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(54) **Sewing station for a bookbinding machine**

(57) A sewing station (130) for a bookbinding machine (100) is proposed. The sewing station has at least one sewing unit (203) including a needle (205) and a hook needle (210) for sewing blocks of signatures (105) in succession using a continuous thread (310), and a cutting device (220) having means (305) for engaging

the thread in the proximity of the needle after sewing a last signature of each block and means (305c,315) for cutting the engaged thread; the sewing station further includes means (240-255) for moving the cutting device to an operative position between the needle and the hook needle after engaging the thread, the thread being cut in the operative position.

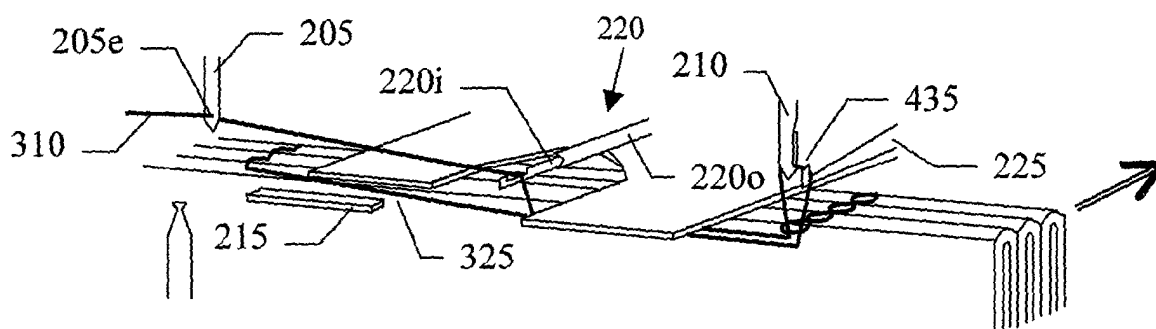


FIG.4f

Description

[0001] The present invention relates to the bookbinding field, and more specifically to a sewing station for a bookbinding machine.

[0002] Bookbinding machines are commonly used for making sewn books. A sewn book consists of a block of signatures that are sewn together in a corresponding station of the bookbinding machine. The sewing station includes a series of needles and hook needles (or crochets), which cooperate to sew the signatures by means of continuous threads.

[0003] In order to separate the different blocks of signatures, the threads are automatically cut after sewing a last signature of every block. Typically, as described in EP-A-0295220, the sewing station is provided with a blade for each needle and with a hook for each hook needle. Once the last signature of the block has been sewn, the blade is moved close to the needle and the hook is moved close to the hook needle. In this way, the blade interferes with the thread that will be used by the needle to sew a first signature of a next block; at the same time, the hook picks up a loop of the thread that is held by the hook needle. As the block of signatures moves away from the needles and the hook needles, the thread is tightened on the blade and cut. The hook thus unravels the loop, so that the block of signatures is completely separated from the next one.

[0004] Different solutions have been proposed in the last years for improving the above-described cutting operation. For example, in several bookbinding machines known in the art the blades reciprocate, so as to increase their efficiency. Alternatively, US-A-5,507,524 suggests replacing the blades with scissors-like cutting devices; in this way, it is possible to prevent any tensioning of the thread that could damage the signatures.

[0005] A drawback of the solutions known in the art is that the length of the thread (projecting from the signatures after the cutting operation) cannot be controlled efficiently.

[0006] Particularly, a portion of the thread projecting from the first signature of each block (in the proximity of the needle) is very short; therefore, the thread can slip into the signature impairing its sewing. Conversely, the portion of the thread projecting from the last signature of each block (in the proximity of the hook needle) is very long; the thread can then interfere with the next operations that are carried out on the block of signatures (for example, the gluing of a spine or the forming of a soft cover).

[0007] In order to avoid those problems, in the bookbinding machine described in US-A-5,507,524 the projecting portions of the thread are fastened to the signatures (either gluing or welding the portions of the thread). Different bookbinding machines known in the art are equipped with a device for sucking and cutting the portions of the thread projecting from the last signatures of the blocks. However, the solutions described above re-

quire additional operations after sewing the signatures; moreover, the technique based on the welding is quite unreliable and requires the use of specific threads (with a high content of synthetic fibers).

[0008] An additional drawback is experienced in the bookbinding machines using the blades. In this case, it is not possible to select the moment when the thread is cut with precision. Indeed, the cutting operation depends on many uncontrollable factors (such as the sharpening of the blades, the type of thread, the thickness of the signatures, and the like).

[0009] It is an object of the present invention to provide a sewing station, which allows controlling the length of the portions of the thread projecting from the signatures efficiently.

[0010] It is another object of the present invention to increase the length of the portions of the thread projecting from the first signatures of the blocks in the proximity of the needles.

[0011] It is yet another object of the present invention to prevent the threads from slipping into the signatures.

[0012] Moreover, it is an object of the present invention to reduce the length of the portions of the thread projecting from the last signatures of the blocks in the proximity of the hook needles.

[0013] It is another object of the present invention to limit the additional operations that must be performed on the blocks of signatures (after their sewing).

[0014] The accomplishment of these and other related objects is achieved by a sewing station as set out in the first claim.

[0015] Briefly, an aspect of the present invention provides a sewing station for a bookbinding machine, the sewing station having at least one sewing unit including a needle and a hook needle for sewing blocks of signatures in succession using a continuous thread, and a cutting device having means for engaging the thread in the proximity of the needle after sewing a last signature of each block and means for cutting the engaged thread; the sewing station further includes means for moving the cutting device to an operative position between the needle and the hook needle after engaging the thread, the thread being cut in the operative position.

[0016] The present invention also provides a bookbinding machine including the sewing station. Moreover, a corresponding sewing method is encompassed.

[0017] Further features and the advantages of the solution according to the present invention will be made clear by the following description of a preferred embodiment thereof, given purely by way of a non-restrictive indication, with reference to the attached figures, in which:

Figure 1 depicts a bookbinding machine in which the sewing station of the invention can be used; Figures 2a and 2b are a top view and a bottom view, respectively, of the sewing station; Figures 3a and 3b illustrate operation of a cutter

used in the sewing station;

Figure 3c is an enlarged view of an insert of the sewing station;

Figures 4a-4i show the sequence of operations relating to a sewing process.

[0018] With reference in particular to Figure 1, a bookbinding machine 100 is shown. The machine 100 is used to sew together blocks of signatures 105, in order to form corresponding books; each signature 105 consists of a large printed sheet, which is folded one or more times (so as to define the pages of the book). A hopper 110 feeds the signatures 105 in succession to an opening station 120 (for example, including 4 upper opening heads and 4 lower opening heads arranged along a feeding direction of the signatures 105). The signatures 105 are opened in the middle and placed astride a fixed saddle 125, which conveys the signatures 105 to a sewing station 130.

