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(54) **DEVICE FOR A SEWING MACHINE AND OPERATING METHOD**

(57) The present disclosure describes a device and a method for controlling the quality of a textile seam for a sewing machine comprising: a rear presser foot with compensation comprising two forks for pressing the workpiece being sewn, a fork for each side of the seam after its passage through the needle seam area, wherein

said forks are vertically and independently oscillating; a sensor configured to detect the height of a first fork; a signal processor configured to detect whether the height detected by the sensor when the first fork is pressing the workpiece is above a predetermined value of excessive thickness.

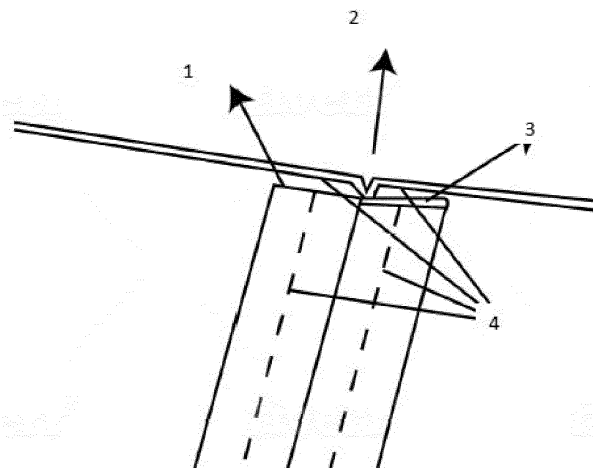


Fig. 1

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Description**TECHNICAL FIELD**

5 **[0001]** This disclosure describes a device and a method for controlling the quality of a textile seam for a sewing machine. More specifically, it describes a device that allows the seam allowances to be controlled during the formation of the stitch when using a sewing machine.

BACKGROUND

10 **[0002]** The need to control the position of both parts of the seam allowance, called edges or overlaps, when sewing a fabric is especially relevant in the seams designated in the industry as "backstitch", where after joining the two parts of the piece patterns, it is necessary to make a second seam, which aims to present decorative stitching, as well as ensuring that the allowance falls inwards, that is, faces against the inside, to the right side - which corresponds to the same side of the pattern corresponding to the seam allowance - providing a better finish and greater comfort to the user when, for example, it is in direct contact with the body of the end user of the garment.

15 **[0003]** There are cases where it is intended to keep both edges on one of the sides, requiring the seamstress to advance the seam ensuring that both edges are turned to one of the sides during the entire sewing process.

20 **[0004]** In the automotive industry, this type of decorative stitch is increasingly used, constituting an important adornment for car seat covers to elevate the visual impression of the vehicle's interior, as well as in particular for covering the airbags. The existence of an overlap of layers may prevent the airbag from opening, in the area intended for the seat to rupture, as it does not have enough strength to break the additional decorative seam and the fusible seam, which joins the two parts of the cover, or change the comfort of a garment in contact with the body, or even aesthetically alter the appearance of the seam by the increase in volume it causes.

25 **[0005]** As in all industries, the automotive industry has an increasing need to present novelties and innovate in the supply of innovative materials and finishes. This increasing need for innovation in terms of design and use of different technical materials in the same product, makes this control solution impractical.

[0006] Some situations that hinder the control of this sewing process, consist in that there are:

30 Similar colors - Common situations today, wherein the color of the right side varies along the seam and/or has a color similar to the color of the wrong side (foam);
 Movement of the workpieces on the machine;
 Intersections with critical sewing;
 Very pronounced curves;
 35 Small cuts of nicks (marks on the pattern allowance) inside (towards the inside of the seam allowance) or outside (outside the seam allowance).

40 **[0007]** Currently, in some cases, the control of the opening of the seam allowances (edges) of the airbags in the industry is carried out through chromatic sensors, sensitive to color variations, with the ability to distinguish the right side and the wrong side of the materials used in the covers of the seats, during the assembly process in the sewing room (textile fabrics, natural leathers or synthetic leathers).

45 **[0008]** The working principle of this type of sensor is based on its ability to detect that the edges are correctly opened, as the sensor can only "see" the right side of the material. In the event of an edge being fallen, the sensor will "see" the wrong side of the material, which is often of a different color from the right side.

50 **[0009]** In terms of the development of presser feet, there are some solutions but they only serve to measure the displacement of the entire presser system, not allowing differential control on both sides of the seam.

55 **[0010]** CN102587049 describes an industrial flat sewing machine that provides an automatic line-tightening mechanism capable of sensing the thickness of a fabric. The automatic line-tightening mechanism comprises a yarn trapper fixed at the front side of a sewing machine head, a compressor arm provided with a presser foot arranged on the lower end of the compressor arm, a fabric thickness sensor, a follow-up line-tightening frame and two line-tightening pins. The fabric thickness sensor is fixedly arranged on the compressor arm and provided with a vertical curve on one side. A pivot of the follow-up line-tightening frame is pivoted on a vertical shaft inside the sewing machine head, one end of the follow-up line-tightening frame is a follow-up arm tightly adjoined with the curve of the fabric thickness sensor, and a line-tightening surface is formed between the pivot and the follow-up arm. The two line-tightening pins are arranged in guide holes in a wall of a machine shell in a sliding manner, the rear ends of the line-tightening pins are arranged in the sewing machine head and tightly adjoined with the line-tightening surface of the follow-up line-tightening frame, and the front ends of the line-tightening pins are arranged outside the machine head and tightly abuts against the back of a rear yarn bracket of the yarn trapper.

[0011] US4928611 describes a sewing machine equipped with guide means and ironing means comprising ultrasonic heating means. The middle and orientation fold the free margins of an upper and lower piece of fabric and the folded margins are pressed or ironed by the ultrasonic heating means. The ultrasonic heating means include an ultrasonic horn and a relatively movable anvil towards and away from each other. A thickness detector is provided for detecting a combined thickness of the upper and lower parts of a fabric, and control means are also provided to control the heating energy of one of the ultrasonic heating means and the distance between the horn and the anvil in response to thickness detection.

[0012] These facts are described in order to illustrate the technical problem solved by the embodiments of this document.

GENERAL DESCRIPTION

[0013] The present disclosure refers to a device that allows a continuous validation of the seam allowances, also called edges, in order to guarantee the formation of seams without unwanted overlaps of material, controlling the number of fabric layers along the sewing process, namely in the critical areas of textile workpieces and leather articles. One of the most relevant examples of this need is the safety zone of the airbags - the side area of the seat cover that will have to break to allow the airbag to exit.

[0014] The seams that require this monitoring are decorative seams, made on an edge using Lockstitch sewing machines with one or more needles, but only with one of the needles in operation; or on both edges using a two-needle sewing machine. The existence of irregularities in the decorative seam, such as an overlap of layers or a variation in stitch density per centimeter, may prevent the airbag from exiting, as it does not have enough strength to break the additional decorative seam and the fusible seam that joins the two parts of the upholstery cover. This decorative seam is made with a type of seam line having a resistance higher than the seam line used in the previous seam, where the two parts were joined, so its ability to join the two parts of the upholstery, which are intended to be easily separated when the airbag is opened, is high, higher than that of the fusible seam that previously joined the parts together. This increases the risk of the seam not bursting, preventing the airbag from exiting at the desired location.

[0015] The present solution is relevant not only for textile companies in the automotive industry, but for the entire industry in general, since it allows to guarantee the formation of quality seams, thanks to the continuous capacity, and at the time of sewing, to detect the formation of irregular stitches, avoiding further dismantling of the pieces in rework, which become highly expensive for companies, since they affect the quality of fabrics and seams, with several needle holes, and require considerable time that affects the normal flow of the work in the line/group of work, thus guaranteeing manufacturers the certification of a quality sewing, with a high impact on the quality of the sewing but mainly on the safety of the users of these products.

