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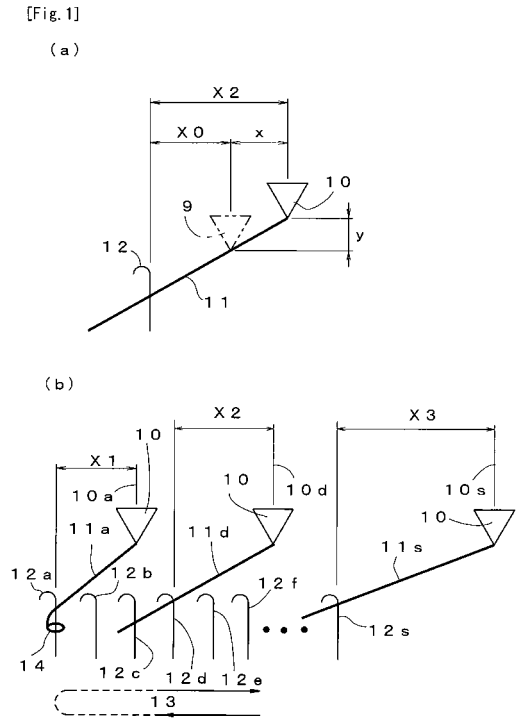
(54) WEFT KNITTING MACHINE, AND ITS FEEDING METHOD

(57) The invention provides a flatbed knitting machine that enables proper feeding of a knitting yarn without moving vertically a yarn feeder port as well as a method for properly feeding the yarn.

A height of a yarn feeder port 10 is held high to avoid interference with knitting needles 12 that advance to the needle bed gap even when the yarn feeders 10 of a plurality of tracks intersect, and to allow a knitting yarn 11 to be caught on a hook of the knitting needle 12. As shown in Fig. 1(a), when a knitting yarn is properly fed from a feeder port 9 of a yarn feeding position 9a that advances by a lead "X0" only to a knitting needle at a yarn catching position 4a, the yarn fed from the yearn feeder port 10 located at the position only "y" higher from the yarn feeder port 9 can be subject to the equivalent yarn catching conditions. Even if the knitting yarn 11 from the feeder port 10 is fed to the knitting needle 12, making the lead "X2" of the yarn feeder port 10 only "x" larger than the lead "X0" of the yarn feeder port 9 can achieve the same gradient for the knitting yarn 11. As shown in Fig. 1(b), adjusting leads "X1", "X2", and "X3" at the yarn feeding positions 10a, 10d, and 10s in accordance with knitting conditions of knitting needles 12a, 12d, and 12s further enables appropriate yarn feeding.

[Fig. 1]



EP 2 206 815 A1

Description

Technical Field

[0001] The present invention relates to a flatbed knitting machine which feeds a knitting yarn to a knitting needle that carries out knitting motion and knits a knit fabric, and to its yarn feeding method.

Background Art

[0002] Hitherto, in a flatbed knitting machine, knitting needles arranged in parallel on a needle bed is selectively driven by a cam mounded on a carriage that runs along the needle bed and a knit fabric is knitted. In a V-bed type flatbed knitting machine, a pair of needle beds is arranged in front and back in such a manner as to be opposed to each other with a needle bed gap in-between. The needle bed gap extends in a horizontal direction of the flatbed knitting machine, and each needle bed is tilted with the needle bed gap side raised and the far back side lowered as it departs from the needle bed gap. A knitting needle which is selectively driven on each needle bed advances to and retreats from the needle bed gap, and receives a knitting yarn fed from above the needle bed gap to form a stitch. The knitting yarn fed to the knitting needle is supplied from a yarn feeder port which is provided to a carrier such as a yarn feeder, etc. running along a thread guide rail disposed above the needle bed gap. By installing a plurality of carriers and selectively hauling a carrier by a carriage, the knitting yarn can be changed over and a knit fabric can be knitted.

[0003] Fig. 3 shows an example of arrangement of cams mounted to a carriage. To a base board 1 of the carriage, for example, two sets of cam systems 2 and 3 are respectively mounted on left and right sides of a center line 1a. The cam systems 2 and 3 each include knitting cams 2a and 3a for driving knitting needles and needle selecting cams 2b and 3b for selecting knitting needles, and have the same configuration on both sides. The number of cam systems mounted to carriages may be one set or may be three or more sets. The cam system with a plurality of sets has each set in the same configuration or in different configurations. Knitting needles driven by the cam systems 2 and 3 of this kind of configuration are latch needles, which have a hook on a head end that advances to and retreats from the needle bed gap, the hook opened and closed by a latch, and have a needle-selecting butt on the tail end side. Between the head end and the tail end of the knitting needle, a driving butt on which the knitting cams 2a and 3a work on is provided.

[0004] Knitting cams 2a and 2b guide a driving butt of a knitting needle along a butt passage 4. On the needle bed, needle grooves extending in the direction corresponding to the vertical direction in Fig. 3 are formed in such a manner that they line up at predetermined intervals in the horizontal direction in Fig. 3. Each of the knitting needles is housed in each of the needle grooves, and slides and displaces in the needle groove in the needle-groove extending direction. The butt passage 4 is formed between the upper edge of a needle raising cam 5 and the lower edge of a needle guide cam 6. On both sides of the butt passage 4, stitch cams 7 and 8, also called as knitting cams, are disposed.