[0019] The sewing station 130 includes a movable saddle 135, which is aligned with the fixed saddle 125 when opened (in a lowered position). Whenever a signature 105 is in the proximity of the sewing station 130, the signature 105 is accelerated so as to be separated from the following signatures and thrown onto the movable saddle 135. The movable saddle 135 is then closed (to a raised position). The signature 105 loaded on the movable saddle 135 is sewn to a previous signature by means of continuous threads. Once a last signature of a current block 140 has been sewn, the threads are cut. The block of signatures 140 is then conveyed to a holder 145 (in order to be supplied to further machines that complete the production of the book). Operation of the bookbinding machine 100 is remotely managed by means of a programmable logic controller (PLC) 150.

[0020] Similar considerations apply if the bookbinding machine has a different structure or includes other units (for example, a series of trays for pre-loading the signatures or a different number of opening heads), if the PLC is replaced with an equivalent data processing system (for example, a Personal Computer), and the like.

[0021] Moving now to Figure 2a, the sewing station 130 is illustrated in detail in a partially cut away view. The sewing station 130 is formed by a bank of units 203 (for example, 10-15). Each sewing unit 203 includes a needle 205 and a hook needle 210, which cooperate to sew together the signatures by means of a corresponding thread (not shown in the figure). The needle 205 consists of a slender element with an eye 205e at its pointed end for inserting the thread; the hook needle 210 consists of a similar slender element but with a hook 210h at its pointed end for catching the thread.

[0022] The needle 205 and the hook needle 210 are driven with a reciprocating motion towards the signature 105 put astride the movable saddle 135; for this purpose, the movable saddle 135 features a longitudinal slit (not shown in the figure) along a back of the signature 105, for allowing the passage of the needles 205 and

the hook needles 210. A pressure insert 215 is interposed between each pair of elements 205, 210 and the signature 105 (so as to hold down the signature 105 on the movable saddle 135). The insert 215 has a through hole 215n for the passage of the needle 205 and a through hole 215c for the passage of the hook needle 210.

[0023] A cutter 220 is associated with the needle 205, and a separator 225 is associated with the hook needle 210. The cutter 220 is used to sever the thread after sewing the last signature of each block. The separator 225 consists of a hook, which catches the cut thread to complete the separation of the block of signatures. A gripper 227 (shown in dashed lines in the figure) is arranged inside the movable saddle 135; the gripper 227 acts as a thread carrier, which conveys the thread from the needle 205 to the hook needle 210 (inside the signature 105 put astride the movable saddle 135).

[0024] As shown in Figure 2b, all the separators 225 are fastened to a bar 230, which is driven by a tie rod mechanism 235. The bar 230 moves the separators 225 so as to encircle and hook the cut threads (held by the corresponding hook needles).

[0025] Each cutter 220 has a telescopic structure, with an inner element 220i that slides inside an outer element 220o. All the outer elements 220o are fastened to a bar 240. A further bar 245 drives all the inner elements 220i. The bar 245 is hinged at the free ends of two clamps 250 (only one shown in the figure). The clamps 250 are fastened to a shaft 255, which slides and rotates inside a sleeve of the tie rod mechanism 235.

[0026] When the shaft 255 is caused to slide, the cutters 220 are moved transversally to their longitudinal axes (by means of the clamps 250 and the bars 240, 245). When the shaft 255 rotates, the movement is transmitted to the clamps 250. The bar 245 pivots about the clamps 250, and then moves transversally to its longitudinal axis (rightwards when the shaft 255 rotates counterclockwise and leftwards when the shaft 255 rotates clockwise). In this way, the inner elements 220i are extracted from or retracted into, respectively, the respective outer elements 220o.

[0027] Similar considerations apply if the sewing station has another structure, or if a different number of sewing units are provided (down to a single one); moreover, the concepts of the present invention are also applicable when equivalent mechanisms are used to drive the separators and the cutters, or when the cutters have a different structure (for example, with pneumatic pistons).

[0028] Operation of a generic cutter 220 is described in detail with reference to Figures 3a and 3b. Considering in particular Figure 3a, the cutter 220 is illustrated with the inner element 220i extracted from the outer element 220o. A recess 305 is formed in the proximity of a free end of the inner element 220i. The recess 305 has a left corner 305n and a right corner 305c; when the

cutter 220 is placed between the respective needle and hook needle, the corner 305n faces the needle and the corner 305c faces the hook needle. The recess 305 defines a hook, which is used to catch the corresponding thread (denoted with 310). The outer element 220o ends with a circular edge 315. A notch 320 is formed at the free end of the outer element 220o; the notch 320 is in line with the corner 305n.

[0029] When the inner element 220i is retracted into the outer element 220o, as shown in Figure 3b, the thread 310 remains engaged between those elements 220i, 220o. The corner 305c and the edge 315 act as blades, which cut the thread 310. On the contrary, the notch 320 clears the portion of the thread 310 arranged on the corner 305n. As a consequence, the thread 310 is cut at a single position (on the side facing the hook needle).

[0030] Similar considerations apply if the cutter has a different structure (for example, with the outer element and the inner element that have a square section), if the recess of the inner element is made in a different way, or if the notch has another shape.

[0031] With reference now to Figure 3c, the insert 215 is illustrated in an enlarged view from below. A hollow 320 extends from a free end of the insert 215, between the through hole 215n (for the needle) and the through hole 215c (for the hook needle). A slit 325 is made on a lower surface of the insert 215 (which lower surface is used to hold down the signatures); the slit 325 connects the through hole 215n with the hollow 320 (on the lower surface). A chamfer 327 is formed at an outer joint between the slit 325 and the through hole 215n (to avoid damaging the thread when it is drawn towards the hollow 320). The hollow 320 has an inner portion 320i, which extends inwards from the slit 325.

[0032] However, the concepts of the present invention are also applicable when the insert has a different structure (for example, consisting of a simple plate), or when all the inserts are replaced with one or more equivalent members. Alternatively, the hollow has a different shape, the slit is formed in another way, and the like.

[0033] The sequence of operations relating to a sewing process is illustrated schematically in Figures 4a-4i. Considering in particular Figure 4a, at the beginning of the sewing process the thread 310 (typically supplied by a bobbin, not shown in the figure) is inserted into the eye 205e of the needle 205; the thread 310 is then used to sew together adjacent signatures (forming a stack 403). For this purpose, the thread 310 is drawn through the back of each signature of the stack 403 to form interlocked stitches, each one bridging between two adjacent signatures of the stack 403; particularly, a row of plain stitches 405 is formed by the needle 205 and a row of looped stitches 410 is formed by the hook needle 210.

[0034] The stack of signatures 403 moves forward along a shifting direction indicated by the arrow in the figure; a new signature (denoted with 105n) is then fed to the stack 403 (by means of the movable saddle). The

signature 105n is pierced (using a punching device arranged inside the movable saddle); in particular, a through hole 415 and a through hole 420 are formed in the back of the signature 105n for the needle 205 and for the hook needle 210, respectively.

