Research Concerning the Adjustment of Fabric Density Produced by Circular Knitting Machines with Large Diameter

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The group of circular knitting machines with large diameter includes machines with one or two needle-beds with diameters higher than 178 mm and that use knitting process with final loop for stitch forming. The fabrics produced by circular knitting machines with large diameter are designed both for underwear products, clothing products and other destinations items (items for interior decorations, bed linen, technical articles, toys). Manufacturers of circular knitting machines have improved these machines in particular for: increasing productivity and polyvalence of these machines, reducing production costs, increasing quality of knitted fabrics. Appearance and uniformity of knitted fabrics are quality characteristics that directly depend on technological parameters of knitting. The paper presents ways for adjustment of fabric density at knitted fabrics produced by circular knitting machine with large diameter, type interlock, belonging to Mayer & Cie company.

Keywords: circular knitting machine, knitted fabrics, fabric density

Transformation of yarns into stitches in the knitting area depends on the following factors: the type of machine, the number and the relative position of needle-beds, the knitting process, and the type of machinery used for stitch formation, the type and profile of the cams from the feeder system, the type and profile of the sinker cams.

By its manufacture and adjustment, the mechanism for stitch formation also assures, among other things, the precision and the interval for the adjustment of the gauge of the needle-bed and of the stitch forming depth.

In the case of the final loop knitting procedure, the stitch forming depth represents the needle running compared to the pitch line for new stitches formation. The size of this parameter determines, to a great degree, the fabric density and uniformity, and thus its appearance [2].

In case of the circular knitting machine with large diameter, the density adjustment could be made [1], [2]:

- generally – by the vertical movement of the dial from the cylinder;
- individually – within each system.

The machine of Mayer&Cie company which was subject of the research is of OV 3.2 type and it presents the following technical characteristics [3]:

- nominal diameter: 762 mm (30 inches);
- machine gauge: 18 E;
- number of feeders: 96;
- number of needles: 2x1680;
- nominal speed: 35 rpm.

The machine can process natural, chemical or mixed yarns, and the resulting knitted fabrics are designed for clothing products.

The machine manufacture allows it to produce knitted fabrics with basic bonds (single jersy, double jersy) and derivatives of different types: interlock, interlock with annulled needles, interlock with tuck and miss knits.

General adjustment of the fabric density - OV 3.2 machine

he cylinder (1) and the dial (2) are simultaneously activated and they present synchronized work. The needles from the two needle-beds receive movements along the channels (3) from the cams (fig. 1.)

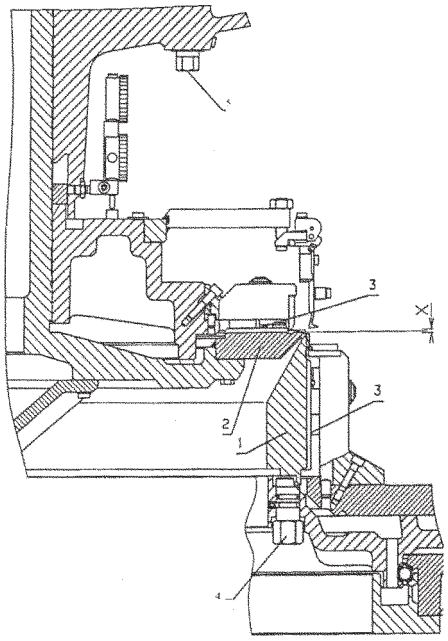

Fig. 1. Section by M.F.O. of OV3.2 machine

The general adjustment of the fabric density can be made by the modification of the „x" distance between the cylinder and the dial, using the adjustment device (5). The adjustment of the needles operation position (interlock or double jersy) is made by using the device (4) that is placed under the cylinder.