[0016] The present disclosure consists of a device capable of measuring the individual displacement of the rear presserfoot, independently and continuously, on both sides of a seam, on a sewing machine. The machine used can be of any type, such as the Lockstitch sewing machine with one or two needles; Covering machine; Chain Stitch Machine; Cut-and-sew machine, or any other type of sewing machine. However, it should preferably be applied to sewing machines of the Lockstitch type, which comprise one or two needles and with different types of feed dogs, particularly in triple feed dog machines, where the movement of the fabric during sewing is not ensured only by the lower feed dogs (most common situation) but also by the elliptical movement of the front presser foot bar, and the needle bar, with similar movement.

[0017] The present disclosure thus relates to an innovative compensating device, in that it comprises a rear presser foot with the ability to compensate between the two sides of the seam and which comprises two targets, at least one optical sensor or at least one inductive sensor, responsible for converting the thickness of the material being sewn, at each stitch, into two independent vertical movements, allowing to determine its individual vertical oscillation value, as well as its differential, and thus ensuring the desired thickness stitch by stitch along the sewing. In a preferred embodiment, two sensors are used that provide independent control of the thickness on each side. In addition to also increasing the error detection capacity, since they double the thickness error value. The use of only one sensor is recommended in simpler cases where it is intended to reduce the costs and there is no need to obtain the differential between both seam allowances (edge).

[0018] Although there are prior art compensating pressers, these are front presser feet with elliptical movement. This movement would not allow the sensors to make an accurate measurement. Therefore, it was opted to compensate the rear presser foot which has a vertical movement.

[0019] The present disclosure concerns a device for processing the three-dimensional assembly of a piece on a sewing machine, of any type of material selected from natural, artificial and synthetic textile materials, natural and/or synthetic leathers. More specifically, it describes a device that allows to control the sewing margins during the formation of the stitch when using a sewing machine.

[0020] The device of the present disclosure allows the presser foot to also assume the function of variable compensation (compensating presser foot), currently only existing on the front presser foot of triple feed dog sewing machines.

[0021] One aspect of the present disclosure relates to a device for controlling the quality of a textile seam for a sewing machine comprising: a rear presser foot with compensation comprising two forks for pressing the workpiece being sewn, a fork for each side of the seam after its passage through the needle seam area, in which said forks are vertically and independently oscillating; at least one sensor configured to detect the height or displacement (vertical) of a first fork; and a signal processor configured to detect whether the height detected by the sensor when the first fork that is pressing the workpiece is above or below a predetermined value of excessive thickness.

[0022] The device and the methodology described in the present embodiment make it possible to detect the defect at the time of making the seam - *"in loco"*, in many cases allowing the user to detect the error, undo the part of the seam with error and fix it. Therefore, the present device allows the reduction of the occurrence of defective decorative seams/fusible seams sewn with errors. The present methodology also allows the reduction of waste due to the reduction of defective products.

[0023] In one embodiment, each fork comprises a stem for the sensor to detect the height of the fork.

[0024] In one embodiment, the sensor configured to detect the height of the first fork is an optical sensor.

[0025] In one embodiment, alternatively the sensor configured to detect the height of the first fork is an inductive sensor, preferably analog.

[0026] In one embodiment, the fork stem comprises an optical target with a variable inclination, preferably substantially 45°.

[0027] In one embodiment, the device comprises an additional sensor configured to detect the height of the second fork and wherein the signal processor is additionally configured to detect whether the height detected by the additional sensor when the second fork is pressing the workpiece is above or below a predetermined value, that is, if the workpiece edge has insufficient or excessive thickness leading to its non-conformity. This configuration allows to increase the accuracy of the system, further reducing the occurrence of defects in the workpiece or in parts of the workpiece.

[0028] In one embodiment, the signal processor is additionally configured to detect whether the height difference detected between the sensor of the first fork and the additional sensor of the second fork when the first and second forks are pressing the workpiece, is above a predetermined value of differential thickness.

[0029] In one embodiment, the signal processor is configured to detect the height difference detected between the sensor of the first fork and the additional sensor of the second fork, in a continuous way, i.e. during the preparation of the workpiece.

[0030] In one embodiment, the optical sensors are located on the head of the sewing machine.

[0031] In one embodiment, the inductive sensors are located on the side walls of the rear presser foot, in order to allow the calculation of the displacement of the stem. That is, the inductives are located next to the side walls of the presser foot. On the sides of the presser feet, 2 magnets are mounted which move with the respective presser fork. Inductive sensors measure the displacement of the magnets relative to themselves.

[0032] In one embodiment, the number of layers of the piece being sewn is at least 2.

[0033] In one embodiment, the number of layers of the piece being sewn is at least 3.

[0034] In one embodiment, the device further comprises at least two needles.

[0035] In one embodiment, the rear presser foot comprises a cavity at the base of the presser foot (in the line of the seam guide) for the passage of the joining of the pieces, since if the material is too thick on each side it could cause a measurement error.

[0036] In one embodiment, the rear presser foot further comprises a central guide between the forks to guide the user when sewing.

[0037] In one embodiment, the device further comprises a front presser foot, preferably a front presser foot with articulated and interlocking forks.

[0038] In one embodiment, the center guide can be next to one of the forks.

[0039] Another aspect of the present disclosure describes a sewing machine comprising the device described in the present disclosure, preferably a lockstitch machine.

[0040] The present solution has as one of its main objectives to ensure that the thickness of the material being sewn remains within the predetermined limits throughout the sewing process, allowing the seam allowance not to fall towards the wrong side of the seam and consequently being caught by the decorative seam, after the process of assembling the parts of the upholstery of the cars, where the airbag is expected to pop out due to the upholstery bursting in the event of a vehicle impact.

[0041] The present device also allows to control the individual displacement of both sides of the seam, ensuring that the thickness on both sides remains as expected, throughout the sewing process, stitch by stitch during sewing, regardless of the thickness difference, color, intersections, tight curves and existence of cuts, which may exist between the two parts being sewn.

[0042] The present disclosure also concerns a system of automatic and continuous control of the sewing dynamics of the sewing machines that may comprise: a compensating rear presser foot that comprises at least one target on the upper part of the presser foot and a cutout on the base; at least two optical or inductive sensors positioned at the rear

or side part of the sewing block.

[0043] In one embodiment, if the sensor is inductive, it can be located on the side part of the sewing block and the target can be a parallelepiped, preferably of magnetic material.

[0044] In one embodiment, the presser foot may have a base cutout of about 2 millimeters deep and about 2 millimeters wide.

[0045] In one embodiment, the cutout can be on both sides of the central seam guide, or it can be on the left side of the central seam guide or it can be on the right side of the central seam guide.

[0046] In one embodiment, the device can be applied to single-needle or two-needle sewing machines, preferably to lockstitch machines, more preferably triple feed dog lockstitch sewing machines.

[0047] Another aspect of the present embodiment also concerns a method for controlling the quality of a textile seam on a sewing machine that comprises the device described in the present disclosure, which comprises the following steps:

defining in a signal processor the thickness value of at least one edge of a workpiece being sewn;
 converting the thickness value of the edge into the displacement of a stem of a rear presser foot;
 placing said workpiece on the sewing machine;
 pressing the workpiece with a rear presser foot whose fork is vertically oscillating;
 obtaining the value of the vertical displacement of the stem of one of the forks of the rear presser foot; for example by a sensor;
 comparing the value of the vertical displacement of the fork stem with the predetermined value wherein, if the value of the vertical displacement of the fork stem is higher or lower than the defined value, the signal processor informs the user, for example by triggering a warning; preferably a light warning, an audible warning or by stopping the machine.