[0035] In the condition shown in the figure, the thread 310 passes through the eye 205e of the needle 205 (between the bobbin and the plain stitches 405). The hook 210h of the hook needle 210 faces forward (opposite to the shifting direction of the stack 403), and holds a loop 425 that has been freshly formed by the thread 310.

[0036] Moving now to Figure 4b, the needle 205 and the hook needle 210 are lowered, after rotating the hook needle 210 by 180°. In this way, the thread 310 is conveyed inside the signature 105n by the needle 205, while the loop 425 remains wound around the hook needle 210 (outside the signature 105n). The needle 205 and the hook needle 210 are then slightly retracted, in order to form a bend 427 in the double-stranded thread 310 inside the signature 105n.

[0037] With reference to Figure 4c, the thread carrier 227 grips the thread 310 at that bend, and pulls it past the hook needle 210. The thread carrier 227 then pivots towards the hook needle 210, to have the thread 310 contact the hook needle 210 (above the hook 210h). The needle 205 and the hook needle 210 are then extracted from the signature 105n; at the same time, the thread carrier 227 returns to its starting position (close to the needle 205).

[0038] In this way, as shown in Figure 4d, the hook 210h picks up the thread 310; as a consequence, the thread 310 is pulled out the signature 105n and forms a new loop 430 that is concatenated with the previous loop 425. The hook needle 210 then rotates by 180° so as to return to its starting position. At the same time, the double-stranded thread 310 between the needle 205 and the hook needle 210 is tightened against an inner edge of the back of the signature 105n.

[0039] Considering now Figure 4e, a blind stitch is performed after a last signature of a current block (denoted with 1051) has been sewn. For this purpose, the same operations described above are executed without any signature (exploiting the insert 215 for the abutment of the double-stranded thread 310 between the needle 205 and the hook needle 210). As a consequence, a further loop 435 is formed and concatenated with the previous loop 430. In this case, however, the hook needle 210 is not rotated (so that the hook 210h remains turned backward).

[0040] Moving to Figure 4f, the inner element 220i of the cutter 220 is extracted from the outer element 220o; the cutter 220 is then moved to an operative position between the needle 205 and the hook needle 210. The operative position is substantially equidistant from the needle 205 and the hook needle 210; for example, the distance of the operative position from a central point (in the middle between the needle 205 and the hook needle 210) is lower than 20%, and preferably lower

than 10%, of the distance between the needle 205 and the hook needle 210. In this way, the recess of the inner element 220i engages the thread 310 (with the portion of the thread 310 between the needle 205 and the cutter 220 that crosses the slit 325 of the insert 215). At the same time, the separator 225 picks up the loop 435 (formed by the hook needle 210).

[0041] As a consequence, as illustrated in Figure 4g, when the needle 205 and the hook needle 210 are lowered for sewing the first signature of a next block (denoted with 105f), the loop 435 is released from the hook 210h but remains held by the separator 225. As the signature 1051 moves forward, a slight tension is applied to the thread 310 (by the cutter 220 and the separator 225); at the same time, the portion of the thread 310 extending from the cutter 220 towards the separator 225 is received by the inner portion 320i of the hollow 320 (thereby avoiding any interference of the thread 310 with the insert 215).

[0042] Proceeding to Figure 4h, the inner element 220i is retracted into the outer element 220o so as to cut the thread 310. This operation is performed in response to a corresponding command received from the controller of the bookbinding machine. The cutting command is issued after a predefined delay, which is programmable by an operator. For example, when working with light paper the thread 310 is cut immediately, so as to avoid tearing the signatures. Conversely, when working with hard paper the thread 310 is cut after sewing some further signatures (for example, from 1 to 5); in this way, the stitches are further tightened so as to compact the signatures.

[0043] With reference now to Figure 4i, as the signature 1051 further moves forward the separator 225 unravels the loop 435. As a consequence, the block of signatures so obtained is completely separated from the previous one (being both the plain stitches 405 and the loop stitches 410 discontinued). The length of the portion of the thread projecting from the last signature 1051 of the block just sewn (denoted with 3101) and the length of the portion of the thread projecting from the first signature 105f of the next block (denoted with 310f) depend on the operative position of the cutter 220. Particularly, the length of the projecting portion 310f increases (and the length of the projecting portion 3101 decreases accordingly) as the operative position of the cutter 220 moves away from the needle 205 towards the hook needle 210.

[0044] Similar considerations apply if the sewing process includes equivalent operations, if no blind stitch is performed after sewing the last signature of each block, and the like.

[0045] More generally, an aspect of the present invention proposes a sewing station for a bookbinding machine. The sewing station has one or more sewing units. Each sewing unit includes a needle and a hook needle for sewing blocks of signatures in succession using a continuous thread. Moreover, the sewing unit is provided

with a cutting device; the cutting device has means for engaging the thread in the proximity of the needle after sewing a last signature of each block, and means for cutting the engaged thread. The sewing station of the invention further includes means for moving the cutting device to an operative position between the needle and the hook needle after engaging the thread; the thread is then cut in the operative position.

[0046] The sewing station of the invention allows controlling the length of the portions of the thread projecting from the signatures in a very efficient way.

[0047] Particularly, the length of the portions of the thread projecting from the first signatures of the blocks (in the proximity of the needles) is increased.

[0048] In this way, the threads are prevented from slipping into the signatures; as a consequence, the reliability of the sewing process is strongly increased.

[0049] At the same time, the proposed solution reduces the length of the portions of the thread projecting from the last signatures of the blocks (in the proximity of the hook needles).

[0050] Therefore, in most practical situations no additional operations are required on the blocks of signatures (after their sewing). For example, it is possible to avoid fastening the projecting portions of the threads to the signatures and/or cutting the portions of the thread projecting from the last signatures of the blocks. In any case, the use of the proposed sewing station in different bookbinding machines is not excluded and within the scope of the invention.

[0051] The preferred embodiment of the invention described above offers further advantages.

[0052] Particularly, the thread is cut in a position that is substantially equidistant from the needle and the hook needle.

[0053] In this way, the portions of the thread that project from the first and the last signatures of every block nearly have the same length.

[0054] In a specific embodiment of the invention, the insert has an opening that clears the thread between the needle and the cutter.

[0055] The opening prevents the thread (to be cut) from interfering with the insert (which interference would result in an increase of the length of the portion of the thread projecting from the last signature of each block).

[0056] Advantageously, the opening includes a portion extending towards the shifting direction of the sewn signatures, so as to clear the thread between the last signature of the block and the cutter.

[0057] This additional feature avoids any contact of the thread to be cut with the insert as the sewn signatures move away from the needles and the hook needles.

[0058] However, the present invention can be practiced cutting the thread in a different position (closer to either the needle or the hook needle), or using a different insert; for example, in alternative embodiments of the invention the opening of the insert does not include any

portion extending towards the shifting direction of the sewn signatures, or the insert has no opening for clearing the thread to be cut. In any case, the use of the proposed solution in a sewing station without any insert is not excluded.

[0059] As a further enhancement, the cutter includes an active element that is responsive to a corresponding programmable command.

