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(54) **KNITTED GLOVES AND METHODS OF MAKING THEM**

(57) A knitted glove comprises: at least one finger component, an upper palm component, a thumb component, a lower palm component, and a wrist component wherein each of the components comprises courses and each course is made of stitches, wherein each of the courses of the upper palm component includes a tuck knit stitch adjacent the upper palm inner edge and each of the courses of the thumb component includes a tuck knit stitch adjacent the thumb inner edge, such that the glove has a tuck knitted ridge along the upper palm inner edge, around the thumb crotch and along the thumb inner edge. The knitted glove has high strength in the thumb crotch area and is useful as a protective glove. The tuck knitted ridge provided in the glove not only increases the safety of the wearer but also increases the useful working life of the glove. Also provided is a method of making the knitted glove. The glove is knitted on a flat knitting machine.

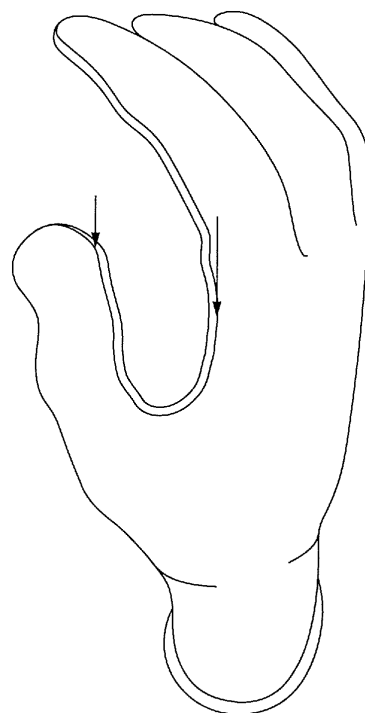


FIG. 5

Description

[0001] The present invention relates to knitted gloves for protecting the hands of the wearer against physical hazards, such as abrasion, cuts or puncturing. The invention, further, relates to methods of making such knitted gloves.

[0002] Personal protective gloves are used in many areas of activity, for instance, industry, agriculture and leisure activities. Gloves typically have four finger stalls to cover each of the four fingers and a thumb stall to cover the thumb, but may also be mittens which have a thumb stall and fewer than four finger stalls, usually one to cover all four fingers together. Gauntlets are gloves, including mittens, which have extended wrist-covering areas to protect the arms. Gloves, whether typical style, mitten style, or gauntlet style, all have a thumb stall separate from the stall which encloses the forefinger to allow the wearer to grip objects. Gloves also have a palm region and the inside edge of this, i.e. the edge which joins the edge of the forefinger stall to the base of the thumb stall, is generally known as the thumb crotch area of a glove. Protective gloves are essential items in hazardous handling environments where an important property of the glove is resistance to physical harm caused by abrasion, cutting, or puncturing. Protective gloves must also be comfortable to maximise the willingness of handlers to wear the gloves during potentially dangerous handling procedures.

[0003] In harsh physical environments, the useful life of a glove depends very much on the strength of the thumb crotch area since this is subjected to stress due to the constant flexing of the thumb and forefinger to grab hold of, and grip, objects. Consequently, it is beneficial to increase the strength of the thumb crotch area so as to increase the safety of the wearer and to increase the useful working life of the glove.

[0004] Many safety gloves are made up of a primary fabric layer, known as a liner, which is then covered with a secondary elastomeric polymer, plastic or rubber layer. Such primary fabric layers are the foundation of a glove acting as both a physical reinforcement for the outer polymer elastomeric layer and also as a moisture absorbant or sweat management inner material. Traditional cut and sewn fabric glove liners are being increasingly replaced by automated knitted glove liners, often referred to as shells.

[0005] Methods of knitting glove liners are well known to those practised in the art. There are now many manufacturers of flat bed knitting machines for knitting gloves. Probably the best known is Shima Seiki, of Wakayama City, Japan. Examples of patents relating to flat bed knitting machines include US 5,398,527 and US 5,992,183, both in the name of Shima Seiki Manufacturing Limited.

[0006] It has been long known that gloves will last longer and give greater protection when the thumb crotch is reinforced. With both traditional cut and sewn fabric liners and knitted liners, additional pieces of fabric have been

sewn into the thumb crotch area. The same can be said for newer machine knit liners where additional materials are sewn into the crotch area. Sometimes, liners with polymer dip coatings are subjected to multiple dipping steps or are multi-layered specifically in the thumb crotch area to increase protection and durability.

[0007] A simple, previously-known method to increase the strength of the thumb crotch is with the use of a sewing machine to add a line of lock stitch, commonly known as Overlock stitching, around the crotch edge, around the thumb crotch palm edge and, optionally, up the forefinger of cut and sewn liners and machine-knitted liners. This additional sewing runs along the edge of the forefinger and then down around the thumb crotch and up the inside edge of the thumb.

[0008] These conventional methods of thumb crotch reinforcement, whether by multiple-layer polymer dip-coating, by the sewing on of patches in the crotch area, or by adding Overlock stitching to the liner edge, all require additional processes and so affect the final production costs, both in terms of materials and manufacturing time.

[0009] Various manufacturers have tried to address the issue of providing additional reinforcement to the thumb crotch area of a glove. For instance, US 7,089,600 describes a process which involves the double polymer coating of the forefinger to thumb crotch region of a glove. US patents Nos. 6,962,064, 7,213,419, 7,555,921 and 7,908,891 describe the knitting of gloves with variable knitted regions. The provision of a polymer coating containing a hard particulate filler to a knitted glove liner or shell by a dip coating method is described in US 9,456,645.

[0010] There is a range of glove knitting machines. These are set in gauges of machine which relate to needles per inch. Usually, the machines are rated as 7, 10, 13, 15 and 18 gauge. There are machines which are termed 18 gauge. These, having 18 needles per inch, will knit finer yarns and produce thinner finer fabrics from finer yarns as opposed to 7 gauge knitting machines, which, with only 7 needles per inch, knit much heavier, coarser yarns so producing heavier fabric gloves.

[0011] Generally, the greatest number of safety gloves made today are made on the finer 15 gauge knitted shells. Such 15 gauge shells are then coated with an elastomeric outer layer. These gloves are, thus, lighter and more dextrous. However, gloves that are much lighter and dextrous face a problem when higher physical strength is required. In most cases, lighter gloves fail in the thumb crotch prematurely, long before the palm or finger regions split or wear through. The reason for the premature thumb crotch failure is due to the constant grab, grip and holding actions during a work process on a relatively lighter weight dextrous glove material.

[0012] Knitted gloves, for the purposes described above, are currently made using flat knitting machines that use a number of needles in the form of a needle array in a needle bed and a single feed of yarn, or yarns.

