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(54) Knitting machine and method of producing knitted fabrics
Strickmaschine und Verfahren zur Herstellung von Strickwaren
Méthier à tricoter et procédé pour la fabrication d’articles tricotés

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Description

The invention relates to a knitting machine (see GB-A-2 022 871) and a method of producing knitted fabrics. In conventional knitting machines, the separation between all the knitting needles is kept constant, whereas the feed speed of the yarn used for knitting and the rotational speed of a cylinder of the knitting machine are linked with each other in order to provide knitted fabrics of constant loop size. Sometimes, knitting needles are removed at fixed intervals or at random intervals in order to impart a certain irregularity to the knitted fabric.

In conventional knitted fabrics produced in the manner as outlined above, the following deficiency is to be observed. Since the density of the knitted loops is constant or varying at random, the knitted fabric does not have a natural irregular feel which is typical for a hand-knitted fabric, and therefore it is not very comfortable to a wearer.

Therefore, the object underlying the present invention is to provide a knitting machine and a method of producing knitted fabrics by means of which knits are provided having a natural, irregular feel that is comfortable to a wearer.

This object is solved in a satisfying manner by the knitting machine and the method according to the invention, wherein the needles are arranged with a specific distribution having a 1/f fluctuation. Hence, knitted fabrics can be produced in which the stitching pattern varies with a 1/f fluctuation across the width of the fabric.

One advantage of the present invention resides in that knitted fabrics are provided, which can be produced on an industrial scale and which provide the comfortable feel of hand-knitted fabrics.

In the present invention, the expression "1/f fluctuation" is defined and understood as a power spectrum, with a frequency component 1/k, and proportional to 1/k^s, wherein k is approximately 1, and as a power spectrum which is similar to the above.

According to the invention, knitted fabrics can be obtained wherein the stitching pattern is not constant, nor does it vary randomly. Rather, the stitching pattern varies with a particular correlation, namely a correlation with a 1/f fluctuation, thus imparting to the fabric a feel with the natural irregularity of a hand-knitted fabric, which provides a special esthetic beauty and is comfortable to wear. Such knitted fabrics giving the same natural irregular feel as that of hand-knitted fabrics can be produced as machine-knitted goods at low cost on an industrial scale.

The object underlying the present invention is solved in a satisfying manner by the knitting machine and the method of producing knitted fabrics as disclosed in detail hereinafter with reference to the accompanying drawings and specified in the claims.

The invention will be explained in more detail below by means of preferred embodiments and with reference to the accompanying drawings, wherein

Fig. 1 is an overview diagram of the main components of a knitting machine according to the invention;
Fig. 2 shows the yarn feed unit of the knitting machine;
Fig. 3 shows the knitting unit of the knitting machine;
Fig. 4 shows the needle positioning of a two-stage cam;
Fig. 5 shows the needle positioning of another two-stage cam;
Fig. 6 shows the needle positioning of a three-stage cam;
Fig. 7 shows a melody having a 1/f fluctuation;
Fig. 8 shows a needle arrangement having a 1/f fluctuation used in the knitting machine; and
Fig. 9 shows a knitted fabric in which a welt stitch has been distributed with a 1/f fluctuation.

General Concept of the Knitting Machine (Fig. 1)

An example of a circular knitting machine 1 is shown in Fig. 1 of the drawings. The knitting machine 1 comprises a plurality of bobbins 21 arranged around the perimeter in the upper portion thereof. A yarn feed unit 2 is provided which controls and feeds yarn 22 from the bobbins 21 to a knitting unit 3 in which needles 30 knit the yarn 22 into a knitted fabric 6. Furthermore, a take-up unit 4 is provided which takes up the knitted fabric 6. The operation of the knitting machine 1 is controlled by means of a controller unit 5. Of course, the invention is not restricted to a circular knitting machine as set forth above, rather, the invention can also be applied to a weft knitting machine, a warp knitting machine or other types of knitting machines.

Yarn Feed Unit (Fig. 2)

The yarn feed unit 2 supplies yarn 22 to the knitting unit 3, and it comprises a plurality of bobbins 21 onto which the yarn 22 is wound. The yarn 22 is supplied from the bobbins 21 to the needles 30 in the knitting unit 3 by means of a top stopper 23, an IRO tape 24 and a feeder. The operation of the IRO tape 24 is controlled by the torque which is transferred by the rotation of a main motor 52 belonging to the controller unit 5. The rotation of the main motor 52 is transmitted via gear boxes 51 and 25 and other components in order to adjust thereby the amount of yarn 22 which is
fed from the bobbins 21 to the needles 30.