[0060] In this way, it is possible to control the moment when the thread is cut with high precision. Moreover, the sewing station can be configured for different operative conditions in a very simple manner.

[0061] A suggested choice for implementing the cutting element is that of using a telescopic structure.

[0062] The devised solution is very simple, but at the same time efficient.

[0063] As a further enhancement, the outer element has a notch that clears a corner of the inner element when retracted (while another corner of the inner element interferes with the edge of the outer element to cut the thread).

[0064] In this way the thread is cut at a single point, thereby avoiding losing small pieces of threads that could damage the sewing station.

[0065] A way to further improve the solution is to turn the corner of the inner element (which is active to cut the thread) towards the hook needle.

[0066] As a consequence, the length of the portion of the thread projecting from the first signature is further reduced (with the length of the portion of the thread projecting from the last signature that is increased accordingly).

[0067] However, the sewing station of the invention is also suitable to be implemented without the possibility of programming the cutting command, or even using a cutting element of the passive type. Alternatively, the cutting element has a different structure; for example, the active edge of the inner element can face the needle (instead of the hook needle), the outer element can be configured without any notch, or another mechanism can be used (for example, a scissors-like cutter).

[0068] Naturally, in order to satisfy local and specific requirements, a person skilled in the art may apply to the solution described above many modifications and alterations all of which, however, are included within the scope of protection of the invention as defined by the following claims.

Claims

1. A sewing station (130) for a bookbinding machine (100), the sewing station having at least one sewing unit (203) including a needle (205) and a hook needle (210) for sewing blocks of signatures (105) in succession using a continuous thread (310), and a cutting device (220) having means (305) for engaging the thread in the proximity of the needle after

sewing a last signature of each block and means (305c,315) for cutting the engaged thread,

characterized in that

the sewing station further includes means (240-255) for moving the cutting device to an operative position between the needle and the hook needle after engaging the thread, the thread being cut in the operative position.

2. The sewing station (130) according to claim 1, wherein the operative position is substantially equidistant from the needle (205) and the hook needle (210).
3. The sewing station (130) according to claim 1 or 2, wherein the at least one sewing unit further includes a pressure insert (215), the pressure insert having an opening (325) for clearing the thread between the needle (205) and the cutting device (220) in the operative position.
4. The sewing station (130) according to claim 3, wherein the sewn signatures moves away from the sewing station along a shifting direction, the opening including a portion (320i) extending towards the shifting direction for clearing the thread (310) between the last signature of the block and the cutting device (220) in the operative position.
5. The sewing station (130) according to any claim from 1 to 4, wherein the means for cutting (305c, 315) includes an active element (305c) responsive to a cutting command, the sewing station further including means (150) for programming the cutting command.
6. The sewing station (130) according to claim 5, wherein the cutting device (220) includes a telescopic structure with an outer element (220o) and an inner element (220i) sliding inside the outer element, the inner element including a recess (305) for engaging the thread (310) when the inner element is extracted from the outer element and for interfering with an edge (315) of the outer element to cut the engaged thread when the inner element is retracted into the outer element.
7. The sewing station (130) according to claim 6, wherein the recess (305) of the inner element (220i) has a first corner (305n) and a second corner (305c), and wherein the outer element (220o) has a notch (320) for clearing the first corner when the inner element is retracted, the second corner interfering with the edge (315) to cut the engaged thread when the inner element is retracted.
8. The sewing station (130) according to claim 7, wherein the first corner (305n) faces the needle

(205) and the second corner (305c) faces the hook needle (210) in the operative position.

9. A bookbinding machine (100) including the sewing station (130) according to any claim from 1 to 8, and means (110-125) for feeding the signatures in succession to the sewing station. 5

10. In a bookbinding machine, a sewing method including the steps of: 10

at least one needle and at least one hook needle sewing blocks of signatures in succession using a corresponding continuous thread, a cutting device engaging the thread in the proximity of the needle after sewing a last signature of each block, 15
moving the cutting device to an operative position between the needle and the hook needle after engaging the thread, and 20
cutting the engaged thread in the operative position.