An important factor that determines the knit size is the distance between the bottom of the dial channels and the superior edge of the knock-over teeth from the cylinder. The values of this distance could be read on the comparing watch (3) (fig.2.). This distance between the dial and the cylinder must be adapted to the machine produced knitted fabrics' structure and characteristics. After the adjustment

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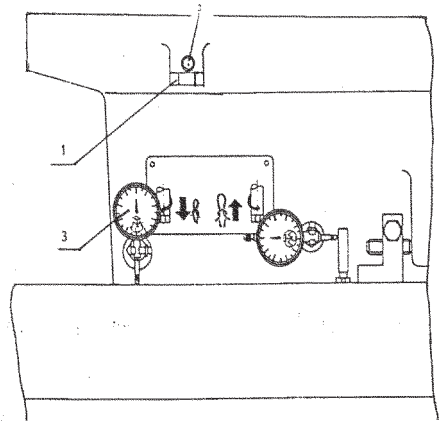

Fig.2. Dial height adjustment device

on systems of the loop's depth, so that the knock-over should be assured in minimal distance conditions between the needle-beds, the further density stages could be obtained by the successive dial elevation, and thus by the increase in the distance between the two needle-beds [2]. The adjustment of this distance is presented in figures 2 and 3 (a, b).

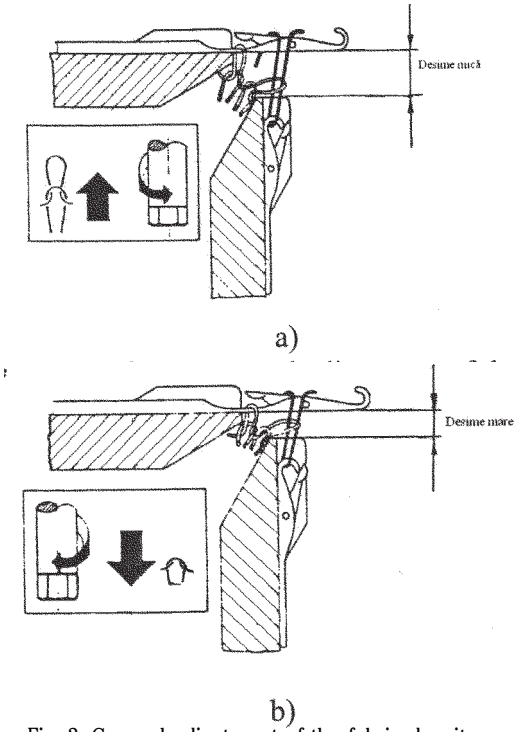

Fig. 3. General adjustment of the fabric density – OV3.2 circular machine

The dial height adjustment device (fig.2) contains: a blocking screw (2), the pin with rotation movement to the right or to the left (1) and the comparing watch. (3). Actually, the adjustment of the dial position is made by the pin's rotation (1), previously being made the unblocking of the adjusting device by using the screw (2).

The pin's rotation to the right leads to the dial elevation, on watch (3) it can be read a big numeric value, and this means a knitted fabric with low density (fig.3.a). The pin's rotation to the left leads to the dial's descent, on watch (3) it can be read a small numeric value, and the resulted knitted fabric shall have a high density (fig. 3.b.)

In figure 4 it is presented a general view of the adjustment device on the dial position towards the cylinder.

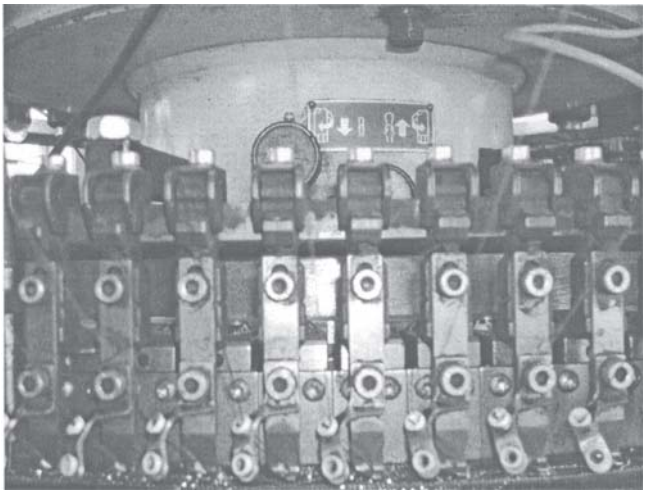

Fig. 4. View of the adjustment device on the dial position towards the cylinder

Individual adjustment of the density - OV 3.2 machine

It is realized within each system of the cylinder or of the dial.

