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(54) A method of producing figured knitted fabric lengths on a flat knitting machine.

(57) With certain advanced knitting methods it is possible to produce arbitrarily figured knitted fabrics, but when using a flat knitting machine the figuring has so far been limited to the inclusion of transverse, throughgoing stripes made of one or more rows of stitches. With the invention advantage is taken by the fact that the needles (4) of such a machine are switchable between an operative and a non-operative condition, as it is hereby possible to knit in one or more rows of stitches (20-24) of a figure producing yarn along only a partial width of the fabric, from one edge thereof, while thereafter, optionally after addition of an additional throughgoing stripe of one or more rows (28) of stitches, it is possible to effect a complementary knitting in of stitches and stitch rows (30) from the opposite edge of the fabric, whereby the earlier introduced wryness of the fabric will be relieved or compensated for. The result is a flat knitted fabric that may show stripe figures terminating at places on the very fabric surface spaced from one of the edges thereof, and/or stripes (28) stretching partially in a curved manner.

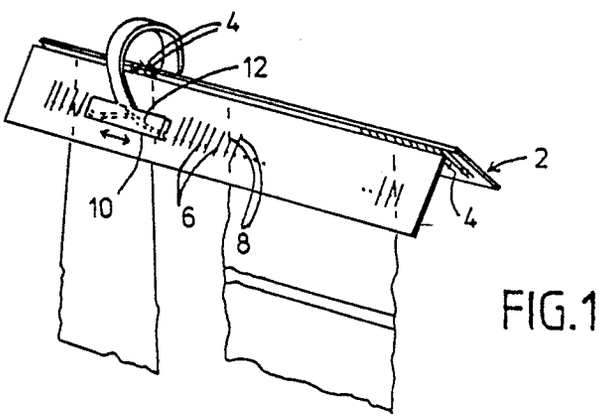

FIG.1

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A method of producing figured knitted fabric lenghts on a flat knitting machine.

The present invention relates to a method of producing figured knitwear by means of a knitting machine. It is already known that figured knitwear may be knitted from yarns of different colours, but apart from the simple methods, by which a simple transverse stripe pattern is provided by knitting throughgoing rows of stitches of different colours, the employed techniques are rather complicated compared with a simple flat knitting. Normally is used either a double sided knitting, where two or more yarns of different colours are brought forward in each row of stitches in such a manner that the yarns are alternatingly exposed on the respective front and rear sides of the knitted fabric, or a simple knitting with a single yarn, which is made up of small pieces of yarns of different colours; in the former case a rather complicated knitting machine is required and the consumption of yarn is considerably larger than would be required for the very formation of the pattern, while in the latter case an expensive yarn joining technique is required and the knitwear will comprise noticeable thickenings in the transition areas between the various pattern sub areas.

The present invention is based on the recognition that with the use of a flat knitting machine for producing a single layer knitted fabric it is possible to produce a uniformly knitted fabric showing pattern areas or stripes that - with certain limitations - may be only partially throughgoing or entirely throughgoing in a continuous or discontinuous, oblique manner, whereby entirely new possibilities of creating figured knitted fabrics are provided.

The invention is based on the use of a specific type of knitting machines, in which the needles may be optionally put out of operation, viz. by a lowering of the needle foot in such a manner that the needle cam as moved along the row of needles will not actuate the respective selected needles. On a broad knitting machine it is hereby possible to produce a plurality of mutually entirely separated knitted fabric lengths, viz. when the needles between these lengths are kept inoperative. This result is achievable already by a manually effected passivation of the needles between the fabric lengths, but machines have been developed, in which the lowering and the raising of the needle feet may be effected automatically in a preprogrammed manner in order to effect, continuously during the operation, a widening or narrowing of the single fabric lengths, e.g. for the knitting of a fabric member for forming a truncated cone member for a sweater sleeve or a rounded armhole edge on a front or rear fabric member for a sweater or a similar garment. Thus, for each new operational movement of the knitting sledge it is possible to change the number of active needles according to a predetermined control program.