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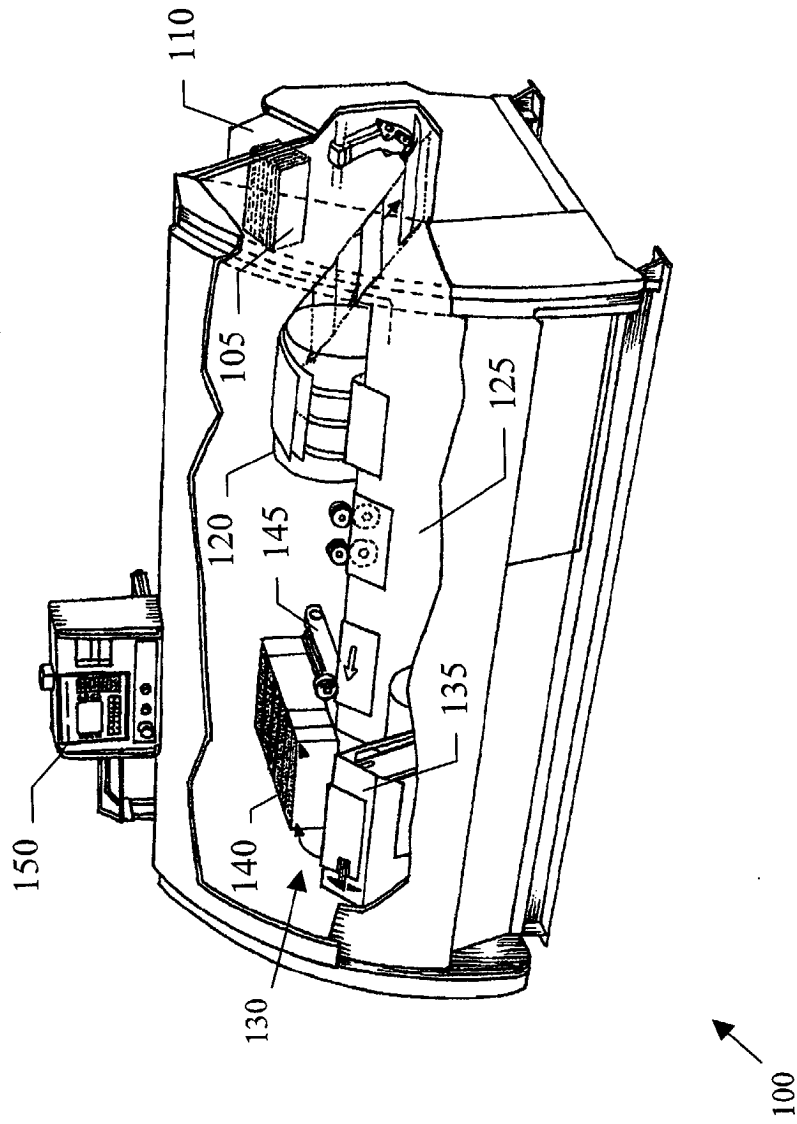
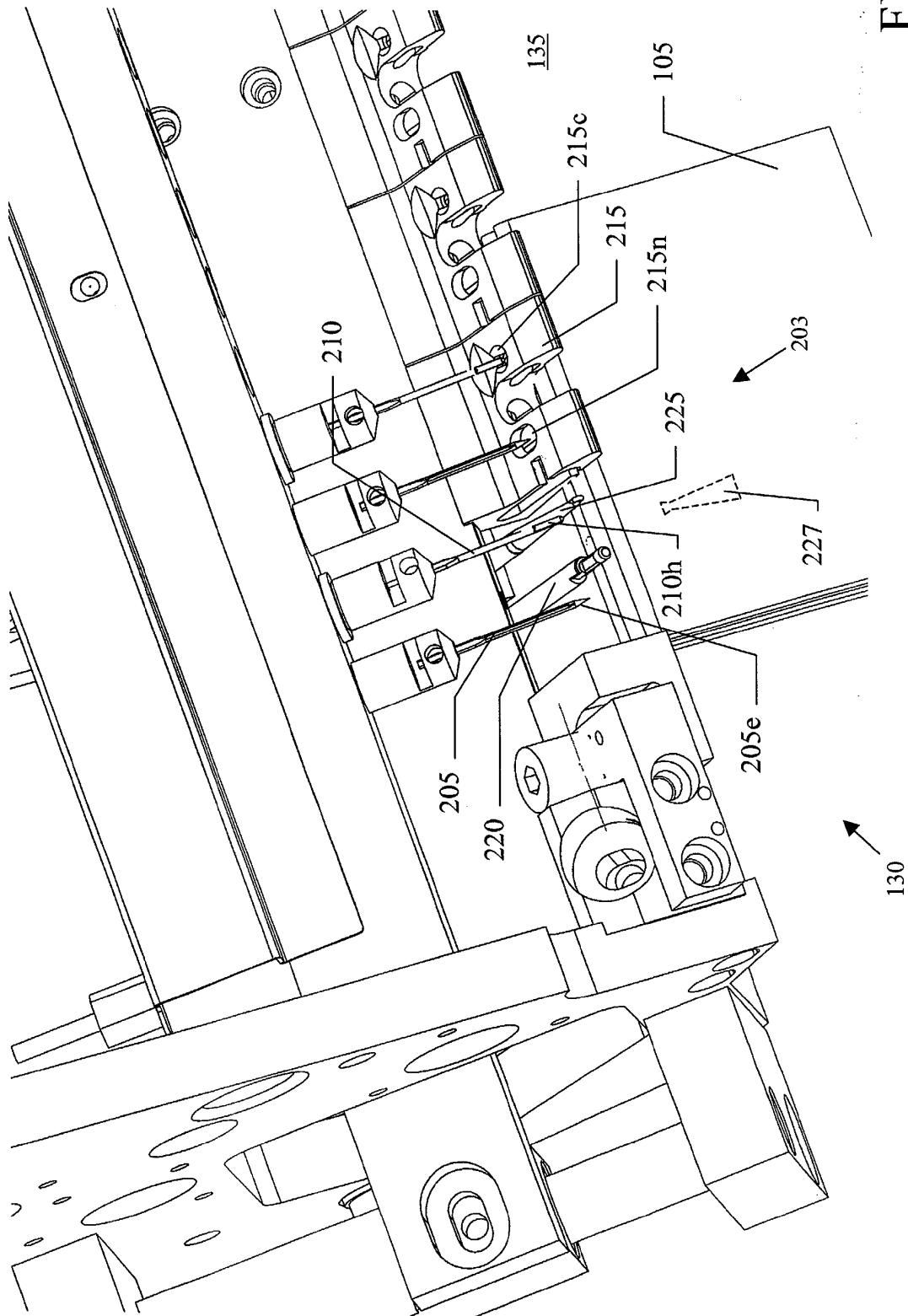


