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(71) Applicant: **Stäubli Sargans AG**
7320 Sargans (CH)

(72) Inventors:
- **ROMAGNA, Hanspeter**
7320 SARGANS (CH)
- **FROMMELT, Igor**
9467 Frümsen (CH)

(74) Representative: **Lavoix**
62, rue de Bonnel
69448 Lyon Cedex 03 (FR)

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(54) DRAWING-IN GRIPPER, DRAWING-IN MACHINE INCLUDING SUCH A GRIPPER AND PROCESS FOR DRAWING-IN WARP YARNS ON SUCH A DRAWING-IN MACHINE

(57) A drawing-in gripper (8) for drawing warp yarns of extends longitudinally along a main axis (X8) between a gripper nose (82) and a coupling rear end (84). The gripper defines a yarn-receiving cavity (86) which extends, between the gripper nose and the coupling read end, through the gripper along a transverse axis perpendicular to the main axis. The gripper forms a bite portion (88), which extends longitudinally at the rear of the gripper nose, and an entry opening (866) of the yarn-receiving cavity (86) is defined between a rear tip (882) of the bite portion and a rectilinear back surface (868) of the yarn receiving cavity. In a longitudinal plane perpendicular to the transverse axis (Y8), the yarn-receiving cavity (86) is L-shaped. An angle (β), defined between the main axis (X8) and the rectilinear back surface (868) and measured in the longitudinal plane and within the yarn-receiving cavity (86), is between 90° and 105°, preferably equal to 90°.

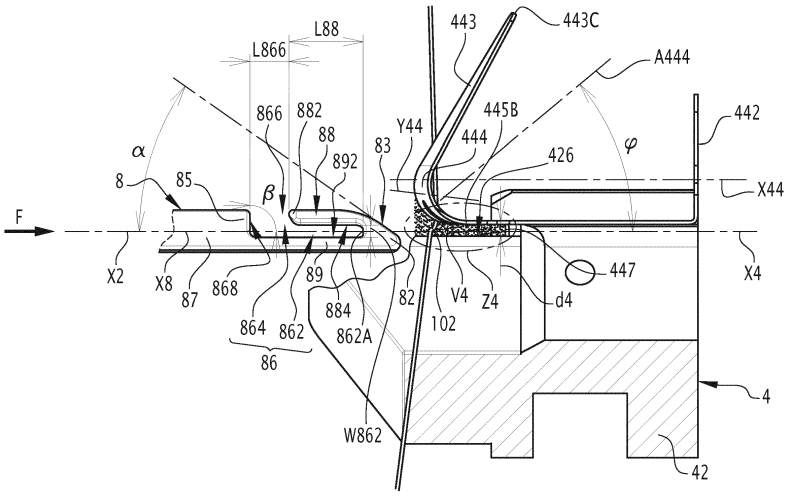

FIG.6

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to a drawing-in gripper for drawing warp yarns of warp into several elements of a weaving harness. This invention also relates to a drawing-in machine for drawing-in warp yarns and to a process for drawing-in warp yarns onto such a machine.

[0002] The technical field of the invention is the field of weaving preparation where a set of warp yarns, typically several thousands of warp yarns, must be drawn into several weaving harness elements, such as heddles, drop wires or a reed, intended to equip a weaving machine for weaving operations. The warp yarns must be drawn-in, into the harness elements, and arranged in parallel to each other, following a specific order, in relation to the heddles whose vertical oscillations will define the shed motion in the weaving loom.

BACKGROUND OF THE INVENTION

[0003] In the field of weaving preparation, it is known to use an automatic machine to fill successive heddles of neighboring heddle-frames or of a Jacquard harness with warp yarns drawn from a warp beam, these warp yarns going also through a reed and, optionally, through drop wires, depending on the requirements of the weaving process. In such a machine, one can use a hook-shaped gripper for successively catching warp yarns from the warp and for drawing them, one by one, through one or several elements of a harness, in particular the eyelet of a heddle. Such a gripper has an alternative movement between a first position, where it can catch or grip a warp yarn, and a second position remote from the first position. In the first position, each warp yarn is supposed to dive into a cavity of the gripper during its forward movement, that is a movement from the second position toward the first position, and to remain in this cavity during the reward movement of the hook, in the opposite direction.