[0005] For example, let's assume a case in which the carriage runs so as that the base board 1 moves rightward shown by arrow mark 1R. When a knitting needle reaches a yarn catching position 4a by the guide of the butt passage 4, the knitting yarn is supplied to the hook of the knitting needle from the yarn feeder port 9 of the carrier which goes ahead by a lead "X0" only with respect to the yarn catching position 4a. The driving butt of the knitting needle guided along the butt passage 4 begins lowering again at the yarn catching position 4a after the driving butt passes the center chevron zone 4b and moves to a horizontal shoulder zone 4c. A knitting needle located on the left side of the yarn catching position 4a, which has already received the yarn has the driving butt dragged down along an inclined plane of the stitch cam 8. On the occasion of this drag-down, an old loop whose knitting yarn was caught in the hook and is hanging on the needle shank side is knocked over. On the occasion of the knock-over, the hook is closed by the latch. In the event that there is any knitting needle which received the yarn fed in advance and had a stitch formed on the following side of the yarn catching position 4a, a knitting yarn extending from the knitting yarn caught in the knitting needle hook on the following side to the yarn feeder port 9 is caught by the hook of a knitting needle at the yarn catching position 4a. In the event that there is no knitting needle which receives the yarn in advance of the knitting needle at the yarn catching position 4a, the knitting needle at the yarn catching position 4a serves as an entry-side knitting end, and the knitting yarn extending from the old loop latched on the needle shank side of this knitting needle itself to the yarn feeder port 9 is caught by the hook.

[0006] The carrier is hauled being latched to a hauling pin which pops in and out from the carriage. The yarn feeder port 9 of the carrier being hauled by the carriage stopped at the yarn feeder position 9a relatively with respect to the carriage cam system. The yarn feeder position 9a is located ahead by the lead "X0" from the yarn catching position 4a.

[0007] In the event that a plurality of carriers are used with switching by the use of pop-in and out control of the carriage hauling pins, the relevant yarn feeder ports 9 occupy the same space in the vicinity of the needle bed gap and may interfere with one another. Evacuating the carrier to be used to the outside of the knitting width before switching and hauling the carrier to be used after switching can avoid interference, but a running distance of the carriage increases. In addition, in the event that a plurality of carriers are held in the vicinity of the boundary where the zone knitted by the knitting yarn from relevant

carriers is finished in the knitting width and the carriers are repeatedly used as in the case of knitting intarsia patterns or Jacquard patterns, carriers are unable to be evacuated to the outside of the knitting width. In order to hold and switch a plurality of carriers inside the knitting width, the yarn feeder port 9 needs to be movable vertically in the direction hanging from the carrier (for example, see Patent Citation 1). Furthermore, a carrier that has the yarn feeder port 9 capable of displacing in a swing motion to change over from yarn feeding to evacuation and vice versa may be used (for example, see Patent Citation 2).

[0008] If the carrier is not hauled by the carriage to move but is self-propelled, it is expected that the running of the carriage which is required only for changing over carriers can be omitted and the productivity can be improved. It is disclosed a pattern producing mechanism of a flatbed knitting machine which knits intarsia patterns, etc. while a plurality of self-propelled carriers are changed over and used while the carriage runs in one stroke (for example, see Patent Citation 3). From the 5th line to the 16th line in column 4 of Patent Citation 3, it is described that the portion corresponding to the yarn feeder port 9 "is free to slide vertically" and "is constantly energized with upward elasticity by coil springs and slightly moves vertically as required according to patterns." This description is interpreted in the light of Fig. 8, etc. of Patent Citation 3 that yarn feeder ports used for knitting a plurality of zones of intarsia patterns are held to a high position by spring energizing to avoid interference, and only the yarn feeder port used for knitting of each zone is lowered by vertical movement.

Patent Citation 1: Japanese Patent No. 3044370
Patent Citation 2: International Publication WO02/079556 pamphlet
Patent Citation 3: Japanese Examined Utility Model Publication No. 3-54150

Disclosure of the Invention

Technical Problem

[0009] It is preferable to keep it lower the height at the needle bed gap of the yarn feeder port 9 of a carrier that supplies knitting yarn for allowing the knitting yarn hook to catch the yarn even above the knitting needle because of less knitting yarn deflection. However, there could be problems that yarn feeder ports 9 interfere with one another or a knitting needle used for knitting erroneously catches the knitting yarn extending from the stopped yarn feeder port 9 when intarsia patters or Jacquard patterns, etc. are being knitted. The vertical moving mechanism of the yarn feeder port 9 as described in Patent Citation 1 and Patent Citation 2 is installed to prevent this kind of problem.

[0010] However, installing a vertical movement mechanism of the yarn feeder port 9 makes the carrier configuration complicated and increases the manufacturing cost. Furthermore, in a self-propelled carrier as described in Patent Citation 3, an increase of weight by equipping the vertical movement mechanism increases drive loads for running, too.

[0011] It is an object of the present invention to provide a flatbed knitting machine that enables proper yarn feeding without vertically moving the yarn feeder port and its yarn feeding method.

