Feb. 21, 1967 F. SEILER 3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

Filed Jan. 31, 1963 10 Sheets-Sheet 1

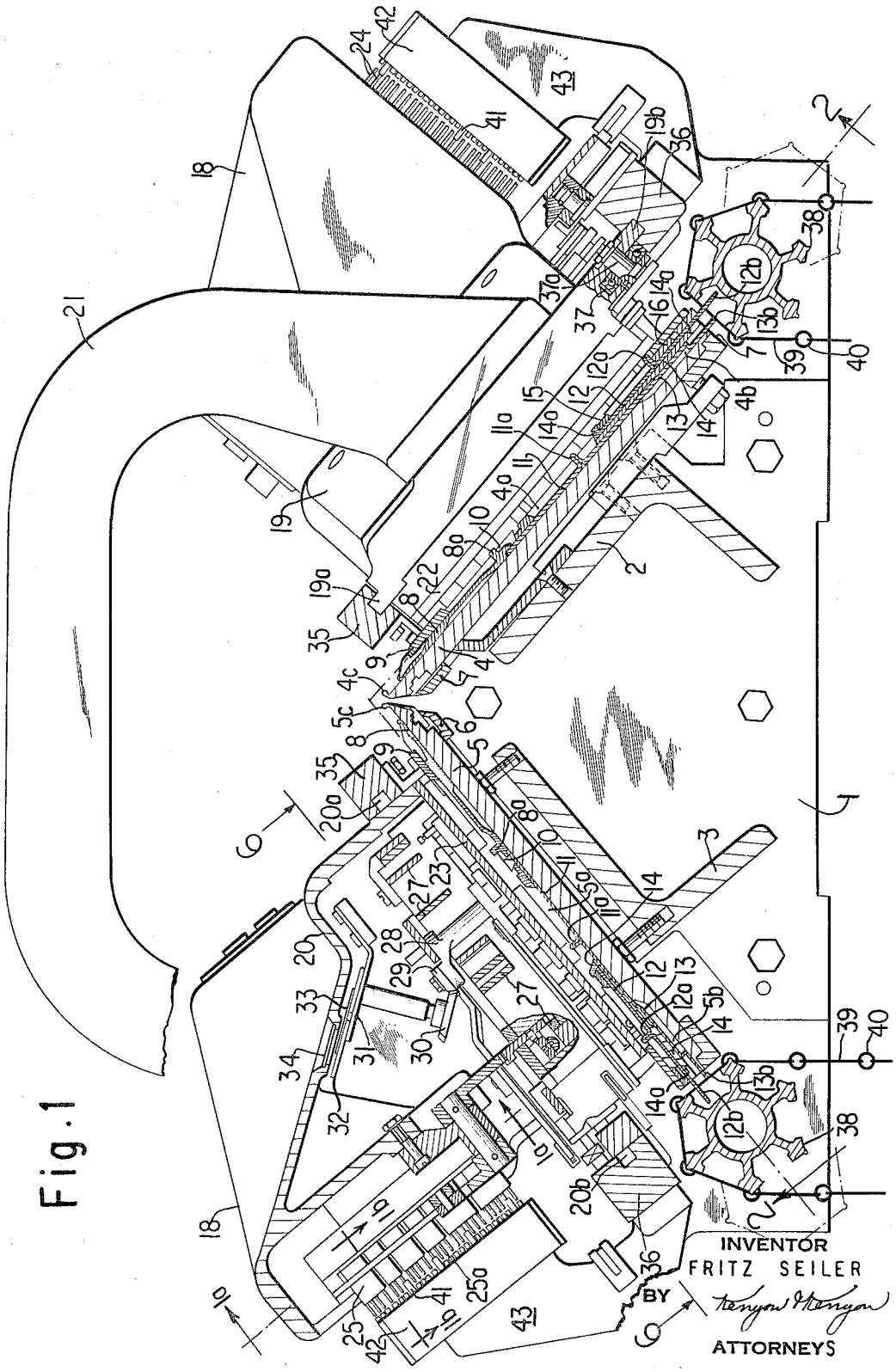


Fig. 1

INVENTOR
FRITZ SEILER
BY Kenyon & Kenyon
ATTORNEYS

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CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

Filed Jan. 31, 1963 10 Sheets-Sheet 2

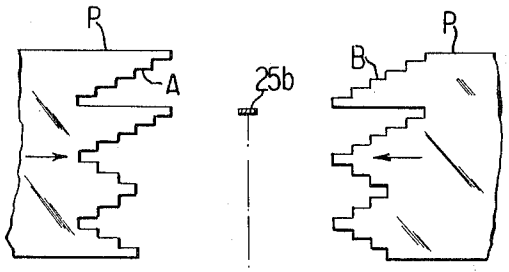


FIG. 1a

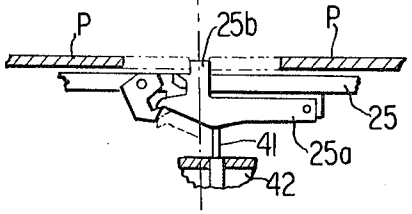


FIG. 1b

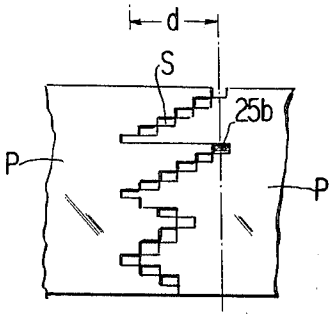


FIG. 1c

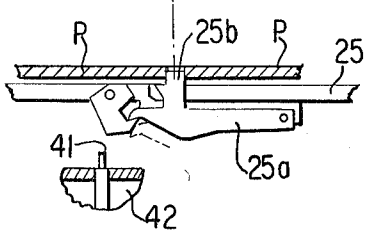


FIG. 1d

INVENTOR
FRITZ SEILER
BY Kenyon & Kenyon
ATTORNEYS

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CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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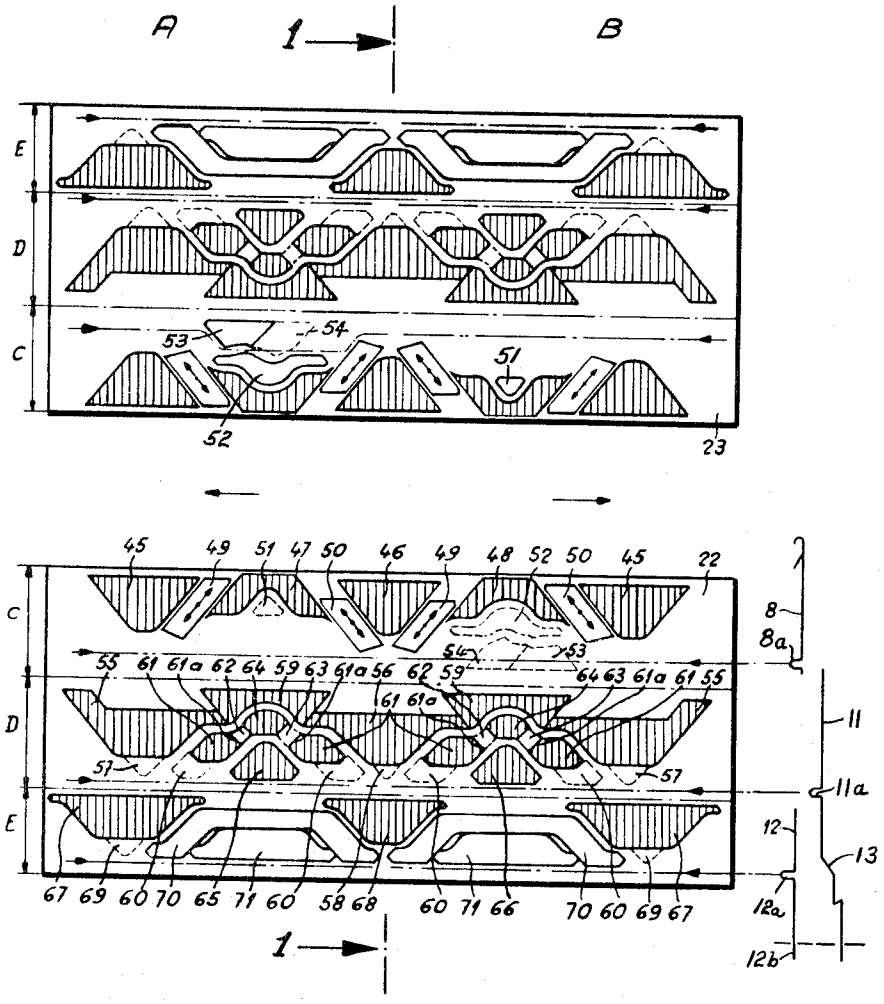


Fig. 2.