[0004] Nowadays, one usually needs different kinds of warp material in different looms or successively on a same loom, so that different warp yarns must be drawn-in from a warp sheet into the harness elements. With heavy and bouclé yarns, it is not sure that the yarn remains in the cavity of the hook during the reward movement of the hook, or the yarn can be ripped, which may lead to defaults in the drawing-in process. These defaults must be manually corrected by an operator, which requires a highly qualified manpower and takes time.

[0005] EP-A-2 199 443 discloses a mobile threading unit for threading warp yarns coming from two warps into some elements of a weaving harness. Each yarn is threaded via a pulling movement of a gripper through the respective openings of the harness. With this known device, there is a risk that the gripper tip misses a heavy thread or a boucle-like thread.

[0006] On the other hand, EP-A-0 460 129 discloses an apparatus for drawing-in warp threads with a gripper having two movable parts. This gripper is rather complicated to manufacture and needs a specific control of its moving part. The gripper opening might not be adapted for heavy/boucle yarns and the hook may rip a heavy/boucle yarn. In addition, the gripper must be open during the reward motion, in order to free a yarn at the end of a drawing-in cycle, which can lead to synchronization problems and machine stops. Moreover, the closing of the movable parts can lead to a yarn compressing, to the jam of thread fibers, or worst, to the yarn breaking.

[0007] The same problems occur with warps formed of tapes or ribbons.

SUMMARY OF THE INVENTION

[0008] This invention aims at solving these problems with a new drawing-in gripper ensuring secure, fast and reliable drawing-in of warp yarns of different types, for instance heavy yarns, boucle yarns, tapes and ribbons, so that the error rate of a drawing-in machine can be reduced during the weaving preparation.

[0009] To this aim, the invention relates to a drawing-in gripper for drawing warp yarns of a warp into elements of a weaving harness along a drawing-in path, the gripper extending longitudinally along a main axis between a gripper nose and a coupling rear end for coupling the gripper to a linear drive. The gripper defines a yarn-receiving cavity, which extends, between the gripper nose and the coupling read end. This cavity also extends through the gripper along a transverse axis perpendicular to the main axis. The gripper forms a bite portion, which extends longitudinally at the rear of the gripper nose. An entry opening of the yarn-receiving cavity is defined between a rear tip of the bite portion and a rectilinear back surface of the yarn receiving cavity. According to the invention, in a longitudinal plane perpendicular to the transverse axis, the yarn-receiving cavity is L-shaped. Moreover, an angle, defined between the main axis and the rectilinear back surface and measured in the longitudinal plane and within the yarn-receiving cavity, is between 90° and 105°, preferably equal to 90°.

[0010] In the meaning of the invention, a warp yarn can be of any known type, in particular a heavy yarn, with a diameter of 1.5 or 2 mm, a bouclé yarn, a tape or a ribbon.

[0011] Owing to the invention, the rectilinear back surface guarantees that a warp yarn previously introduced into the cavity remains in this cavity when the gripper reaches the first position. This avoids that the warp yarn gets out of the cavity prior to being drawn-in through the weaving harness. Due to the relatively simple geometry of the gripper, the warp yarn does not risk to be ripped or otherwise damaged during the drawing-in process. No movable part needs to be mounted on the gripper, which keeps the gripper simple, economic and reliable.

[0012] According to advantageous but optional aspects of the invention, such a drawing-in gripper can in-

corporate one or several of the following features considered in any technically allowable combination:

- along the main axis, the bite portion is at least as long as the entry opening of the yarn receiving cavity;
- the bite portion extends longitudinally in parallel to the main axis and in that the bite portion has an interior surface, which extends between the gripper nose and the bite portion rear tip, which delimits the yarn-receiving cavity and which is parallel to the main axis.

[0013] According to another aspect, this invention also relates to a drawing-in machine which benefits from the advantages of the above-mentioned gripper. More precisely, this drawing-in machine is for drawing-in warp yarns of a warp into elements of a weaving harness along a drawing-in path and includes a drawing-in gripper, a drawing-in station belonging to a linear drive for driving the drawing-in gripper along the drawing-in path, in a backward direction between a first position and a second position and also in a forward direction between the second position and the first position. This drawing-in machine also includes a yarn unit including yarn positioning means for positioning a portion of a yarn to be drawn-in a transfer zone located on the drawing path, near the first position. According to the invention, the drawing-in gripper is as mentioned here above and the yarn unit includes a closing member provided with at least one closing surface located on at least one longitudinal side of the gripper, at least when the gripper is in the first position, these closing surfaces being oriented toward a yarn portion received in the yarn-receiving cavity and designed for preventing an exit movement of the yarn portion out of the yarn-receiving cavity and through the entry opening, at least when the gripper is in the first position.