Technical Solution

[0012] The present invention is a flatbed knitting machine for knitting a fabric, provided with
a plurality of tracks installed above the needle bed gap side of the needle beds on which knitting needles are installed side by side,
each track having a carrier equipped with a yarn feeder port and self-propelled,
knitting yarn fed from the yarn feeder port to the knitting needles for carrying out knitting operation by successively advancing to and retracting from the needle bed gap, driven by a carriage running along the needle bed,
wherein heights of the yarn feeder ports of the carriers are set to such heights that even if the yarn feeder ports of carriers on different tracks intersect, the yarn feeder ports do not interfere with a knitting needle that advances to the needle bed gap for knitting operation, and
the flatbed knitting machine further provided with a controller for controlling running speed of carriers in one knitting course and adjusting a lead of a carrier to be larger than the knitting needle at the entry side end of the knitting width, with respect to knitting needles within the knitting width except the entry side end, and a height of the yarn feeding position from yarn feeder port to the knitting needle to be a proper yarn catching height in accordance with the conditions at the time of knitting.

[0013] In the flatbed knitting machine according to the present invention,
wherein said controller adjusts the lead of said carrier to be increased in a zone where knitting needles to which no knitting yarn is fed continuously exist within said knitting width.

[0014] In the flatbed knitting machine according to the present invention,
wherein said controller adjusts the lead of said carrier by varying its speed to the speed of said carriage.

[0015] Furthermore, the present invention is a method for feeding knitting yarn from a yarn feeder port above a needle bed gap to knitting needles, when a knit fabric is knitted with varying the position of the knitting needle to carry out knitting motion by advancing to and retracting from the needle bed gap, is being successively transferred to one side of a needle bed in a flatbed knitting machine,
wherein a lead in which the yarn feeder port advances on the one side of the needle bed with respect to a knitting needle is adjusted so that a yarn catching height at a

knitting needle that receives the knitting yarn becomes appropriate in accordance with knitting conditions.

Advantageous Effects

[0016] According to the present invention, the height of a self-propelled carrier is set to the height at which a yarn feeder port does not interfere with a knitting needle that advances to the needle bed gap for knitting even when yarn feeder ports of carriers of different tracks intersect. Thus interference with knitting needles can be avoided even when plural carriers are used. Since the yarn feeder port is located high, a problem of a knitting needle used for knitting to erroneously catch a knitting yarn extending from a stopped yarn feeder port could be made less likely to occur. In addition, even when yarn feeder ports come into contact with each other due to their interference, damage would not be caused and knitting can be carried out without any trouble. For the knitting needle of the knitting end on the knitting width entry-side, a lead of the carrier is reduced and the yarn feeder port located at a high position comes close to the knitting needle, and therefore even when the knitting yarn is pulled out at a lower position with respect to a hook from an old loop hanged on the needle shank side, the knitting yarn can be allowed to be caught by a hook at a proper height in the middle of ascending to the yarn feeder port at a high location. For other knitting needles inside the knitting width, the lead of the carrier is increased, and therefore, the height of knitting yarn to be caught by a hook is made lower than the height of the yarn feeder port, thereby enabling the proper yarn feeding. Since proper yarn feeding is enabled even if a vertical movement mechanism is not installed to a carrier to vertically move the yarn feeder port, the cost can be reduced and drive loads for running can be reduced, too.

[0017] In addition, according to the present invention, the lead of the carrier is adjusted within the knitting width to be increased at a zone where knitting needles to which no feed yarns are fed continuously exist. Therefore, for knitting needles to which knitting yarn is fed, hooks are allowed to catch knitting yarns at a proper height in the middle of ascending to the yarn feeder port at a high location. Since the knitting yarn height is made lower, knitting needles which are not used for knitting need not be used, and proper yarn feed is achieved by adjusting a carrier lead.

[0018] In addition, according to the present invention, the lead of the carrier is adjusted by varying speed in accordance with the running of a carriage that drives a knitting needle for knitting. Therefore, knitting yarn is able to be properly fed in accordance with the knitting motion of the knitting needle.

[0019] Furthermore, according to the present invention, the lead with respect to the knitting needle at the yarn feeder port is adjusted in such a manner that the yarn catching height at a knitting needle which receives the yarn is made appropriate in accordance with the knitting conditions. Therefore, appropriate yarn feeding is enabled even if the yarn feeder port is not moved vertically.

Brief Description of Drawings

[0020]

[Fig. 1] Fig. 1 is a diagram showing a basic concept of a yarn feeding method of a flatbed knitting machine as one embodiment of the present invention.

[Fig. 2] Fig. 2 is a block diagram showing a schematic electric construction of a flatbed knitting machine 20 in a simplified manner, which can feed knitting yarn in accordance with the yarn feeding method as shown in Fig. 1.

[Fig. 3] Fig. 3 is a diagram showing an example of an arrangement of cams mounted to carriages hitherto.

Explanation of References

[0021]

10. Yarn feeder port
10a, 10b, 10c, 10d, 10e, 10f, ..., 10s. Yarn feeding position
11, 11a, 11b, 11s Knitting yarn
12, 12a, 12b, 12c, 12d, 12e, 12f, 12s Knitting needle
14. Old loop
20. Flatbed knitting machine
21. Needle bed
22. Needle bed gap
23. Carriage
33. Carrier
40. Controller
41. Main controller

Best Mode for Carrying Out the Invention

[0022] Fig. 1 shows a basic concept of a knitting yarn feeding method of a flatbed knitting machine as one embodiment of the present invention. Fig. 1(a) shows a criterion for setting a lead of a yarn feeder port with respect to a knitting needle in the middle of knitting width. Fig. 1 (b) shows a criterion for a yarn feeder port to adjust an advancing lead with respect to a knitting needle subject to yarn feed so that the proper yarn catching height is achieved in accordance with knitting conditions.