Typical gloves comprise eight basic component knitted sections to form the finished glove. These eight components include one component for each of the four fingers and thumb, two components for the palm including an upper section and a lower section, and finally one component for the wrist area. All of these sections are essentially knitted tubular or conical sections that join to each other fashioning the general anatomical shape of a hand. Conventional knitting processes use a flat knitting machine to knit each of these areas in a particular sequence. The sequence of knitting the components follows with one finger at a time, beginning with the little finger and continuing on through the ring and middle finger to the forefinger. After each finger is knitted using only selected needles in the needle knitting bed, the knitting process for each finger is stopped, and yarn is cut and bound. The finished knitted finger or component is held in place by holders, weighted down by sinkers. The next finger is then knitted sequentially one at a time using a different set of needles in the needle bed. When all four fingers are knitted in this fashion, the knitting machine then knits the upper section of the palm, picking stitches from each of the previously knit four fingers. After knitting an appropriate length of the upper palm, the thumb portion is then initiated. Next the lower section of the palm is knitted using all of the needles across the needle bed. Finally, the knitting machine knits the wrist component to the desired length. The sequence of knitting the components of the glove is illustrated in Fig 1. The number of knitted courses down each of the knitted components is controlled by a computer program in the knitting machine where the number of courses can be varied to suit the required lengths of the components. It is well known by those practised in the art as how to set up the knitting machines to knit the required gloves.

[0013] The typical flat knitting machine has two stationary knitting beds arranged in an inverted V formation. Latch needles slide in the tricks during the knitting action. For a needle to be selected for knitting, the butt of the needle is caused to protrude out of the needle bed. The needles are controlled as they pass through the tracks formed by angular cams of a bidirectional cam system attached to the underside of a carriage that transverses the bed in a reciprocating manner across the machine width on guide rails.

[0014] In the knitting process using the machine described above, needles are selected for use in knitting using needles which are located in the knitting bed. A drum, which is cylindrical, and rotatable about its central axis and which has a plurality of lateral grooves in its outer surface which are parallel to each other and to the axis of rotation of the cylinder is located beneath the needle bed. The drum has a number of needle selection pins or rods laid down in the grooves of the drum. The length of the pin for each portion of the glove to be knitted (fingers, thumb, palms and wrist) is different and it defines the number of needles to be activated for each portion. This controls the width of the knitted component. The

needle bed comprises a plurality of needles ready for activation in the knitting process. Each needle is retained slidably in a needle jack which is itself retained in a control jack. The control jacks are located above the needle selection drum. The control jack has a butt which extends into a groove of the needle selection drum. If the groove does not contain a needle selection pin, the position of the control jack is not altered and the needle retained is not brought into action in the knitting process. If the drum rotates to present a groove, to the control jack butt, which does contain a needle selection pin, the needle selection pin in the groove of the drum pushes up the control jack in which the needle is secured. The control jack causes the needle butt to protrude upwards out of the needle bed with the result that, as the carriage moves across the knitting bed, it contacts the needle butts and so engages those needles in the knitting process. This is shown diagrammatically in Fig. 2. Fig. 2 shows a cross sectional view of the needle bed, wherein a needle 1 is secured to needle jack 2 retained in control jack 3. When the control jack 3 is pushed up by a pin 4 located in a groove 5 of needle selection drum 6 this causes the needle jack butt 7 to be raised. When a needle moves up the knitting bed, the latch of the needle opens, thus allowing the needle hook to hold yarn. The needle then moves downward taking the yarn with it. The yarn is then pressed by sinkers to complete the stitch and, hence, advances the fabric formation process. This conventional operation of a flat knitting machine creates a glove with the conventional edges which, as described above, have to be provided with reinforcement in at least the thumb crotch area by additional processes which increase production time and costs.

[0015] It is the aim of the present invention to overcome the problems of the prior art by providing knitted gloves with higher strength in the thumb crotch area which do not require additional processes to achieve this. It is also the aim of the present invention to provide methods by which such knitted gloves may be produced on a flat knitting machine.

[0016] Accordingly, the present invention provides a knitted glove comprising at least one finger component, an upper palm component, a thumb component, a lower palm component, and a wrist component wherein each of the components comprises courses and each course is made of stitches, wherein each of the courses of the upper palm component includes a tuck knit stitch adjacent the upper palm inner edge and each of the courses of the thumb component includes a tuck knit stitch adjacent the thumb inner edge, such that the glove has a tuck knitted ridge along the upper palm inner edge, around the thumb crotch and along the thumb inner edge.

[0017] The invention also provides a method of making a knitted glove comprising knitting, in sequence at least one finger component,

an upper palm component,
a thumb component,
a lower palm component, and
a wrist component,

wherein each of the components comprises knitted courses and each course is made of stitches, wherein each course of the upper palm component is knitted to include a tuck knit stitch in the course adjacent the upper palm inner edge and each course of the thumb component is knitted to include a tuck knit stitch in the course adjacent the thumb inner edge, such that a tuck knit ridge is created along the upper palm inner edge, around the thumb crotch and along the thumb inner edge as the upper palm component and the thumb component are knitted sequentially.

[0018] Thus, according to the invention, it is possible to provide a knitted glove which is provided with a high strength ridge in the thumb crotch region while it is being knitted on the glove knitting machine.

[0019] The knitted glove of the invention comprises at least one finger component, i.e. at least one component for enclosing the fingers of the wearer's hand. The four fingers of the wearer's hand can be enclosed in a single component and a glove providing a single enclosure for all four fingers of a wearer's hand is generally called a mitten as mentioned above. The four fingers of a wearer's hand may each be enclosed separately in a conventional glove which has four separate finger components. In either case, the index finger of the wearer's hand is enabled to interact with the thumb so as to allow a holding or gripping action principally involving the thumb and the index finger of the hand.

[0020] A knitted fabric consists of a number of consecutive rows or courses of intermeshing of loops of a yarn (stitches). Each of the components of the knitted glove of the invention comprises a plurality of courses. Thus, the length of a component is determined by the number of courses across the width of the fabric. This number will be determined by the size of the garment to be produced,

[0021] In addition to the finger component(s), the lower palm component and the wrist component, the knitted glove of the invention comprises an upper palm component and a thumb component.

[0022] The upper palm component is the component to which the at least one finger component is adjoined. The upper palm component has an inner edge which adjoins the thumb crotch area and the edge of the glove adjacent the index finger position in the finger component and, also, an outer edge which adjoins the edge of the glove adjacent the little finger position in the finger component. Thus, the upper palm inner edge is on the thumb side of the glove. Each of the courses or rows of the upper palm component includes a tuck knit stitch adjacent the upper palm inner edge. By the term "tuck knit stitch", we mean a stitch which knits two consecutive courses or rows together. The presence of a tuck knit stitch in each of the courses or rows of the upper palm component ad-

jacent the upper palm inner edge results in a ridge that projects outwards along the upper palm inner edge.

[0023] The thumb component has an inner edge which faces the upper palm inner edge and the edge of the glove adjacent the index finger position in the finger component and an outer edge. Each of the courses or rows of the thumb component of the glove includes a tuck knit stitch adjacent the thumb inner edge. The result of the presence of the tuck knit stitches adjacent the thumb inner edge is that a tuck knit ridge extends from the upper palm inner edge, around the thumb crotch and along the thumb inner edge. This ridge provides increased strength to the glove in the thumb crotch area which not only improves the wear resistance and, thus, the working life of the glove but also improves the safety afforded to the wearer by the glove.