Within the cylinder, the machine is provided with latch needles of two or four types, according to the manufacture model. As it can be seen in fig.5, the needles from the cylinder have 4-level drawing heels. The standard model is the machine that has within the cylinder two types of latch needles (type-2 needle and type-4 needle).

Exchange cams could exist in each knitting system; they could be of the following types: knit cam, tuck cam, miss knit cam, support cam, supplementary sinker cam. By these cams, the needles could run three paths corresponding to the three technological effects: knit, tuck, miss knit.

According to the technical card of the machine, the cams have the following codes:

ZA - knit cams;
ZB – tuck cams;
ZC – miss knit cam;
ZD – support cams;
ZCN – supplementary sinker cams.

ZD support cams are installed to the systems whose cylinder needles do not work, but whose dial needles work. These cams elevate the needles from the cylinder into a position that is inferior to the uncompleted closure, in order to sustain the stitch formed on the dial's needle. The ZCN supplementary sinker cams are installed only to the needle tracks of type-2 and type-4 needles, in the case of the knitted fabrics having tubular binding and produced with low stitch forming depths. Its presence determines the stitch produced on the dial's needle to slide easily on the needle's ends. But in many cases, knitted fabrics having tubular binding could be produced, without the absolute necessity of this cam, this one could be replaced by a ZC miss knit cam.

Exchange cams could be installed to each system and to each action level of the needles.

ZA, ZB, ZCN cams are installed with screws (5) on the vertical-slider (6), and ZC, ZD cams are installed directly on the cam segment (8) (fig. 5.) with screws (7).

In order to change the cams, screws (5) and (7), and (9), respectively, are being unscrewed from each cam segment (8).

In order to adjust the stitch forming depth and the fabric density, it should be realized the vertical slider (6), where the needles' action cams are fixed with screws (5). This can be made by turning the adjustment button (10), using

a hexagonal key. The graduated ring (13) must not be rotated backwards the adjustment button (10). Rotation of button (10), determines the movement of slider (6) by bolt (11) and of the cams fixed on it in the same time. The variation interval of slider (6) movement is of 1.20 mm.

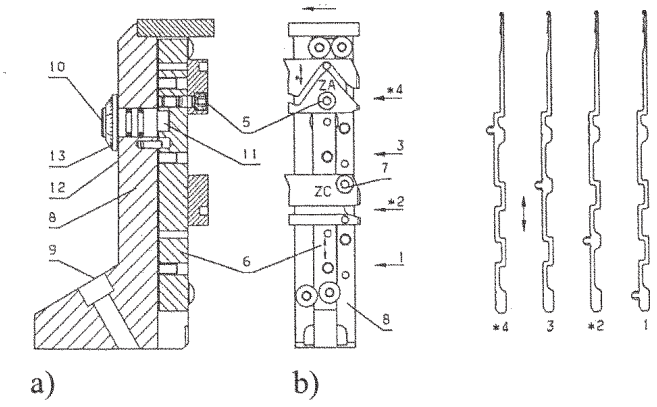

Fig. 5. Cylinder camming at OV3.2 circular machine with large diameter a) section view b) interior view

ZC, ZD cams that are directly fixed on the cam segment (8) are not influenced by the rotation of the adjustment button (10). By the rotation of the adjustment button (10) it occurs in fact the modification of the distance between the needle's ends and the knocking-over line. The registered values set are read in comparison with mark (12) (fig. 6).