[0014] According to some other advantageous but optional aspects of the invention, such a drawing-in machine may incorporate one or several of the following features, considered in any technically allowable combination:

-, at least when the gripper is in the first position, the closing surfaces of the closing member extend at a distance of a longitudinal surface of the gripper, which delimits the yarn-receiving cavity and is opposite to its entry opening, this distance being equal to, or smaller than, a width of the yarn-receiving cavity measured in the cavity between this longitudinal surface and a longitudinal surface of the bite portion.

- the closing member includes a guiding portion which extends in the continuation of the closing surfaces, toward the front of the closing member, and this guiding portion converges toward the gripper nose in the forward direction, at least when the gripper is in the first position.

- along an axis parallel to the main axis of the gripper, the closing surfaces of the closing member are at least as long as the entry opening of the yarn receiving cavity of the gripper and the guiding portion is bent around a bending axis which forms, with a longitudinal axis of the drawing-in path, an angle between 80° and 100°.

- the yarn unit includes a yarn support member, which includes a groove extending along the drawing in path for guiding the gripper in the transfer zone and the closing member is secured to the yarn support member.

- the yarn unit provided with a stop extending perpendicularly to the drawing-in path, at a rear end of at least one of the closing surfaces along the drawing-in path, configured to stop a movement of a yarn portion in the forward direction, this stop being preferably made in one piece with the closing member.

- the linear drive is configured to drive the gripper along the drawing-in path in the forward direction, such that the bite portion of the gripper reaches a position located beyond the stop of the yarn unit in the forward direction.

- the closing member is provided with a slit centered on the drawing-in path, this slit separating two closing surfaces of the closing member and preferably having a width large enough to be crossed by the gripper travelling in the forward direction or in the backward direction, near or through the transfer zone.

- the drawing-in station includes a channel forming a guide for the gripper, this channel is provided with a lateral slit and the two longitudinal edges of this slit are beveled and diverge in a direction away from the channel.

- the closing member cooperates with the yarn portion in the transfer zone and in that the length of the transfer zone along the drawing-in path represents at most 10% of the length of the total drawing-in path of the gripper, between the first and second positions.

[0015] According to a third aspect, this invention relates to a process for drawing-in warp yarns which can be of different types, in particular heavy yarns or bouclé yarns. This process is for drawing-in warp yarns into one harness elements, of a weaving harness along a drawing-in path. It is implemented on a drawing-in machine which includes a drawing-in gripper, a drawing-in station belonging to a linear drive for driving the drawing-in gripper along the drawing-in path, in a backward direction between a first position and a second position and also in a forward direction between the second position and the first position, and a yarn unit including yarn positioning means for positioning a portion of a yarn to be drawn-in a transfer zone located on the drawing path, near the first position. This process includes at least the following steps consisting in:

a) positioning a portion of a yarn to be drawn-in in

the transfer zone;
b)transferring the yarn portion into a yarn-receiving cavity of the yarn gripper;

[0016] According to the invention, the process includes at least a step implemented after step b) at least when the gripper is in the first position and consisting in:
c), securing the yarn portion in the yarn-receiving cavity by preventing, with a closing member secured to the yarn unit, an exit movement of the yarn portion out of the yarn receiving cavity through the entry opening

[0017] Optionally, such a process can incorporate one or several of the following features, considered in any technically allowable combination:

- when the gripper travels in the forward direction after step b), a back surface of the gripper, which defines the yarn-receiving cavity, pushes the yarn portion in the forward direction.
- step c) is implemented when the back surface of the yarn receiving cavity reaches the closing member along the drawing-in path, near the first position..
- prior to step b), the yarn portion is pushed by the gripper and a displacement of the yarn portion in the forward direction, is limited by a stop member.
- the closing member is flexible, and elastically deformable (A2, A3, A4, A5) between a nominal shape and a flexed shape, this closing member being preferably in the form of a metallic blade, and in that the closing member bends from a flexed shape to its nominal shape during step b).