[0024] In a preferred embodiment, each of the courses of at least the lower region of the finger component which encloses the index finger of the wearer also includes a tuck knit stitch adjacent the edge of the finger component which is closest to the position of the index finger. Thus, in the case where the glove has one finger component for enclosing all fingers of the wearer, each of the courses or rows of at least a lower region of the finger component adjacent the upper palm component includes a tuck knit stitch adjacent the index finger edge, such that the glove has a tuck knit ridge along the index finger edge of the finger component. Preferably, the tuck knit ridge extends continuously down from at least a lower region of the index finger edge, along the upper palm inner edge, around the thumb crotch and along the thumb inner edge. The continuous nature of such a ridge gives a glove increased strength and resistance to wear.

[0025] In the case where a glove has four finger components, each of the courses or rows of at least a lower region of the index finger component adjacent the upper palm component preferably also includes a tuck knit stitch adjacent the outer edge of the index finger component such that the glove has a tuck knit ridge along the outer edge of the index finger component. According to an embodiment, the glove has a tuck knit ridge that extends continuously down from at least a lower region of the outer edge of the index finger component, along the upper palm inner edge, around the thumb crotch and along the thumb inner edge. The continuous nature of such a ridge gives a glove increased strength and resistance to wear.

[0026] As stated above, the finger component preferably has a tuck knit ridge along at least a lower region of the index finger edge. This is a consequence of each of the courses or rows of at least a lower region of the finger component having a tuck stitch which stitches together consecutive courses or rows in the fabric. By the term "at least a lower region", we mean at least one tenth ($\frac{1}{10}$) of the length of the finger component from the bottom of the finger component, preferably at least one eighth ($\frac{1}{8}$), more preferably at least one quarter and most preferably at least one half of the length of the finger component

measured from the bottom of the finger component.

[0027] According to a different preferred embodiment, the glove of the invention having a tuck knit ridge along upper palm edge, around the thumb crotch and along the thumb inner edge, whether or not it also has a tuck knit ridge along at least a lower region of the index finger edge as described above, also has a tuck knit ridge along the edge of the heel of the hand (i.e. along the outside edge of the palm/hand). Such a tuck knit ridge, in such an embodiment, extends along at least part of the outer edge of the glove, lying between the base of the little finger component and the wrist component.

[0028] The glove of the present invention may be knitted from yarn comprising natural fibres, synthetic fibres or mixtures thereof. For example, the yarns used to knit the glove may be spun yarns, textured filament yarns or multicomponent composite yarns. Examples of compositions that may be used as, or in, yarns include cotton, nylon fibres, polyester fibres, high performance polyethylene (HPPE) fibres or aramid or other fire-resistant fibres that can be used to knit gloves.

[0029] Typically, the knitted gloves of the invention will additionally have a coating on at least part of the glove of an elastomeric polymer composition, for instance a natural or synthetic rubber composition. Such a coating may be provided on any, or all, of the fingers, thumb, thumb crotch, upper and/or lower palm in order to provide glove surfaces that have water or oil-resistance, extra strength or improved gripping or holding properties.

[0030] The invention further provides a method of making a knitted glove, as stated above. The method comprises the steps of knitting, in sequence, at least one finger component,

an upper palm component,
a thumb component,
a lower palm component, and
a wrist component,

wherein each course of the upper palm component is knitted to include a tuck knit stitch in the course adjacent the upper palm inner edge and each course of the thumb component is knitted to include a tuck knit stitch in the course adjacent the thumb inner edge, such that a tuck knit ridge is created along the upper palm inner edge, around the thumb crotch and along the thumb inner edge as the upper palm component and the thumb component are knitted sequentially.

[0031] Each of the components is knitted in sequence, as mentioned above and, generally, as illustrated in Fig.1. Thus, the knitting machine used will, first, knit the one or more finger components. If only one finger component is required, i.e. in the production of a mitten, then after that component has been knitted the knitting sequence continues with the knitting of the upper palm component. If more than one finger component is to be knitted, the sequence begins with the knitting of the finger components, starting with the finger component furthest away from the thumb. The knitting sequence continues with the knitting of the finger components moving closer

to the thumb, one finger component at a time. Thus, in the case of a typical glove with four finger components, the sequence begins with the component for the little finger, continuing on through the third finger and middle finger to the index finger. After each finger component is knitted using the needles selected for this, the knitting process for each finger component is stopped and, typically, the yarn is cut and bound. The finished knitted finger component is held in place by holders, weighted down by sinkers and, if further finger components are required, these are knitted sequentially one at a time using a different set of needles in the needle bed. When all four fingers are knitted in this fashion, the knitting machine then knits the upper palm component, picking stitches from each of the previously knit finger components. After knitting an appropriate length of the upper palm component, the thumb component is then initiated. Next, the lower palm component is knitted using all of the needles across the needle bed. Finally, the knitting machine knits the wrist component to the desired length.

[0032] The gloves of the invention can be knitted using a flat knitting machine which has a needle selection drum located beneath the knitting bed. Such knitting machines are well known. The needle selection drum in such machines has a plurality of parallel grooves in the direction of the drum axis. Needle selection pins, which are rod-like, of various lengths depending on the knitting requirements, are located in the grooves in a predetermined arrangement pattern. A two-dimensional representation of the position of needle selection pins in the grooves of the cylindrical needle selection drum in the manufacture of the four-fingered glove shown in Fig. 1 is shown in Fig. 3. As indicated in Fig. 3, the knitting process for the glove begins with the pin arrangement A (the little finger) and sequentially proceeds through B (Ring finger), C (middle finger) to D (forefinger). In Fig. 3 E represents the pin arrangement for the knitting of the upper palm component of the glove, F represents the pin arrangement for the thumb component, G is the arrangement for the lower palm component and H indicates the pin arrangement for the wrist component of the glove. In Fig.3, numbers are shown for each of the pins and these correspond to the numbers of courses to be knitted for each pin. Beneath the pin arrangement for the thumb component is shown the pin arrangement for knitting the lower palm component of the glove and, beneath this, the pin arrangement for knitting the wrist component of the glove. The length of the round pin, provided in the grooves of the needle selection drum of the knitting machine, for each portion of the glove (fingers, thumb, palms, wrist) is different and it defines the number of needles to be activated for each portion. This controls the width of the knitted component. When one component of the glove has been knitted, the drum is rotated by one pitch corresponding to the interval between one groove and the next and the pins located in this next groove are brought into play. When a needle selection pin in the drum groove pushes up a control jack in which the knitting needle is

secured, the needle jack butt of the needle jack is caused to protrude from an opening in the needle bed. The control jack, when pushed up by the pin, pushes the needle jack butt upwards and out of the needle bed. As a carriage moves across the knitting bed, it contacts all needle jack butts protruding out of the needle bed and so engages those needles in the knitting process. When the needle moves up the knitting bed, a latch on the hooked end of the needle opens which allows the needle to hook and hold yarn and, subsequently, to pull the yarn down as it moves downwards. The yarn is then pressed by sinkers to complete the stitch and hence advance the fabric formation process.

