and inoperative edge 6″ and 7″, respectively.

It has thus been achieved that thread guide 10 need no longer change from the movement of leading in one direction to that of leading in the other direction in the positions of reverse movement of the cam box. Furthermore, the thread guide remains in the same position as is shown in FIGURE 2, because in the construction of the cam box according to the invention the position of the two operative stitch-cam edges 6′ and 7′ also remains the same with regard to the fixed thread guide 10.

The necessity for a repositioning is thus avoided, and thread guide 10 can also be fitted as a fixture to the cam box.

It is also necessary to build the cam box as shown in FIGURE 2 longer than hitherto.

During the movement of the needle butts in the di-

rection of the arrow 13, they should first meet with the edge 7' of the stitch cam 12, but since the stitch cam 11 is in the way, it is necessary to provide this stitch cam with an inclined slide surface 11' and at the same time to make the stitch cam capable of pivotal movement, against the action of a light spring, in such a way that the stitch cam will be pressed into the cam plate and out of the path of the oncoming needle butts by the impact of the needle butts on the inclined slide surface upon a crossing of the inoperative edge 6'' or 7'' by these butts, as will be further described with reference to FIGURES 3 and 7. In this process, the needle butts pass the stitch cam 11 without being displaced in the longitudinal direction of the needles, until they meet the edge 7' of the stitch cam 12.

Similar relationships exist in the case of the return movement of the cam plates. In this case the needle butts are relatively displaced in the direction of the arrow 14, pressing the stitch cam 12 into the cam box, in order finally to meet the edge 6' of the stitch cam and to slide downwards along the latter. The remaining cam-box parts, such as needle lifter, spring latches, auxiliary stitch cam, release plates and the like, can remain the same as regards relative positions and construction.

Each of the stitch cams 11 and 12 has a point 16 for tensioning the thread and an oblique flank 15 for slackening the thread.

In the cam box used hitherto, it was necessary to make the single stitch cam displaceable, in a direction at right angles to the length of the cam box, for adjusting the size of the mesh. Similarly, the two stitch cams 11 and 12 are also displaceable in the cam box according to the invention. For this purpose both stitch cams 11 and 12 are mounted on a common plate 17, which is fixed and can be displaced to and fro in the direction of the double arrow 17'.

In a further development of the idea of the invention, each main needle-lifting cam 18 and the adjacent latch 19 of the construction shown in FIGURE 2 are combined into one single element, which according to FIGURE 3 comprises a single needle-lifting cam 20 and 21 respectively. These needle-lifting cams 20 and 21 also have sloping slide surfaces 20', 21', operative edges 20'', 21' and inoperative edges 20''', 21''', and they are fitted within recesses in the cam plate for swinging movement about inclined pivotal axis 175 parallel to the cam-supporting surface of the plate. This formation of the needle-lifting cam has the advantage over the two-part cam, as shown in FIGURE 2, in that the length of the cam box can thereby be decreased. On the other hand, the auxiliary needle-lowering cams 22 are designed in this embodiment exactly along the lines of the auxiliary draw cams 23 shown in FIGURE 2.

In order to be able to knit certain definite patterns, it is desirable to split the cam 21 into two portions 24 and 25 together defining the edges 21'', 21''' and being each capable of receding into the cam plate, against the action of a spring, when met by the needle butts. In this event the cam portion 24 corresponds in its functioning to the needle-lifting cam 18 of FIGURE 2, and the cam portion 25 corresponds to the latch 19.

As a result of the replacement of the single stitch cam 3 of FIGURE 1 by two generally trapezoidal stitch cams 11, 12 a space is formed between these two stitch cams which is used for accommodating a pattern-forming needle-selector star wheel 26. This star wheel permits automatic knitting of patterns, because the usually required individual withdrawal by hand of certain needles is no longer necessary since the star wheel by acting successively on individual needle butts causes certain needles to remain in the knitting position, whereas others are moved into non-working positions. In order to knit different patterns, different star wheels are inserted in the cam box, these being fitted wtih various large teeth corresponding to the patterns to be knitted.