**Knitting Unit (Figs. 3 and 4)**

In the knitting unit 3, a large number of grooves is formed around the circumference of a needle cylinder 24 in the axial direction thereof, for example a number of 2088 grooves is provided, and knitting needles 30 are maintained to be movable within the grooves. As shown in Fig. 4, each knitting needle 30 comprises a butt 33 at the one side, and a hook 31 and a latch 32 onto which the yarn 22 is looped and knitted. As indicated in Fig. 3, a cam holder 35 encloses the outer circumference of the needle cylinder 34, and a cam 36, shown in detail in Fig. 4, is positioned inside the cam holder 35, wherein the butt 33 of a needle 30 interlocks in a respective cam groove 37.

Apart from a single knitting machine, such a configuration is also applicable to a double knitting machine of any generally-known configuration, such as a dial and cylinder knitting machine. For example, in a dial and cylinder knitting machine, in addition to the set of knitting needles 30 arranged axially around the needle cylinder 34, another set of needles is arranged radially on the upper face of a dial, wherein a cam is set on the dial upper face.

**Cam Configuration (Figs. 4 to 6)**

As mentioned above, each cam 36 has a cam groove 37 in which the butt 33 of the respective needle 30 interlocks. The pattern of the cam groove 37 corresponds to the stitching mode. For example, a knit stitch pattern of embodiment 61 is formed with a continuous series of mountain-shaped grooves; a welt-and-knit stitch pattern of embodiment 62 comprises a combination of a mountain-shaped groove and a flat groove; and a tuck-and-knit stitch pattern of embodiment 63 comprises a combination of a mountain-shaped groove and a plateau-shaped groove. As the needle cylinder 34 is rotated, the butt 33 of the needle 30 moves up and down along the cam groove 37, forming a knitted fabric 6 corresponding to the pattern of the cam groove 37. The pattern of the cam groove 37 can be formed from two or more vertical stages in order to produce a knitted fabric 6 in which the stitching mode varies along the width of the fabric 6 as the butt 33 of the needle 30 interlocks with the cam groove 37 of each pattern.

Suppose for example, as shown in Fig. 4, that the upper cam groove 37 is set to have a knit stitch pattern of embodiment 61 and the lower cam groove 37 is set to have a welt-and-knit stitch pattern of embodiment 62. Then, by having a series of needles 30 which interlock successively in the upper cam groove 37, the next single adjacent needle 30 interlocks in the lower cam groove 37, a following series of needles 30 interlock in the upper level, and so forth, and the alternating positioning thereof produces a knitted fabric 6 in which a knit stitch 64 and a welt-and-knit stitch 65 are expressed along the width of the fabric 6.

If the two types of patterns as shown in Fig. 5 are used, then a knitted fabric 6 is produced in which a knit stitch 64 and a tuck-and-knit stitch 65 are expressed along the width of the fabric 6. Alternatively, by arranging three types of patterns as shown in Fig. 6 of the drawings, a knitted fabric 6 is obtained in which a knit stitch 64, a welt-and-knit stitch 65, and a tuck-and-knit stitch are expressed along the width of the fabric 6.

**1/f Fluctuation**

One of the present inventors, Toshimitsu MUSHI, was the first in the world to discover that a 1/f fluctuation would impart a particularly comfortable feel to human beings. The results were published in a paper entitled "Seitai Seiyo to 1/f Yuragi" (Biocontrol and 1/f Fluctuation), Journal of Japan Society of Precision Machinery, 1984, Vol. 50, No. 6, and another paper entitled "Seitai Joho to 1/f Yuragi" (Bioinformation and 1/f Fluctuation), Applied Physics, 1985, pp. 429 to 443, as well as in a recent publication called "Yuragi no Hassou" (The Concept of Fluctuations), published by NHK Publishers in 1994.