Based on this technique, according to the invention, it is possible to produce particularly figured, knitted single fabric lengths such that the single lengths maintain the character of simply knitted single layer fabrics, yet without particular material characteristics in the transitions between the various figure areas.

According to the invention it is possible to effect a knitting of several successive rows of stitches along a partial width of a knitted fabric length, while the needles along the remaining width are kept temporarily inactive, but in operative engagement with the previously knitted remaining width of the fabric length; underneath the needle bed of the knitting machine there will be delivered new fabric under the active needles, but not under the inactive needles, where the previously knitted fabric portion will just keep hanging until the associated needles are reactuated. The knitting all over the width of the length may be resumed upon some excess stitch rows having been knitted along the first partial width of the length, and if for this knitting a yarn of another colour has been used the result as seen on the final product will be that in the transition area a jump in the height direction will occur between the respective colour areas, while otherwise the result is a fully customary knitting together of yarns of different colours.

For practical reasons, however, the said height jumps are limited to a single stitch per stitch row, such that a concentrated jump over more stitch rows will reveal itself as an oblique line with an inclination of in principle 45°.

There are certain practical limits for how far the concerned 'wry knitting' of the knitted fabric length can be driven, but it is perfectly possible to knit 5-15 stitch rows over a partial width of the fabric before the knitting is resumed over the remaining partial width, and already this is sufficient for creating marked and hitherto unknown figure effects in knitwear of the type in question.

By the resuming of the further knitting after the said wry knitting it can be selected, in stead of a throughgoing transverse knitting, to effect a more or less extensive complementary wry knitting, such that the knitting pattern is put back to normal or even wry knitted oppositely. When hereby use is made of different yarn colours and/or different knitting types it is possible to produce a countless number of different figures, which, however, will be characteristic in showing either throughgoing transverse figure areas, the upper and lower border

lines of which may present jumps along inclined lines, or and figure areas projecting inwardly from either side and being of a limited height extension, such areas jumps along their upper and lower border lines and being endwise terminated along oblique lines. Even with these limitations for the formation of different figures there will still be unlimited possibilities for the production of different figures, and when the required adjustments of the needle operations are effectable in an automatically preprogrammed manner it will even be possible to produce series of respective unique specimens.

The invention, as defined by the appended claims, will now be described in more detail with reference to the drawing, in which:-

Fig. 1 is a schematic perspective view of a flat knitting machine,

Fig. 2 is a knitting diagram for illustrating the invention,

Fig. 3 is a corresponding diagram, partly shown naturalistically during the knitting,

Fig. 4 is a representation of the finished, figured fabric,

Fig. 5 is a correspondingly surface marked view, and

Fig. 6 is a plan view illustrating additional figuring possibilities.

In Fig. 1 is indicated a flat knitting machine having a needle bed 2 and a plurality of knitting needles 4 obliquely upstanding therefrom and each having a needle foot 6 projecting outwardly through a guiding slot 8. A cam 10 arranged for reciprocal movement along the needle bed has a curved locking groove 12, which engages with the needle feet 6 so as to cause the needles to carry out the displacements thereof resulting in a new row of stitches for each length movement of the cam when a non-illustrated thread guide on the cam serves to feed the required yarn. The yarn cannot be shifted during each working stroke of the cam, but for each working stroke it is possible to select between two or more different yarns, such that it is possible straight away to produce knitted fabric lengths of desired transverse figures.

The width of the knitted length is adjustable by depressing the needle feet 6 of the needles which are not desired to be used, whereby these needles will not be actuated by the moving cam, and by this measure it is possible to knit several mutually separated fabric lengths at the same time. Knitting machines have been developed, in which the needles may be inactuated in a preprogrammed manner, such that it is possible, without temporarily stopping the machine, to produce a narrowing of the knitted length at one or both sides thereof, though at a rate of maximally one needle per working stroke of the cam.