[0048] In one embodiment, the method described in the present disclosure can further comprise the following steps:

defining in a signal processor the thickness value of a second edge of a workpiece being sewn;
 converting the thickness value of a second edge into the displacement of a second stem of the rear presser foot;
 placing said workpiece on the sewing machine;
 pressing the workpiece with the rear presser foot whose forks are vertically oscillating;
 obtaining the value of the vertical displacement of each stem of the forks of the rear presser foot;
 comparing the value of the vertical displacement of the stem of each fork or the differential of the two displacements with the predetermined value wherein if the displacement value or the differential is different from the defined value the signal processor informs the user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] For an easier understanding, figures are herein attached, which represent preferred embodiments that do not intend to limit the object of this description.

Figure 1: Schematic representation of a correct seam on a two-needle lockstitch machine, with the seam allowances (edges) open, one for each side wherein (1) corresponds to the edge on the left pattern; (2) corresponds to the joining seam; (3) corresponds to the edge on the right pattern and (4) corresponds to the decorative seams.

Figure 2: Schematic representation of incorrect seam on a two-needle lockstitch machine, with the seam allowances (edges) falling towards the same side (left wherein (1) corresponds to the edge on the left pattern; (2) corresponds to joining seam; (3) corresponds to the edge on the right pattern and (4) corresponds to the decorative seams.

Figure 3: Schematic representation of an incorrect seam on a two-needle lockstitch machine, with the seam allowances (edges) falling towards the same right side wherein (1) corresponds to the edge in the left pattern; (2) corresponds to the joining seam; (3) corresponds to the edge in the right pattern and (4) corresponds to the decorative seams.

Figure 4: Schematic representation of a set of two optical sensors (5) wherein at the bottom of the sensor there is the emitter (7) of the laser beam and at the upper part the receiver (6) of the laser beam, after reflection in the target.

Figure 5: Schematic representation of one embodiment wherein the optical sensors are attached to a support and fixation structure (8) of the optical sensor at the rear of the sewing machine block (12), where the incidence of the laser beam (11) is visible from the optical sensor's (5) emitter (7), at the target (9), and its reflection to the sensor

receiver (6) and wherein (10) corresponds to the presser foot.

Figure 6: Schematic representation of a traditional complete compensator presser foot of the triple feed dog lockstitch machine; Rear presser foot, with vertical movement, with no targets at the top and no compensation between both "forks" or tabs (equal pressure on the material to be sewn on both sides of the seam); Compensating front presser foot, with elliptical movement to assist in the feeding of the material during the formation of the stitch.

Figure 7: Schematic representation of an embodiment of the rear presser foot with inductive sensors placed on the side of the compensating rear presser foot of the two-needle lockstitch sewing machine.

Figure 8: Schematic representation of the Complete Control device.

Figure 9: Schematic representation of the calculation of the displacement value of the presser foot in a control system with Optical Sensors.

Figure 10: Schematic representation of an embodiment of the presser foot for two needles, wherein (a) is a bottom view, (b) is a front view (c) is a side view and (d) is a rear view.

Figure 11: Representation schematic of an embodiment of the left rear presser foot for a single needle machine, wherein (a) is a bottom view, (b) is a front view (c) is a side view and (d) is a rear view.

Figure 12: Schematic representation of an embodiment of the right rear presser foot for a two-needle machine, wherein (a) is a bottom view, (b) is a front view (c) is a side view and (d) is a rear view.

Figure 13: Representation of the rear view of the compensating rear presser foot with the cavities (sags) at the base of the presser foot 2 mm wide and 2 mm deep, in the central zone (union between the two forks), on each side of the Central Sewing Guide, in a two-needle Lockstitch Sewing Machine.

DETAILED DESCRIPTION

[0050] The present disclosure relates to a device controlling the quality of a textile seam for a sewing machine that comprises a rear presser foot wherein each presser foot comprises at least two forks or tabs, configured to be in contact with the workpiece being sewn; wherein the forks of the rear presser foot oscillate with each other in order to change position independently of one another, according to the thickness of the fabric; at least one sensor configured to detect the oscillation of the height of one of the forks of the rear presser foot and a microcontroller configured to compare the oscillation of the fork detected by the sensor with a predetermined value and if the oscillation value is substantially different from the predetermined value, trigger an alarm.

[0051] In one embodiment, the present disclosure further relates to an intelligent control system for a sewing machine, preferably a lockstitch machine, comprising a compensating rear presser foot that comprises at least one target at the upper part of the presser foot and one cutout at the base; as well as two optical or inductive sensors positioned at the side part of the sewing block.

[0052] The present disclosure describes a device/system that allows to control the sewing margins during the formation of the stitch when using a sewing machine (*in loco*), reducing the occurrence of defective products.

[0053] In a preferred embodiment, the device comprises a compensating rear presser foot (Figure 10), with two targets (Figure 10) at the upper part of the fork stem (and consequently nonexistent in current presser feet), two optical sensors (Figure 4) positioned at the rear part of the sewing machine block (Figure 5), in order to point the beam of laser light to the targets; or, alternatively, two inductive sensors (Figure 7) mounted on the side of the presser bar, pointing laterally to the targets. The compensating rear presser foot also has a cavity (a sinking or cutout) at the base of the presser foot (Figure 10), 2 mm deep and 2 mm wide, on both sides of the central seam guide, on the two-needle Lockstitch machine (Figure 10).

[0054] In a preferred embodiment, the cavity can be only on the left side of the central sewing guide, when sewing is done on the right side, on the lockstitch machine with only one sewing line (Figure 12) or on the right side of the central sewing guide, when sewing is done on the left side, on the lockstitch machine with only one sewing line (Figure 11). These cavities allow the excess thickness resulting from the folding of the material in the crease or fold (folding point of the material, wherein the seam allowance falls (turned) inwards), does not allow the presser foot to be raised vertically, being detected by the sensors, and thus provide an oscillation value of the presser foot that does not correspond to the situation intended to control. The excess material in the fold area is thus accommodated in this innovative channel at the base of the presser foot.

[0055] In a preferred embodiment, the device presents a reduction in the contact area between the base of the presser foot and the material, in the central zone (union between the two forks), through a 2 mm cavity, on each side of the Central Guide of the sewing, in the case of two-needle machines (Figure 10); or only on the side corresponding to the needle entrance, in the case of single needle machines (Figure 11 (a) and Figure 12 (a)).

[0056] In a preferred embodiment, this device can be applied to machines using a needle or two needles, where there is the need to change the type of presser foot (Figure 10). In the case of a needle, sewing can be done on the left side (Figure 12), or on the right side (Figure 11), that is, the type of presser foot to be used has the two positioning variations of the Central Sewing Guide, at the right or left, respectively.

[0057] In a preferred embodiment, the sewing dynamics control device of this disclosure can use two types of distance/displacement measurement sensors, responsible for measuring the independent movement of each of the elements called "forks" of the presser foot (points of support of the presser foot over the material to be sewn - Figure 6), on both sides of the seam. The difference between the two methods of measuring the displacement of the presser foot is currently found only in the cost of the sensors, since the measurement accuracy is identical between the two solutions developed in this disclosure.

[0058] In one embodiment of the present disclosure, the device comprises at least one optical sensor.

[0059] In one embodiment, the following concerns the optical sensor. Use of two laser systems (Figure 4), mounted on the rear part of the sewing machine block (Figure 5), so that the two light beams fall on each of the targets mounted on the upper part of the presser foot, more specifically on the upper part of the fork stems, so that they reflect the beam of light on the target's inclined plane (Figure 5).