The abstract of these publications reads as follows: "The 1/f fluctuation provides a comfortable feeling to human beings; the reason is that the variations in the basic rhythm of the human body have a 1/f spectrum. From another perspective, the human body eventually becomes tired of a constant stimulation from the same source, but conversely the body feels uncomfortable if the stimulation were to change too suddenly. Therefore, a 1/f fluctuation is a fluctuation of the right proportion between these two extremes."

In addition, an excerpt from "Yuragi no Sekai" (The World of Fluctuations), published by Kodansha Publishers, reads as follows: "*For example, the rhythms exhibited by the human body such as heart beats, hand-clapping to music, impulse-release period of neurons, and α rhythms observed in the brain, are all basically 1/f fluctuations, and it has been shown experimentally that if a body is stimulated by a fluctuation like these biorhythmic 1/f fluctuations, it would feel comfortable.*"

Fluctuations or variations exist in various forms throughout nature, but the murmur of a brook, a breeze of wind, and other phenomena that impart a comfortable feeling to human beings, have a 1/f fluctuation, while typhoons and other strong winds that impart uneasiness do not have a 1/f fluctuation.
A 1/f fluctuation numerical sequence is determined from \( y_1, y_2, y_3, \ldots \) formed by multiplying \( n \) coefficients, \( a_1, a_2, a_3, \ldots, a_n \), with numbers \( x_1, x_2, x_3, \ldots \). Generally, \( y \) can be expressed by the following Equation 1. Here, the sequence of numerical values forming \( y_1, y_2, y_3, \ldots \) has a 1/f spectrum. For further details, reference is made to Seiichi Shingou (Biological Signaling), Chapter 10, "Biological Rhythms and Fluctuations", published by Corona Publishers, Ltd. in 1989.

**Equation 1:**

\[
Y_j = x_j + \left( \frac{1}{2} \right) x_{j-1} + \left( \frac{1 \cdot 3}{2 \cdot 2!} \right) x_{j-2} + \left( \frac{1 \cdot 3 \cdot 5}{2 \cdot 3 \cdot 3!} \right) x_{j-3} + \cdots \\
\cdots + \left( \frac{1 \cdot 3 \cdot 5 \ldots \ldots (2n-1)}{2n-1 \cdot (n-1)!} \right) x_{j-n+1} 
\]

A 1/f fluctuation sequence is usually generated in two steps. In a first step, a sequence of random numbers is generated by using a computer, for example. In a second step, a certain number \( n \) of coefficients \( a \) - which are stored in a memory device - are successively multiplied on the random numbers. Then, a sequence of numerical values \( y \) is obtained by a linear transformation. This numerical sequence has a 1/f spectrum, and it can be used in a 1/f numerical sequence.

Equation 1 for a sequence of numerical values \( y \) having a 1/f sequence can be used in order to create a melody. For this purpose, at first the scale and the range with the lowest frequency \( f_L \), and a highest frequency \( f_U \) are determined. Then, a 1/f sequence \( y \) is derived, and a linear transformation is performed so that the upper and lower limits become the lowest frequency \( f_L \) and the highest frequency \( f_U \), respectively. The values of the sequence \( y \) so derived are regarded as acoustic oscillation frequencies, and are substituted for the oscillation frequencies of the scale they most closely approximate.

In other words, they are arranged, for example, as quarter notes, between or on the lines of a staff on music paper. Fig. 7 shows a portion of a melody derived using this method. An example of a numerical sequence derived by assigning numerical values corresponding to the notes of the melody of Fig. 7 - giving a value of 1 to the reference note - is shown in Example 1 of Fig. 8. Example 2 and Example 3 have been derived proportionally from Example 1 in which 2088 needles 33 are combined in the knitting machine 1. In other words, in Example 2, six patterns of the same numerical sequence are arranged on the circumference of the needle cylinder 34, whereas in Example 3 four patterns of the same numerical sequence are arranged on the circumference of the needle cylinder 34.

**Knitted Fabric - Example 1 (Fig. 8)**

The needles 30 are arranged in cam grooves 37 of equal spacing around the circumference of the needle cylinder 34 in a manner such that one cam groove 37 is left empty at specified intervals varying with a 1/f fluctuation in order to form a stitching pattern with a 1/f fluctuation across the width of the fabric 6, wherein the stitching varies in the cross direction, and the variation has a 1/f fluctuation.