In connection with the invention it is precisely this possibility of controlling which is utilized, independently of whether or not the width of the fabric length is adjusted. Even though the knitting machine is not adapted for anything else than a successive taking in of stitches, the associated needle control equipment will still be operative for all individual needles, and consequently it will be possible to abruptly stop the knitting along a partial width of the fabric upon the knitting having been commenced from one side of the fabric length, the remaining row of deactuated needles just being kept inoperative, yet still in holding engagement with the already knitted fabric length. When hereafter some stitch rows are knitted only along a partial width of the knitted length this length will be locally expanded downwardly and thus be "wry", irrespectively of the fact that the enitre top edge line be held along a straight line. This wryness, however, may be rectified by a subsequent complementary wry knitting, and a resulting effect can be that on the final non-wry product figures are present which will reflect the wryness having occurred during the entire knitting operation.

This technique is illustrated in Fig. 2, which shows how the stitches are laid along the top edge of a knitted fabric length 14, which has so far been knitted in a homogeneous manner as marked by crosses, the uppermost or lastly knitted, straight lined row of x-stitches being designated 16. Hereafter it is desired to continue the knitting by adding a partial area of another colour as shown by "o-stitches", and the associated yarn is knitted into the fabric from the left side thereof, whereby a control signal is produced for a part of the needles to remain inoperative, namely the needles marked with spots outwardly towards the right hand edge from the needle marked A. In the following stitch row 18 the "o-stitches" will thus be knitted until the needle marked B. In the subsequent row 20 a following needle C will be made inoperative, and the operation is continued correspondingly until row 24 has been knitted.

The actual picture of the upper end of the knitted fabric length in the knitting machine will not be as shown in Fig. 2, but rather as shown in Fig. 3, from below and up to the indicated line 24-16, inasfar as each lastly added row of o-stitches will be aligned with the x-stitches in the row 16. The area holding the o-stitches will be compressed, as also to some degree applying to the underlying area holding the x-stitches. Such a compression will be possible because on the cam 10 there is mounted a non-illustrated pressure foot, which exerts a pressure downwardly on the produced stitches in the space between the opposed two rows of needles, just as additional means may be provided for effecting a down holding of the top edge of the knitted fabric length.

Thereafter a yarn with a third colour may be added by knitting along following full stitch rows in a zone 28 marked by horizontal border lines 26 in Fig. 3.

Thereafter it is possible to continue with a complementary wry knitting as schematically shown adjacent the upper end of the fabric length illustrated in Fig. 3. In the line 30 there is knitted from the right hand side a row of x-stitches until the needle A is reached, care being taken that the needles to the left thereof being kept inoperative, although the stitch adjacent the needle A is brought to engage the adjacent "o-stitch" on the needle B; this will correspond entirely to a knitting in into A,B in Fig. 2, viz. if the parallel stripe 28 is not produced. Thereafter the knitting may go on with an extra needle actuated for each additional stitch row, until the field missing in Fig. 2 has been knitted out. By this local filling out the local compression in the left hand side of the fabric length will be gradually compensated for, and as the first full row of x-stitches designated 32 is added, the underhanging fabric length will be entirely straightened out and flattened.

However, it will hereby be characteristic that the stripe area 28 has been bent out as shown in Fig. 4, which shows the finished product, and that the o-stitch area appears with a characteristic oblique end portion on the fabric surface, what would be so even if the stripe 28 was not added. The finished fabric according to Fig. 4 is illustrated more clearly in Fig. 5. In practice the broken areas of the stripe 28 and the obtuse angled portion of the o-stitch area will extend in a rounded manner, while the acute angled portion of the latter area will be pronounced pointed.

The use of yarns of different colours may be substituted or supplemented by the use of changes of the type or shape of the stitches, the concerned knitting machines already normally being adapted to be able to change between different stitch forming methods, such that it is possible to produce correspondingly figured areas having the same colour as the surrounding fabric, but just having another surface character.

Fig. 6 shows some further examples of figures produceable by the method according to the invention.

Theorectically the method may be used even in connection with knitting machines having needles which may be only manually passivated, but in the successive changes of the mode of operation of the needles can be effected automatically based on a control program, such that the cam may operate without interruptions. Usable types of machines for this purpose are JET-2F and JET-3F from the Swiss company Dubied & Cie.