[0060] In one embodiment of the present disclosure, the device comprises at least one inductive sensor.

[0061] In one embodiment of the present disclosure, two inductive sensors mounted on the side part of the presser foot bar can be used (Figure 7), measuring the displacement of each of the targets mounted on the upper part of the presser foot (on the presser forks).

[0062] In one embodiment of the present disclosure, the device may comprise the elements of Figure 8.

[0063] In one embodiment of the present disclosure, laser (Figure 4 and Figure 5) or inductive (Figure 7) can be used. They convert the measured distance between the sensors and the respective targets and convert that measurement into an electrical greatness.

[0064] In one embodiment of the present disclosure, an inductive sensor mounted in a specific position on the sewing machine steering wheel (Figure 8). Its function is to indicate to the processing board "AUP", the point at which it should consider the measurement of the distance sensors (making the trigger). This function is essential since the presser foot during a sewing machine cycle (a stitch), goes up and down, but only firmly holds the material on it during part of this cycle. Only in that part of the cycle does the presser foot perform its function of holding the material being sewn "feeler", used specifically for this solution.

[0065] In a preferred embodiment, if the device is implemented with the laser sensors or analog inductive sensors to measure the distance from the sensor to the reflectors, they will always have to include a sensor mounted on the machine's steering wheel that has the function of informing the processor that the presser foot is in the exact position where the respective distance measurements (thicknesses) are to be taken. The sensor used is also a sensor of the inductive type but with a digital output and not analog. The sensor is always inductive because it is cheap and reliable, but it can be of another type.

[0066] This specific position where measurements are performed corresponds to the position of the seam where the presser foot is in the complete lowered position.

[0067] In one embodiment of the present disclosure, the electronic board responsible for AUP signal processing may comprise:

Treatment of analog signals from sensors;

Filtration of electrical noise;

Adaptation of the sensor signals to the nominal input values of the analog/digital converter (ADC);

Conversion of the analog values of the sensors at each positive transition of the Trigger signal.

Digital treatment of values:

Zero value (Offset);

Gain;

End of scale value.

Calculation of the differential value (Subtraction between displacement values):

Right sensor - Left sensor;

Left sensor - Right sensor.

Activation of Digital Outputs

Right Sensor > MAX;
 Right Sensor < MIN;
 Right Sensor > MIN and < MAX;
 Left Sensor > MAX;
 Left Sensor < MIN;
 Left Sensor > MIN and < MAX.

Communication with the PC (Computer):

Setup Offset;
 Setup Gain;
 Setup End of scale;
 Setup Set points;
 Digital outputs;
 Outputs of the values measured by the sensors in real time;
 Differential outputs of values measured by sensors in real time.

[0068] In one embodiment of the present disclosure, the PC (Computer) is responsible for parameterizing and processing of the data.

[0069] In one embodiment of the present disclosure, the PLC - programmable logic controllers is responsible for the fast processing of the signals.

[0070] In one embodiment of the present disclosure, the calculations made by the device described in this disclosure are based on the following:
 the optical sensors measure the vertical displacement value of the presser foot caused by the presence of the material under the presser foot (material thickness) is converted into a horizontal displacement, in a 1:1 ratio, due to the angle chosen for the targets: 45 degrees. (Figure 9).

D - Presser foot displacement detected by the Optical Sensor
 ESPA - Material thickness at point A
 ESPB - Material thickness at point B
 Angle α - 45 degrees
 CA - Measured Distance
 CO- ESPA - ESPB

$$\tan \alpha = CA / CO$$

[0071] In that the Measured Distance is given by:

$$\text{Measured Distance} = \tan 45 \times (\text{ESPB} - \text{ESPA}) \text{ i.e.:}$$

$$\text{Measured Distance} = \text{ESPB} - \text{ESPA}$$

[0072] If there is a variation of this value in one of the two sensors, the system provides the indication of SEWING NOT OK.

[0073] In one embodiment of the present disclosure, at the same time, the device makes the difference between the Measured Distance values between the two sensors, in order to amplify the difference in relation to the correct seam.

[0074] In one embodiment of the present disclosure, the calculation performed by the device described in the present disclosure can be based on the displacement determined by the sensors, preferably analog inductive sensors.

[0075] In one embodiment of the present disclosure, in the case of the device using inductive sensors, the value read by the sensor is direct, as it detects the vertical variation of the Target (and consequently of the presser foot) (Figure 9).

[0076] In one embodiment of the present disclosure, the vertical displacement value of the presser foot caused by the presence of the material under the presser foot (material thickness) is read directly by the Sensor.

DE - Presser foot displacement detected by the Left Fork Inductive Sensor
 DD - Presser foot displacement detected by the Left Fork Inductive Sensor
 ESPA - Material thickness at point A
 ESPB - Material thickness at point B

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$$\tan \alpha = CA / CO$$

[0077] In that the Measured Distance is given by:

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$$\text{Measured Distance} = \text{ESPB} - \text{ESPA}$$

[0078] If there is a variation of this value in one of the two sensors, the system provides the indication of SEWING NOT OK.

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[0079] In one embodiment of the present disclosure, at the same time, the system makes the Difference between the Measured Distance values between the two sensors, in order to amplify the difference in relation to the correct seam.

[0080] The present disclosure allows to:

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- Check the state of the decorative seam: Correct seam: Seam allowances open inside the piece (Figure 1); Incorrect seam: Seam allowances falling towards the same left side (Figure 2); Incorrect seam: Seam allowances falling towards the same right side (Figure 3);
- Ensure that the thickness of the material being sewn remains constant throughout the sewing process, ensuring that the seam allowance does not fall towards the wrong side of the seam, and thus being caught by the decorative seam. The decorative seam is subsequent to the process of assembling the car upholstery parts (joining seam), where the airbag is expected to pop out due to the upholstery bursting in the event of a vehicle impact.

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[0081] In a preferred embodiment, the device has a reduction in the contact area between the base of the presser foot and the material, in the central zone (union between the two forks), through a 2 mm cavity, on each side of the central seam guide in the case of two-needle machines (Figure 10); or only on the side corresponding to the needle entrance, in the case of single needle machines (Figure 11 and Figure 12).

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[0082] In a preferred embodiment, the device can be applied to machines using a needle or two needles, where there is the need to change the type of presser foot (Figures 10, 11 and 12). In the case of one needle, sewing can be done on the left side (Figure 12), or on the right side (Figure 11), that is, the type of presser foot to be used has the two positioning variations of the central seam guide, on the right or on the left, respectively.

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[0083] The term "comprises" or "comprising" when used in this document is intended to indicate the presence of the characteristics, elements, integers, steps and components mentioned, but does not prevent the presence or addition of one or more other characteristics, elements, integers, steps and components, or groups thereof.

[0084] The present invention is not, of course, in any way restricted to the embodiments described in this document and a person with ordinary skills in the art will be able to foresee many possibilities for modifying it and replacing technical characteristics with equivalent ones, depending on the requirements of each situation, as defined in the appended claims.

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[0085] The following claims define additional embodiments of the present description.

45 Claims

1. Device for controlling the quality of a textile seam for a sewing machine comprising:

a rear presser foot with compensation comprising two forks for pressing the workpiece being sewn, a fork for each side of the seam, after it passes through the needle seam area, wherein said forks are vertically and independently oscillating;
 a sensor configured to detect the height or the displacement of a first fork;
 a signal processor configured to detect if the height detected by the sensor when the first fork is pressing the workpiece is above a predetermined value of excessive thickness.

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2. Device according to the preceding claim, wherein each fork comprises a stem so that the sensor detects the height of the fork.