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The invention will be better understood and other advantages thereof will appear more clearly upon reading of the following description of two embodiments of a drawing-in machine according to the invention, which include a drawing-in gripper according to the invention and where a process according to the invention can be implemented, this description being provided solely as an example and made in reference to the appended drawings in which:

- figure 1 is a schematic perspective view of some parts of a drawing-in machine according to a first embodiment of the invention;
- figure 2 is a perspective view of a drawing-in station belonging to the drawing-in machine of figure 1;
- figure 3 is a partial cross-section at Ia larger scale, along line III-III on figure 2;
- figure 4 is a perspective view of some elements of the drawing-in machine of figure 1, seen from another angle;
- figure 5 is a top perspective view of a yarn unit of the machine of figures 1 to 4;
- figure 6 is a side view, with partial tearing off, of a drawing-in gripper and a yarn unit of the machine of figures 1 to 5, during a step of a drawing-in process;
- Figure 7 is a side view similar to figure 6, but without tearing off, of the same elements of the drawing-in machine, during a subsequent step of the process;
- Figures 8 to 10 are side views similar to figure 6 during subsequent steps of the process;
- figure 11 is a perspective view similar to figure 4 during the process step represented on figure 10;
- figure 12 is a perspective view of a closing and guiding blade used in the drawing-in machine of figures 1 to 10;
- figure 13 is a side view comparable to figure 7 of an alternative step of the drawing-in process;
- figure 14 is a side view comparable to figure 8 of an alternative step following the one of figure 13; and
- figure 15 is a perspective view of a closing and guiding blade used in a drawing-in machine according to a second embodiment of the invention.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

[0019] The drawing-in machine 2 partially represented on the figures includes a yarn unit 4 for positioning a portion 102 of a yarn 100 taken from a warp 200, which is very schematically represented on figures 1 and 4 only, at a smaller scale, for the sake of simplification.

[0020] The drawing-in machine 2 also includes a drawing-in station 6 schematically represented by a cubical box on figure 1 but visible on a larger scale and in a more realistic way on figures 2 and 3.

[0021] The drawing-in machine 2 also includes a gripper 8 coupled to a ribbon 10 driven by the drawing-in station 6 to move this gripper 8 along an axis X2 of drawing-in machine, between a first position or extended position represented on figure 9, where the gripper 8 cooperates with some parts of the yarn unit 4, and a second position represented on figure 2, where the gripper 8 is located within drawing-in station 6. The drawing-in station 6 includes a non-represented motor with a main axis defining a rotating disk coupled to the ribbon 10, which moves the gripper along the axis X2 such that the drawing-in station and the ribbon form a "linear drive" by simplification. Alternatively, the drawing-in station includes another system for driving the ribbon 6 and the gripper in a linear way, for example a linear actuator.

[0022] The position of figure 2 is an intermediate position, where the gripper 8 is partly retracted and located between the first position and a fully retracted position, which is not represented and located at the opposite of the first position along the drawing path. The drawing-in station 6 and the ribbon 10 form a linear drive for driving the gripper 8 along axis X2.The gripper 8 moves in a forward direction F when going, along axis X2, from the partly retracted position of figure 2 to the extended position of figure 9 and in a backward direction B when going, along axis X2, from the extended position to the partly retracted position.

[0023] The drawing-in machine 2 includes a non-rep-

resented reed module with a movable support member for a reed 150 installed between the yarn unit 4 and the drawing-in station 6, so that the gripper 8 and the ribbon 10 can cross reed gaps 152 defined between adjacent dents 154 of the reed 150 and brought successively at the level of axis X2. This reed module is capable of moving the reed 150 along an axis parallel to its longitudinal direction and perpendicular to axis X2, as shown by arrow A1 on figure 1.

[0024] A non-represented heddle module belongs to the drawing-in machine 2 and allows successively feeding heddles between reed 150 and yarn unit 4, one of these heddles being represented with reference 160 on figures 1, 4 and 11. Each heddle 160 is held by the heddle module in such a way that its eyelet 162 can be crossed by the gripper 8 and, possibly, by the ribbon 10 when the gripper 8 is moving along axis X2 between its first and second positions.

[0025] A non-represented drop wire module also belongs to the drawing-in machine 2 and allows successively feeding drop wires between reed 150 and yarn unit 4. One of these drop wires is visible on figures 1, 4 and 11 with reference 170. Each drop wire 170 is fed by the drop wire module in such a way that its eyelet 172 can be crossed by the gripper 8 and, possibly, by the ribbon 10, when the gripper 8 is moving along axis X2 between its first and second positions.

[0026] Reed 150, heddles 160 and drop wires 170 belong to the harness of a loom to be equipped with drawn-in warp yarns.