Fig. 8 shows the sequence of the needles 30 and the corresponding numerical sequences of Examples 1 to 3. For example, for a numerical sequence 27, 27, 21, which has a 1/f fluctuation, as shown in Example 3, there are 26 needles 30 positioned in adjacent cam grooves 37, and one cam groove 37 is skipped (the total of 26 cam grooves with needles plus one empty groove is 27 grooves), the next 26 needles 30 are positioned in adjacent cam grooves 37 starting from the 28th cam groove 37 after which the following cam groove 37 is skipped. This is repeatedly following the numerical sequence, wherein the empty cam grooves 37 without a needle form a distributed pattern 65 with a 1/f fluctuation, which imparts a 1/f fluctuation to the stitching along the width of the fabric 6.

**Knitted Fabric - Example 2 (Figs. 8 and 9)**

A knitted fabric 6 is produced by incorporating welt-and-knit stitching 65 into knit stitching 64 such that the welt-
and-knit stitching 65 is distributed with a 1/f fluctuation. For example, using the cam 36 as shown in Fig. 4 and the numerical sequence Example 3 in Fig. 8, the butts 33 of 26 needles 30 are interlocked in the upper cam groove 37 designed with a knit stitching pattern of embodiment 61, and the butt 33 of the single adjacent needle 30 is interlocked in the lower cam groove 37 designed with a welt-and-knit stitch pattern of embodiment 62 (the total of 26 knit stitch needles plus 1 welt-and-knit stitch needle is 27 needles); then the next 26 needles 33 are interlocked in the upper cam groove 37 and the following single needle 33 is interlocked in the lower cam groove 37.

This process is repeated while adjusting the number of needles 33 to the values of the numerical sequence, to incorporate welt-and-knit stitching 65 into the knit stitching 64 in order to create a knitted fabric 6 in which the welt- and-knit stitch distribution has a 1/f fluctuation (the stitching changes along the width of the fabric 6 such that a welt-and-knit stitch 65 is distributed among knit stitches 64 with a 1/f fluctuation). A portion of the knitted fabric 6, namely the knitted fabric according to Example 2, obtained by this method is shown in Fig. 9 of the drawings. A sequence for a 3-stage pattern as shown in Fig. 6 is also possible. For example, a welt-and-knit stitch pattern of embodiment 62 of the knitted fabric according to Example 2 is alternated with the tuck-and-knit stitch pattern of embodiment 63.

Claims

1. A knitting machine comprising:

   a plurality of knitting needles (30) mounted axially and in parallel around the outer circumference of a needle cylinder (34) and cam means (36) disposed around said outer circumference,

   optionally, another set of needles (30) mounted radially on the upper surface of a dial having a further cam,

   wherein the spacing between adjacent needles (30) around the circumference of the cylinder (34) or a round the cylinder (34) and the dial is substantially constant,

   a yarn feed unit (2) for feeding yarn (22) to the needles (30) and a knitting unit (3) for knitting the yarn (22) by the needles (30) as the cylinder (34) or the cylinder (34) and the dial rotate relative to the cam means (36),

   characterized in that

   the needles (30) for knitting one stitching pattern are arranged in groups around the cylinder (34), the number of needles (30) within each successive group being varied with a 1/f fluctuation, the knitting machine thereby being capable of producing a knitted fabric with said one stitching pattern having a 1/f fluctuation across the width of the fabric.

2. The machine of Claim 1, wherein one needle (30) is missing between each successive group of needles (30) arranged around the cylinder (34).

3. The machine of Claim 1, wherein two or more stitching patterns (61, 62, 63) are defined by respective grooves (37) provided in said cam means (36) and butts (33) of the needles (30) engage with the respective grooves (37), and wherein said needles (30) arranged in groups engage in a groove (37) for said one pattern (61), while the needles (30) between each of these groups engage in a groove (37) for another pattern (62, 63).

4. A method of producing knitted fabrics in a knitting machine having a plurality of knitting needles (30) mounted axially and in parallel around the outer circumference of a needle cylinder (34) and cam means (36) disposed around said outer circumference, optionally, another set of needles (30) mounted radially on the upper surface of a dial, the dial having further cam means, wherein the spacing between the adjacent needles (30) around the circumference of the cylinder (34) and optionally around the dial is substantially constant, said method comprising the steps of

   feeding yarn (22) by a yarn feed unit (2) to the needles (30);

   knitting the yarn (22) with the needles (30) in a knitting unit (3) as the cylinder (34) or the cylinder (34) and the dial rotate relative to the cam means (36),

   characterized by
prior to said knitting step, arranging the needles (30) for one pattern in groups around the cylinder (34), the number of needles (30) within each successive group being varied with a 1/1 fluctuation,

continuing the knitting step to produce a knitted fabric with said stitching pattern having a 1/1 fluctuation across the width of the fabric.