INVENTOR.
FRITZ SEILER

BY Kenyon & Kenyon
ATTORNEYS

Feb. 21, 1967 F. SEILER 3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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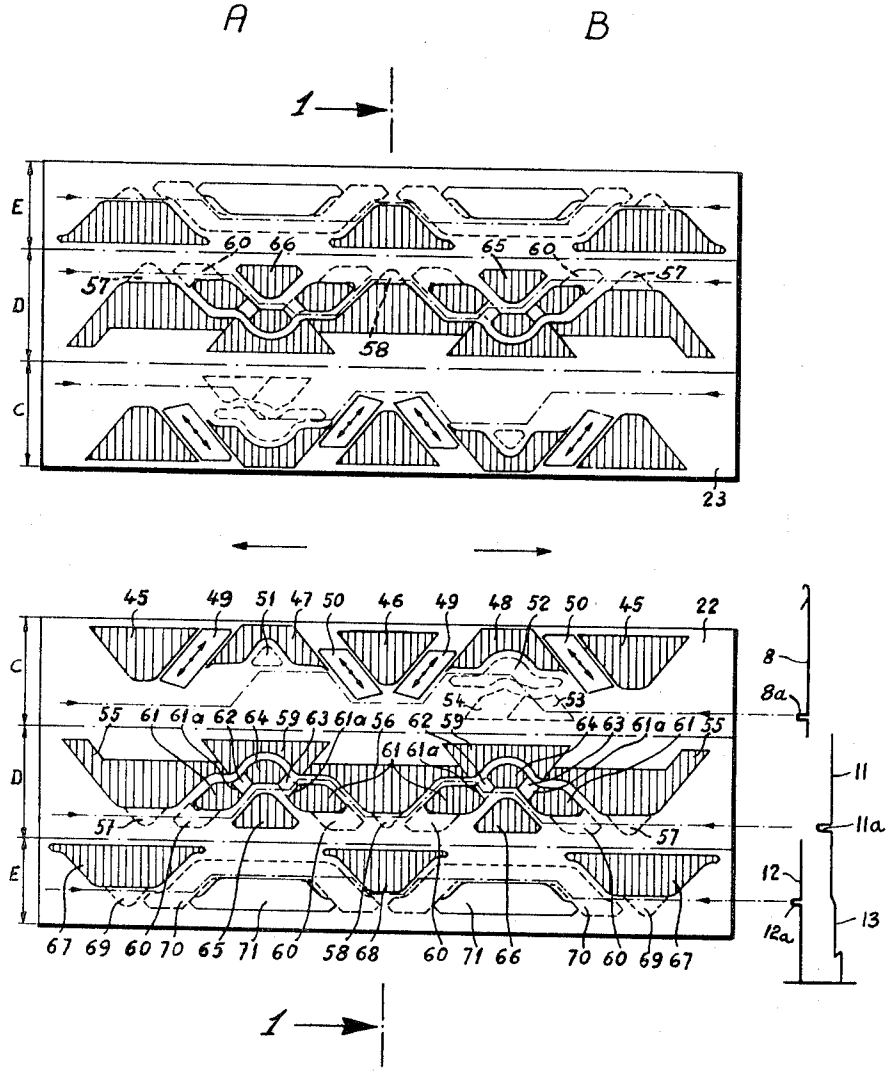


Fig. 3.

INVENTOR.
FRITZ SEILER

BY Kenyon & Kenyon
ATTORNEYS

Feb. 21, 1967 F. SEILER 3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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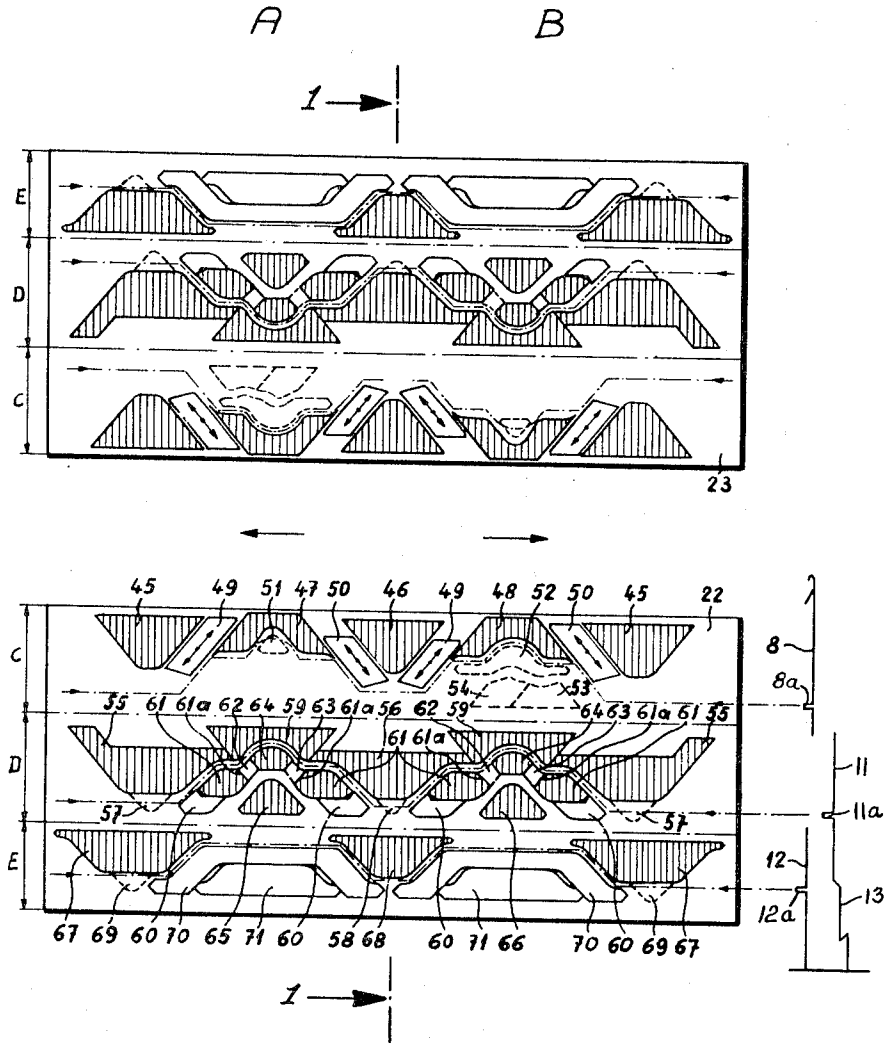


Fig. 4.