[0027] The drawing-in machine 2 is configured so that the gripper 8 can pick-up a yarn 100 positioned within the yarn unit 4 and draw it successively through the eyelets 172, 162 and one reed gap 152 when travelling along axis X2 in the backward direction between its first and second positions. Thus, axis X2 defines a drawing-in path of the gripper 8 between its first and second positions and vice-versa.

[0028] One defines the forward side of a component 4 or 6 of drawing-in machine 2 as the side of this component oriented toward the other component. The front side of the yarn unit 4 is visible, for instance, on the left of figures 4 and 5, whereas the front side of the drawing-in station 6 is visible on the left of figure 2. The front side of the gripper 8 is oriented toward the yarn unit 4 and visible, for instance, on figure 1.

[0029] As shown on figure 2, the drawing-in station 6 includes a guiding unit 61 which comprises a main body 62 mounted on a frame 22 of the drawing-in machine 2 and a heddle holder 64, mounted on this body 62 and adapted to hold a heddle 160 with its eyelet 162 aligned on axis X2. This guiding unit is installed within drawing-in machine 2 between reed 150 and heddle 160, along the drawing path. For the sake of simplicity, guiding unit 61 is not represented on figure 1.

[0030] Two guide rails 63 and 65 are immobilized on the body 62 by screws 67 and define, between them, a channel 68 where the gripper 8 and the ribbon 10 are guided along axis X2.

[0031] As visible on figures 2 and 3, this channel 68 is provided with a lateral slit 682 allowing a portion of a warp yarn 100 drawn by the gripper 8 to circulate along axis X2. The longitudinal edges of the lateral slit 682 are formed by two chamfers 632 and 652 provided on the guide rails 63 and 65, these chamfers being divergent in a direction going away from body 62. In other words, the longitudinal edges 632 and 652 of the lateral slit 682 are beveled and diverge in a direction going away from the channel 68, so that they do not risk deteriorating a yarn 100 when it moves along channel 68, together with the gripper 8. δ denotes the divergence angle between the longitudinal edges 632 and 652. This angle has a value between 30 and 150°, preferably between 80 and 100°, more preferably equal to 90° Longitudinal edges 632 and 652 form two longitudinal surfaces parallel to axis X8, which are more than 2mm, or more preferably more than 4mm wide.

[0032] A body 42 of the yarn unit 4 is made of a front portion 422 and a rear portion 424. For the sake of simplification, the rear portion 424 is represented on figure 4 only. The front portion 422 of the body 42 defines a flat surface 426 adapted to receive a portion 102 of yarn 100 with a linear contact. Thus, the body 42 forms a yarn support within yarn unit 4. This surface 426 is inclined with respect to a horizontal plane. This surface 426 can also be horizontal. Two clamps 43 and 45 belong to yarn unit 4. They are provided for holding the yarn 100 with respect to the yarn unit body 42, so that its portion 102 extends along the flat surface 426, along a direction substantially perpendicular to axis X2, that is a direction making with this axis an angle between 70 and 110°. The clamps 43 and 45 are represented, very schematically, on figure 1 only. In practice, they can be selected among known clamps by the designer of the drawing-in machine 2.

[0033] A groove 428 is made within the front portion 422 of the body 42 and extends along a longitudinal axis X4 of the yarn unit 4, which is aligned with axis X2 when the yarn unit 4 is mounted within the drawing-in machine 2. This groove 428 opens toward the front of the front portion 422 and upwardly into the surface 426. Thus, the groove 428 splits the flat surface 426 into two half surfaces 426A and 426B. The groove 428, which has a U-shaped cross-section, forms a guiding receptacle for guiding the gripper 8 toward its first position, at the end of its movement in the forward direction F, and when it leaves its first position, at the beginning of its movement in the backward direction B.

[0034] The yarn unit 4 includes a proximity sensor 46 for detecting when the gripper 8 reaches its first position.

[0035] The gripper 8 extends along a longitudinal axis X8 between, a gripper nose 82 and a coupling end or back end 84 provided with a series of through holes 842 adapted to cooperate with corresponding engaging reliefs provided on the ribbon 10, for coupling the gripper and the ribbon. When the gripper 8 is mounted on the

ribbon 10, axes X2 and X8 are aligned. The gripper nose 82 forms the forward or front end of the gripper 8, whereas the holes 842 are made within the rearward or back end 84 of this gripper.