Patentansprüche

1. Strickmaschine, die folgendes aufweist:

eine Vielzahl von Stricknadeln (30), die axial sowie parallel um den Außenumfang eines Nadelzyinders (34) sowie einer Nockeneinrichtung (36) herum angebracht sind, die um den Außenumfang herum angeordnet ist, wahlweise einen weiteren Satz von Nadeln (30), die radial an der oberen Oberfläche einer Rippsscheibe angebracht sind, die eine weitere Nockeneinrichtung aufweist,

wobei der Abstand zwischen einander benachbarten Nadeln (30) um den Umfang des Zylinders (34) oder um den Zylinder (34) und die Rippsscheibe im wesentlichen konstant ist,

eine Garnzuführungseinheit (2) zum Zuführen von Garn (22) zu den Nadeln (30) sowie eine Strickeinheit (3) zum Verstricken des Gams (22) mittels der Nadeln (30), während sich der Zylinder (34) oder der Zylinder (34) und die Rippsscheibe relativ zu der Nockeneinrichtung (36) dreht bzw. drehen,

dadurch gekennzeichnet,

daß die Nadeln (30) zum Stricken eines Maschinenmusters in Gruppen um den Zylinder (34) herum angeordnet sind, wobei die Anzahl der Nadeln (30) in jeder aufeinander folgenden Gruppe mit einer 1/1-Fluktuation variiert wird, so daß die Strickmaschine dadurch in der Lage ist, ein Strickstück mit dem genannten Maschinenmuster herzustellen, das eine 1/1-Fluktuation über die Breite des Strickstücks aufweist.

2. Maschine nach Anspruch 1,

wobei eine Nadel (30) zwischen jeder aufeinander folgenden Gruppe von Nadeln (30) fehlt, die um den Zylinder (34) herum angeordnet sind.

3. Maschine nach Anspruch 1,

wobei zwei oder mehr Maschinenmuster (61, 62, 63) durch jeweilige Nuten (37) definiert sind, die in der Nockeneinrichtung (36) vorgesehen sind, und Nadelfüße (33) der Nadeln (30) mit den jeweiligen Nuten (37) in Eingriff stehen, wobei die in Gruppen angeordneten Nadeln (30) in eine Nut (37) für das genannte Muster (61) eingreifen, während die Nadeln (30) zwischen jeder dieser Gruppen in eine Nut (37) für ein anderes Muster (62, 63) eingreifen.

4. Verfahren zum Herstellen von Strickwaren auf einer Strickmaschine, die eine Vielzahl von Stricknadeln (30) aufweist, die axial sowie parallel um den Außenumfang eines Nadelzyinders (34) sowie einer Nockeneinrichtung (36) herum angebracht sind, die um den Außenumfang herum angeordnet ist, und die wahlweise einen weiteren Satz von Nadeln (30) aufweist, die radial an der oberen Oberfläche einer Rippsscheibe angebracht sind, wobei die Rippsscheibe eine weitere Nockeneinrichtung aufweist,

wobei der Abstand zwischen einander benachbarten Nadeln (30) um den Umfang des Zylinders (34) und wahlweise um die Rippsscheibe im wesentlichen konstant ist,

wobei das Verfahren folgende Schritte aufweist:

Zuführen von Garn (22) zu den Nadeln (30) mittels einer Garnzuführungseinheit (2);
Verstricken des Gams (22) mittels der Nadeln (30) in einer Strickung (3), während sich der Zylinder (34) oder der Zylinder (34) und die Rippsscheibe relativ zu der Nockeneinrichtung (36) dreht bzw. drehen;

gekennzeichnet durch

vor dem Strickschritt erfolgendes Anordnen der Nadeln (30) für ein Muster in Gruppen um den Zylinder (34), wobei die Anzahl der Nadeln (30) in jeder aufeinander folgenden Gruppe mit einer 1/1-Fluktuation variiert wird,
Revendications

