Automated design of proposal for new construction knitting unit consisting of a needle bed, needles and CAM systems for flat knitting automatic machine

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Abstract: *The work proposes a new design of a new kind of knitting unit consisting of a needle bed, needles and cam systems that allow selection in operation only with the needles on the needle bed without any other additional details, such as springing or stopping jack. The proposed construction is designed in accordance with the requirements of modern flat knitting machines with the possibility of individual needle selection. Because the structures are interdependent, the braiding systems are designed to work only with the new proposed needles and needle bed construction. The three new construction for needle, needle bed and cam systems are aligned with one another and allow the introduction of a new principle for electromechanical needle selection with a special electromechanical selector operating with negative selection, i.e. turns the needle off when is on. The choice is made by working with needles with three types of butts, short and long, one-sidedly rounded, and long two-sidedly rounded, as well as with cam systems divided into two parts. This makes it possible to remove the additional details used in existing methods. Which would lead to a reduction in the depreciation of the machine and, consequently, to a lower maintenance cost. The designs are designed in Solid works environments, providing excellent exploration and dynamic visualization capabilities.*

Keywords: FLAT KNITTING MACHINES, KNITWEAR, CAM SYSTEMS, KNITTING

1. Introduction

In today's knitwear production, the main trends that are developing are increasing the capacity of the machine's sample, reducing the time for knitting the parts and the possibilities for a quick transition from one model to another. This inseparably adds to the complexity of the basic structures by adding additional elements, which subsequently results in more depreciation and consequently higher maintenance costs for the machines. [1,6,7]

These trends also lead to a wide variety of flat knitting machines, which also leads to a huge diversity in the basic mechanisms involved in the contour formation process. Such mechanisms are: cam systems, pull mechanism, thread control mechanism and more. These mechanisms for each machine model are differentiated for the specific type of machine, with the individual details aligned with the location and construction of the others to accomplished the knitting process. This leads not only to the specificity of the mechanisms used in machines manufactured by different companies, but even from different models of the same company. This naturally affects the actuators because of their direct relationship to the location, position, and trajectory of the knitting needles performed by the knitting mechanism to create the individual knitting structures, but also respectively of the structure and knitting needle. For this reason, the location, profile and drive of the cam systems must be consistent with the trajectory of the knitting needles and the restrictive metal strip located on the needle bed. [1,6]

2. Implementation

As already mentioned, the designs of the needle bed, the needles and cam systems, as well as their propulsion, respectively, are interconnected, and accordingly changes in the structure of one mechanism would automatically lead to changes in the others. [2,3,4]

The uniqueness of the proposed mechanism is that its cam systems are made of two parts and not one. The upper knitting loop and the lower knitting tuck, this in itself also leads to adjustments in the design of the needle bed and the construction of the knitting needle, which is driven by three types of butts, upper systems working for stitch loop formation, and lower for tuck loop formation or miss loop, and ultimate butt in knitting field selection.