According to Figs. 4 and 5 it is the oblique configuration of stripe portions or area edges that are quite characteristic, but it is another essential feature that it is possible to produce figure areas stretching from a side edge only partially across the width of the fabric. By way of exemple, as also indicated in Fig. 6, it is possible hereby to incorporate quite thin, but if desires strongly coloures transvers stripes, the appearance of which it is insignificant that at their free ends they are obliquely terminated. Thus, a pronounced figure effect is achievable already with the use of one or more stripes cinsisting of but a single row of stitches, i.e. a row, the end of which is of no particularly oblique shape. Just that kind of figures will be the most economical, because they minimize the idling of the cam along the passivated needles. The cam could well be reversed just prior to such idling runs, but that would hardly be advantageous from a practical point of view.

Withe use of such quite thin figure stripes it may even be acceptable that the said complementary knitting not be effected at all.

Claims

1. A method of producing figured knitted fabric lengths on a flat knitting machine be selective use of yarns of different colours and/or different types of stitches, characterized in that use is made of such a knitting machine, the needles of which are individually controllable for switching between an operative and a non-operative condition, and in that over a given knitting width, i.e. after the knitting being started, the needles are successively switched so as to be operative and non-operative, respectively along complementary partial widths of the fabric length inwardly from the respective side edges thereof, a knitting of one or more stitch rows of a deviating character hereby being effected along the row of operative needles, whereafter -. optionally after adding one or more throughgoing rows of stitches - the needles are switched to effect knitting along complementary inverted operative/non-operative partial lengths of the row of needles.

2. A method according to claim 1, characterized in that the knitting of the figure area og said deviating character is effected through two or more rows of stitches, and in that for each new row knitted from the edge of the fabric length the row is shortened by switching the last needle or needles in the associated row af active operative needles into the non-operative condition.