[0023] As shown in Fig. 1(a), applying the concept of the present invention enables a hook of a knitting needle 12 to catch a knitting yarn 11 under the conditions nearly equivalent to the conventional even when a height of the yarn feeder port 10 is made higher than the optimum height of a yarn feeder port 9 which serves as a conventional criterion. For example, in a conventional example of Fig. 3, it is based on the condition in which feeding a knitting yarn from a yarn feeder port 9 of a yarn feeding

position 9a advancing by a lead "X0" only to a knitting needle at a yarn catching position 4a can achieve proper yarn catching. Fig. 1(a) shows that feeding a knitting yarn 11 to a knitting needle 12 from the yarn feeder port 10 located at a position only "y" higher than the criterion of the conventional feeder port 9 provides the same gradient to the knitting yarn 11 if a lead "X2" of the yarn feeder port 10 is increased by "x" from the lead "X0" of the yarn feeder port 9. The knitting yarn 11 extends from a hook of a knitting needle which receives knitting yarn ahead of, for example, the knitting needle 12 to yarn feeder ports 9 and 10, provided, however, that the optimum lead which achieves proper yarn catching height varies in accordance with the knitting conditions relevant to the knitting needle 12. Incidentally, for the knitting needle 12, the present invention is able to be applied not only to a latch needle which is driven by a cam as shown in Fig. 3 but also to a composite needle as disclosed, for example, in Japanese Patent 2946323.

[0024] When a plurality of yarn feeder ports 10 are used, a plurality of tracks on which the yarn feeder ports 10 run are arranged. Allowing yarn feeder ports 10 that run on different tracks to intersect with each other expands a range of space where the yarn feeder port 10 passes at the needle bed gap and makes it likely to interfere with a knitting needle that advances to the needle bed gap, even though a contact of the yarn feeder ports 10 themselves which may not cause damage is admitted. By making the height of the yarn feeder port 10 only "y" higher than the conventional yarn feeder port 9, interference between the yarn feeder port 10 and a knitting needle that advances to the needle bed gap can be avoided when the yarn feeder port 10 passes the needle bed gap, etc.

[0025] Fig. 1(b) shows that it is desirable to vary the optimum lead in accordance with the knitting conditions of each of knitting needles 12a, 12b, 12c, 12d, 12e, 12f..., 12s when a zone in which the knitting needles 12a, 12b, 12c, 12d, 12e, 12f..., 12s are arranged is knitted. In the event that the zone of knitting needles 12a, 12b, 12c, 12d, 12e, 12f..., 12s is knitted while the yarn feeder port 10 moves rightward, the knitting needle 12a on the left end serves as an entry side. This kind of the rightward knitting course takes place following the leftward knitting course. The carriage turns around the running direction as shown by the arrow mark 13. When a hook is advanced to the needle bed gap in the rightward knitting, in the knitting needle 12a on the left end, a stitch formed by leftward knitting is moved from the hook to the needle shank as an old loop 14.

[0026] In order to form a stitch as a new loop on a hook of the knitting needle 12a on the left end, which serves as the start of rightward knitting, the knitting yarn 11a fed from the yarn feeder port 10 at the yarn feeding position l0a is pulled out from the old loop 14 moved to the needle shank. The old loop 14 is hanged on the needle shank of the knitting needle 12a and therefore, the position from which the knitting yarn 11a is pulled out becomes lower than the position of the hook of the knitting needle 12a. Feeding the knitting yarn 11 from the yarn feeder port 10 which is advanced only by lead "X2" as shown in Fig. 1 (a) to the knitting needle 12a, too, lowers the position from which the knitting yarn 11 is pulled out, and therefore lowers the yarn catching height, too. When the yarn catching height lowers, in the knitting needle 12a, the knitting yarn may be fed to the needle shank side on which the old loop 14 is hanged and the knitting yarn may be knocked over together with the old loop 14 without being caught in the hook, or in the case of a latch needle, the knitting yarn gets stuck on the head end of the latch and the knitting needle 11 may be split off. Consequently, for the knitting needle 12a on the entry side end, it is desirable to set the lead "X1" of the yarn feeding position l0a to be smaller than the lead "X2" at the yarn feeding positions 10d, etc. for intermediate knitting needle 12d, and to allow the knitting yarn 11a to be fed at a high position. In the knitting needle 12a on the knitting end on the entry side of the knitting width, the lead "X1" of the yarn feeding position l0a is reduced, whereby the feeder l0a at a high position approaches to the knitting needle 12a, and the knitting yarn 11a can be caught by a hook at a proper height in the middle of ascending to the yarn feeder port 10 at a high position even if the knitting yarn 11a is pulled out from the former loop latched on the needle shank side at a low position with respect to a hook.