3. Device according to any one of the preceding claims, wherein the sensor configured to detect the height of the first fork is an optical sensor or an inductive sensor.
4. Device according to any one of the preceding claims, wherein the fork stem comprises an optical target with an inclination of substantially 45 °.
5. Device according to any one of the preceding claims comprising an additional sensor configured to detect the height of the other fork and wherein the signal processor is additionally configured to detect whether the height detected by the additional sensor when the other fork is pressing the workpiece is below or above a predetermined value of insufficient thickness.
6. Device according to the preceding claim wherein the signal processor is additionally configured to detect whether the height difference detected between the sensor of the first fork and the additional sensor of the second fork when the first and second forks are pressing the workpiece, is above a predetermined value of differential thickness.
7. Device according to any one of the preceding claims wherein the signal processor is configured to detect the height difference detected between the sensor of the first fork and the additional sensor of the second fork, in a continuous manner.
8. Device according to any one of the preceding claims, wherein the optical sensors are located on the head of the sewing machine.
9. Device according to any one of the preceding claims, wherein the inductive sensors are located on the side walls of the rear presser foot.
10. Device according to any one of the preceding claims, wherein the number of layers of the workpiece being sewn is at least 2.
11. Device according to any one of the preceding claims, wherein the number of layers of the workpiece being sewn is at least 3.
12. Device according to any one of the preceding claims, wherein it further comprises 2 needles.
13. Device according to any one of the preceding claims, wherein the rear presser foot comprises a cavity in the base of the presser foot.
14. Device according to any one of the preceding claims, wherein the rear presser foot further comprises a central guide between the forks for guiding the user.
15. Device according to any one of the preceding claims, wherein the central guide is next to one of the forks.
16. Device according to any one of the preceding claims, which further comprises a front presser foot, preferably a front presser foot with articulated and interlocking forks.
17. Sewing machine comprising the device described in any one of claims 1 to 16.
18. Sewing machine according to any one of the claims wherein it is a lockstitch machine, preferably a triple feed dog lockstitch machine.
19. Sewing machine according to any one of claims 17-18 wherein the machine is a two-needle machine.
20. Method for controlling the quality of a textile seam on a sewing machine comprising the device described in any one of claims 1 to 16, comprising the following steps:
 - defining in a signal processor the thickness value of at least one edge of a workpiece being sewn;
 - converting the thickness value of the edge into the displacement of a stem of a rear presser foot;
 - placing said workpiece on the sewing machine;
 - pressing the workpiece with a rear presser foot whose fork is vertically oscillating;

obtaining the vertical displacement value of the stem of one of the forks of the rear presser foot;
comparing the value of the vertical displacement of the fork stem with the predetermined value wherein if the
value of the vertical displacement of the fork stem is higher or lower than the defined value the signal processor
informs the user.

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21. Method according to the previous claim which further comprises

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defining in a signal processor the thickness value of a second edge of a workpiece being sewn;
converting the thickness value of a second edge into the displacement of a second stem of the rear presser foot;
placing said workpiece on the sewing machine;
pressing the workpiece with the rear presser foot whose forks are vertically oscillating; obtaining the value of
the vertical displacement of each stem of the forks of the rear presser foot;
comparing the value of the vertical displacement of the stem of each fork or the differential of the two displace-
ments with the predetermined value wherein if the displacement value or the differential is different from the
defined value the signal processor informs the user.

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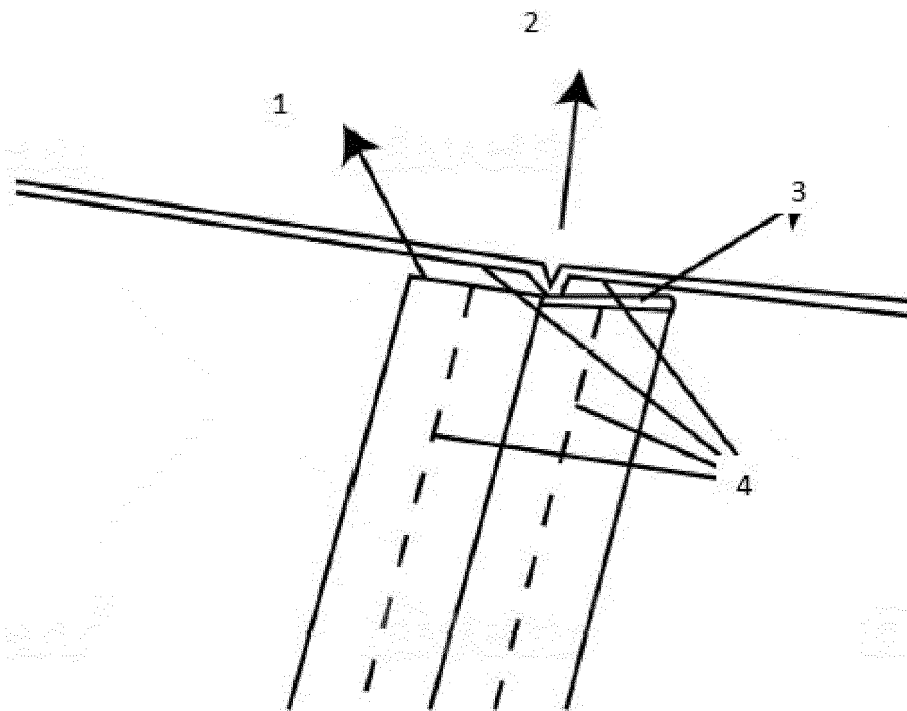