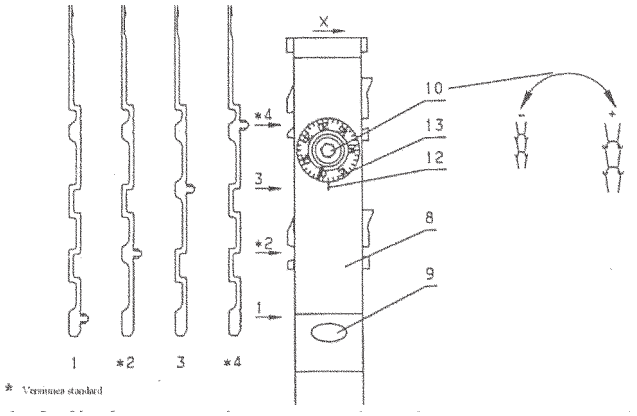

Fig. 6. Cylinder camming – exterior view–OV 3.2 machine

According to the technical card of the machine, the variation interval of the stitch forming depth is (0.6 - 1.8 mm), and the following three intervals are used for the adjustment of the density:

- within interval 1 – divisions (0 – 3) from the graduated ring – high density knitted fabrics shall be produced;
- within interval 2 – divisions (4 – 7) from the graduated ring – medium density knitted fabrics shall be produced;
- within interval 3 – divisions (8 – 11) from the graduated ring – low density knitted fabrics shall be produced.

In the dial, the machine is provided with needles of two types: short needles (S) and long needles (L) and with exchange cams for: knit, tuck, miss knit and support cams, both for short and long needles. They are also different according to the timing type (synchronized or delayed). Different symbols are used in order to identify the cams, as it follows:

A – knit cam;
B – tuck cam;
C – miss knit cam;
D – support cam;
1 – cams for short needles;
2 – cams for long needles;
N – cams for delayed timing;
G – cams for synchronized timing.

The adjustment of stitch forming depth in the dial is made identically to the one in the cylinder. (fig. 7 and fig. 8). The adjustment button (9) is rotated with a special key, and the graduated ring (10) is not rotated backwards button (9). By rotating button (9), bolt (11) moves the slider (6), and in the same time, the cams that are fixed by this one (A1 – NI and C2 - according to fig.7).

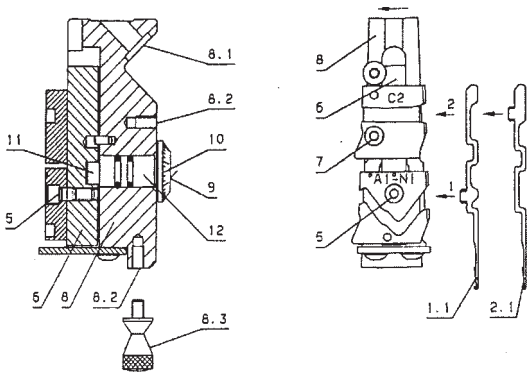

Fig. 7. Dial camming at OV 3.2 circular machine with large diameter Section view and interior view

On the slider (6) only the elevating-closing cams can be fixed with screws (5) and (7) – for both types of needles and timing (synchronized or delayed). Miss knit cams and the support cam are being fixed with screws (7) on the cam segment (8) directly.

The adjustment of the stitch forming depth is made by rotating button (9) to low values read on the graduated ring (10), compared to mark (12) (fig.8).

As in the case of the cylinder, the technical card of the machine indicated the variation interval of the stitch forming depth, which is of (0.4 - 1.6 mm), the same three intervals are used for the adjustment of the density:

- within interval 1 – divisions (0 – 3) from the graduated ring – high density knitted fabrics shall be produced;
- within interval 2 – divisions (4 – 7) from the graduated ring – medium density knitted fabrics shall be produced;
- within interval 3 – divisions (8 – 11) from the graduated ring – low density knitted fabrics shall be produced.

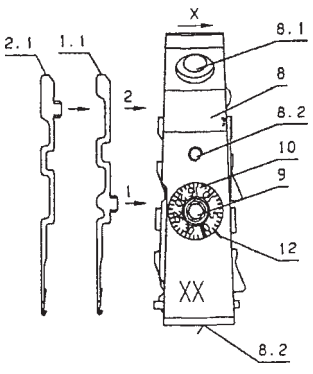

Fig. 8. Dial camming – OV3.2 machine Exterior view

One can observe that the properly adjustment of the stitch forming depth, both in the cylinder and in the dial, is made by bolt (11), which, in its rotation movement impressed during the adjustment, goes for the form of a channel from a tough plate incorporated into a tambour (fig. 9).