[0027] Following the entry-side knitting needle 12d, for the knitting needle 12a in the middle of the zone of knitting needles 12b, 12c, 12d, 12e, 12f, ... which continuously form stitches, the knitting yarn caught on a hook of the knitting needle 12c which receives the knitting yarn in advance is supplied to a hook. Consequently, the yarn feeder port 10 is advanced so as to obtain the yarn feeding position 10d with the lead "X2" as shown in Fig. 1(a). The change from the lead "X1" of the yarn feeding position 10a with respect to the knitting needle 12a on the knitting end to the lead "X2" of the yarn feeding positions 10d, etc., with respect to knitting needles 12b, 12c, 12d, 12e, 12f, ... of the continuous knitting zone is achieved by varying the self-propelling speed of the yarn feeder port 10, provided, however, that it is difficult to instantaneously change the lead from "X1" to "X2" for the knitting needle 12b adjacent to the entry-side knitting needle 12a. Consequently, when a carrier enters the zone of knitting needles 12b, 12c, 12d, 12e, 12f..., which continuously form stitches, the lead is changed from "X1" to "X2" by continuously controlling the speed of the carrier.

[0028] In the event that a knitting yarn 11s is fed to a hook of the knitting yarn 12s after unused knitting needles 12e, 12f... continue, the lead "X3" at a yarn feeding position 10s is increased from "X2". Since the portion corresponding to the length of the knitting yarn 11 up to a hook of a knitting needle which has already received the knitting yarn on the left side of the knitting needle 12 in Fig. 1(a) extends, keeping the lead of the portion corresponding to the right side to "X2" increases the height of the knitting yarn to be fed to the knitting needle 12. In

order to allow the hook of the knitting needle 12s to definitely catch the knitting yarn 11s, the lead "X3" at the yarn feeding position 10s of the yarn feeder port 10 needs to be increased from "X2".

[0029] Incidentally, when the knitting yarn 11 is first used for set-up, etc., the left end of the figure is held by, for example, a gripper, etc. installed at the end portion of the needle bed. A height for holding the knitting yarn 11 at the end of the needle bed becomes lower than the yarn hanging height at the needle shank of the knitting needle 12 which serves as the entry side on the way of repeated knitting. In the event that the knitting yarn 11 is first fed to the knitting needle 12, the lead of the yarn feeder port 10 is set in accordance with a space between the holding position of the knitting yarn 11 at the end of the needle bed and the knitting needle 12 located at the entry-end of the knit width. When the height of the knitting yarn 11 to be fed is increased, the lead should be decreased, and when the height is lowered, the lead should be increased.

[0030] Fig. 2 shows a schematic electric structure of a flatbed knitting machine 20 that can feed knitting yarn in accordance with the yarn feeding method as shown in Fig. 1 in a simplified form. The flatbed knitting machine 20 has a needle bed 21 that extends in the horizontal direction in the figure. The needle bed 21 is installed so as to make a pair in front and rear. The needle beds 21 in the front and in the rear stand face to face with a space provided in-between, and in-between formed is a needle bed gap 22. To the needle beds 21, a large number of knitting needles are arranged in parallel at a predetermined pitch, though their illustrations are omitted. Selective drive of knitting needles is conducted while a carriage 23 equipped with a cam advances and retires back and forth along the needle bed. To the needle beds 21 or its vicinity, a carriage rail 24 that guides running of a carriage 23 is installed. The running drive of the carriage 23 along the needle beds 21 is conducted by a motor 25 via a timing belt 26. For the motor 25, for example, a servo motor is used. To an output shaft of the motor 25, a pulley 27 is mounted, and the endless-form timing belt 26 is installed over the pulley.

[0031] The yarn feeder port 10 hangs from a carrier 33 which is guided by a track of a carrier rail 31 installed above the needle bed gap 22 and is self-propelled transversely. The height of the feeder port 10 can be made higher than the height which was conventionally believed to be appropriate. When the height of the yarn feeder port 10 is increased, interference of yarn feeder ports 10 can be avoided and crossing of yarn feeder ports 10 is possible, even if a plurality of carrier rails 31 are arranged and the yarn feeder port 10 is used by each carrier rail. Furthermore, interference of the yarn feeder port 10 with a knitting needle that advances to the needle bed gap 22 can be avoided, too. In the figure, only one yarn feeder port 10 is shown, but on the back side of the carrier rail 31, the similar carrier 33 can be guided. In this case, on the back and the front of one carrier rail 31, tracks on which a carrier 33 is self-propelled are installed, respectively. In addition, plural similar carrier rails 31 are able to be arranged in a direction perpendicular to the paper surface.

[0032] The carrier 33 is able to be run with a timing belt 36 driven by a motor 35. To an output shaft of the motor 35, a pulley 37 is installed and the timing belt 36 is installed over the pulley 37. In the event that plural carriers 33 are used, the same construction may be used for each carrier 33. The carrier 33 does not include a mechanism to vertically move the yarn feeder port 10 and therefore, the carrier 33 can be reduced in size and weight. The load of the motor 35 can be alleviated to enable the carrier 33 to run at high speed. For the motor 35, a servo motor and a stepping motor may be used.

[0033] The yarn feeding method as shown in Fig. 1 may be achieved by running control of the carriage 23 and the carrier 33 by the use of a controller 40. The controller 40 for carrying out overall control of the flatbed knitting machine 20 includes a driver 42 of the motor 25 that drives running of the carriage 23 and a driver 43 of the motor 35 that drives running of the carrier 33. A main controller 41 sets a plurality of knitting courses on which the carriage 23 runs and decides knitting needles used for knitting for each knitting course in accordance with the pattern data of knit fabrics knitted by the flatbed knitting machine 20. Furthermore, the main controller 41 carries out control over the drivers 42 and 43 to make the carriage 23 and the carrier 33 to run so that the proper lead is achieved at the yarn catching timing for each knitting needle used for knitting.