Fig. 1

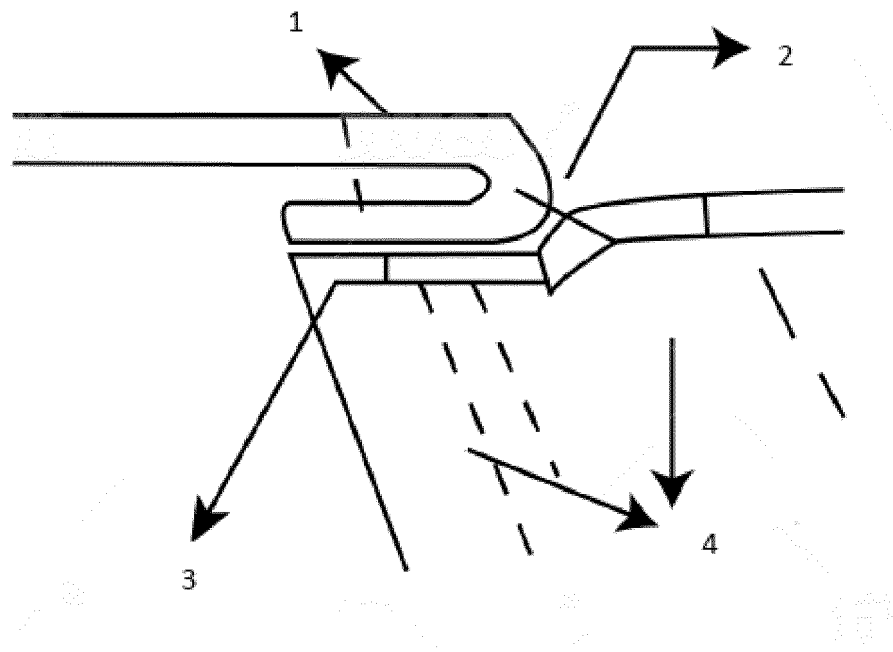


Fig. 2

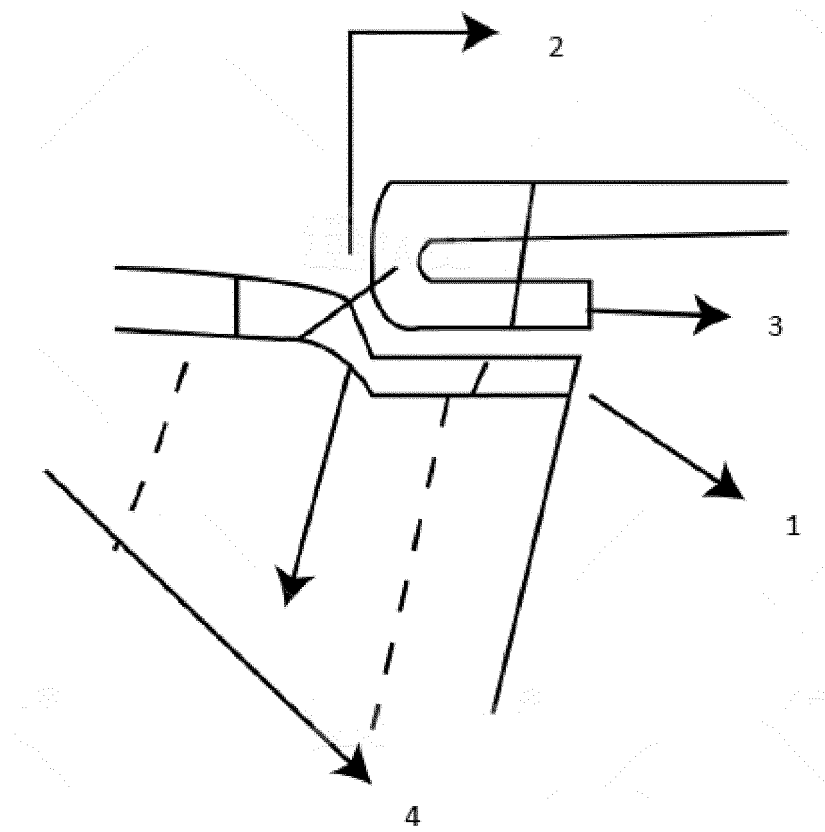


Fig. 3

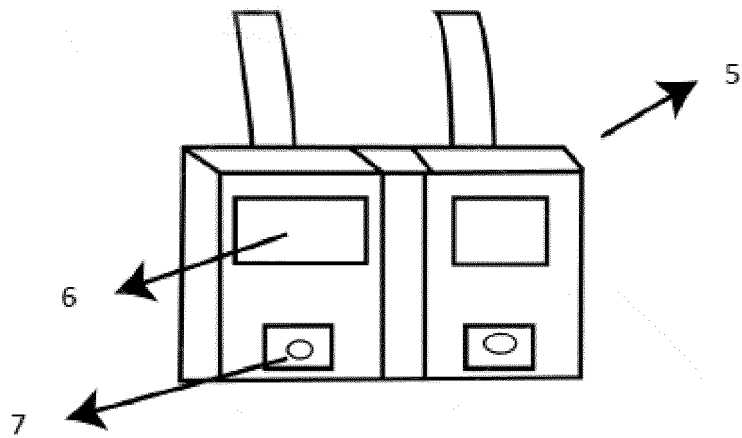


Fig. 4

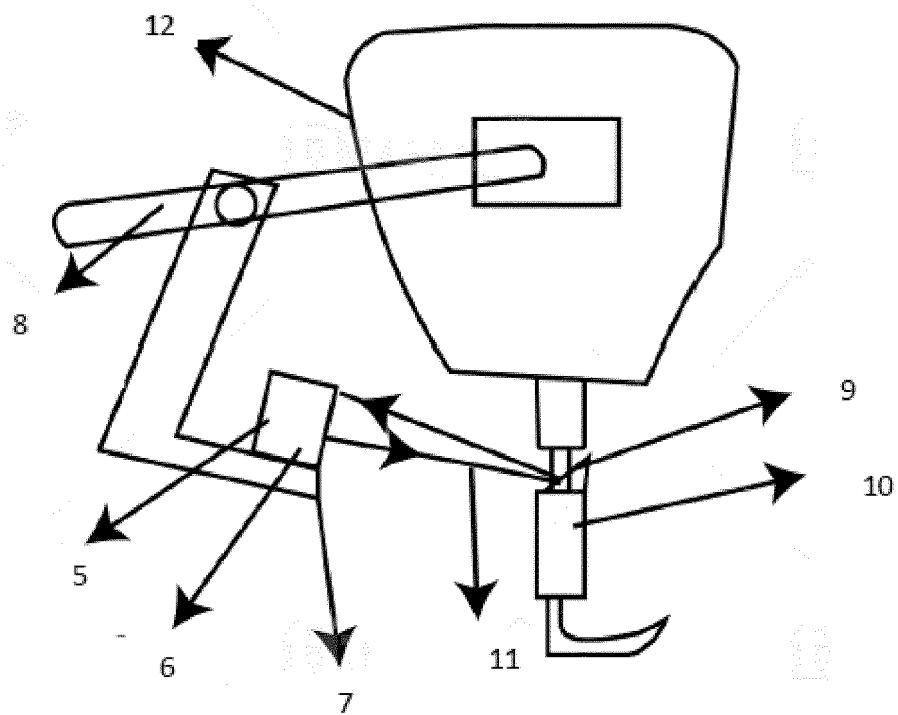


Fig. 5

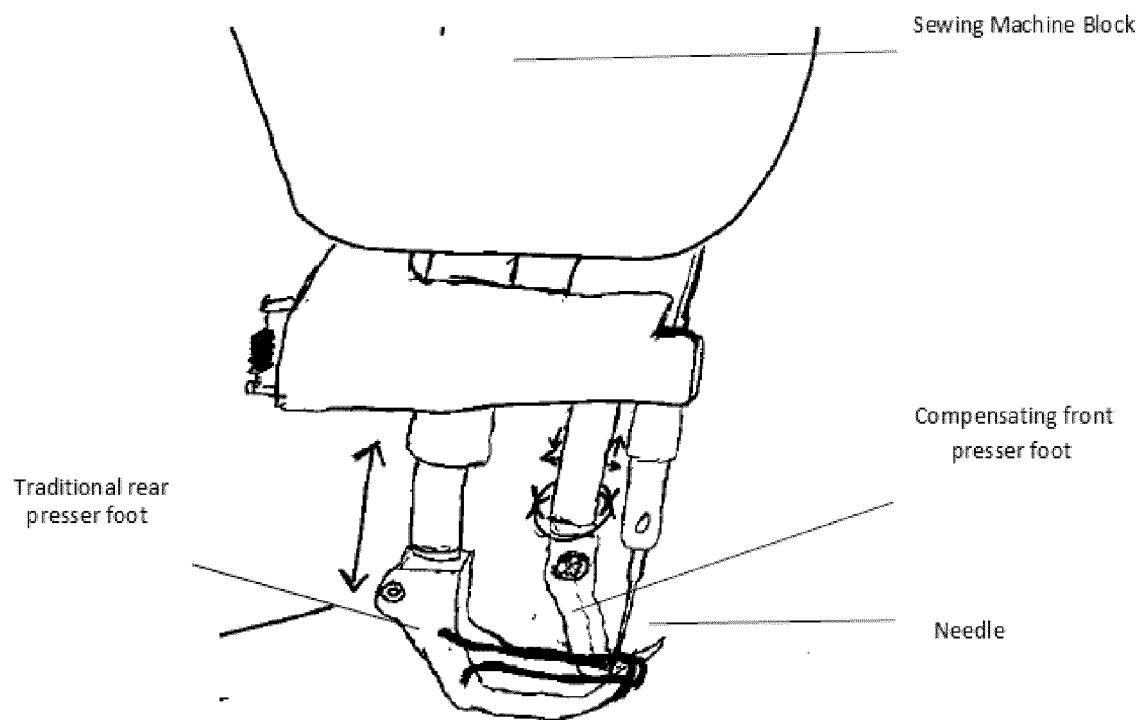


Fig.6

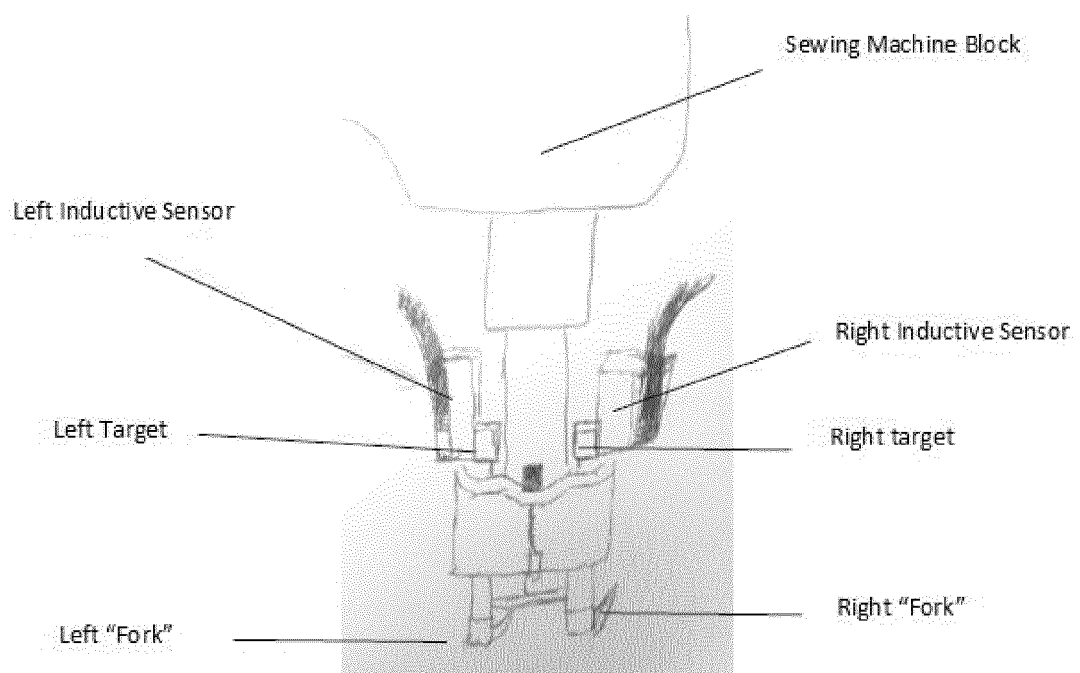