Since in the course of knitting and according to the shape of the knitted garment required, for example a pullover, a decrease or an increase in the number of stitches is required during the knitting process, it is necessary either to inactivate a corresponding number of marginally disposed needles or to shift additional marginal needles into a working position. Since the star wheel is rotated during the movement of the cam box by the tooth-like needle butts which are in a knitting position, and since it thereby brings the needles either into the knitting position or into the non-working position, according to the arrangement of the small and large teeth, it follows that upon the activation or deactivation of individual marginal needles, the toothed engagement of the star wheel would occur at different times. The star wheel would thereby be brought into a different position, whereby at times other needles than those intended would be brought into a non-working position through the action of the star wheel so that the desired pattern could not be executed. To prevent this, the star wheel would have to be correspondingly adjusted by hand after each decrease or increase in the number of active knitting needles, before the return movement of the cam box, which is a very cumbersome operation.

The above conditions are better illustrated in FIGURE 4. If the star wheel 26 is moved in the direction of the arrow 27, the needle butt 28 is pushed into the inactive position by the large tooth 29 of the star wheel, whilst the butts of the needles 28', 32 and 30 are brought into the gaps between the teeth and thus remain in the knitting position. When the star wheel has finally lost contact with the last needle butt 30, it remains stationary during the further movement of the cam box, because it is no longer rolled in a cog-like manner by the needle butts. If no decrease or increase is made in the number of active knitting needles, then, during the return movement of the star wheel in the direction of the arrow 31, its peripheral projections formed by the large teeth 29 will always engage the same needle butts so that nothing is altered in the position of the needles and consequently the desired pattern formation can be made.

If however the number of active needles is decreased, for example, then first of all the needle of butt 30 is brought by hand into the non-working position, so that during the return movement of the star wheel, in the direction of the arrow 31, the star wheel 26 does not begin to rotate with the needle butt 30, but only with the subsequent needle butt 32. Consequently, the butt 28 would not be brought into its withdrawn position by a projection 29, but only the subsequent butt 33 would be so affected. In this way an undesirable displacement of the total pattern would occur, unless the star wheel is rotated by hand before the return movement of the cam box. This rotation by hand is, however, cumbersome and easily leads to faults in the pattern if forgotten or improperly executed.

In order to overcome this disadvantage, the displacement is effected automatically, according to the invention, by mechanically driving the star wheel by means of a toothed wheel operatively connected to the star wheel and meshing with rack means rigid with the needle bed. For this purpose, as shown in FIGURE 5, the star wheel 26 is fixed to a bush 34 which is fitted to a shaft 36 mounted in the slidable cam box 35. Secured to the upper face of the bush 34 is a spur wheel 37 which engages a wide spur wheel 38 rotatably mounted in the cam box 35 by means of a journal stud 39. A further spur wheel 40 engages this spur wheel 38 and is fixed to a shaft 41 rotatable in a bearing block 42 secured to the side wall 43 of the cam box. To the lower end of the shaft 41 a toothed wheel 44 is attached which engages studs 45 of which only one appears in FIGURE 5. As shown in FIGURE 6, these studs 45 are arranged in a row near the ends of the needle-bed grooves and between these grooves, near one guide rail 46 for the cam box in the needle bed; these studs operate like the teeth of a rack.

The shaft 36 is fitted within a sleeve 47 and can be rotated therein, the sleeve being riveted from above into the cam box 35. At the upper end of the shaft 36 a handle 48 is attached. In order to be able to bring the star wheel into and out of operation, two circumferential grooves 49, 50 lying one above the other are provided on the shaft 36. These grooves can be engaged as required by a ball check 51', loaded by an annular spring 51, when the handle 48 is pulled upwards or pushed downwards. FIGURE 5 shows the star wheel 26 (solid lines) in the lowered or working position. If the handle 48 is pulled up, so that the ball check 51' engages the lower groove 50, then the star wheel 26 is brought into the position shown by the dot-dash lines and thereby into a position outside the track of the needle butts. The spur wheel 37 thereupon slides upwards along the long teeth of the spur wheel 38 so that the star wheel 26 still rotates as before but, upon being indexed in its upper position, does not come into contact with the needle butts.