[0034] Furthermore, in Fig. 1(b), in one knitting course, the lead at the yarn feeding positions 10a, 10d, and 10s of the yarn feeder port 10 is changed from "X1" to "X2", and then to "X3", but the lead may be changed from "X1" to "X3" or "X3" to "X2". All the changes in leads can be achieved by changing the speed of the yarn feeder port 10.

Claims

1. A flatbed knitting machine for knitting a fabric, provided with
   a plurality of tracks installed above the needle bed gap side of the needle beds on which knitting needles are installed side by side,
   each track having a carrier equipped with a yarn feeder port and self propelled,
   knitting yarn fed from the yarn feeder port to the knitting needles for carrying out knitting operation by successively advancing to and retracting from the needle bed gap, driven by a carriage running along the needle bed,
   wherein heights of the yarn feeder ports of the carriers are set to such heights that even if the yarn feeder ports of carriers on different tracks intersect, the yarn feeder ports do not interfere with a knitting

needle that advances to the needle bed gap for knitting operation, and
the flatbed knitting machine further provided with a controller for controlling running speed of carriers in one knitting course and adjusting a lead of a carrier to be larger than the knitting needle at the entry side end of the knitting width, with respect to knitting needles within the knitting width except the entry side end, and a height of the yarn feeding position from yarn feeder port to the knitting needle to be a proper yarn catching height in accordance with the conditions at the time of knitting.

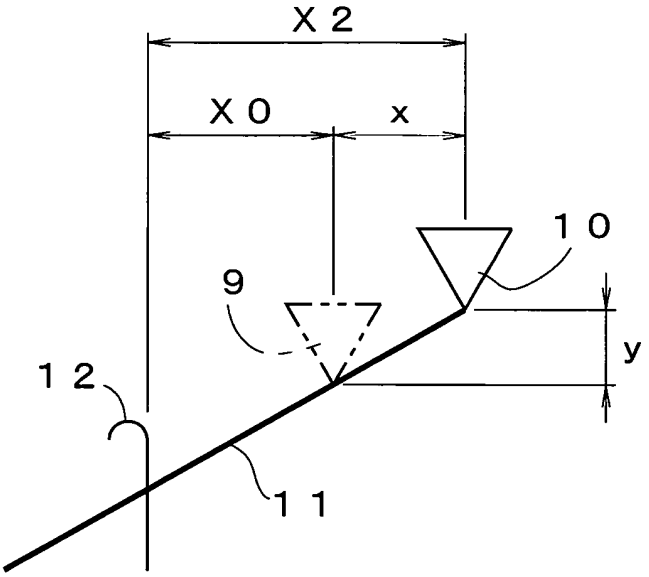
2. The flatbed knitting machine according to claim 1, wherein said controller adjusts the lead of said carrier to be increased in a zone where knitting needles to which no knitting yarn is fed continuously exist within said knitting width.

3. The flatbed knitting machine according to claims 1 or 2,
wherein said controller adjusts the lead of said carrier by varying its speed to the speed of said carriage.

4. A method for feeding knitting yarn from a yarn feeder port above a needle bed gap to knitting needles, when a knit fabric is knitted with varying the position of the knitting needle to carry out knitting motion by advancing to and retracting from the needle bed gap, is being successively transferred to one side of a needle bed in a flatbed knitting machine,
wherein a lead in which the yarn feeder port advances on the one side of the needle bed with respect to a knitting needle is adjusted so that a yarn catching height at a knitting needle that receives the knitting yarn becomes appropriate in accordance with knitting conditions.

[Fig. 1]

(a)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x
10
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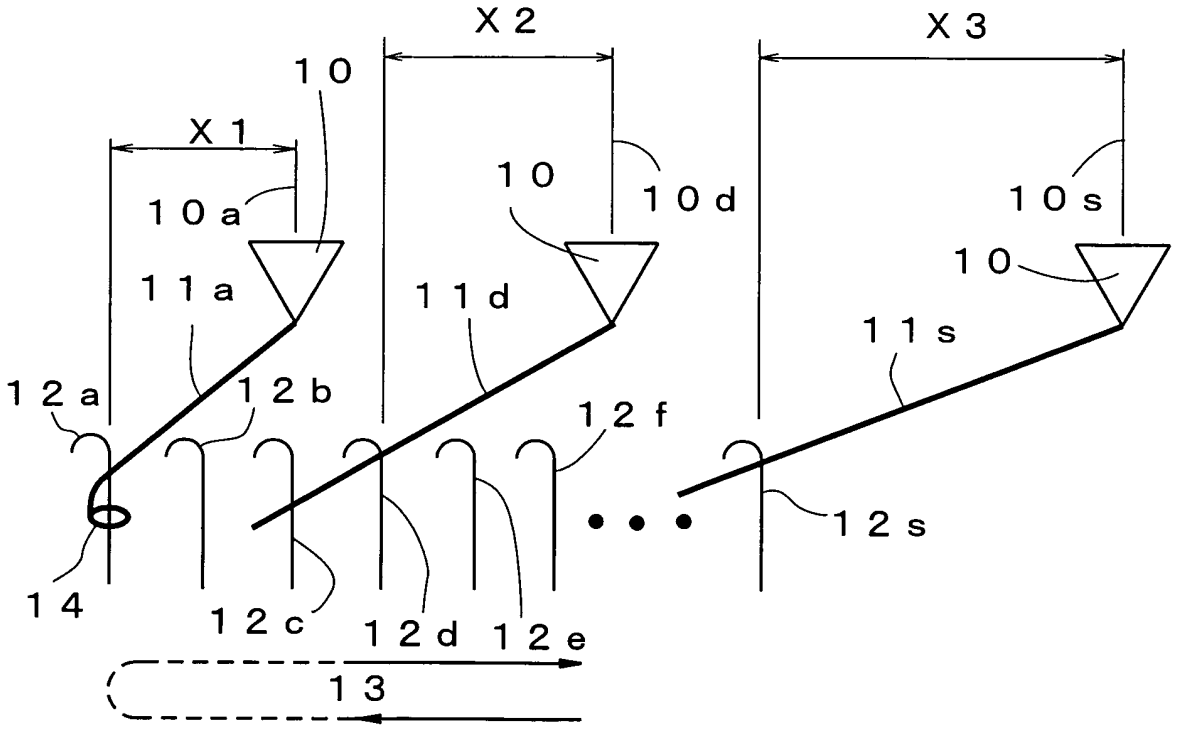
y
12
11