[0036] H8 denotes the height of the gripper 8, which is the longest dimension of the gripper perpendicular to axis X8, as shown on figure 3. Height H8 is measured along an elevation axis Z8 of the gripper, which is vertical in this embodiment. W8 denotes the width of the gripper 8, which is perpendicular to axis X8 and height H8. Width W8 is smaller than height H8 and measured along a transverse axis Y8.

[0037] A cavity 86 is provided within gripper 8 for partly accommodating a portion 102 of yarn 100. This cavity 8 is formed by a notch that extends through the gripper 8, between its two lateral sides. Each lateral side of the gripper 8 is parallel to axes X8 and Z8 and perpendicular to axis Y8. Along axis X8, the cavity 86 extends between the gripper nose 82 and the coupling end 84. All the edges of the cavity 86 are rounded in order to limit the risks of harming of ripping a yarn. As can be derived from figures 2, 3, 4 and 6, the gripper 8 has, outside of cavity 86, a main body 87 of a rectangular cross-section, with its height H8 parallel to the height of the dents 154 of the reed 150. This main body 87 is located backward of the cavity 86, between this cavity 86 and the back end 84.

[0038] Figures 2 and 4 respectively show the two longitudinal sides of the gripper 8.

[0039] In the upper direction corresponding to the top of figures 1, 4 and 6 to 11, a bite portion 88 delimits the cavity 86. This bite portion 88 extends parallel to the longitudinal axis X8 at the rear of the gripper nose 82.

[0040] A ramp 83 is formed between the nose 82 and the bite portion 88. This ramp is inclined, with respect to axis X8 by an angle α between 20° and 50°, preferably between 30° and 40°, most preferably equal to 35°. The orientation of ramp 83 is such that it diverges from axis X8 toward the back end 84 of gripper 8.

[0041] The plane of figure 6 is longitudinal, that is slightly inclined with respect to the longitudinal sides of gripper 8. This plane is parallel to longitudinal axis X8 and inclined with respect to transverse axis Y8 through which cavity 86, extends between the two longitudinal sides of gripper 8. In the longitudinal plane of the gripper 8 defined by axes X8 and Z8, and in the plane of figure 6, cavity 86 has the shape of an L, with a first longitudinal branch 862 parallel to axis X8 and a second branch 864 perpendicular to axis X8. The branches 862 and 864 are perpendicular to each other in the plane of figure 6. The branch 864 is parallel to axis Z8 and extends perpendicularly to axis X8, in the height direction of gripper 8, and forms a vertical branch.

[0042] An entry opening 866 of cavity 86 is defined between a rear tip 882 of the bite portion 88, which forms the back end of this bite portion, and a heel or shoulder 85 formed by the main body 87. The entry opening 866 opens in the second branch 864 of the cavity 86.

[0043] A shank 89 protrudes from the main body 87 up to the nose 82 and extends parallel to axis X8. This shank defines a side of the longitudinal branch 862 of the cavity 86.

[0044] 892 denotes a surface of the shank 89 defining a longitudinal side of the cavity 86, at the level of the branch 862. 884 denotes an interior surface of the bite portion 88 defining another longitudinal side of the cavity 86 at the level of the branch 862. Surfaces 884 and 892 together delimit the branch 862 in a longitudinal direction and are parallel to axis X8, so that branch 862 has a globally constant vertical width W862, measured vertically in the longitudinal plane of the gripper, parallel to axis Z8 .

[0045] The gripper 8 is made of one piece. In other words, it is monobloc, so that parts 85, 87, 88 and 89 are integral.

[0046] 868 denotes the back surface of the cavity 86, that is a surface extending along the shoulder 85, between the entry opening 866 and the shank 89, in a direction non parallel to axis X8.

[0047] β denotes an angle measured in the plane of axes X8 and Z8, that is perpendicularly to axis Y8, between axis X8 and the surface 868, within the cavity 86. Angle β equals 90° in the example of the figures.

[0048] Actually, angle β can be chosen between 90° and 105°, while still providing the technical effect of the invention.

[0049] The surface 892 is opposite to and partly in register with the entry opening 866 along axis Z8.

[0050] L866 denotes the length of the entry opening 866, measured along axis X8. L88 denotes the length of the bite portion 88 measured along axis X8. The length L88 is larger than the length L866. In other words, the bite portion 88 is longer than the entry opening 866 along axis X8.