INVENTOR.
FRITZ SEILER

BY Kenyon & Kenyon
ATTORNEYS

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CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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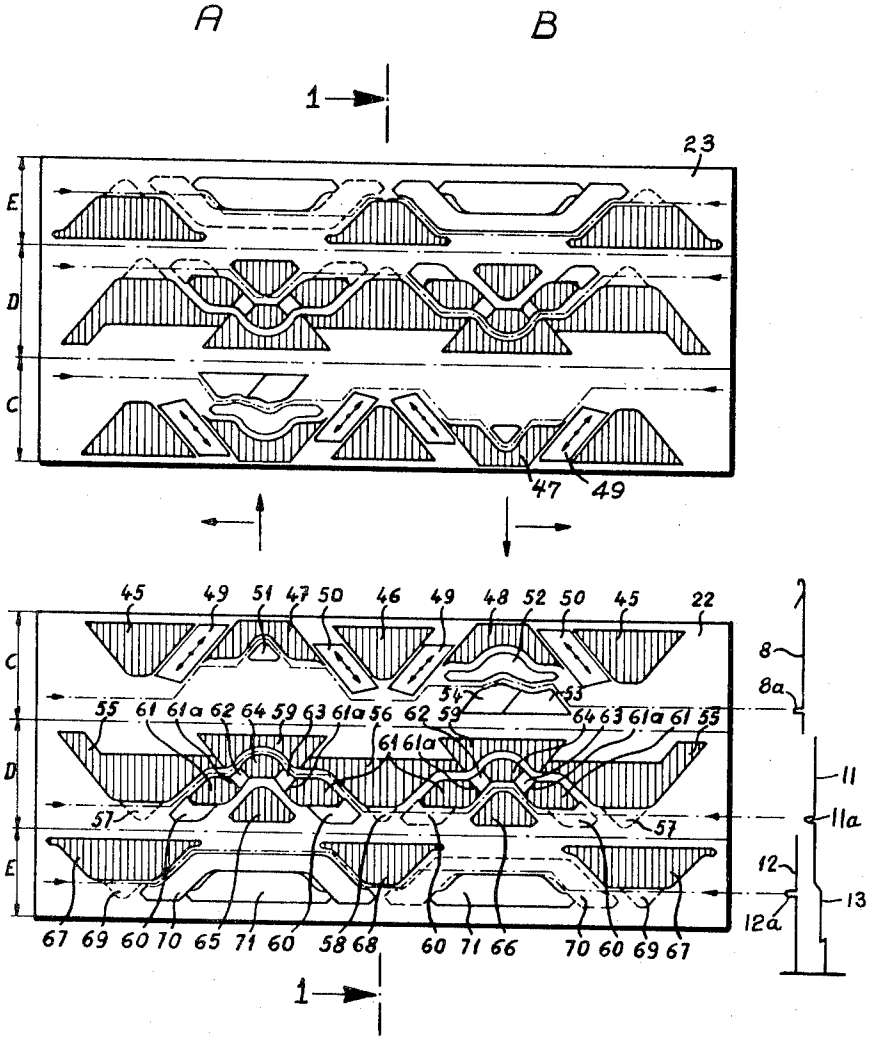


Fig. 5

INVENTOR.
FRITZ SEILER

BY

Kenyon & Kenyon
ATTORNEYS

Feb. 21, 1967 F. SEILER 3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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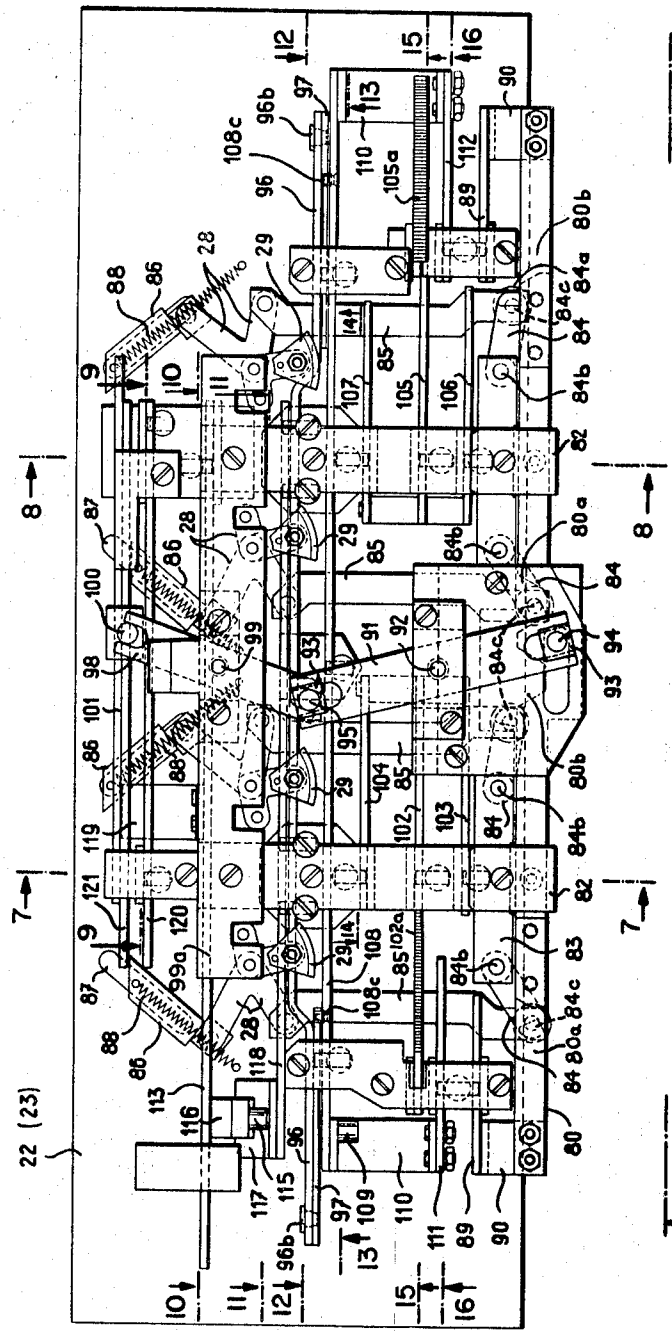


Fig. 6

INVENTOR.
FRITZ SEILER

BY Kenyon & Kenyon
ATTORNEYS

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CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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Fig. 7

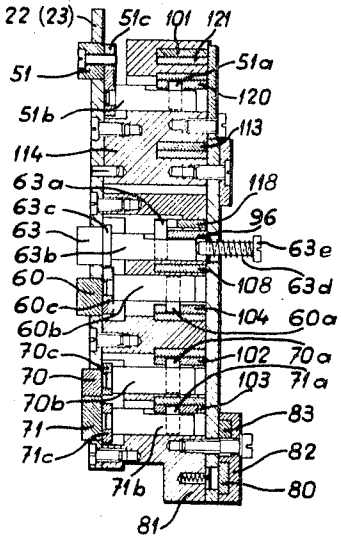


Fig. 8

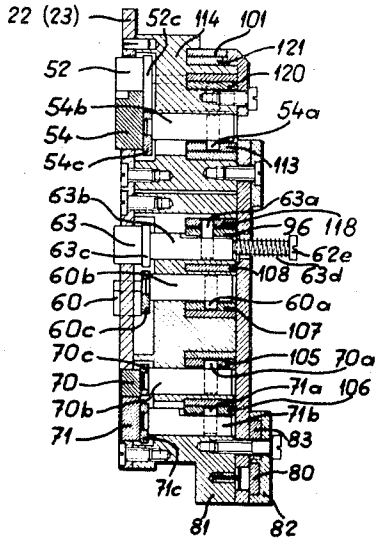
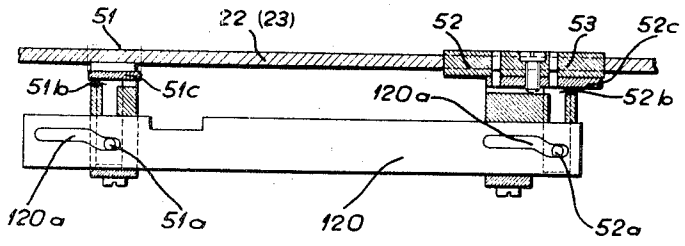


Fig. 9



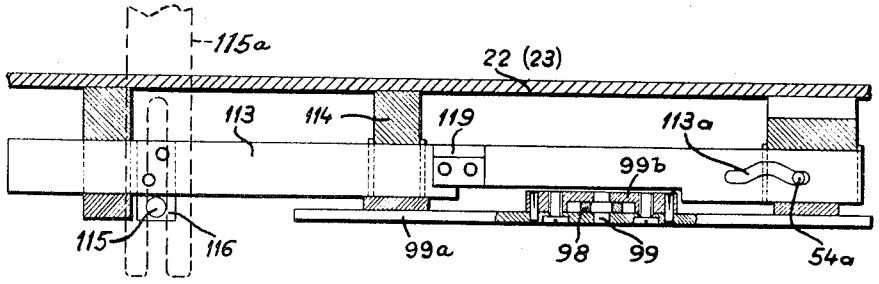


Fig. 10

INVENTOR.
FRITZ SEILER

BY

Kenyon & Kenyon
ATTORNEYS

Feb. 21, 1967 F. SEILER 3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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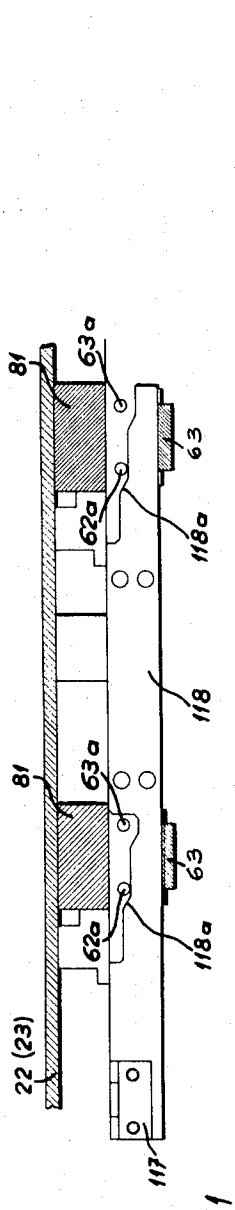