(b)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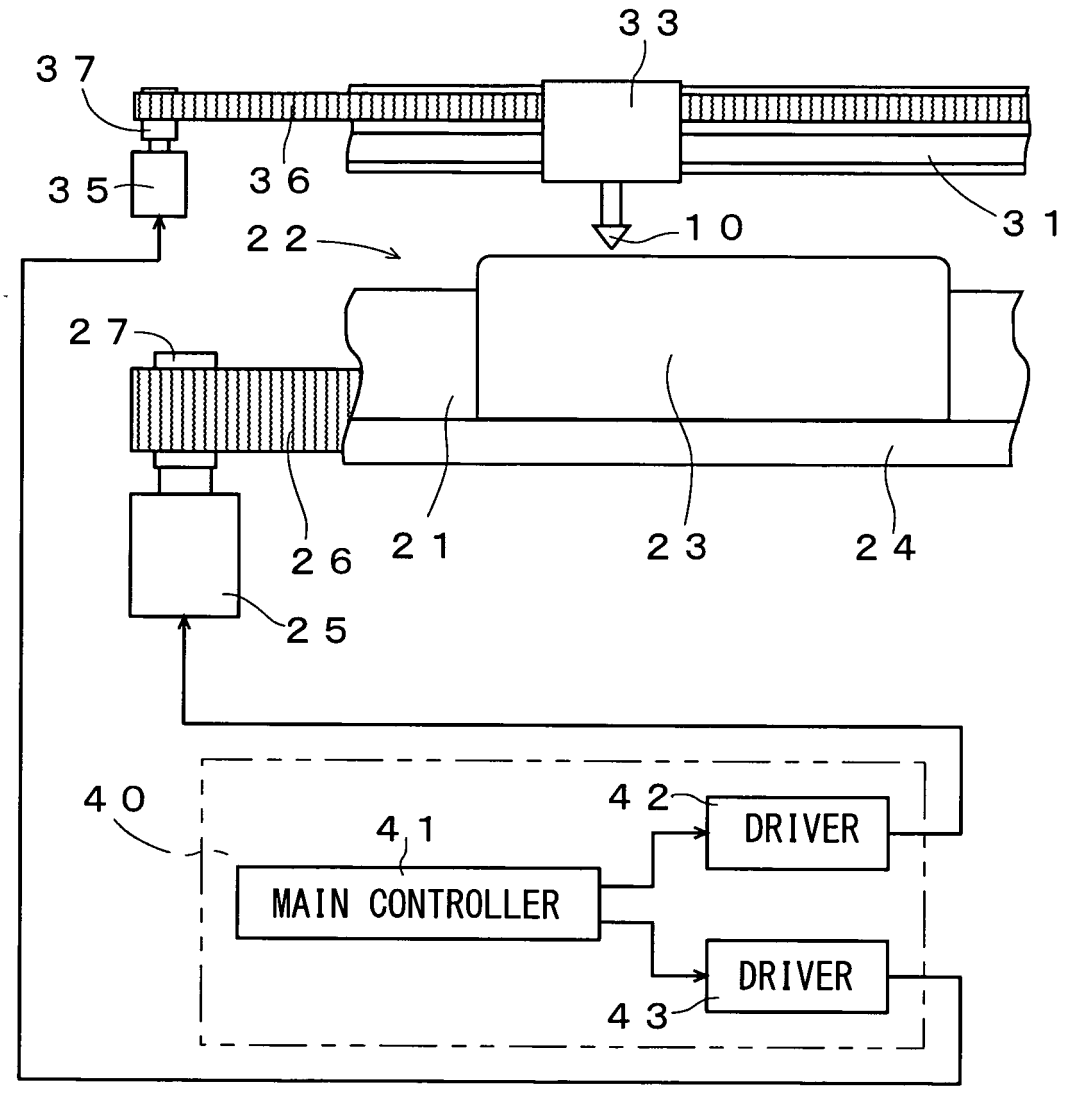
[Fig. 2]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DRIVER
MAIN CONTROLLER
DRIVER
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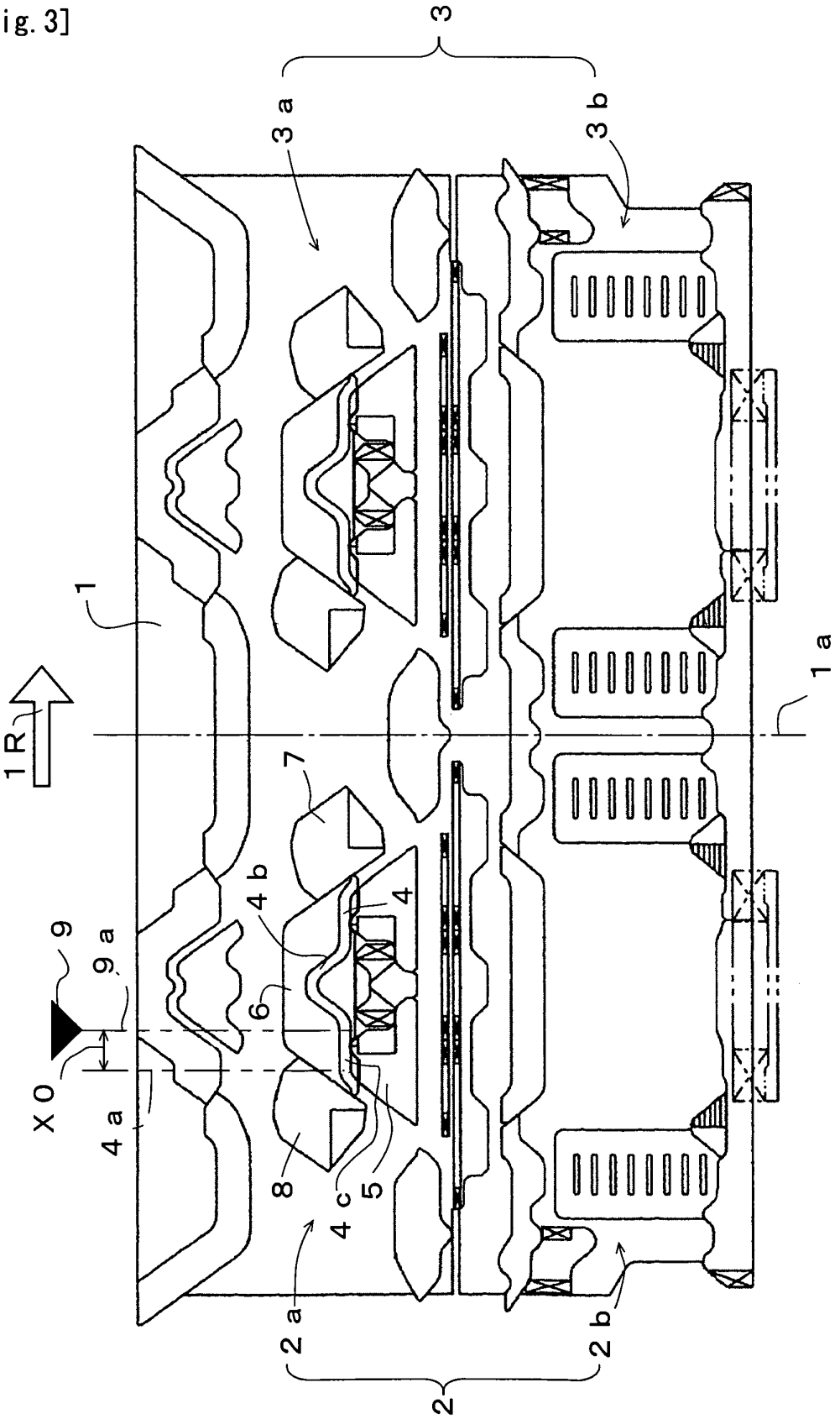
[Fig. 3]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/002464