Furthermore, a cam disc 52 is fitted on to the sleeve 47 and can be freely rotated thereon to serve as an adjustable abutment for a transversely displaceable cam-supporting part 64. This cam disc rests on the cam box 35 by means of a projecting hub 53 provided on its upper front side with a circular groove 54 for receiving a spring ring 55 which engages a circular groove 56 in the sleeve 47. On the underside of the rotatable cam disc 52 there is a circular recess 57 which a rotating guide roller 58 engages from beneath, this roller being journaled on a stud 60' attached to a generally V-shaped bracket 59 at the vertex 60 thereof. The bracket 59, whose legs straddle the hub 53, is fixed at the lower end of the arms 61 of the V (FIGURE 3) to two bolts 62, 63 rigid with the movable part 64 of the cam plate 64, 64', 64'' for joint displacement therewith to alter the relative positions of cams 20, 21, 11 and 12 in order to vary the length of the stitches drawn by the latter cams. Such displacement can be effected only after the cam disc 52 has been rotated out of the position illustrated in FIGURE 5 in which the roller 58 abuts the wall of recess 57.

The part 64 has essentially a rectangular shape, as shown in FIGURE 3, with side recesses 65, 66 which have the purpose of providing space for the needle-lifting cams 20 and 21. The two bolts 62 and 63, and a third bolt 67 also rigid with the movable part 64, are movable in slots 68 in the plate 35. The movable part 64 of the cam top wall of cam carrier 64, 64', 64'' corresponds essentially to the cam plate 17 described with reference to FIGURE 2.

Since the large teeth of the star wheel 26 can only move the needle butts upwards through a short distance, it is necessary, in order to enable the needle butts to reach their withdrawn position, to have two auxiliary needle-lifting cams 69 of parallelgrammatic configuration each fixed with respect to the box 35 by two bolts 70, 70*a* of which the latter passes through an elongated hole 71 in the movable part 64. Each auxiliary needle-lifting cam 69 is formed on its outer and inner narrow edges with respective extensions defining downwardly directed ledges 72, 73 providing a contact surface for the needle butts, as shown in FIGURES 3 and 7; it will be noted that the ledges 72, 73 are perpendicular to the operative edges 6' or 7' of the associated stitch cam 11 or 12 and parallel to the operative edge 20'' or 21'' of the adjacent lifting cam 20 or 21.

By virtue of the depending ledges 73 of the cams 69 partly overlying the cams 11, 12, the needle butts which have been moved slightly upwardly by the large teeth of the star wheel 26 are displaced still further upwardly into a position in which the needles take no part in the knitting operation or in pattern formation. In this position, the needle heads are completely withdrawn into the needle bed.

The needle-lowering stitch cams 11 and 12 are provided on their upper surface (FIGURE 7) with cam bodies 74 which are hinged by pivots 75 to respective bearing blocks 76. These bearings are situated on the movable part 64 of the cam plate. By means of a spring 77 the stitch cam is pressed downwards to project beyond the cam-supporting surface formed by the movable part 64 of the cam plate, until a projection 74' on the body 74 strikes the part 64 from above to arrest the cam 11 or 12 in a position in which its operative edge 6' or 7' can intercept a needle butt cleared without transverse shifting by the star wheel 26. A needle butt moving in the opposite direction relative to cam 11 (i.e. from left to right in FIGURE 7) mounts its sliding surface 11' to move the cam out of the way against the force of spring 77. The main needle lifters 20, 21 also are mounted for resilient pivotal movement about hinges 175 (FIGURE 3) in a manner similar to that described above with reference to FIGURE 7.

FIGURE 8 shows how the star wheel can be removed and replaced. For this purpose, a stud 80 is attached to the wheel at its center and projects upwards, and this stud fits into a bore 81 in the bush 34. The stud has a circular groove 82 engaged by the sides of a hairpin spring 83, which rests in two side slits in the bush 34. The star wheel 26 is prevented from rotating with respect to the bush 34 by means of a projection 93 formed on the wheel 26 and engaging a recess 93' in the bush 34. For the interchange of the star wheel, this wheel is withdrawn downwards, whereby the two sides of the hairpin spring are moved outwards out of the circular groove 82. For the introduction of another star wheel the latter need only be slipped from below with its stud 80 into the bore 81, until the hairpin spring snaps into the circular groove.

The shaft 36 is provided at its lower end with a flange 84 which engages a shouldered recess 85 in the spur wheel 37. In a bore 86 of the shaft 36 a spring 87 is horizontally disposed as part of a yieldable coupling mechanism for enabling manual adjustment of the angular position of gear 26 in a given position of the carriage 35, 64, 64', 64''.