Fig. 11

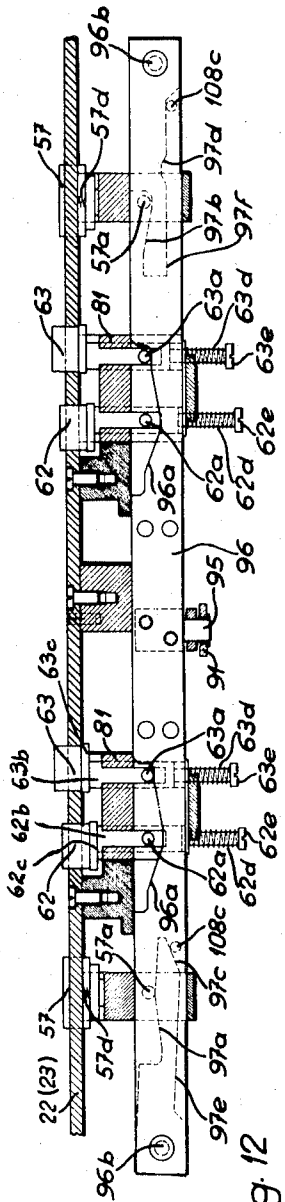


Fig. 12

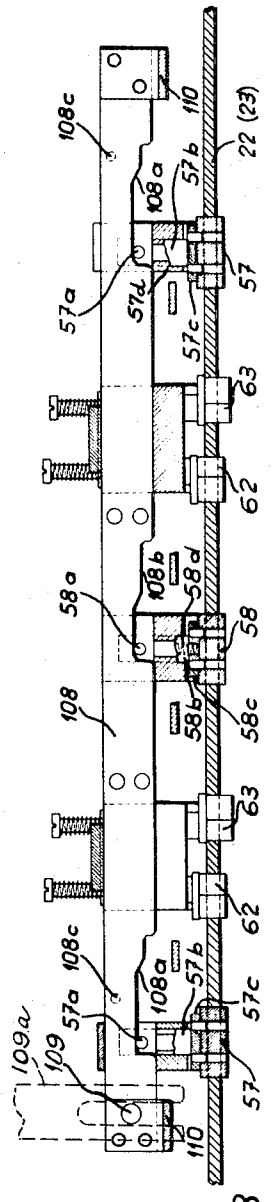


Fig. 13

INVENTOR.
FRITZ SEILER

BY Kenyon & Kenyon
ATTORNEYS

Feb. 21, 1967 F. SEILER 3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

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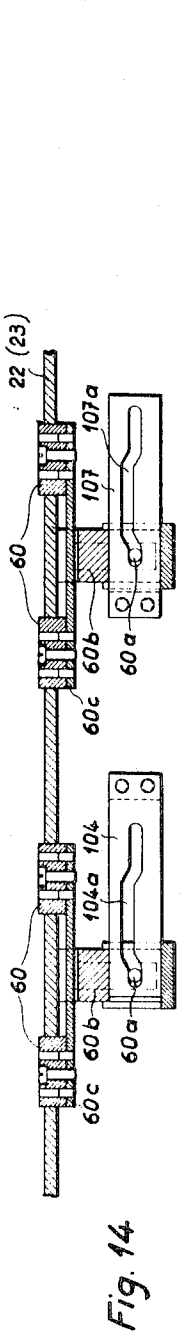


Fig. 14

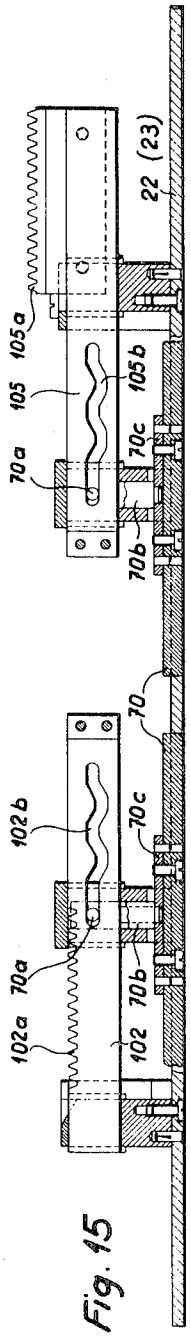


Fig. 15

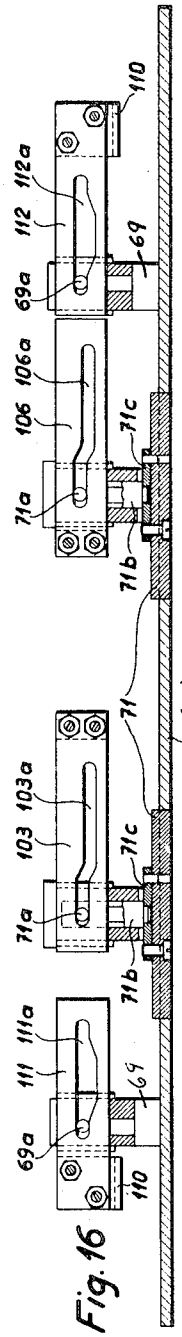


Fig. 16

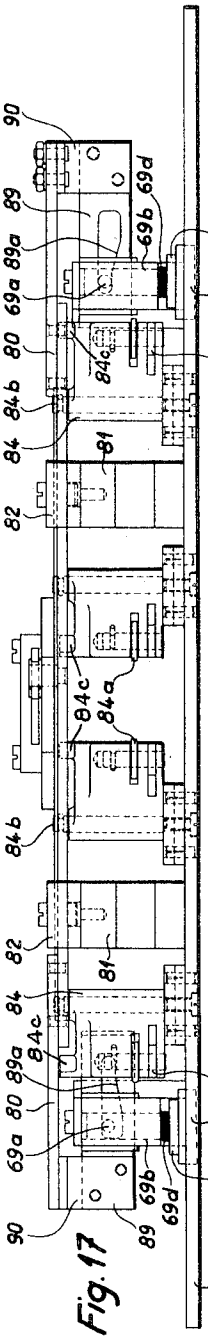


Fig. 17

INVENTOR.
FRITZ SEILER
BY
Kenyon & Kenyon
ATTORNEYS

United States Patent Office 3,304,748 Patented Feb. 21, 1967

3,304,748

CAM-BOX FOR A JACQUARD FLAT KNITTING MACHINE

Fritz Seiler, Neuchatel, Switzerland, assignor to Edouard Dubied et Cie (Societe Anonyme), Neuchatel, Switzerland

Filed Jan. 31, 1963, Ser. No. 255,369
4 Claims. (Cl. 66—64)

The present invention relates to an automatic Jacquard flat knitting machine of the type and is a continuation-in-part of my copending application, Serial No. 64,867, filed October 25, 1960, now abandoned.

The group of automatic flat knitting machines of the classic type with two needle beds arranged in an inverted V shape and equipped with independent needles and with a Jacquard device, includes among others some machines that are equipped with a system of transferring the stitches, that is to say, the possibility of transferring automatically the stitches of the needles from one of the beds to those of the other bed and vice versa. By such system, the range of patterns is considerably increased, permitting, for instance, the execution of hemstitch patterns in addition to Jacquard patterns, or the reduction in widths of the knitted articles.

The production of such a machine implies a corresponding arrangement of transfer knitting needles, including, in addition, the requisite intermediary acting parts, such as jacks, and lifters, and the like, as well as a selective system, as for instance, a Jacquard device; and also cam boxes containing an assembly of cams capable of communicating to said needles their requisite longitudinal travel as needed for the transfer of the stitches.