FIG. 1



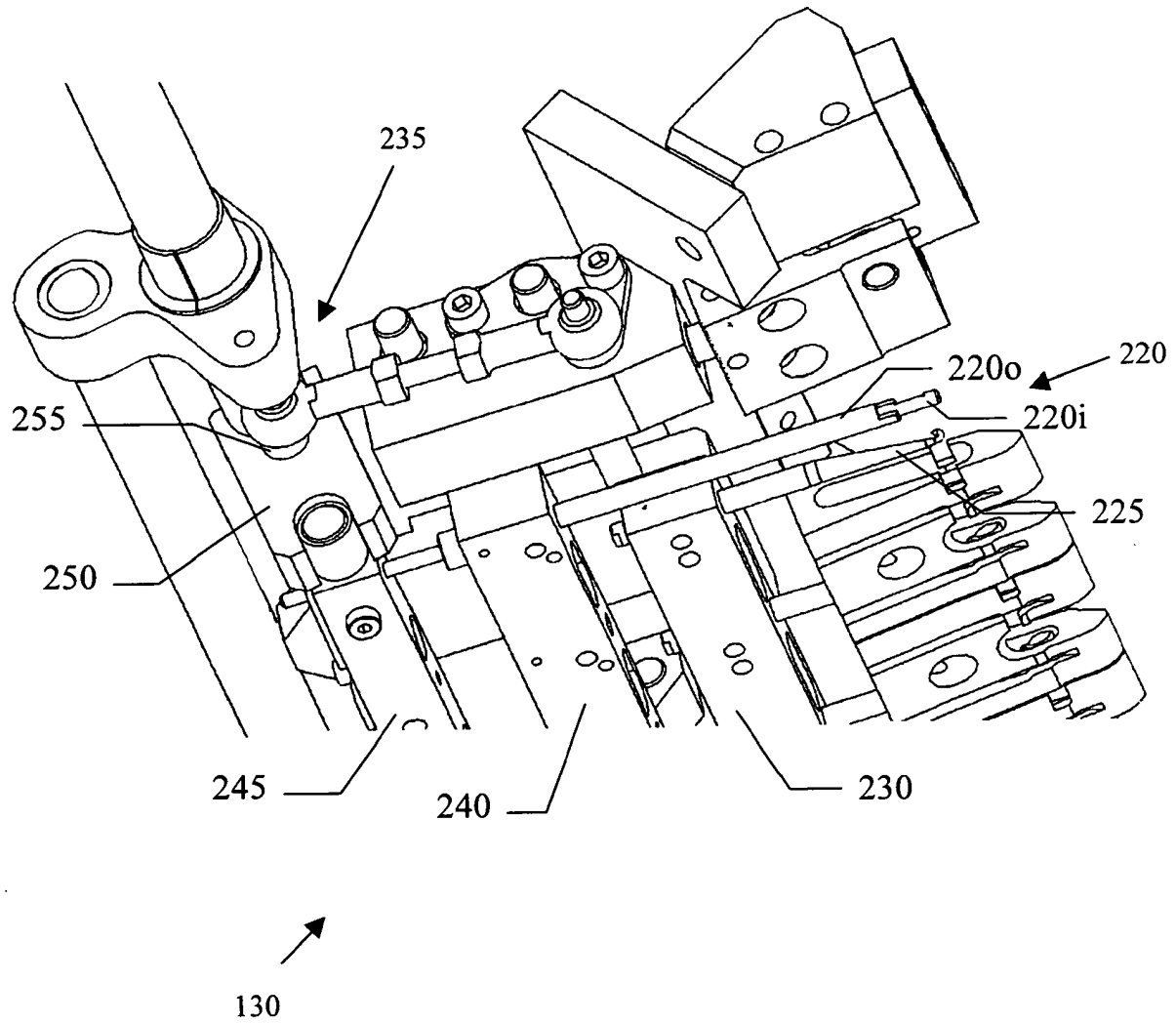


FIG.2b

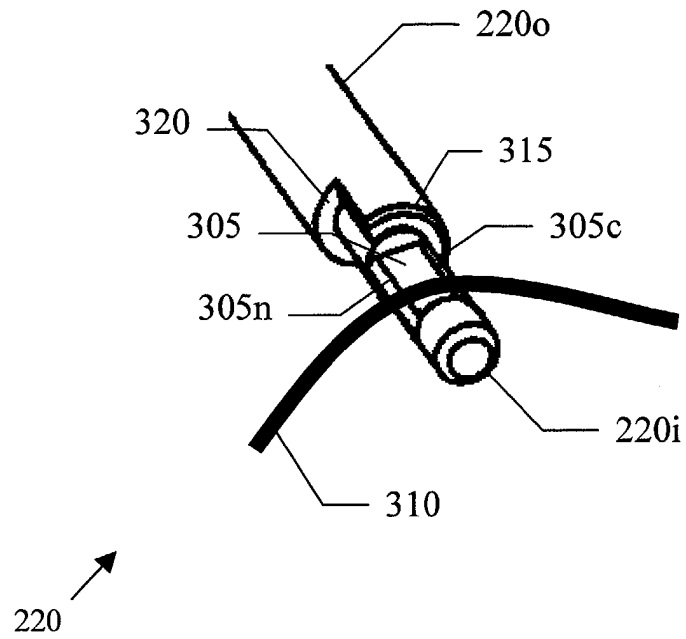


FIG.3a

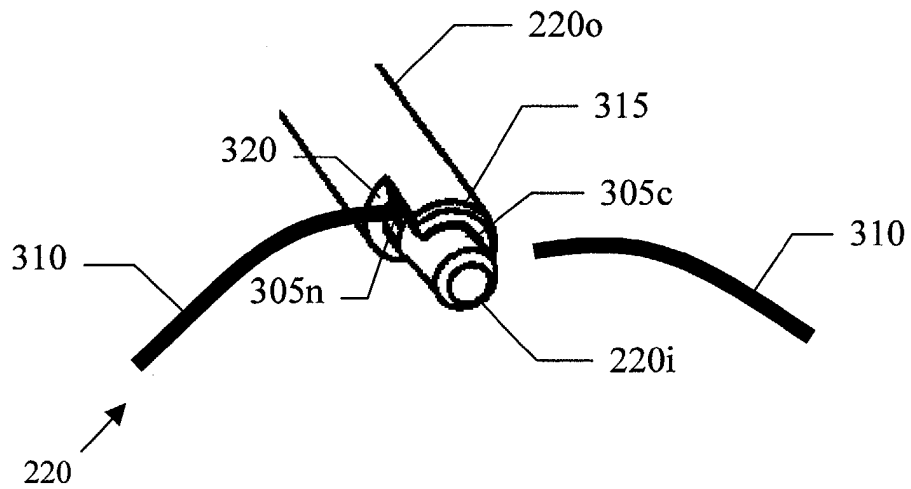


FIG.3b

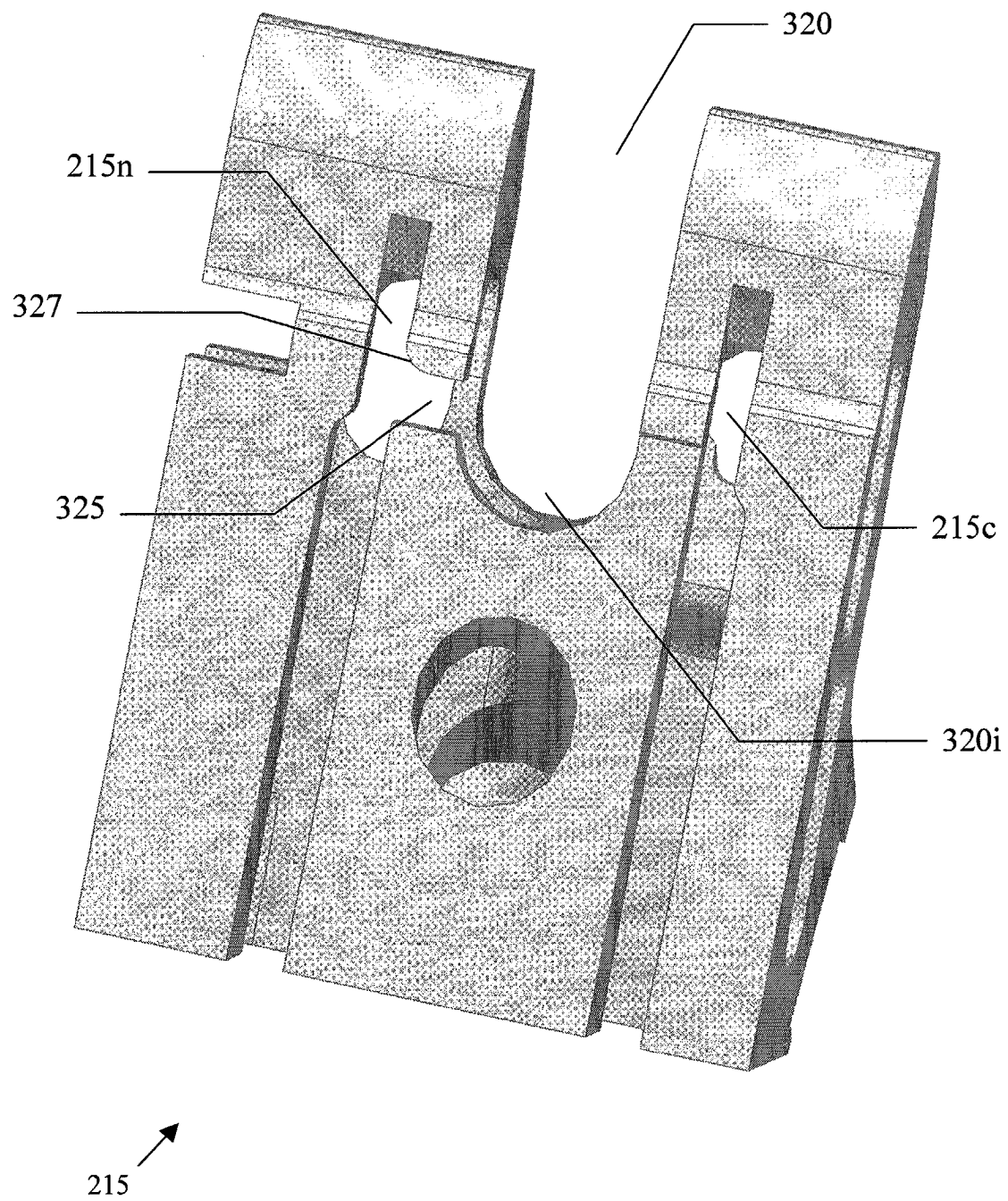


FIG.3c

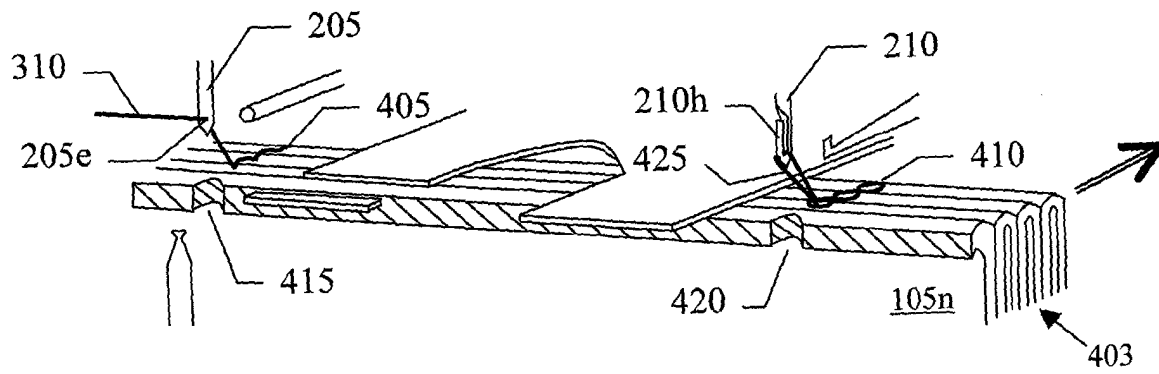


FIG.4a

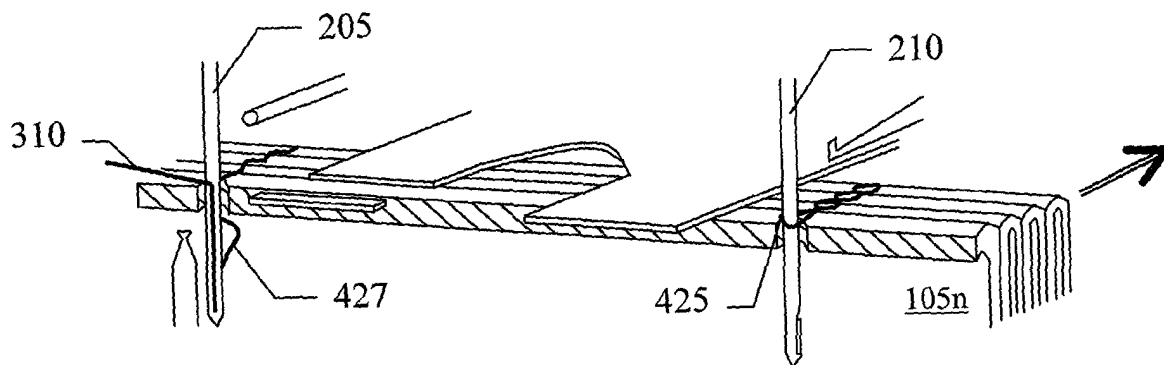