The spring 87 urges two retaining balls 88 into one of twelve pairs of diametrically opposite holes, which are distributed at equal angular intervals around the inner surface of the bore 89 in the spur wheel 37. The shaft 36 and the bush 34 can be made integral with one another, as shown in FIGURE 8. The spur wheel 37 is kept in position by means of a spring ring 90. The spring ring 90 engages a circular groove of the shaft 36. The spur wheel 37 can be indexed in various angular positions in relation to the shaft 36, by means of the retaining balls 88, so that during the knitting of patterns the star wheel 26 can be rotated from its original position whereby different needles are brought into inoperative position for purposes of altering the pattern. In this way the patterns which are obtained by bringing certain needles into the holding position can be transposed and so-called cardigan rack patterns can be obtained. Furthermore, as can be seen from FIGURE 3, additional drawing cams 91 are mounted on cam-plate parts 64', 64'' and extend from the vicinity of cams 22, parallel to flanks 120 and 121 of cams 20 and 21, towards the middle of the movable part 64.

With the aid of these additional needle-lowering cams, the needles which are in the inoperative position can be brought again into the knitting position, this being done upon a movement of the cam plate from right to left with the aid of the right-hand cam 91, and during the reverse movement of the cam plate with the aid of the left-hand cam 91, by guiding these needle butts to the associated auxiliary needle-lowering cam 22 for subsequent engagement by the depending ledge 72 of the adjacent cam 69 upon the next reciprocation of the cam carrier. The needles referred to are those which have been pushed upwards by the flank 73 of the auxiliary needle-lifting cam 69 at an earlier stage.

Usually, for the knitting of rib patterns, these additional needle-lowering cams 91 are made inoperative. These cams are brought into operation, in order to change over from rib-pattern knitting to plain knitting or to an-

other pattern, by displacing the star-wheel **26**, for example by means of the handle **48**, by one or several tooth divisions, or by replacing one star wheel by another. The two additional cams **91** are thus displaced to and fro from time to time, according to requirements.

If desired, the additional cams **91** and the auxiliary cams **22** can be constructed as swiveling auxiliary cams **92** of generally triangular shape, as shown in FIGURE 9. In the solid-line position, these swiveling needle-lowering cams **92** operate in the same way as the cams **22**, while in the position shown in broken lines they also perform the function of the additional cams **91**, i.e. the restoration of inactive needles to operative position.

I claim:

1. In a hand knitting machine, in combination, a cam carrier forming a cam-supporting surface of elongated shape with a transverse plane of symmetry extending at right angles to the length of said surface; two main needle-lowering stitch cams spaced apart from one another on said surface and arranged one on each side of said plane of symmetry; at least two needle lifters disposed on said surface outwardly of said main stitch cams; two auxiliary needle-lowering cams each arranged on said surface adjacent to a respective one of said needle lifters between the latter; pivot means connecting each of said main stitch cams to said carrier for swinging movement about an axis substantially parallel to said surface and inclined to said plane of symmetry; spring means for swinging each of said main stitch cams about said axis in a direction making the stitch cams project from said surface, each main stitch cam being of generally trapezoidal configuration and having an operative edge substantially parallel to said axis engageable with a needle butt upon longitudinal reciprocation of said carrier; stop means for arresting the swinging movement of each of said main stitch cams about said axis in a projecting position in which said operative edge faces toward said plane of symmetry to intercept oncoming needle butts; and a pattern-forming needle-selector wheel rotatably mounted on said surface between said main stitch cams, said wheel being provided with butt-receiving peripheral gaps and with peripheral projections for displacing oncoming needle butts out of the range of said one of said operative edges.

2. The combination according to claim 1, further comprising rail means slidably supporting said carrier, rack means on said rail means, and gear means on said carrier in mesh with said rack means and coupled with said wheel for progressively rotating the latter upon reciprocation of said carrier along said rail means.

3. The combination according to claim 2, further comprising yieldable coupling means between said wheel and said gear means for manually adjusting the angular position of said wheel in a given position of said carrier.

4. The combination according to claim 2 wherein said wheel is axially displaceable between an operative position in the path of said needle butts and an inoperative position offset from said path, said gear means being adapted and disposed to maintain said wheel coupled with said rack in both said operative and said inoperative position thereof.

5. The combination according to claim 4 wherein said wheel is provided with a shaft axially displaceable together with said wheel, further comprising indexing means on said carrier engageable with said shaft for releasably maintaining said wheel in either of said positions thereof.

6. The combination according to claim 1 wherein said carrier has a transversely displaceable central part bearing said stitch cams and said wheel, said pivot means being secured to said part.