For such purposes, it has already been suggested that such machines be equipped with special needles to be used for knitting as well as for transfer, capable of being selected by means of jacks and lifters, either by advance hand-setting, or automatically with the aid of a Jacquard device; in combination with a cam box which is also equipped with the usual central group of cams for raising and lowering the needles for plain or pattern knitting and with groups of special cams with jacks for the transfer of the stitches. These groups are placed in said cam box alongside the group of regular knitting cams and are generally set in pairs, one at the left and the other at the right of said central group. This arrangement makes it possible to effect the transfer in both directions of the travel of the carriage, but, on the other hand, it has the great inconvenience of a complicated cam box containing a long and heavy triple cam mechanism. In the case of simple knitting without transfer it is, therefore, necessary for the carriage to perform in each course an unnecessarily long travel in order to disengage itself from the needle assembly. This results both in a loss of time and of production.

Another solution contemplates the combination of the two cam groups, regular for knitting and special ones for the transfer, into a single group which incorporates movable raising cams capable of assuming different positions in height in relation to the plane surface of the beds so as to cooperate with the butts of needles protruding to different heights. The inconvenience of such a system consists in the requisite complicated mechanism for the control of movement of the cams into different positions; also in the relatively light contact of the butts with these cams which causes them to wear out rapidly; also in the need resulting from these two circumstances of adapting the speed of the machine thereto and consequently of reducing it; and finally, because of this reduction of the speed, the resulting decrease in production.

The present invention aims to eliminate all of these inconveniences. It relates to an automatic flat knitting

machine of the classic type with two plane needle beds arranged in an inverted V shape and equipped with independent knitting needles, each one of which may be activated individually by a main jack which is selected either by an auxiliary jack or by a lifter, the butts of said needles and of said two types of jacks all projecting from said needle beds to an even like height; said machine being equipped with a conventional Jacquard device with prism and steel cards with two series of stampings, as well as with a stitch transfer system, composed of needles of already known design, a supporting device made of cast iron for the racking of the needle beds and a special cam box wherein two different sets of cams are placed in boxes opposite each other, each set consisting of three distinct groups of different cams placed in three different parallel zones at three levels and wherein cams of the upper zone work simultaneously with the butts of said needles, the cams of the central zone with the butts of the principal jacks and the cams of the lower zone with the butts of the axiliary jacks; each said cam box is characterized further by the fact that the upper zone of needle cams comprises in lieu of the normal raising cam combination, sinkable transfer cams placed inbetween the normal stitch cams and that each of the two zones of the jack cams presents raising cams, some of which are sinkable, and symmetrically arranged in relation to the center zone of each system.

By preference, said cams for the transfer of the needles are simultaneously carried into working position or idling position by rigidly joined slides in each of the two opposed cam boxes. Finally, said raising cams for the raising of the needles may possess a straight or flat, non-stepped surface facing the upper side of the needle bed.

Other characteristics and advantages of the invention will appear from the description which follows regarding a preferred embodiment of the cam box of a flat, straight, Jacquard knitting machine which is depicted in the drawings as an example and in which:

FIG. 1 is a cross-section of the operating portion of the machine along the line 1—1 of FIG. 2, showing in addition to the cam-plates the carriage with bow, the needle beds and the two Jacquard prisms;

FIGS. 1*a* and 1*b* are sections taken along lines 1*a*—1*a* and 1*b*—1*b* of FIG. 1 with parts in open position;

FIGS. 1*c* and 1*d* illustrate the same parts in closed position;

FIGS. 2 to 5 are bottom plan views of the two opposite cam locks along line 2—2 of FIG. 1, showing the various possible lines of travel of the needle butts and of the jack butts as a function of the various position combinations of the sinkable mobile cams;

FIG. 6 is a view along the plane of line 6—6 of FIG. 1, with parts removed for clarity, of the control slides for the cams;

FIGS. 7 to 16 are cross-sections of the cam box and slide along the lines 7—7, 8—8, 9—9, 10—10, 11—11, 12—12, 13—13, 14—14, 15—15 and 16—16, respectively, of FIG. 6, and

FIG. 17 is a front view viewed from the plane of line 17—17 of FIG. 6 in the direction of the arrows thereof of the cam and slide.

In FIG. 1, the reference 1 indicates one of the two like end cheeks of the frame of the machine which are connected to each other by means of spanning tie bars 2 and 3. This frame acts as the support of the two needle beds 4 and 5 which are arranged in the classical manner, one facing the other to form an inverted V and defining between themselves a nearly 90° angle. Also, in an already known manner and, therefore, not shown in detail in the drawing, the front needle bed 4 may be lowered in a transversal sense as the rear needle bed 5 may be racked a ½ gauge in the longitudinal sense. Each one

of the two needle beds **4** and **5** is provided with a number of parallel transverse slots **4***a* and **5***a* along substantially the entire length of the needle beds; each slot extending from one outer bed edge to the other. For reasons explained hereafter, the knock-over bits **4***c* and **5***c* of the needle beds are not included in these slots, but are inserted individually and fixed jointly by means of the clamping bands **6** and **7**. Said slots **4***a* and **5***a* serve as guide channels for axial movement of the knitting needles **8**, each of which is equipped with a single height butt **8***a* and maintained in its respective slot by the needle covering bands **9** and **10**. The needles **8** are of the already known type shown and described in German Patent No. 692,981 being equipped with a stop-notch for the knitting stitch to be transferred and with a lateral recess permitting the penetration of the loop-receiving needle and chamfered hook so as to facilitate that penetration. Within the same slots **4***a* and **5***a* which are deepened at the lower or outer extremities **4***b* and **5***b* of the two needle beds **4** and **5** and following the rear ends of needles **8**, there are the main jacks **11** with their butts **11***a* each at a single height; auxiliary jacks **12** with fixed butts **12***a* each of the same height; and also lifters **13** without butts. The separation between and guidance of jacks **12** and of lifters **13** is achieved by the well known means of an auxiliary needle bed **14** having dove-tail cross-section **14***a* as seen in FIG. 1 which also has parallel transverse slots to receive jacks **12** and lifters **13** mounted within each of the principal needle beds **4** and **5**. Further, the auxiliary jacks **12** are maintained in their slots by cover bands **15** and **16** secured to bed **14**, while the guidance of their tails **12***b* and the tails **13***b* of lifters **13** is taken care of by a perforated end band **17** through which said tails project for guidance.

Above these needle beds **4** and **5** there is the complete carriage **18** which is composed of two housings or cam boxes **19** and **20** which are connected by the bridge **21** containing the two cam plates **22** and **23** which latter serve as the supports or guides for the various cams shown and numbered in FIGS. 2 to 5, and to be presently described, the two slide casings **24** and **25** forming a part of the housings **19** and **20** and containing all control parts for the automatic movements of the carriage, including the transmission **26** to the cam control slides **27**. The details of this aspect will be described below.

Carriage **18** is suspended and guided by its tenons **19***a*, **19***b* and **20***a*, **20***b* in four guide bars **35** and **36** which extend parallalelly over the entire length of the machine and thus make it possible for carriage **18** to travel in both directions above the needle beds **4** and **5**. Easy execution of this longitudinal travel is assured by roller bearings **37** secured on the tenons by axle **37***a*.

The selection and operation of the auxiliary jacks **12**, as well as of the needle lifters **13** follow the already known procedure with the aid of the Jacquard device or means, the diagrammatic showing of which depicts only the two prisms **38** one placed in front of the lower extremity of each of the two respective needle beds **4** and **5**, extending over the entire length of the same, these prisms being capable of rotating clockwise or counterclockwise for one or two steps and of exercising a striking motion from the rest position **38'** shown in a broken line to the working position **38** shown in full line, being supported and moved, for example, in the manner shown in FIGS. 2 and 3 of Diem Patent No. 2,025,499. Said prisms **38** support chains of steel sheet **39** connected to each other by means of rings **40** and perforated in two rows so that the prisms **38** upon striking the tails **12***b* and **13***b* respectively of the auxiliary jacks **12** and the needle lifters **13** will perform the sorting. The selection of the various slides **24** and **25** is also done in the already known manner at the end of each travel of the carriage by the keys **41** housed in boxes **42** which are attached to bar **36** by means of the supports **43**.