FIG.4b

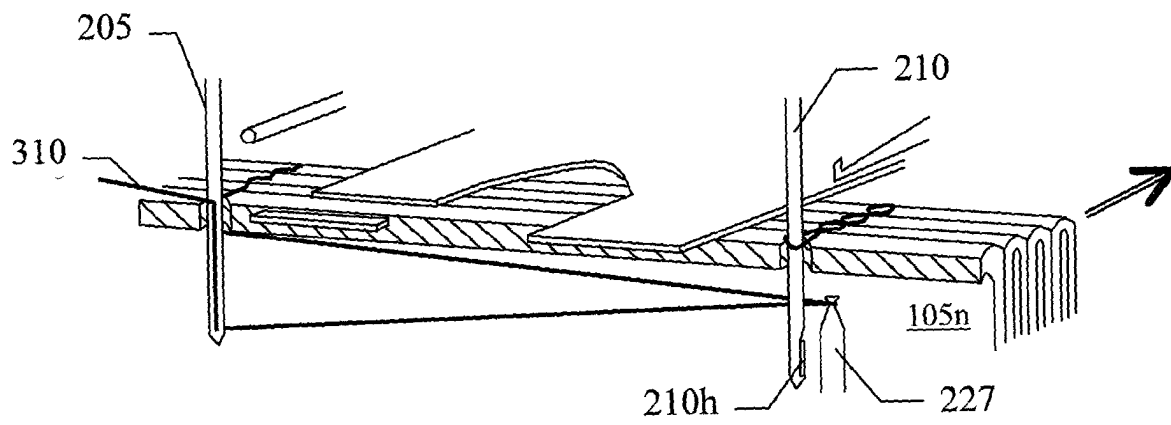


FIG.4c

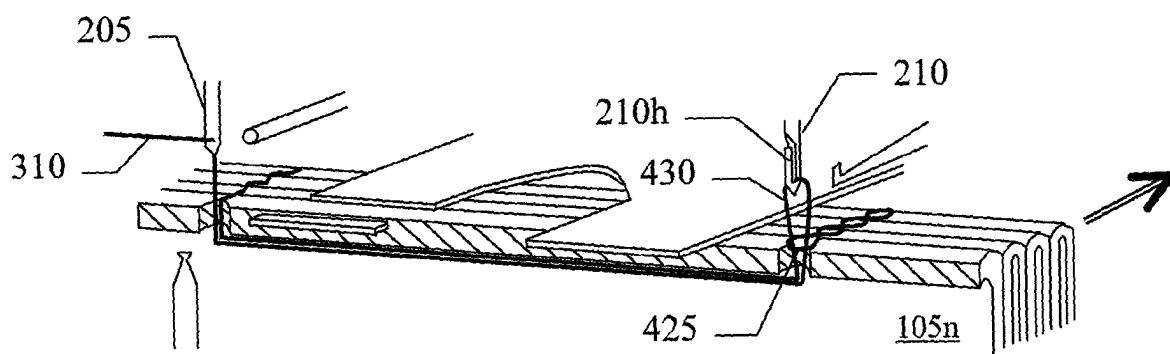


FIG.4d

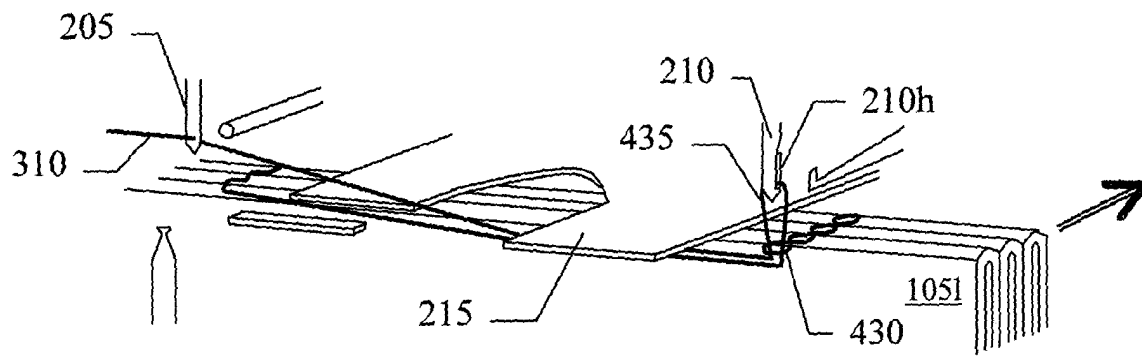


FIG. 4e

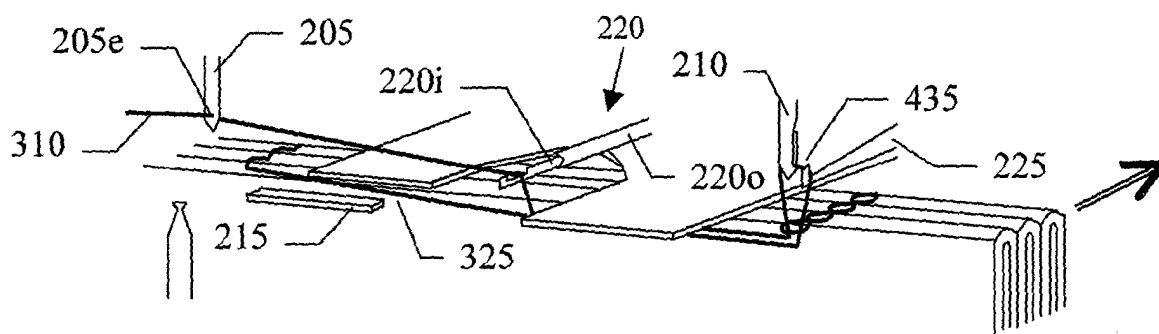


FIG. 4f

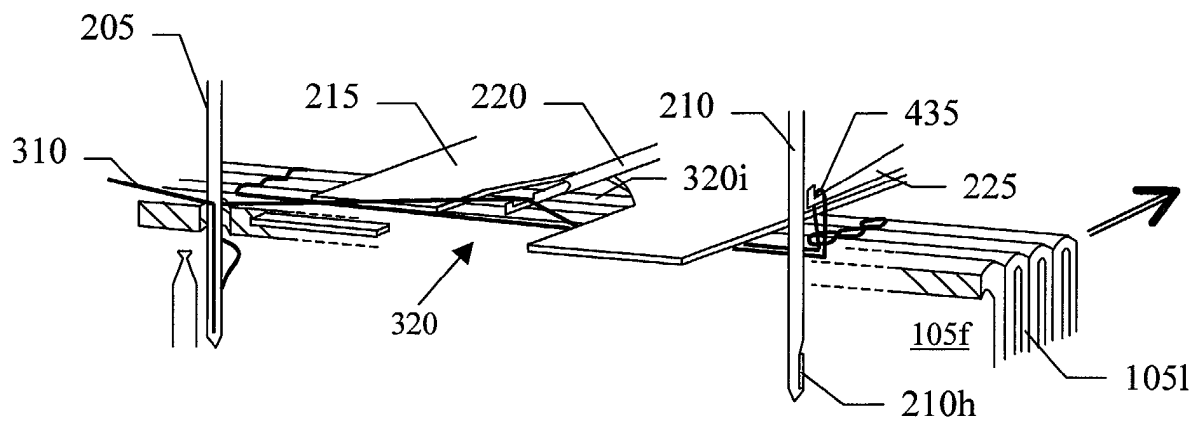


FIG. 4g

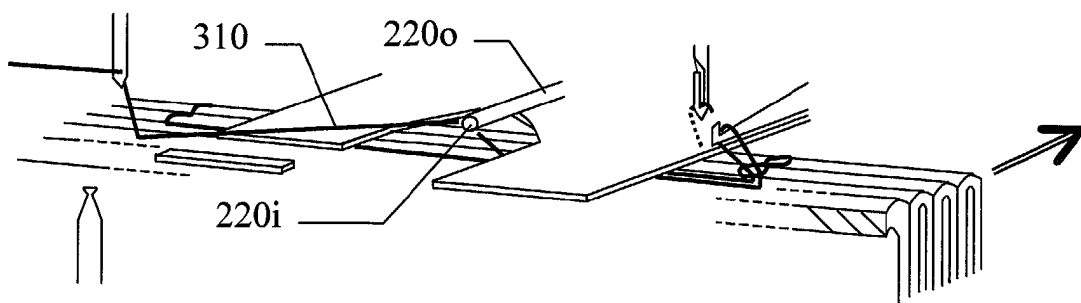