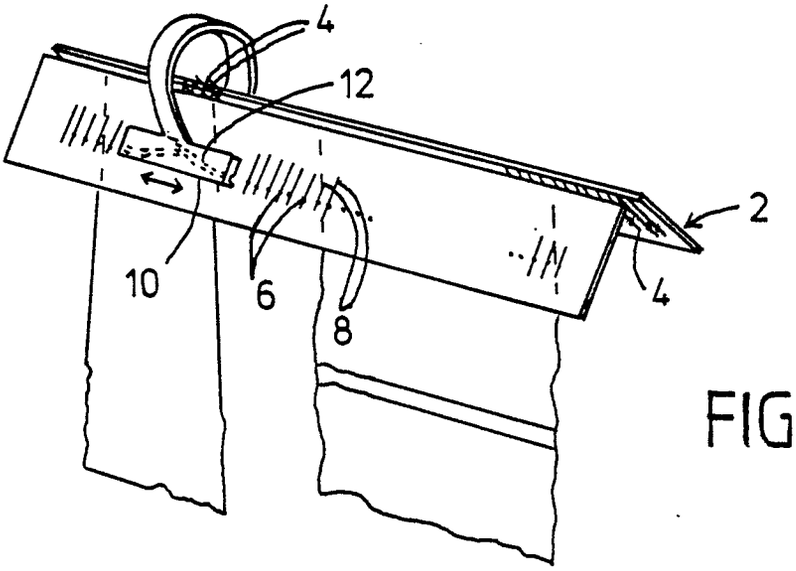

FIG.1

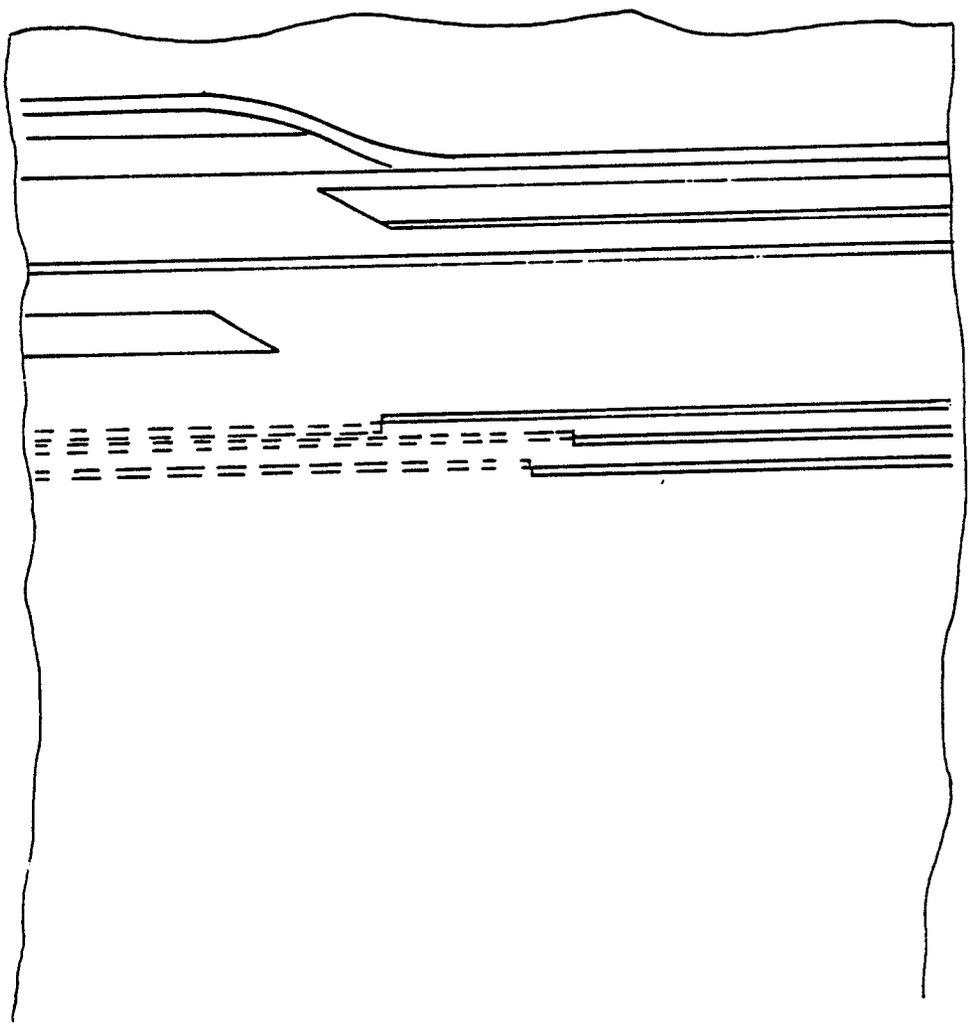

FIG. 6

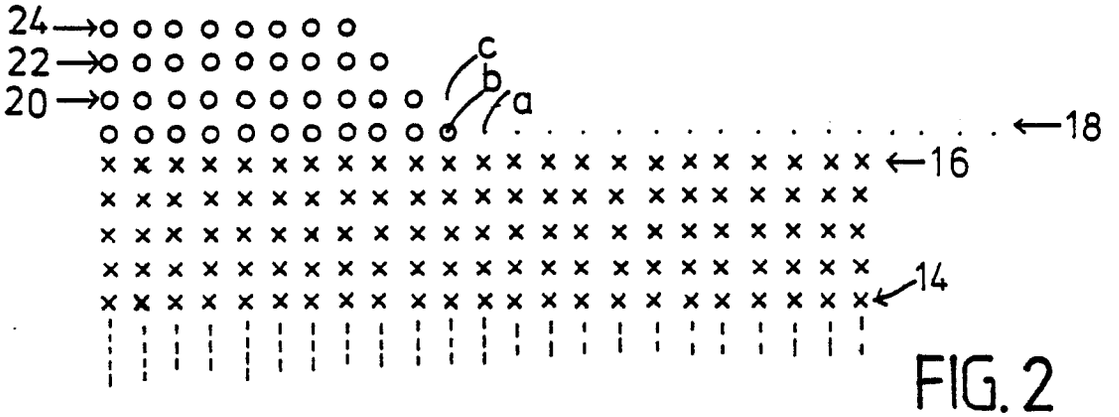

FIG. 2