[0033] We have found that by modifying the conventional glove-knitting process described above, the machine can be activated to produce the tuck knitted ridge in the regions of the glove described. The modifications required can be achieved in several ways.

[0034] One first, alternative, modification of the knitting machine components which results in the knitting of gloves according to the invention requires i) a change to the diameters of the needle selection pins located in the needle selection drum for the upper palm component and for the thumb component; and ii) a change to the diameter of the set-up cam control lever roller which is located in the knitting front carriage. With reference to i) above, we have found that the needle selection pin for the upper palm section should be replaced by two new pins (a) and (b); a first (a) having a diameter increased, from the conventional diameter size of 2.5mm, to 3.07mm-3.08mm and a second (b) having a diameter reduced, from the conventional diameter size of 2.5mm, to 2mm. Additionally, the base needle selection pin for the thumb section should be replaced by two new pins (c) and (d); a first (c) having a diameter increased, from the conventional diameter size of 2.5mm, to 3.07-3.08mm and a second (d) having a diameter reduced, from the conventional diameter size of 2.5mm, to 2mm. A two-dimensional representation of a needle selection pin arrangement which shows the modification to the number and diameters of pins for the knitting of the upper palm and thumb component is shown in Fig. 4. The increased height of the needle selection pins (a) and (c) in the drum grooves will have the effect of raising the needle second in from the edge of the components directly above higher than is normal in the knitting process which causes both back bed needle and front bed needle to cross and create a tuck stitch. This will result in the particular needles in the front bed simultaneously working with the back bed needles to form a tuck knit stitch at the upper palm edge (crotch) and thumb edge (crotch). This creates a knitted external ridge at the edge of the knitted component. It will be understood by the person skilled in the art that if two or even three pins are modified then the number of tuck knit stitches in the weft increases to form a higher, more pronounced ridge. The use of the reduced diameter pins (b) and (d) will result in the avoidance of the working of front bed needles simultaneously with back bed needles

at the upper palm and thumb portions (other than at the edge where the reinforcement is required).

[0035] With reference to (ii) above, in addition to the modifications of the needle selection pins described above, a modification of the set-up cam is also required. The set-up cam, which is located in the knitting front carriage, is capable of movement upwards and downwards. When the set-up cam is in the upward position the cam works and when it is in the downward position the cam does not work. The motion of the set-up cam is controlled by a computer. The set-up cam is normally set to the working position only during finger tip knitting to create a tuck knit at those areas so as to close the finger tips and to create a tucked crotch between successive finger components. The modification of the set-up cam required (in combination with the pin modification discussed above) to enable the machine to create a tuck knit ridge as described involves a reduction of the diameter of the set-up cam control lever roller from the normal size of 5mm to 3.5-3.8mm.

[0036] A second, alternative, modification of the knitting machine components that enables the machine to create a tuck knit ridge as described involves a principle similar to that described above in that the needle is caused to raise and the effect of the set-up cam is reduced. This modification requires a combination of an increase in the height of the control jack butt on the control jack, a reduction in the height of the set-up cam control bar, and a reduction in the diameter of the needle selection pin that slots into the grooves of the selection drum.

[0037] The standard (i.e. normal) height of the butt on the control jack, with finer gauges above 10, is 3mm. According to this modification, the height of the butt for such gauges should be increased by 0.1 to 4mm, preferably by 0.5 to 2mm and more preferably by 1mm. With lower gauge knitting machines, e.g. 5 or 7 gauge, the butt on the control jack as supplied is 4mm high. According to this modification, the height of the butt for such gauges should also be increased by 0.1 to 4mm, preferably by 0.5 to 2mm and more preferably by 1mm.

[0038] The second part of this modification involves resetting the height of the set-up cam control bar, as mentioned above. The set-up cam control bar in a machine set up to knit conventional gloves governs the working of the finger tip knitting end and the finger crotch areas. By reducing the height of the set-up cam control bar the needles at the edge of the workpiece are activated to form tuck knit stitches. For all available gauges of knitting machines, the standard height of the set-up cam bar is 16mm. We have found that, for this modification, the height of the set-up cam bar should be reduced along the whole of its length by 1 to 8mm, preferably by 2 to 4mm and more preferably by 3mm, where the set-up cam bar has a height along the whole of its length of 13mm.

[0039] The third part of this modification involves a reduction in the diameter of the needle selection pin that slots into the grooves of the needle selection drum. With higher gauge knitting needles (10, 13, 15 and 18 gauges),

the standard needle selection pin has a diameter of 2.5mm. According to this modification, the diameter of the needle selection pin will be 0.1 to 1.8mm less than the standard diameter, preferably 0.5 to 1.5mm less and more preferably 1mm less than the standard diameter where the diameter of the pin will be 1mm. With lower gauge knitting needles (5 or 7 gauge), the standard diameter of the needle selection pin, as supplied, is 3mm. According to this modification, for these lower gauge needles, the diameter of the needle selection pin will be 0.1 to 1.8mm less than the standard diameter, preferably 0.5 to 2mm less and more preferably 1mm where the needle selection pin will have a diameter of 2mm.

[0040] A third alternative modification of the machine to enable the formation of a tuck knit ridge as described is to increase the needle selection pin diameter as discussed above for the first alternative modification and to reduce the height of the set-up cam control bar as discussed above for the second alternative modification.

[0041] A fourth alternative modification of the machine to enable the formation of a tuck knit ridge as described above is to increase the height of the control jack butt as discussed in the second alternative modification above and to reduce the diameter of the set-up cam control lever roller as discussed above in the first alternative modification.

[0042] Each of the alternative modifications discussed above has the effect of raising the needles, for the edge of the thumb and the upper palm inner edge of the glove, in the knitting bed in the knitting process such that the back bed needle and the front bed needle cooperate to create a tuck stitch. In the event that a tuck knit ridge is desired along the index finger edge of the glove, as mentioned above, then the appropriate components may be modified accordingly.

Experimental

[0043] Samples of gloves according to the invention having a knitted ridge of one course modified as a tuck stitch through the thumb crotch as shown in Fig. 5 were compared to standard knitted gloves.

[0044] A tear test was performed on a cut section of the gloves using a Testometric M250-3CT testing machine. This machine comprises upper and lower jaws for clamping material between them. The jaws are moved apart from each other and the force required to break and tear the sample is measured.

Specimen Preparation

[0045] As shown in Fig 6, a section was cut from each glove along the line C to E and along the line E to D as shown in the Figure such that the section contains part of the index finger, part of the thumb and the thumb crotch of the glove. The sample was 10mm wide by 90mm long,

[0046] The thumb part of the cut section was clamped in the upper jaw of the testing machine at point B which

lies 5cm from the crotch (point E) and the finger part of the cut section was clamped in the lower jaw of the testing machine at point A which lies 5cm from the crotch (point E).

Method

[0047] A load cell of 300kg was used for testing. The force is applied, by the testing machine, to the specimen at a constant speed of 100 ± 10 mm/minute. The breaking force is recorded at the break point. Four samples of each of the standard glove and the glove of the invention were tested. The results for each are shown in Figs. 7 and 8, where Fig. 7 shows the results obtained for the standard glove and Fig. 8 shows the results obtained for the glove of the invention.