7. The combination according to claim 6 wherein said wheel is provided with a shaft, further comprising abutment means on said shaft for adjustably limiting the transverse displacement of said central part.

8. The combination according to claim 7 wherein said carrier comprises a box with a slotted wall, a cam plate within said box including said central part and forming said surface, a generally V-shaped bracket outside said box adjacent said wall, bolt means connecting said bracket with said part while passing through said slotted wall, said shaft traversing said wall and extending beyond said bracket between the legs of the V, and a guide element on said bracket at the vertex of the V, said abutment means including a cam element on said shaft engageable by said guide element.

9. The combination according to claim 8 wherein said shaft is rigid with said wheel and axially displaceable in said wall between an operative wheel position in the path of said needle butts and an inoperative wheel position offset from said path, further comprising a handle on said shaft beyond said cam element for axially displacing said shaft.

10. The combination according to claim 9, further comprising a sleeve fixed to said wall and surrounding said shaft, said cam element having a hub journaled on said sleeve and held against axial displacement relative thereto, further comprising indexing means in said sleeve engageable with said shaft for releasably maintaining it in either of said wheel positions.

11. The combination according to claim 1 wherein said auxiliary cams partly overlie the adjacent main stitch cams and are provided with depending ledges adjacent said selector wheel engageable by needle butts displaced by said projections for further advancing said displaced needle butts beyond the range of said operative edges.

12. The combination according to claim 11 wherein said operative edges converge at said plane of symmetry in the direction of displacement of said needle butts by said projections, said ledges being substantially perpendicular to said operative edges.

13. In a hand knitting machine, in combination, a cam carrier forming a cam-supporting surface of elongated shape and with a transverse plane of symmetry extending at right angles to the length of said surface; two main needle-lowering stitch cams spaced apart from one another on said surface and arranged one on each side of said plane of symmetry; at least two needle lifters disposed on said surface outwardly of said main stitch cams; two auxiliary needle-lowering cams each arranged on said surface adjacent to a respective one of said needle lifters between the latter; first pivot means connecting each of said main stitch cams to said carrier for swinging movement about a first axis substantially parallel to said surface and inclined to the said plane of symmetry; first spring means for swinging each of said main stitch cams about said first axis in a direction making the stitch cam project from said surface, each main stitch cam being of generally trapezoidal configuration and having an operative cam edge substantially parallel to said first axis engageable with a needle butt upon longitudinal reciprocation of said carrier; first stop means for arresting the swinging movement of each of said main stitch cams about said first axis in a projecting position in which said operative cam edge faces toward said plane of symmetry to intercept oncoming needle butts; second pivot means connecting each of said needle lifters to said carrier for swinging movement about a second axis substantially parallel to said surface and inclined to said plane of symmetry; second spring means for swinging each of said needle lifters about said second axis in a direction making the lifter project from said surface, each main needle lifter being of generally trapezoidal configuration and having an operative lifter edge substantially parallel to said second axis engageable with a needle butt upon longitudinal reciprocation of said carrier; and second stop means for arresting the swinging movement of each of said needle lifters about said second axis in a projecting position in which said opera-

tive lifter edge faces towards said plane of symmetry to intercept oncoming needle butts.

14. The combination according to claim 13 wherein one of said needle lifters is divided along said operative edge thereof into two separately pivoted portions independently swingable about said second axis.

15. The combination according to claim 13 wherein each of said auxiliary cams is substantially trapezoidal and provided with inclined inner and outer edges which are substantially perpendicular to said operative edge and substantially parallel to said operative lifter edge of the main stitch cam and the needle lifter on the same side of said plane of symmetry.

16. The combination according to claim 15 wherein said auxiliary cams partly overlie the adjacent main stitch cams and are provided with depending ledges along said inner and outer edges.

17. The combination according to claim 15, further comprising selector means adjacent said inner edges for inactivating selected needle butts by transverse displacement from a knitting position in the direction of convergence of said operative cam edges for engagement by said inner edges and further displacement thereby in said direction of convergence.

18. The combination according to claim 17, further comprising a pair of additional cams positionable on said surface beyond said outer edges for reactivating said selected needle butts by camming them into engagement with said outer edges for return to said knitting position.

19. The combination according to claim 18 wherein said additional cams are generally triangular and pivotally mounted on said surface.

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