Fig. 7

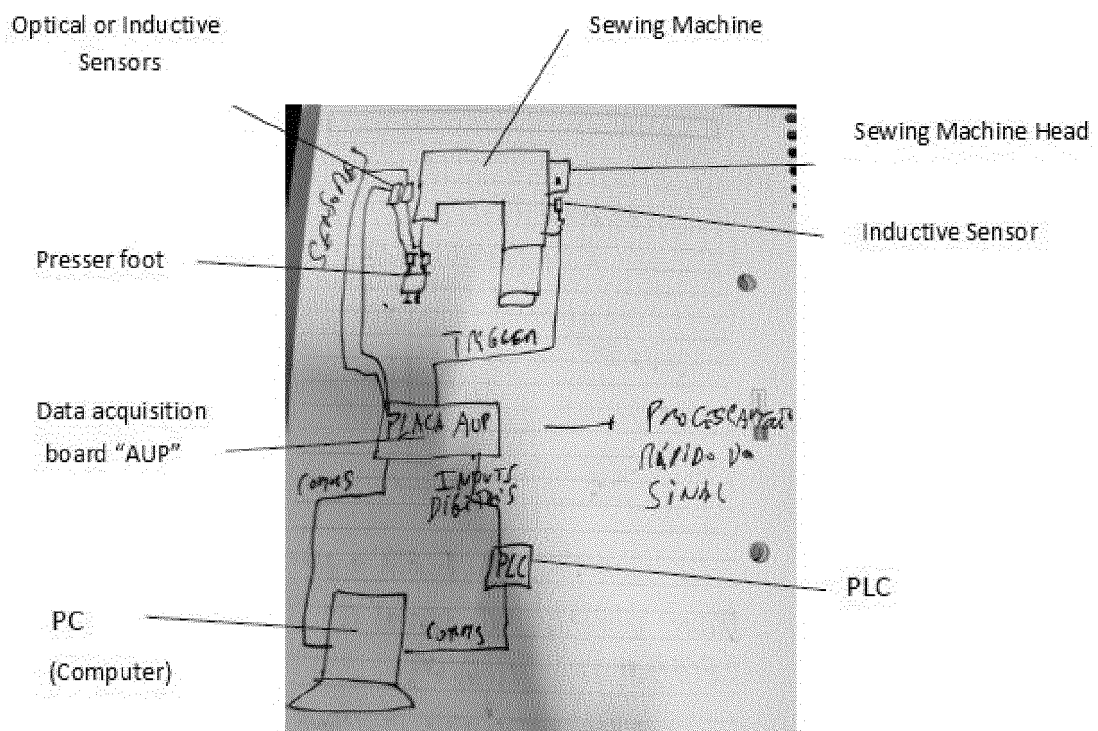


Fig. 8

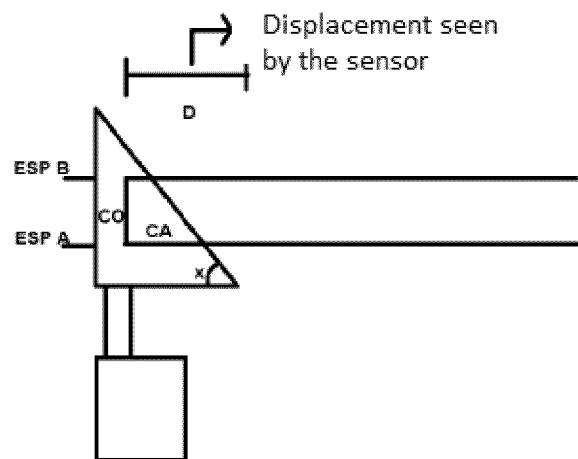
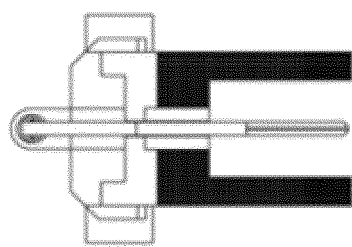
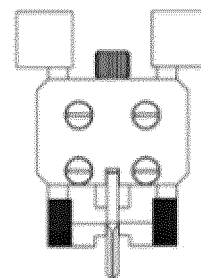


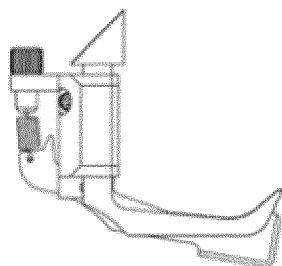
Fig.9



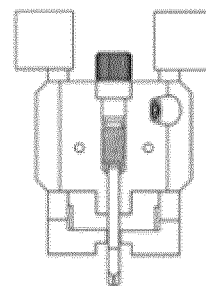
(a)



(b)



(c)



(d)