1. Métier à tricoter comprenant :

une pluralité d'aiguilles à tricoter (30) montées axialement et en parallèle autour de la circonférence extérieure d'un cylindre d'aiguilles (34), et un dispositif de came (36) placé autour de ladite circonférence extérieure, en option, un autre ensemble d'aiguilles (30) montées radialement sur la surface supérieure d'un cadran comportant une autre came, dans lequel l'espacement entre aiguilles adjacentes (30) autour de la circonférence du cylindre (34), ou autour du cylindre (34) et du cadran, est sensiblement constant, une unité de distribution de fil (2) pour fournir un fil (22) aux aiguilles (30), et une unité de tricotage (3) pour tricoter le fil (22) au moyen des aiguilles (30) lorsque le cylindre (34) ou le cylindre (34) et le cadran tournent par rapport au dispositif de came (36),

caractérisé en ce que :

les aiguilles (30) pour tricoter une configuration de mailles sont agencées en groupes autour du cylindre (34), le nombre d'aiguilles (30) dans chaque groupe successif étant modifié avec une fluctuation 1/f, le métier à tricoter pouvant ainsi produire un article tricoté avec ladite une configuration de mailles ayant une fluctuation 1/f sur la largeur de l'article.

2. Métier selon la revendication 1, dans lequel une aiguille (30) est supprimée entre chaque groupe successif d'aiguilles (30) agencées autour du cylindre (34).

3. Métier selon la revendication 1, dans lequel deux configurations de mailles ou davantage (61, 62, 63) sont définies par des rainures respectives (37) prévues dans ledit dispositif de came (36) et des talons (33) des aiguilles (30) sont en prise avec les rainures respectives (37), et dans lequel lesdites aiguilles (30) agencées en groupes sont en prise dans une rainure (37) pour ladite une configuration (61) tandis que les aiguilles (30) entre chacun de ces groupes sont en prise dans une rainure (37) pour une autre configuration (62, 64).

4. Procédé de fabrication d'articles tricotés dans un métier à tricoter comprenant une pluralité d'aiguilles à tricoter (30) montées axialement et en parallèle autour de la circonférence extérieure d'un cylindre d'aiguilles (34) et un dispositif de came (36) placé autour de ladite circonférence extérieure, et en option un autre ensemble d'aiguilles (30) montées radialement sur la surface supérieure d'un cadran, le cadran comportant un autre dispositif de came, dans lequel l'espacement entre les aiguilles adjacentes (30) autour de la circonférence du cylindre (34) et en option autour du cadran est sensiblement constant, ledit procédé comprenant les étapes de :

fourniture de fil (22) par une unité de distribution de fil (2) aux aiguilles (30) ;
tricotage du fil (22) avec les aiguilles (30) dans une unité de tricotage (3) lorsque le cylindre (34) ou le cylindre (34) et le cadran tournent par rapport au dispositif de came (36) ;

caractérisé en ce que :

avant ladite étape de tricotage, on agence les aiguilles (30) pour une configuration en groupes autour du cylindre (34), le nombre d'aiguilles (30) dans chaque groupe successif étant modifié avec une fluctuation 1/f, et on continue l'étape de tricotage pour produire un article tricoté avec ladite configuration de mailles ayant une fluctuation 1/f sur la largeur de l'article.
| Arrangement of Needles | Numerical Sequence | 3 | 27 | 27 | 21 | 29 | 34 | 32 | 21 | 19 | 13 | 11 | 19 | 19 | 11 | 5 | 13 | 11 | 19 | 27 | 34 | 24 | 16 | 29 | 34 | 27 | 522 |
|------------------------|--------------------|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                        |                    | 2 | 18 | 18 | 14 | 20 | 23 | 21 | 14 | 12 | 9  | 7  | 12 | 12 | 7  | 4  | 7 | 7  | 4  | 2  | 5  | 4  | 7  | 10 | 13 | 9  | 6  | 11 | 13 | 10 | 18 | 348 |
|                        |                    | 1 | 10 | 10 | 8  | 11 | 13 | 12 | 8  | 7  | 5  | 4  | 7  | 4  | 2  | 5  | 4  | 7  | 10 | 13 | 9  | 6  | 11 | 13 | 10 | 196 |

**Fig. 8**