[0051] In practice, the axial length L866 of the entry opening 866 is preferably between 5 and 7 mm long whereas the axial length L88 of the bite portion 88 is at least 5 mm long, preferably at least 6 mm long, more preferably at least 10 mm long. The axial length L88 is chosen in view of the axial length L866, in order to satisfy the relationship: $L88 \geq L866$.

[0052] A metallic blade or lamella 44 belongs to the yarn unit 4.

[0053] This metallic blade 44 is elastic, for instance made of stainless spring steel. It is obtained by laser cutting and bending of a sheet of stainless steel. The metallic blade 44 extends along a longitudinal axis X44, which is parallel to axis X4 when the metallic blade 44 is secured on the body 42. The metallic blade 44 includes a proximal bracket 442 and a distal arc-shaped or bended portion 444. Parts 442 and 444 respectively form the back and front ends of the metallic blade 444. Two legs 445A and 445B extend rearward from the arch-shaped portion 444, toward the proximal bracket 442. These legs 445A and 445B are flat and coplanar and the arc-shaped portion 444 extends in continuation of these two legs, toward the front of the metallic blade 44.

[0054] The proximal bracket 442 has a T-shape and is provided with two through holes 442A and 442B where mounting screws 48 are inserted in order to secure the metallic blade 44 onto the rear portion 424 of the body 42, as shown on figure 4 where these screws 48 are represented by their respective axes.

[0055] The proximal bracket 442 extends perpendicularly to two branches 446A and 446B of the metallic blade 44, which respectively connect the proximal bracket 442 with the two legs 445A and 445B. The two branches 446A and 446B extend on either side of a central opening 448 defined through a flat portion of the metallic blade 44, which is perpendicular to the proximal bracket 442. This flat portion of the metallic blade 44 also includes legs 445A and 445B. Thus, the legs 445A and 445B and the branches 446A and 446B are coplanar in a plane perpendicular to bracket 442. In the plane of parts 445A, 445B, 446A and 446B and perpendicularly to axis X44, leg 445A is wider than branch 446A; to which it is united, and leg 445B is wider that branch 446B, to which it is united.

[0056] The opening 448 formed between branches 446A and 446B extends, between branches 445A and 445B and up to arc-shaped portion 444, in the form of a slot 449, which is located above groove 428 when the metallic blade 44 is secured onto the body 42, as explained here-above.

[0057] W449 denotes the width of the slot 449 measured in a direction perpendicular to axis X44 and parallel to a straight-line joining the respective centers of the through holes 442A and 442B. Width W449 is larger than the width W8 of the gripper 8. Thus, an upper part of gripper 8 protruding upwardly, out of groove 428, in particular the bite portion 88, can slide through the slot 449 when the gripper 8 reaches its first position or when it leaves this position.

[0058] The metallic blade 44 also includes a globally triangular nose 443, which extends opposite to the branches 446A and 446B with respect to the arc-shaped portion 444. The nose 443 has two edges 443A and 443B converging toward a tip 443C, away from the arc-shaped portion 444.

[0059] Y44 denotes a bending axis of arc-shaped portion 444, which is a geometrical axis around which arc-shaped portion is bent. In the plane of parts 445A, 445B, 446A and 446B, which is roughly parallel to the plane of figure 5, axes X44 and Y44 define an angle γ between 80 and 100°. When the metallic blade 44 is secured to the body 42 of the yarn unit 4 and when this yarn unit is integrated within the drawing-in machine 2, axes X2 and X44 are located in a same plane parallel to the one of figure 6. Therefore, angle γ defined here-above, which is between 80° and 100°, is also an angle between axes X2 and Y44, in a plane perpendicular to the one of figure 6 and to axis X2.

[0060] S445A denotes the surface of leg 445A opposite to triangular nose 443. Similarly, S445B denotes the surface of leg 445B opposite to triangular nose 443. S446A and S446B denote the surfaces of branches 446A and 446B, which respectively extend surfaces S445A and S445B to the rear of metallic blade 44, that is toward proximal bracket 442.

[0061] The metallic blade 44 is also provided with a tab 447, which extends perpendicularly to the legs 445A and 445B and to the branches 446A and 446B, at the level of a forward edge of the opening 448, in a direction opposite to the arc-shaped portion 444 with respect to the plane of parts 445A, 445B, 446A and 446B. In the example of the figures, tab 447 extends at the rear end of surface S445B, more specifically along a rear edge of this surface. Alternatively, it can be provided on the rear edge of surface S445A.