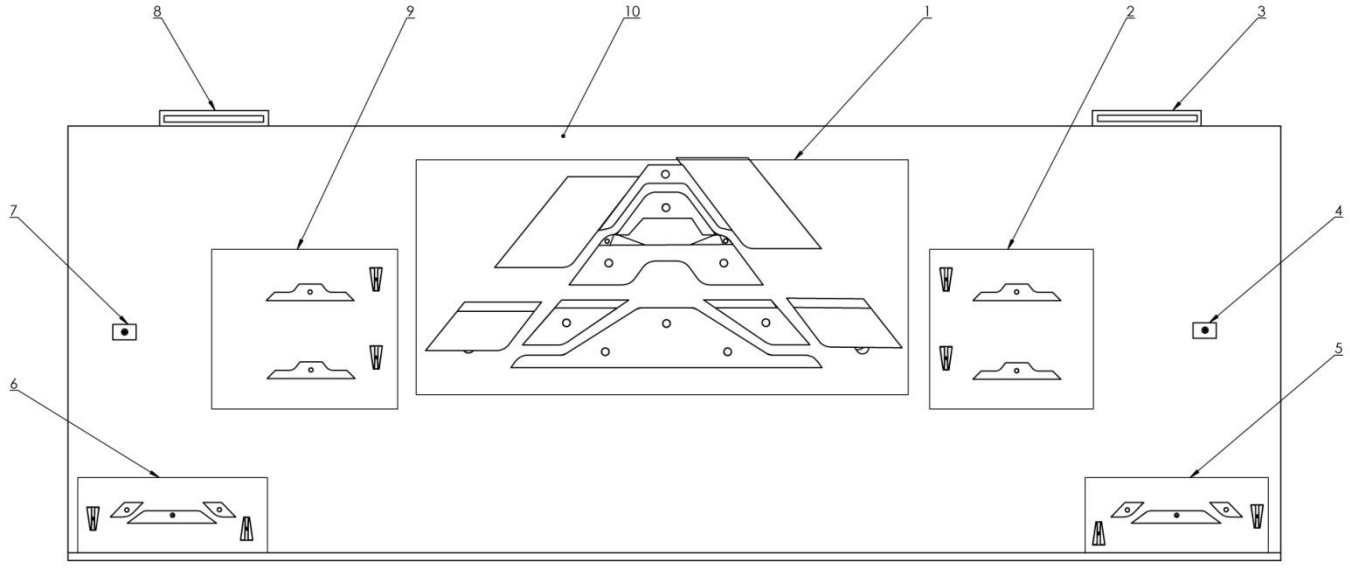

Fig.1 Knitting carriage with the complete design of the cam systems.

Figure 1 shows an image of a knitting carriage showing the complete structure of the cam systems, each mechanism being assigned a corresponding position number. Position number 1 shows the knitting mechanism of the knitting carriage, which, as can be seen, is divided into two parts upper and lower. The upper as mentioned above determines the trajectory of the knitting needle by means of its short butt located at the upper end of the needle for knitting or transmitting needle upon transferring, and the lower forms the trajectory of the tuck loop or receiving needle by its long butt located in the middle of the needle . [4,5]

The designations of positions 2 and 9 represent selector mechanisms for the direct selection of needles determining the working and non-working needles for determining the respective knitting structure. The two selector mechanisms operate independently and sequentially depending on the direction of moving of the knitting carriage. When moving from right to left, the left one, shown in the figure 2, will work, since the lower part of the knitting carriage is represented, and the one with position number 9 will be included in the opposite direction. As shown in the figure, the two mechanisms are located. This is necessary due to the fact that the selectors select the needles in the immediate vicinity of the knitting mechanism. The selector mechanisms are again divided into two parts, the upper working with the short butts and the lower working with the long needle butts. In addition to having two sets of selectors, the main original part of the selector mechanism is the principle of needle selection, which is a combination of the applied selector mechanisms in modern flat-knitting machines allowing individual needle selection and older models allowing only group choice of needles.

The presented construction allows for the individual choice of needles, through an electromechanical approach, whereby by means of a selector with a special form forming a pushing canal and performing a reciprocating motion to the needle bed and driven by an electromagnet, it changes the trajectory of the knitting needle by pressing the canal is in the butt of the needle, which has a rounded portion on the side of the canal, and pushes it towards the bottom of the needle bed, thereby leading it out of its knitting trajectory. [3,4]

The numbers 5 and 6 of the figure show the selector mechanisms determining the knitting field and involved in the inclusion and exclusion of knitting needles in the manufacture of fullyfashion garment .