[0048] The mean force required to tear and break the specimen cut from the standard glove was measured as 94N. The mean force required to tear and break the specimen cut from the glove of the invention was measured as 104N, giving an increase in strength in the glove of the invention of approximately 10%.

[0049] The higher force required to tear and break the specimen cut from the glove of the invention indicates the increased strength provided to the glove by the tuck knit ridge formed around the thumb crotch area of the glove,

Claims

1. A knitted glove comprising
 - at least one finger component,
 - an upper palm component,
 - a thumb component,
 - a lower palm component, and
 - a wrist component
 wherein each of the components comprises courses and each course is made of stitches,
 - wherein each of the courses of the upper palm component includes a tuck knit stitch adjacent the upper palm inner edge and each of the courses of the thumb component includes a tuck knit stitch adjacent the thumb inner edge, such that the glove has a tuck knitted ridge along the upper palm inner edge, around the thumb crotch and along the thumb inner edge.
2. A knitted glove according to claim 1, wherein the glove is a mitten and comprises one finger component for enclosing all fingers of the wearer.
3. A knitted glove according to claim 2, wherein the finger component comprises courses and each course is made of stitches wherein each of the courses of at least a lower region of the finger component adjacent the upper palm component includes a tuck knit stitch adjacent the index finger edge, such that

the glove has a tuck knit ridge along the index finger edge of the finger component.

4. A knitted glove according to claim 2, wherein the glove has a tuck knit ridge continuous from the index finger edge of the finger component, along the upper palm inner edge, around the thumb crotch and along the thumb inner edge. 5
5. A knitted glove according to claim 1, wherein the glove has four finger components. 10
6. A knitted glove according to claim 5, wherein each of the finger components comprises courses and each course is made of stitches wherein each of the courses of at least a lower region of the index finger component adjacent the upper palm component includes a tuck knit stitch adjacent the outer edge of the index finger component such that the glove has a tuck knit ridge along the outer edge of the index finger component. 15
7. A knitted glove according to claim 6, wherein the glove has a tuck knit ridge continuous from the outer edge of the index finger component, along the upper palm edge, around the thumb crotch and along the thumb inner edge. 25
8. A knitted glove according to any one of claims 1 to 7, wherein the glove is knitted from yarn comprising natural fibres, synthetic fibres or mixtures thereof. 30
9. A knitted glove according to any one of claims 1 to 8, wherein the glove is coated with an elastomeric polymer composition. 35
10. A method of making a knitted glove comprising knitting, in sequence,
at least one finger component,
an upper palm component, 40
a thumb component,
a lower palm component, and
a wrist component,
wherein each of the components comprises knitted courses and each course is made of stitches, 45
wherein each course of the upper palm component is knitted to include a tuck knit stitch in the course adjacent the upper palm inner edge and each course of the thumb component is knitted to include a tuck knit stitch in the course adjacent the thumb inner edge, such that a tuck knit ridge is created along the upper palm inner edge, around the thumb crotch and along the thumb inner edge as the upper palm component and the thumb component are knitted sequentially. 50
55
11. A method according to claim 10, wherein the glove is a mitten and comprises one finger component for

enclosing all fingers of the wearer.

12. A method according to claim 11, wherein each of the courses of at least a lower region of the finger component adjacent the upper palm component is knitted to include a tuck knit stitch adjacent the index finger edge, such that a tuck knit ridge is created along the index finger edge of the finger component as the courses of the at least lower region of the finger component are knitted sequentially.
13. A method according to claim 11, wherein the tuck knit ridge is continuous from the index finger edge of the finger component, along the upper palm edge, around the thumb crotch and along the thumb inner edge.
14. A method according to claim 10, wherein the glove has four finger components.
15. A method according to claim 14, wherein each of the courses of at least a lower region of the index finger component adjacent the upper palm component is knitted to include a tuck knit stitch adjacent the outer edge of the index finger component such that a tuck knit ridge is created along the outer edge of the index finger component as the courses of the at least lower region of the index finger component are knitted sequentially.
16. A method according to claim 15, wherein the tuck knit ridge method is continuous from the outer edge of the index finger component, along the upper palm edge, around the thumb crotch and along the thumb inner edge.
17. A method according to any one of claims 1 to 7, wherein the glove is knitted from yarn comprising natural fibres, synthetic fibres or mixtures thereof.
18. A method according to any one of claims 1 to 8, comprising the additional step of coating the knitted glove.