As seen in FIGS. 1, 1*a*, 1*b*, 1*c* and 1*d*, each selection box **42** is fixedly located on bar **36** approximately midway between the opposite ends of its needle bed. The movable keys **41** in this box **42** are individually controlled by conventional push-pull cables or by hand and so can be retracted or projected from the face of box **42**, and when projected lie in the path of travel of the associated cam boxes **19** or **20**. When the particular cam box, say **19**, passes over the selection box **42**, regardless of its direction, the projected keys **41** depress selectors **25***a* mounted on the movable slides **25** in the cam box **19**. These projected movable keys thus constitutes a pre-selection of the next position of the movable slides associated with selectors **25***a* because a selected slide **25** will not be moved until the cam box **19** has advanced to the end of its particular stroke relative to the needle bed. At the end of the cam box stroke, a cam action causes the closing of a pincer device P which has stepped edges A and B, FIGS. 1*a* and 1*c*. When the pincer device P is closed, the form of its edges creates a series of spaces S which are always in the same position relative to the frame of the cam box. These spaces S are aligned with the respective butts **25***b* of the selectors **25***a* mounted on the slides **25**. Where a selector **25** has been depressed by the action of a key **41** in the selection box **42**, its particular butt **25***b* will project into the particular area affected by the pincer device P. When the pincer device P closes, the particular butt **25***a* will be carried to the position of its respective space S between the two parts of the pincer device P. Thus, the particular selector **25***a* that has been depressed during the stroke of the cam box **19** across the needle beds causes the particular slide **25***a* to take up a new position corresponding to distance *d* when the cam box reaches the end of the needle bed. This distance *d* depends on location of space S of pincer device P gripping the particular butt **25***b*.

Each cam box has six slides **25** each with one selector **25***a* for each position required of each such slide for the functioning of the machine. If the position of a slide **25** which controls the knitting cams needs to be maintained for more than one stroke of the cam box **19**, the particular selector **25***a* corresponding to that position remains depressed until a new position is selected by a different key **41**.

The cams actuating the needles and jacks and lifters are controlled by slotted slides as will be described which are connected by levers or gear-like segments **26** to the movable slides **25** described above. The positions of the latter cams are, therefore, controlled by the positions of the movable slides **25** as directed by the selection box **42**.

In FIGS. 2 to 5 the letters A and B designate respectively the head end and tail end systems (pair of locks) arranged side by side in the direction of the length of the cam plates **22**, **23** of a double system Jacquard machine.

The two opposite cam locks in FIGS. 2 to 5, looking toward the same direction each against their symmetrical axis (line of intersection of the intercrossed needles), are identical. The rear cam plate **23** is consequently to be viewed by turning the drawing. The reference figures and letters are then in the same relation toward either one of the said cam plates, system A being always the head end system and B the tail-end system in the direction of the travel of the carriage.

The entire width of each cam plate **22**, **23**, is divided into three zones, of which zone C contains the cams which work simultaneously with the butts **8***a* of needles **8**, zone D contains the cams which act on the butts **11***a* of the principal jacks **11** and zone E contains the cams controlling the butts **12***a* of the auxiliary jack **12**. In these three zones, C, D and E, all of the cams which are shown by hachures are fixed, that is to say, permanently screwed onto the cam plates **22** and **23**, while the cams which are shown without hachures are movable, that is to say, they may either be moved in the longitudinal sense, or be sunken into the cam plate or elevated, perpendicularly to

the surface of the needle beds 4 and 5, those in operation there being shown in a full line and those that are idling being shown in broken lines.

In zone C, 45 and 46 are the usual fixed alignment cams at the entrance and exit of each system A and B, while 47 and 48 are the usual fixed safety cams. 49 and 50 designate the movable stitch cams, placed in the usual manner of all rectilinear knitting machines, at the left and at the right of the central safety cams 47 and 48. Also, in the center of each system A and B are placed the movable transfer cams 51 for the lifting of all supplying needles, that is to say, those which drop their stitch, and the movable separating cams 52 which by either their upper or lower cam faces serve for guiding the butts 8*a* of needle 8 in accordance with the travel of the same. Movable cams 53 are the raising cams for the opening of the needle latches and movable cams 54 are the transfer cams for the partial lifting of the receiving needles, that is to say, those which take up the stitch dropped by the supply needles.

Zone D contains the fixed alignment cams 55 and 56 which are topped, respectively, by the movable lowering cams 57 and 58 for the main jacks; at the centers of respective systems A and B, are the fixed safety cams 59 for guiding the butts 11*a* of said main jacks 11 when travelling upward for knitting; the movable lower lifting cams 60 for these jacks; the fixed median lifting cams 61; the movable upper lifting cams 62 and 63; the fixed clearing cams 64; and the fixed tuck cams 65 and 66.

Finally, in the zone E are the fixed alignment cams 67 and 68 of the auxiliary jacks 12 of which the cams 67 are located at the two extremities of the cam plate 22 or 23 and are continued downward by the movable lowering cams 69. The center of each system A and B in zone E is taken up by the movable upper raising cams 70 of the auxiliary jacks 12 and by the movable lower raising cams 71 for the same jacks.

FIG. 6 shows the arrangement of the control slides 27 (FIG. 1) for the cams housed in the housings or cam boxes 19 or 20. Therein: 80 is the reciprocally movable slide guided in the blocks 81 with covers 82 (FIGS. 7, 8 and 17). This slide 80 controls several alternative motions in the cam locks, namely:

(a) That of the movable stitch cams 49 and 50 mounted on the slides 86 which are guided in the slots 87 of the cam plates 22 (23) and each one subjected to the action of a spring 88. Said slides 86 may each one be displaced in the longitudinal sense by means of a reversing mechanism consisting of lever 84 with a roller 84*a*, pivoting around axis 84*b* in bar 83, of lever 28 and link 85. At the end of each course of travel of the carriage, the rollers 84*a* of the four levers 84 ascend on fixed inclined planes located on bars 36 at appropriate points thereon and thus bring each one of the four stitch cams into their top position (idling). The reciprocating slide 80 is also displaced longitudinally, in the already known manner, by fixed abutments at the end of the course of travel of the carriage. Upon return of the carriage, the rollers 84*a* of levers 84 are again released by the said inclined planes so that as the result of the action of spring 88, each one of the four stitch cams 49, 50 returns to the position assigned to it for the length of the stitch and also by the application of those rollers 84*a* attached to the head-end cams, on slide 80, and also by the penetration of the noses 84*c* of levers 84 actuating the tail end cams, into the gaps 80*a* and 80*b*, respectively, in slide 80. Levers 28 are equipped with toothed segments 29 (FIGS. 1 and 6) which engage with conical pinions 30 (FIG. 1) which are mounted with their axles into supports 31. On these axles are also fixed the graduated sectors 32 permitting one to read the position of the stitch cams (length of stitch) with the aid of index 33 visible through glass 34 of a suitable window of housings 19 and 20.

(b) By means of slides 89 connected with said reciprocating slide 80 by the corner plate 90, control of the movable lowering cams 69 of zone E (FIG. 17) is also effected by said slide 80.

(c) By a first reversing assembly formed by the double lever 91 pivoting on axis 92 and engaging at opposite ends respectively with a nut on a pin 94 on slide 80 or 95 on slide 96, that of slide 96 for the alternative operation or release of the movable upper raising cams 62 and 63 of zone D as well as by means of the pivoting slides 97 pivoted at 96*b* to slide 96, the operation of the movable lowering cams 57 of zone D (FIG. 12) is effected by slide 80. Slides 97 articulate on pivots 96*b* on slides 96 and rest with their free arm on the pins 108*c* which are fixedly attached to a slide 108. When the latter is displaced longitudinally, the pins 108*c* act, by means of the inclined planes 97*c* and 97*d*, and by means of the faces 97*e* and 97*f*, as well as by their inclinations 97*a* and 97*b*, simultaneously with the reciprocating motion of slide 96, so that movable lowering cams 57 go into action or to idle.

(d) By a second reversing assembly composed of the double lever 98 (FIG. 6) with a pivoting point formed by the axle 99 having journals secured in the cross bar 99*a* and the bracket 99*b* (FIG. 10), and which straddles at one end the pin 95 and on the other end the pin 100 on the slide 101, movement of slide 80 places alternatively into action or idling the latch-opening point as already known in stitch transfer machines (see, for example, British Patent 536,028) and, therefore, not shown within this description.