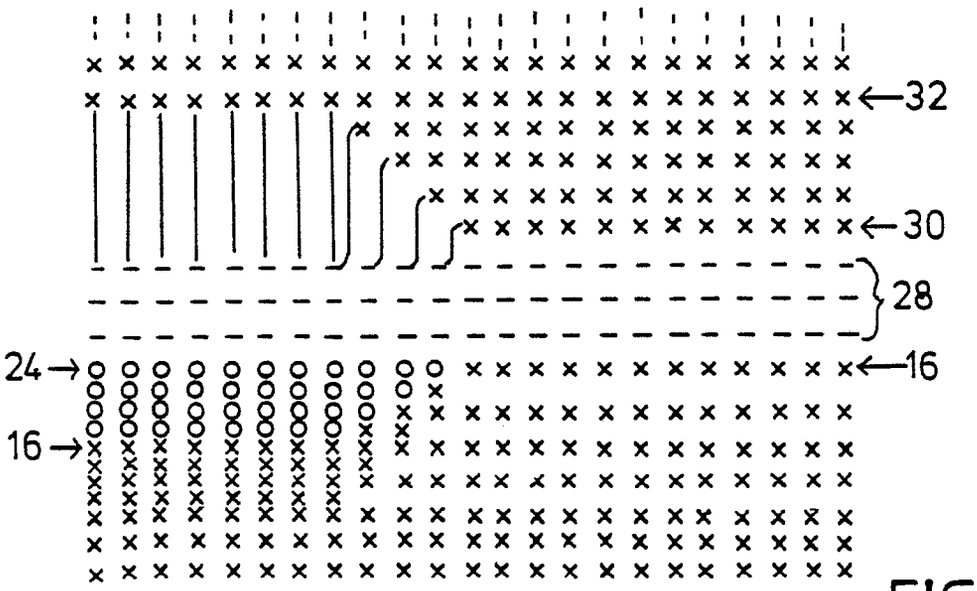

FIG. 3

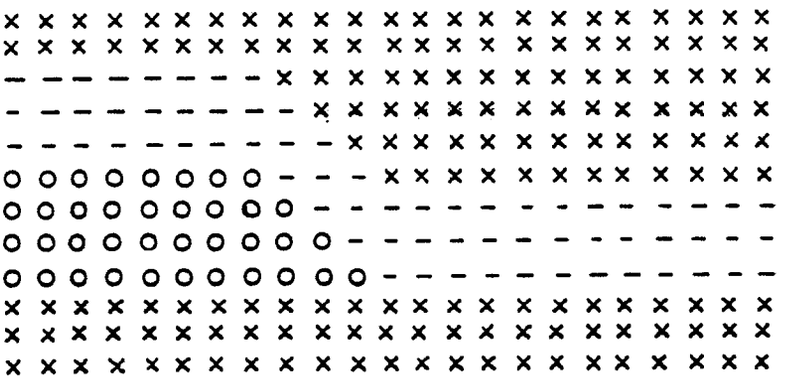

FIG. 4

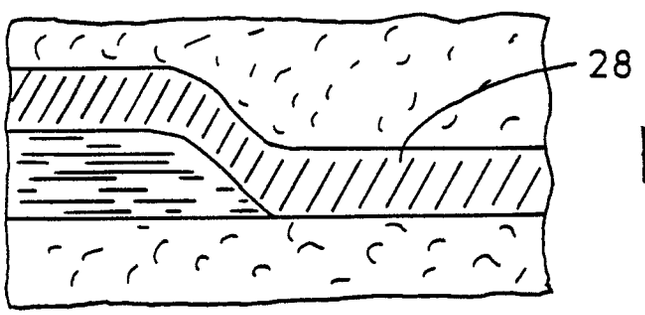

FIG. 5