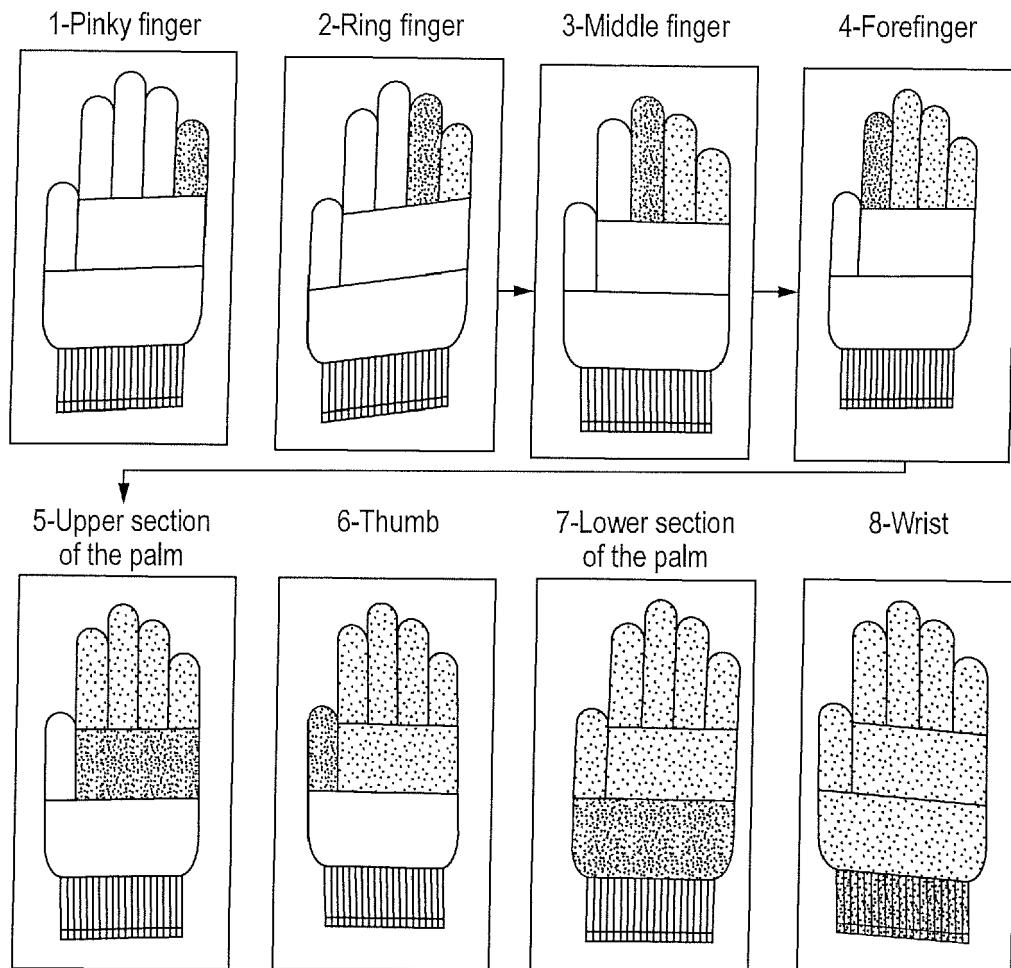


FIG. 1

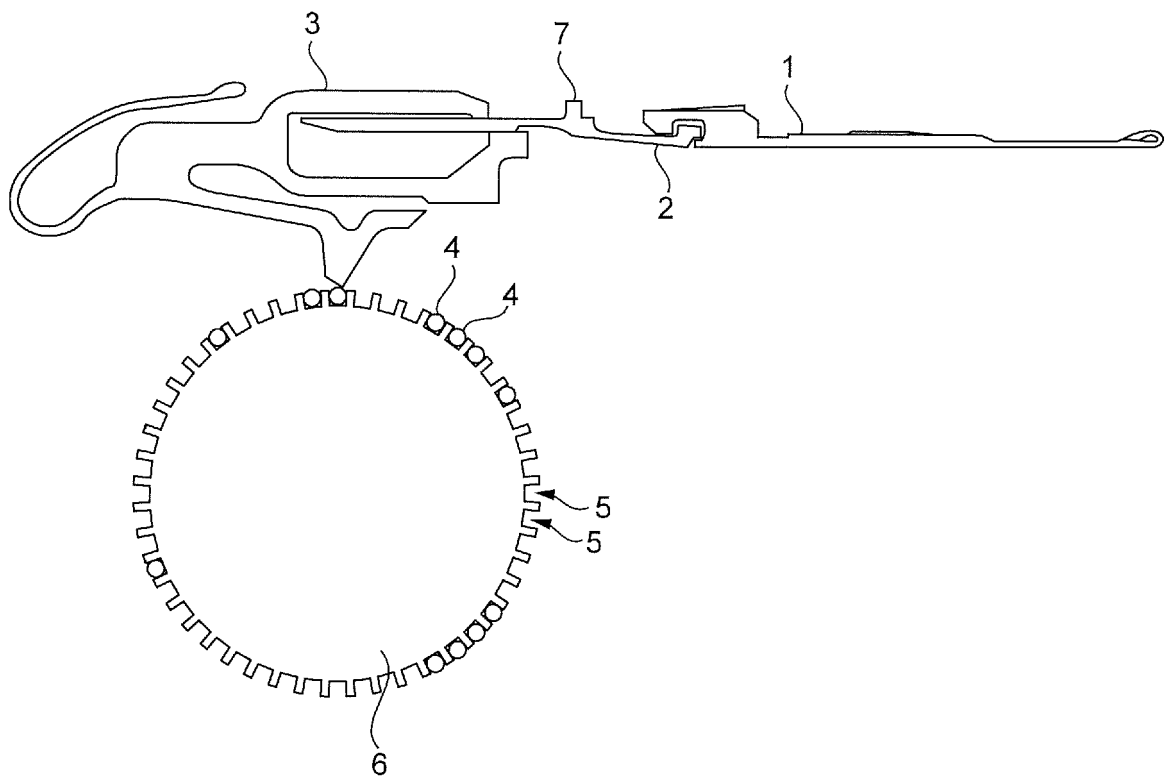


FIG. 2

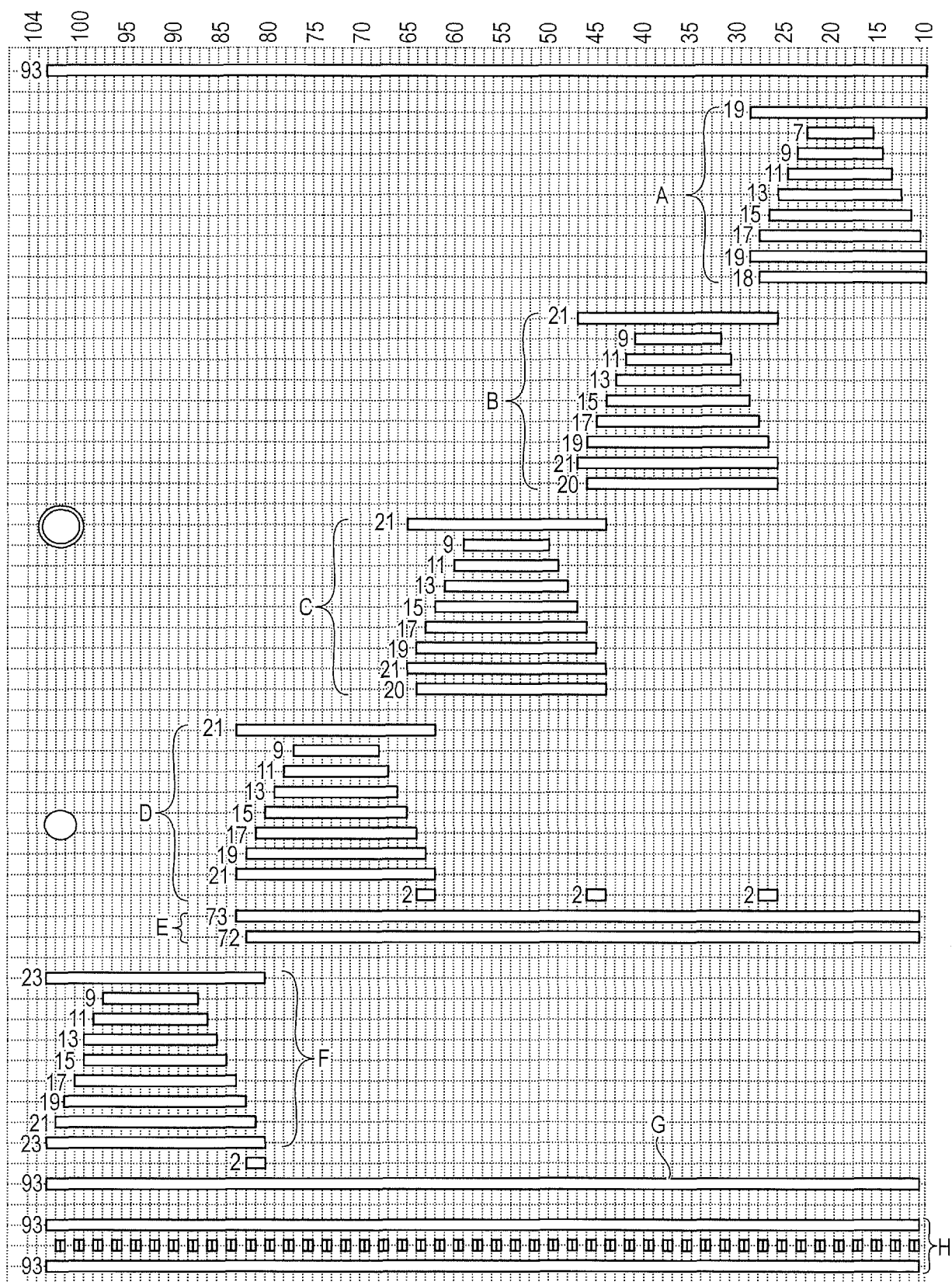


FIG. 3

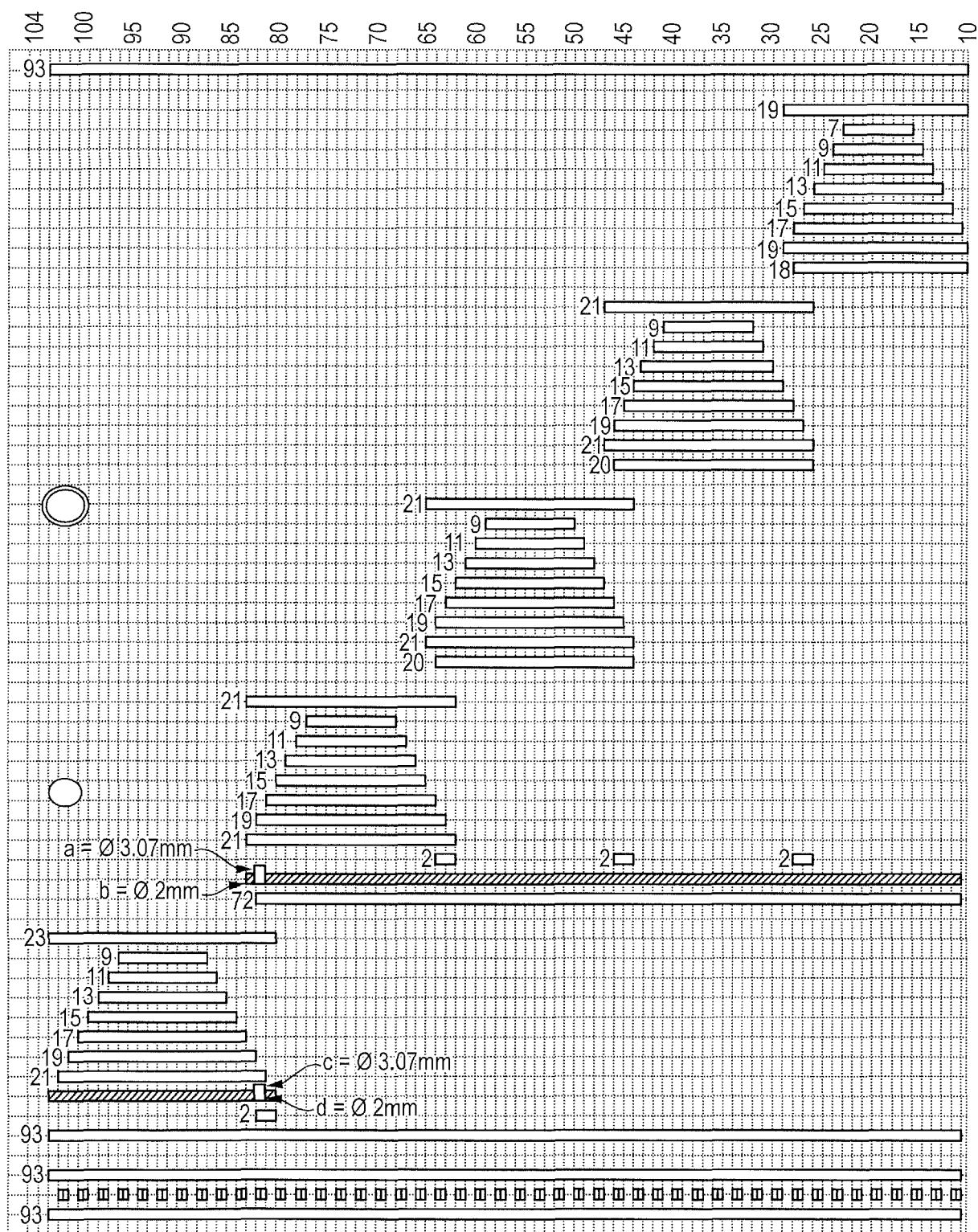


FIG. 4

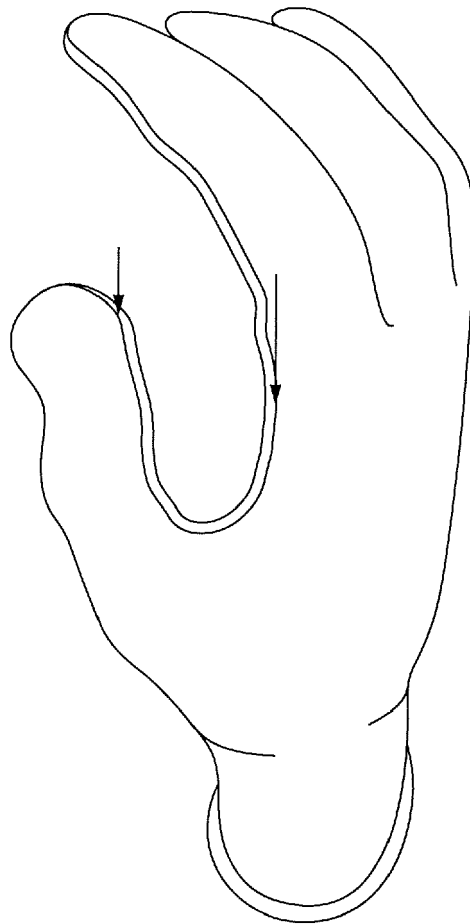


FIG. 5