FIG. 4h

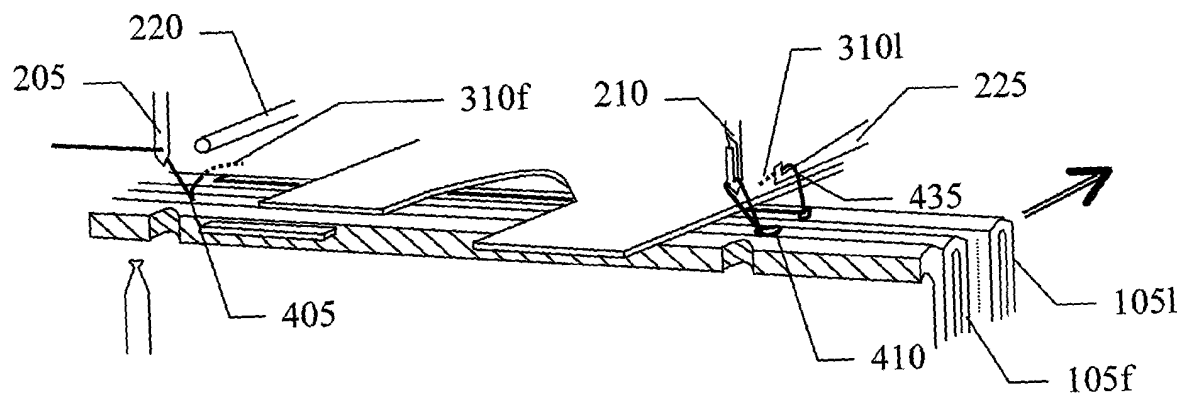


FIG.4i



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5625

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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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