102, 103 and 104 are three coupled slides of cam plates 22, 23 which are a part of the system A (FIG. 2 to 5) and are guided in the blocks 81 (FIG. 7) of which slide 102 receives its motion from rack 102*a* (FIG. 15) operated by a toothed segment 26 from the well known key box 42 (FIG. 1). Movement of slide 102 activates the movable upper raising cam 70 of zone E (FIGS. 7 and 15), movement of slide 103 activates the movable lower raising cam 71 of zone E (FIGS. 7 and 16) and movement of slide 104 activates the movable lower raising cams 60 of zone D, all of which belong to system A (FIGS. 7 and 14).

The group of the three joined slides 105, 106 and 107 of cam plates 22, 23 guided in blocks 81 pertain to the system B (FIGS. 2 and 5) and possesses the same characteristics as the slides 102, 103 and 104 of system A, namely: actuation of slide 105 by the rack and pinion 105*a* (FIG. 15) associated with the key box 42 (FIG. 1) as has been described above effects the operation of the upper raising cams 70 of zone D (FIGS. 8 and 15), activating or idling of movable lower raising cam 71 of zone E is effected by actuation of slide 106 (FIGS. 8 and 16) and movable lower raising cams 60 of zone D are effected by actuation of slide 107, all of such cams forming part of system B (FIGS. 8 and 14).

Slide 108 of cam plates 22, 23, also guided in blocks 81 and controlled by pin 109, serves upon actuation for the movement into active or idling position of the two movable lowering cams 57 of zone D and also for movable lowering cam 58 of said zone (FIG. 13). Attached to this slide 108 at both ends by channel irons 110, are the slides 111 and 112 whose actuation simultaneously control the movable lowering cams 69 of zone E (FIG. 16).

A fourth assembly of slides has as its driving means slide 113 (FIG. 10) guided in blocks 114 and actuated by pin 115 in block 116 and intended by its actuation for the activation or idling of the movable transfer cam 54 of zone C (FIGS. 8 and 10). By means of corner plate 117 (FIG. 11) the block 116 (FIG. 10) also carries along slide 118 (FIG. 8) whose actuation activates or idles the movable upper raising cams 62 and 63 of zone D (FIGS. 8 and 11). To slide 113, there is also attached corner plate 119 for actuation of the two slides 120 and 121 (FIG. 8) guided in the blocks 114, the first one of which 120 when actuated functions for the simultaneous activation or idling of the movable transfer cam 51 of zone C (FIGS. 7 and 9), of the system A as well as of the movable separating cam 52 of zone C with the movable latch-

opening cam 53 (FIG. 9) of zone C of system B, while the second 121, when actuated, acts for the purpose of the transfer to be made by the latch-opening points.

Elementary possibilities of work performance offered by the machine just described and in particular its cam boxes as per FIGS. 2 to 5, are illustrated schematically by the following examples:

FIG. 2.—Travel of carriage from right to left. Course at dot-dash line in both cam plates 22 and 23 (front and rear):

No selection of jacks 12 or lifters 13 as these two parts previously were made to idle by setting to idle the lowering cams 57 and 69 respectively by appropriate actuation of the control slides 108, 111 and 112. Transfer cam 51, separating cam 52 and lifitng cam 53 in zone C of the two cam plates made to idle by slide 120 the slots of which 120*a* work jointly in a positive sense in an already known manner with the pins 51*a* and 52*a* (FIG. 9) so as to transmit retractive motion to the cams controlled by shafts 51*b* and 52*b* respectively and by plates 51*c* and 52*c*. Transfer cam 54 is also activated to a lowered position and made to idle by the slot 113*a* of slide 113 through the intermediary of the pin 54*a*, shaft 54*b* and plate 54*c* (FIGS. 8 and 10). Result: All of the needles 8 remain inactive (in blank row).

Travel of carriage from right to left, course traced in a dot-dash line on the rear cam plate 23:

No selection of jacks or lifters, but rear cam plate transfer cam 51, separating cam 52 and lifting cam 53 are activated to elevated positions by slots 120*a* of the shifted slide 120 and its transfer cam 54 is maintained in idling by reason of the slot of 113*a* of slide 113. Result: all of the needles are idling, but travel a small distance upward through action of elevated lifting cam 53 for the opening of the needle latches which are operated positively in an already known manner by a latch-opening point, activated by slide 121. This positive opening of the latches is indispensable for the starting of knitting or after a transfer of stitches.

FIG. 3.—Travel of carriage from right to left, course shown in dot-dash lines on both cam plates 22 and 23:

Needles 8 which must travel upward into tuck position so as to effect only the picking up of a yarn, are activated by the corresponding main jacks 11 which have been selected (pushed forward) by means of the lifters 13, according to the lower pattern row of a Jacquard card 39. These jacks 11 are made to rise by the fixed cam 65 in zone D of system A behind and tuck cam 66 before, while the lowering cams 57, 58 and lower lifting cam 60 have been made retracted to idle as the result of the action of springs 57*d*, 58*d* (FIG. 13) together with the recesses 108*a* and 108*b* respectively of slide 108, said springs acting upon the pins 57*a*, 58*a*, shafts 57*b*, 58*b* and plates 57*c*, 58*c* to retract lowering cams 57 and 58, and by the slot 104*a* of slide 104 (FIG. 14) carrying along the pins 60*a*, shafts 60*b* and plates 60*c* of lower lifting cam 60. In the event that the course should be effected in the other direction of the travel of the carriage, from left to right, the idling or retracted position of lower lifting cams 60 of system B would have been achieved previously by the slot 107*a* of slide 107 (FIG. 14). Recesses 108*a*, 108*b* in slide 108 (FIG. 13) are open at one side and, therefore, act only in one direction, namely, in a shift from right to left when the slide has reached its limiting right stroke position whereat the pins 57*a*, 58*a* ride onto high positions of slots 108*a* and 108*b* and move the corresponding cams 57 and 58 into operating position, while the idling or retracted position of these cams is achieved by springs 57*d*, 58*d* when the slide 108 is shifted rightwardly at the end of the left stroke of cam plates 22, 23. This arrangement is necessary so as to permit the free action, on the very same cams 57, 58 of the inclined plane 97*a* of the alternating slide 97 (FIG. 12). Such an arrangement for the return of the cams 57, 58 to retracted on idling position by means of a spring is in use in nearly all knitting machines for the alternative control of those cams that are in pairs on the same cam plate, namely: raising cams, active in head systems, idling in tail-end systems, stitch cams, idling in head systems and active in tail-end systems and lowering cams idling in head systems and active in tail-end systems. Arriving at the top of tuck cams 65 or 66 in zone D, the butts 11*a* of the principal jacks 11 travel at first longitudinally in a straight line and are then moved upward in tuck position as the result of inclination 61*a* of fixed median lowering cam 61 inasmuch as the passage is open as the result of the previous idling of upper lowering cam 63 forward and upper lowering cam 62 at the rear cam plate due to the action of spring 63*d* (62*d*) on screw 63*e* (62*e*) by the open recess 96*a* of the reciprocating slide 96 acting on pin 63*a* (62*a*) on the shaft 63*b* (62*b*) and plate 63*c* (62*c*), FIG. 12. Subsequently, the fixed cam 56 guides the butts 11*a* of jacks 11 to their selected position if the lowering cam 58 is retracted or sunken, into the idling position if the pin 58*a* of lowering cam 58 lies at the left of the recess 108*b* of slide 108.

Instead of making the selection by the lifters 13, as just described, it may also be achieved by use of the auxiliary jacks 12. In that case, the butts 12*a* of the latter having been activated by the upper pattern range of a Jacquard card 39, are taken up by lower raising cam 71 previously activated to elevated position by the slot 103*a* of slide 103 (FIG. 16) in the A system (or the slot 106*a* of slide 106 of the B system) by means of pin 71*a*, shaft 71*b* and plate 71*c*, and travel partially upward on that cam 71. Due to this rise, the butts 11*a* of the main jacks 11 are also moved forward so that they meet with tuck cams 65 (or 66) with the aid of which they continue their travel in the above-described manner. For that course, also, lowering cams 69 controlled by means of pin 69*a*, shaft 69*b* and plate 69*c* (FIGS. 16 and 17) which are activated by spring 69*d*, by the slot 112*a* of slide 112 (or else alternatingly by the slot 89*a* of slide 89) remain retracted or sunken as long as it is not desired to idle the auxiliary jacks 12.