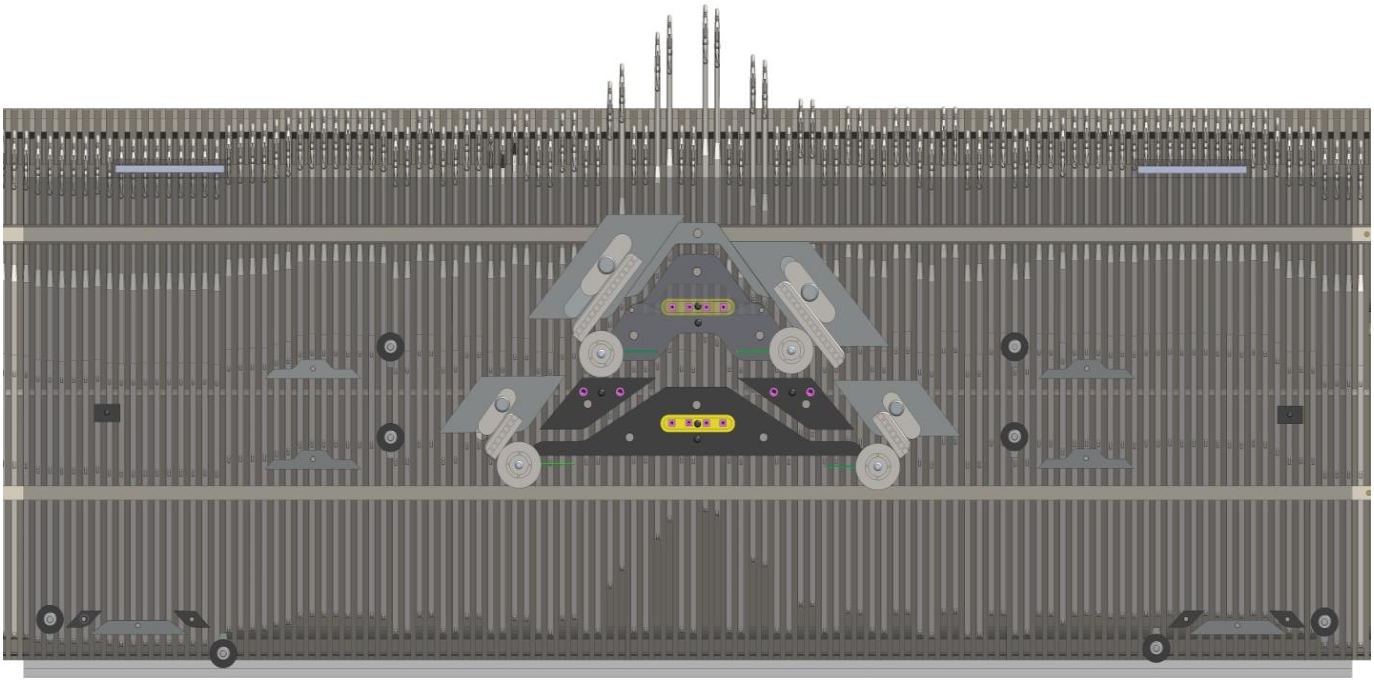

Fig.2 Realistic three-dimensional image of the knot needle bed assembly, needle knitting mechanism in a 2x2 ribbing trajectory

As with the needle selector mechanisms, here again we have two sets of left and right, which are mirrored relative to the knitting mechanism. Both sets are equipped with the same type of selectors that operate independently of one another. When the knitting needles are switched on, the inner selectors work, with the two selectors on the left 5 or right 6 sets sequentially engaged in two different loop rows when the knitting carriage moves toward the knitting field, depending on the direction of its movement. To exclude knitting needles, with the same rule being excluded in two consecutive rows, but in this case when leaving the knitting field. As can be seen with the selectors determining the knitting field, the on and off selectors are mirror-mounted and therefore the knitting needles have a rounded end of the heel on both sides. From this we can see the mentioned interconnectedness of the different mechanisms involved in the knitting knot. [3,4,5]

In the same figure, positions 4 and 7 show permanent magnets used to collect small particles or broken needle heels in order to prevent the broken butt from being hit or wedged in the wedges of the cam systems.

Position numbers 3 and 8 in Figure 1 indicate brushes mounted on the knitting carriage plate represented by position number 10. The brushes are positioned for both cleaning the accumulated moss and for assisting the opening of the tabs of the latch needles. The plate is practically the basic detail of the knitting carriage, ensuring the positioning of all other details.

Figure 2 shows a realistic three-dimensional view of the knot needle bed assembly, a needle knitting mechanism in a 2x2 spacer trajectory. In the image, some of the details are represented by translucent images, such as the plate, for example, to make the details below them visible. The presented figure also gives an opportunity to get an idea of the drive of the individual modules from the cam systems.

Figures 3 and 4 represent respectively a two-dimensional and three-dimensional section view of the knitting carriage, needles and needle bed in the molding process, which makes it possible to see the arrangement of the needle butts with respect to the lifting and removing wedges, and the selectors of the cam systems.

3. Conclusion

The proposed construction is designed in accordance with the requirements of modern flat knitting machines with the possibility of individual needle selection. The three new proposals for needle, needle bed and cam systems are aligned with one another and allow the introduction of a new principle for electromechanical needle selection with a special electromechanical selector operating with negative selection, i.e. turns the needle off and on. The choice is made by working with needles with three types of butts, short and long, one-sidedly rounded, and long two-sidedly rounded, as well as with cam systems divided into two parts. This makes it possible to remove the additional details used in existing methods. Which would lead to a reduction in the depreciation of the machine and, consequently, to a lower maintenance cost.

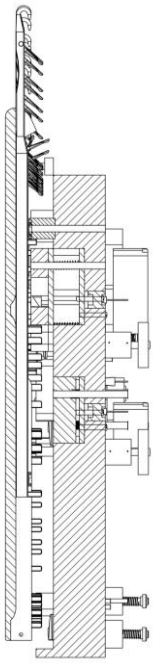

Fig. 3 Two-dimensional section of the knitting carriage, needles and needle bed.

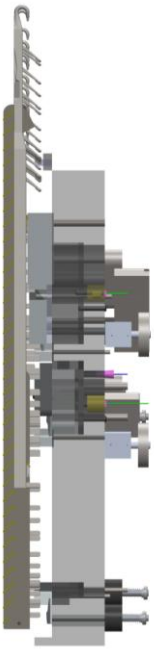

Fig. 4 Three-dimensional section of the knitting carriage, needles and needle bed.

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