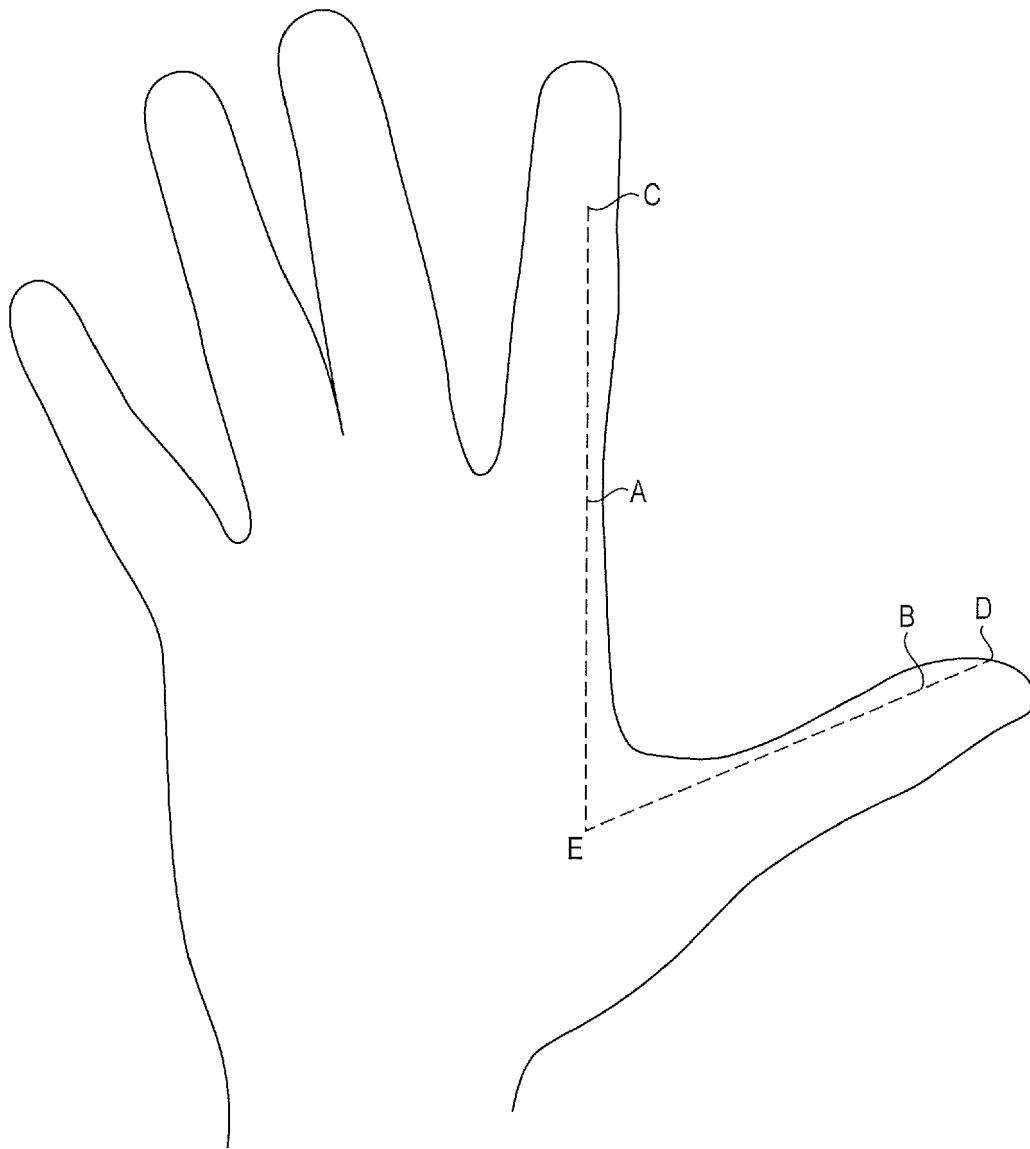


FIG. 6

Test No	Fore @ Peak (N)
1	113.970
2	92.570
3	85.540
4	84.070
Min	84.070
Mean	94.038
Max	113.970
S.D.	13.796
C. of V.	14.671
L.C.L.	72.085
U.C.L.	115.990

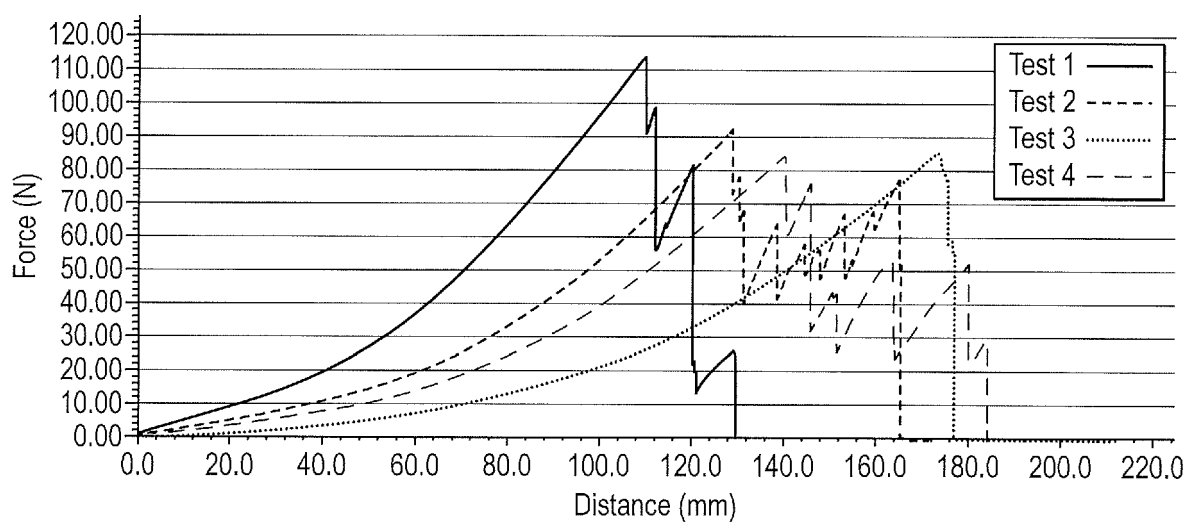


FIG. 7

Test No	Fore @ Peak (N)
1	104.900