A. CLASSIFICATION OF SUBJECT MATTER
D04B15/56(2006.01)i, *D04B15/96*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D04B15/56, 15/96-15/99

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 3360043 B2 (Tsudakoma Corp.), 24 December, 2002 (24.12.02), Par. Nos. [0089] to [0098]; Figs. 3, 12, 13 (Family: none)	4 1-3
X A	JP 9-217254 A (Tsudakoma Corp.), 19 August, 1997 (19.08.97), Par. Nos. [0028], [0047]; Figs. 9, 10 & US 5758518 A & GB 2310220 A & IT 96502586 A	4 1-3
A	JP 9-49156 A (Tsudakoma Corp.), 18 February, 1997 (18.02.97), Par. No. [0003] (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 October, 2008 (02.10.08)	14 October, 2008 (14.10.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/002464

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 9-31807 A (Tsudakoma Corp.), 04 February, 1997 (04.02.97), (Family: none)	1-4
A	JP 2903152 B2 (Shima Seiki Mfg., Ltd.), 07 June, 1999 (07.06.99), & US 6047570 A & EP 872587 A2 & TW 392007 B	1-4
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A	WO 02/079556 A1 (Shima Seiki Mfg., Ltd.), 10 October, 2002 (10.10.02), & US 2004/0159126 A1 & EP 1391545 A1 & CN 1511205 A	1-4
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REFERENCES CITED IN THE DESCRIPTION

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- WO 02079556 A **[0008]**
- JP 3054150 A **[0008]**
- JP 2946323 B **[0023]**