Travel of carriage from left to right, dot-dash line on the front cam plate 22:

Needles 8 which are to receive a stitch to be transferred from the opposite needle bed are also pushed by the corresponding principal jacks 11 selected by means of lifters 13, according to the lower range of perforations of another Jacquard card 39 instead of the one used for the tuck-selected needles. In this case, the rise of the jacks 11 is caused by engagement of their butts 11*a* with the fixed cam 66 which brings them and consequently also needles 8 into the position for receiving the stitch to be transferred. The upper raising cam 62 being in that case in action (elevated) the butts 11*a* of jacks 11 are carried along by the lower face of that cam as well as by that of fixed median cam 61 to the starting position, or, if lowering cam is operating, to the idling position. (System A.)

FIG. 4.—Travel of carriage from right to left, course line in dot-dash lines on both cam plates 22 and 23:

Needles 8 intended for knitting, that is to say, to form ordinary stitches, are selected at the front and at the rear by means of the corresponding auxiliary jacks 12, in accordance with the upper pattern row of a Jacquard card 39, whereby these auxiliary jacks 12 act first on the main jacks 11. The lowering cams 69 of system A having been previously placed in the idling position (sunken) by the slot 111*a* (FIGS. 16 and 17) of slide 111, pin 69*a*, shaft 69*b* and plate 69*c* against the action of spring 69*d*, the butts 12*a* of jacks 12 are lifted by upper raising cam 70 in the zone E of the cam plates which have been moved to the elevated working position (emerged) by reason of the slot 102*b* of slide 102, acting positively on pin 70*a*, shaft 70*b* and plate 70*c* (FIG. 15). By this rise of the auxiliary jacks 12, the butts 11*a* of the main jacks 11 are pushed forward and thus engage in the channel between the fixed cams 55 and 61 in zone D of the came plate so as to be subsequently led by the upper lifting cam 62 at the front and upper lifting cam 63 at the rear toward the

clearing cam 64. For that purpose, upper lifting cam 62 (63) has been activated by the recess 118*a* of slide 118 by means of the pin 62*a* (63*a*), shaft 62*b* (63*b*) and plate 62*c* (63*c*) by compressing spring 62*d* (63*d*) (FIGS. 11 and 12). The auxiliary jacks 12 are carried back to the starting position by the fixed cam 68 while the main jacks 11 are travelling downward by means of safety cam 59 and alignment cam 56, either for the purpose of a new upward travel in the system B (if lowering cam 58 is idling) or to be placed into idling position by the elevating action of that same lowering cam 58. The principal jacks 11, act directly upon needles 8 which follow exactly the trajectory of the first ones, that is to say, they travel entirely to the top so as to form stitches without there being in zone C of the cam plate any lifting cams for that purpose.

Travel of carriage from left to right, dot-dash line course on the rear cam plate:

The same trajectory as in the B system described above, for the butts 12*a* of the auxiliary jacks 12 and for the butts 11*a* of the main jacks 11 and consequently also for needles 8. However, upper raising cam 70 has been activated here by the slot 105*b* of slide 105 (FIG. 15). The result obtained by such a combination of cams is also the forming of stitches in the usual manner. In case that the latter have to be cancelled at the end of the head system or the tail system, either lowering cam 58 or in the alternation movement the exit cam 57 must be activated (elevated) so as to lower jacks 11, or else the exit cam 69 must be activated (elevated) for the lowering of jacks 12.

FIG. 5.—Travel of carriage from right to left course on dot-dash line at the rear cam plate 23:

If the needles 8 must abandon their stitch so as to transfer it to the opposite needle bed, they are selected and activated by means of principal jacks 11 and lifters 13 in accordance with the lower row of stampings of a Jacquard card 39. The butts 11*a* of jacks 11 follow in that case the same trajectory as previously described according to the dot-dash line (FIG. 4). The course of the butts of needles 8 adapts itself in the same manner except at the center of the system where the transfer cam 51 has been previously activated by the slot 120*a* of the slide 120 (FIG. 9) thus carrying the needles in the position "up for transfer." Subsequently, they are again lowered by safety cam 47 and stitch cam 50.

Travel of carriage from left to right indicated by dot-dash line on the front cam plate 22:

Needles 8 opposite to those shown in FIG. 5 and which must grasp the stitches to be transferred, rise to the receiving position by means of lifting cam 53 and transfer cam 54 previously placed in active or elevated position together with separating cam 52, by the slot 120*a* of slide 120 (FIG. 9) working together with pin 52*a*, shaft 52*b* and plate 52*c*; and the slot 113*a* of slide 113, acting on the pin 54*a*, shaft 54*b* and plate 54*c* (FIG. 10). The downward travel of these needles is caused subsequently by separating cam 52 and the stitch cam 49.

The joint operation of the two opposed courses (FIG. 5) for the purpose of the transfer of stitches is carried out in the well known manner. As the widening of the stitch to be transferred by the dished portion of the delivering needle for the purpose of entering into that opened stitch of the grasping needle hook requires sufficient space for that enlarged part of the needle, the knock-over bits of the needle beds must be made thinner accordingly. That is to say, they must have a lesser thickness than the walls between grooves 4*a* and 5*a* of needle beds 4 and 5. The difficulty in milling them and the vulnerability of the remaining knock-over bits, as well as the possibility of an easy replacement of spoiled teeth, are the reasons why these teeth 4*c* and 5*c* have been positioned individually as shown in FIGURE 1.

The elementary examples of course travel of the butts 8*a* of needles 8 in zone C, of the butts 11*a* of the principal jacks 11 in the zone D and the butts 12*a* of the auxiliary jacks 12 in zone E of the cam plates according to FIGS. 2 to 5, make it possible for a man skilled in the art to easily recognize the nearly unlimited possibilities of combinations offered by these elements, be it for one and the same stitch range, or be it for successive ranges whether executed by a single or a double system. In particular, it is thus possible, because of the independent selection of needles 8, whether by the auxiliary jacks 12, or by the lifters 13 and because of the possibility of causing idling at will of cams 51, 52, 53 and 54, to form or transfer stitches within one range without any loss in the travel of the carriage and consequently without a loss of production.

While specific embodiments of the invention have been presented herein, variations within the scope of the appended claims are possible and are contemplated. There is no intention, therefore, of restriction to the exact disclosure herein made.

What is claimed it:

1. In an automatic Jacquard flat knitting machine of the type having a pair of needle beds arranged in an inverted V-shape and having a plurality of independent transfer-knitting needles having butts thereon, and having a plurality of main jacks for individually controlling the needles and having butts thereon, and having a plurality of auxiliary jacks and lifters for alternatively selecting each of the main jacks, each of the auxiliary jacks having butts thereon, and having a Jacquard device having a prism and steel cards with two rows of stamping thereon for aiding actuation of the auxiliary jacks and lifters; a cam box therefor, said cam box comprising a pair of identical cam sets each of which is located opposite the other, each one of said pair of cam sets having three distinct groups of cams arranged in three distinct parallel zones, a first group of said groups of cams having a plurality of combined sinkable transfer cams between a pair of stitch cams whereby the needle butts may be actuated, a second group of said groups of cams having fixed and movable cams whereby the main jacks may be actuated, and the third group of said groups of cams having fixed and movable cams whereby the auxiliary jacks may be actuated.

2. In an automatic Jacquard flat knitting machine, a cam box as set forth in claim **1**, wherein said fixed and movable cams of said second and third groups of said groups of cams are symmetrically arranged with respect to the centerline of said cam set.

3. In an automatic Jacquard flat knitting machine, a cam box as set forth in claim **2**, wherein said fixed and movable cams may be actuated vertically with respect to said cam set while said combined sinkable transfer cams are idle.

4. In an automatic Jacquard flat knitting machine, a cam box as set forth in claim **1** wherein said combined sinkable transfer cams have a straight non-stepped surface facing the upper side of the needle bed.

References Cited by the Examiner

UNITED STATES PATENTS

1,058,242	4/1913	Kellner et al.	66—64 X
1,693,439	11/1928	Goetz	66—69
1,837,101	12/1931	Berner	66—64
2,025,499	12/1935	Diem	66—64
2,059,682	11/1936	Diem	66—69 X
2,521,786	9/1950	Granov	66—70

FOREIGN PATENTS

575,605	4/1924	France.
452,261	8/1936	Great Britain.
146,425	8/1962	Russia.

MERVIN STEIN, *Primary Examiner.*

W. C. REYNOLDS, *Assistant Examiner.*