2	107.840
3	108.740
4	97.970
Min	97.970
Mean	104.862
Max	108.740
S.D.	4.879
C. of V.	4.653
L.C.L.	97.099
U.C.L.	112.626

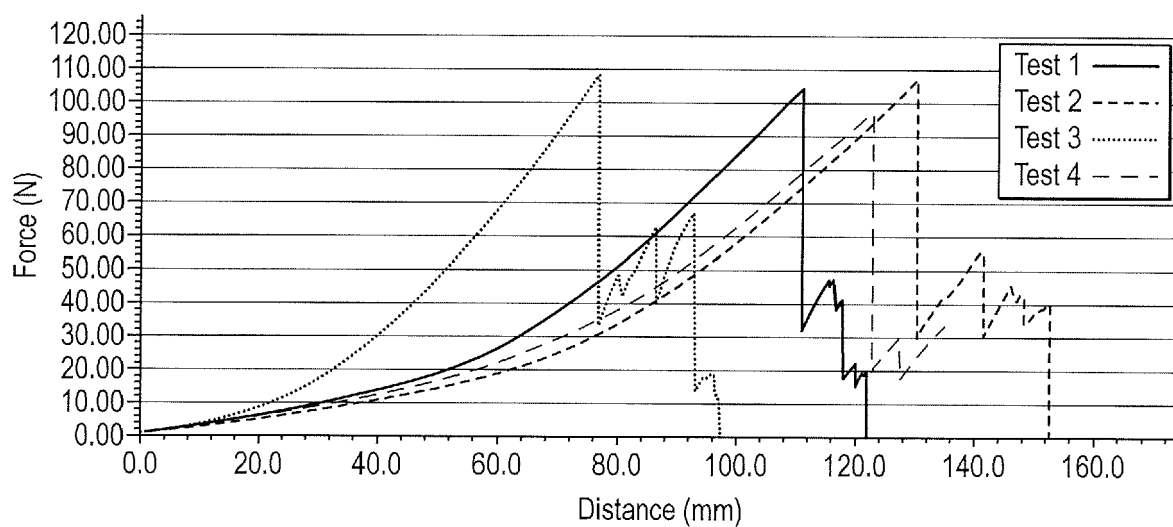


FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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