Fig. 10

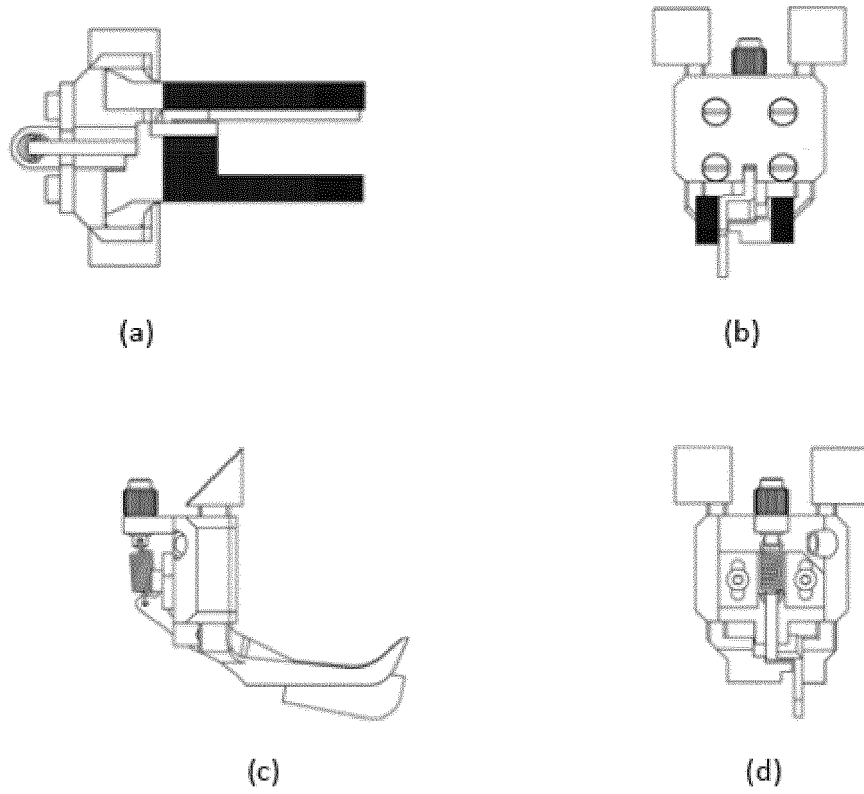


Fig. 11

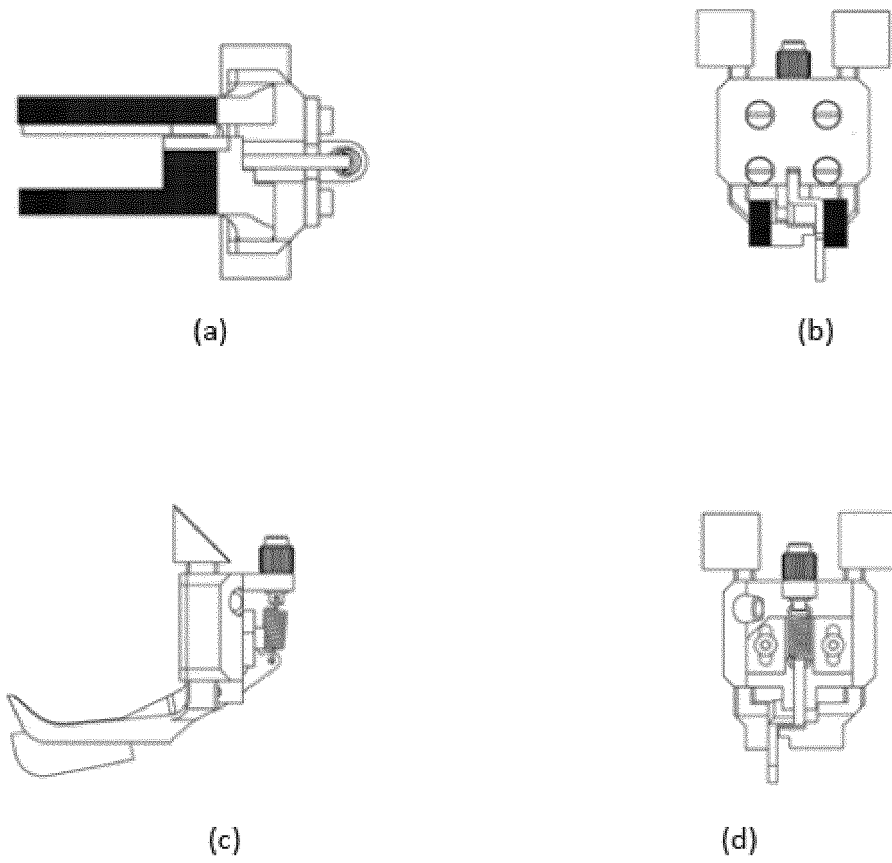


Fig. 12

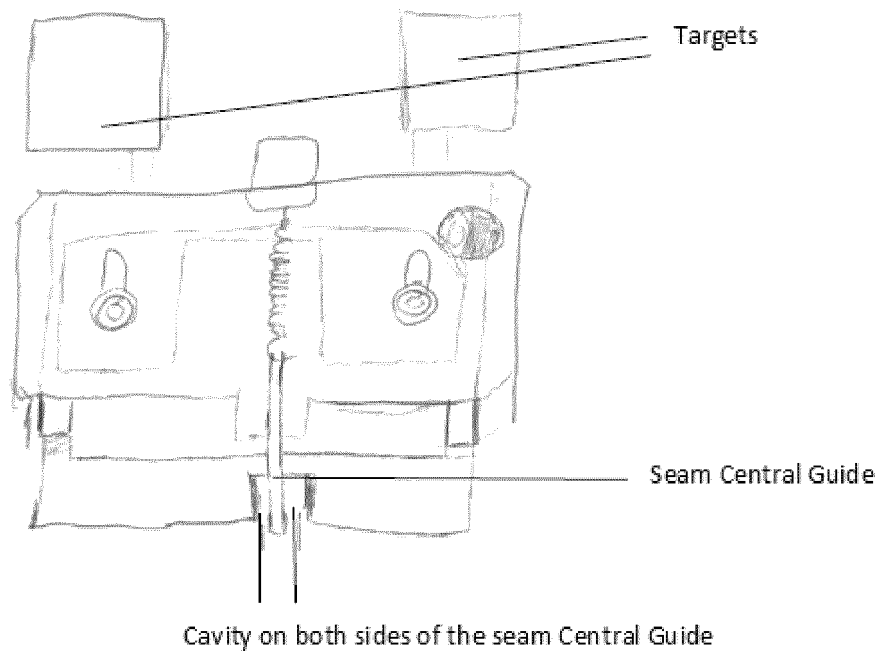


Fig. 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/054542

A. CLASSIFICATION OF SUBJECT MATTER
INV. D05B29/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 327 663 A (SIGODA VICTOR J) 27 June 1967 (1967-06-27) claims 1, 10; figures 1-3 -----	1-21
A	JP H10 165681 A (MASUDA SENI KK) 23 June 1998 (1998-06-23) paragraph [0009] - paragraph [0012]; figures 1-7 -----	1-21
A	CN 105 200 675 B (BULLMER ELECTROMECHANICAL TECHNOLOGY CO LTD) 23 November 2018 (2018-11-23) paragraph [0042] - paragraph [0061]; figures 4-12 -----	1-21
A	DE 10 2017 107281 A1 (JUKI KK [JP]) 5 October 2017 (2017-10-05) paragraphs [0078], [0102] - paragraphs [0104], [0128]; figures 8, 16 -----	1-21

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

15 September 2020

Date of mailing of the international search report

21/09/2020

Name and mailing address of the ISA/

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Authorized officer

Braun, Stefanie

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2020/054542

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REFERENCES CITED IN THE DESCRIPTION

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- US 4928611 A [0011]