The channel is defined by an Archimedes snail, whose variation law is given by the relation:

$$r = A_0 + A_1\varphi \quad (1)$$

where:

r - represents the vector radius of Archimedes snail;

A_0 and A_1 are the coefficients of the argument„r".

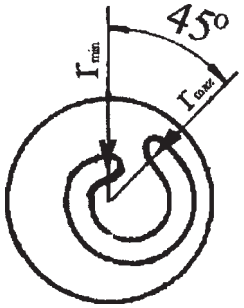

Fig. 9. Form of the tough plate channel

Determination of A_0 and A_1 constants is obtained by entailing some initial conditions generated by constructive restrictions.

For $\varphi = 0$ $r = r_{min}$ so $A_0 = r_{min}$

For $\varphi = \varphi_1$ $r = r_{max}$ so $A_1 = r_{max} - r_{min}$.

The final form of the vector radius's variation law of Archimedes snail shall be:

$$r = r_{min} + \frac{r_{max} - r_{min}}{\varphi_1}\varphi \quad (2)$$

Constants values are the following:

r_{min}=2.5 mm

r_{max}=5.5 mm

$\varphi = 330^0$ – the angle of the snail

By taking into account the values of r_{min}, r_{max} constants and of the angle of the snail, it could be written the final expression for the variation of "r" vector radius.

$$r = 2{,}5 + \frac{3}{330}\varphi \quad (3)$$

$$pt \quad r \in [2{,}5 \div 5{,}5]$$

and

$$\varphi \in [0 \div 330)$$

The variation of the vector radius by taking into account the angle of the snail is presented in figure 10.

The choice of this movement law, as a method for the adjustment of density, is motivated by the existence of a lineal dependence between the vector radius and the angle of the snail, and it is easy to practically materialize this dependence in the properly adjustment system, as it could be noticed in figure 11.

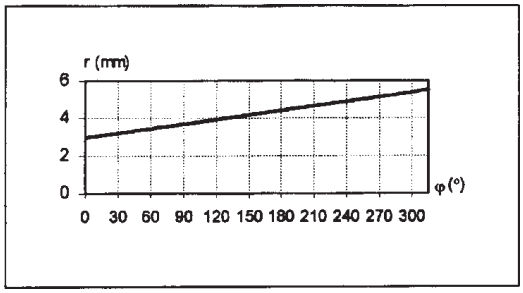

Fig. 10. Variation of the vector radius by taking into account the angle of the snail

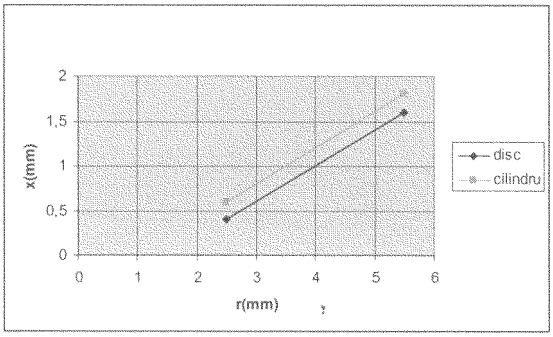

Fig.11.Variation of the stitch forming depth by taking into account the snail radius

Conclusions

The adjustment of this type of machine is made generally and individually. The general adjustment of the density is realized by successive vertical movement of the dial compared to the cylinder, within interval (0 – 4 mm) [3].

The individual adjustment, on systems, is made by moving the stitch cam on a distance of 1.20 mm. Within the cylinder, the variation interval is of (0.6 - 1.8 mm), and within the dial, the interval is of (0.4 – 1.6 mm). The mechanism for individual adjustment of density is a simple structure that is identically designed both for the cylinder and the dial. The modification itself of the stitch forming depth is realized according to an Archimedes snail, and the theoretical adjustment interval of the snail radius is of [2.5 – 5.5 mm].

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