[0062] When the metallic blade 444 is secured to the body 42 of the yarn unit 4 via the screws 48, parts 443 to 449 extend in a cantilever manner with respect to the rear portion 424 of the body 42, above the flat surface 426, at a distance d4 thereof, this distance d4 being measured perpendicularly to this surface 426. In particular, surfaces 445A and 446A face half-surface 426A, at distance d4, whereas surfaces 445A and 446A face half-surface 426A, also at distance d4.

[0063] In this configuration, the opening 448 is in register with the proximity sensor 46. In other words, opening 448 and sensor 46 are aligned in a direction perpendicular to the surface 426, so that the metallic blade 44 does not prevent the proximity sensor 46 from correctly detecting the gripper 8 when it reaches its first position.

[0064] In this configuration, the slot 449 is located above the groove 428. If the groove 428 is symmetrical with respect to the longitudinal plane of the gripper, the slot 449 is also symmetrical with respect to this plane. If the groove 428 is inclined with respect to the plane of figure 6, the slot 449 is inclined in the same direction and located offset with respect to a median plane P44 of the metallic blade 44, perpendicular to the plane of parts 445A, 445B, 446A and 446B and equidistant from the through-holes 442A and 442B. Then, the groove is also inclined with respect to plane P44.

[0065] Apart from tab 447, nose 443, arc-shaped portion 444 and possibly slot 449, metallic blade 44 is symmetrical with respect to plane P44.

[0066] When the metallic blade 44 is secured to the body 42 as considered here above, the tab 447 extends toward the flat surface 426, in order to constitute a stop to the movement of a yarn portion 102 along axis X2, in the forward direction, as explained hereafter.

[0067] In practice, the metallic blade 44 can be made in a relatively thin sheet of stainless spring steel, with a thickness of about 0,3 mm. This provides a good elasticity, so that the metallic blade 44 can be bent upwardly under an effort exerted by a yarn, for example by the passage of a stretched warp portion of yarn under the blade, in a direction going away from the flat surface 426, and immediately reach back its nominal shape when this effort disappears.

[0068] All edges of metallic blade 44 are preferably

rounded, in order not to damage a yarn in its vicinity.

[0069] L445 defines the length of a leg 445, measured along axis X44, between its most forward part, which is a transition line with arch-shaped portion 444, and its rear edge. This length L445 is larger than the axial length L866 of entry opening 866.

[0070] In the plane of figure 6, the arc-shaped portion 444 has a trace centered on an axis A444 which is inclined with respect to axes X2, by a non-zero angle φ. Angle φ is also the angle between axes A444 and X44 in the plane P44. The value of angle φ is chosen between 30 and 60°, preferably between 40 and 50°, more preferably equal to about 45°.

[0071] Non-represented sensors allow checking the position of the respective parts needed for a drawing-in process implemented on the drawing-in machine 2 throughout this process, in particular the gripper 8, the ribbon 10, the yarn 100, its portion 102, the reed 150, the heddles 160 and the drop wires 170.

[0072] A process for drawing-in warp yarn with the drawing-in machine 2 of the invention is described here below.

[0073] First, a warp beam 200 is prepared and a yarn 100 is taken from the prepared beam and clamped by clamps 43 and 45, so that its portion 102 is presented on the drawing-in path of gripper 8, above and along the flat surface 426. The position of this yarn portion 102 might not be accurately defined, even if it is stretched between the clamps 43 and 45, so that it can move a few millimeters along the drawing-in axis X2 and along metallic blade 44, as can be observed by comparing figures 4, 5 and 6. In addition, the nose 443 can be used to guide this yarn portion 102 toward this position when the yarn 100 is coming from above or from a side of the yarn unit 4.

[0074] The yarn portion 102 ends up into a volume V4 defined between flat surface 426 and metallic blade 44, this volume V4 extending along axes X2 and X4, between the forward end of arc-shaped portion 444 and tab 447. Because of the shape of metallic tab 44, this volume V4 converges toward tab 447, that is toward the first position of gripper 8, in the forward direction. This volume V4 is represented in dark on figures 6, 7 and 10. The clamps maintain the yarn portion 102 in the volume V4 and apply a stretching force on the yarn portion.

[0075] When moving forward, toward its first position, in the direction of arrows F along axis X2, the gripper 8 successively takes the positions represented on figures 1, 4 and 6 to 9.

[0076] When moving forward from the position of figure 6 to the position of figure 7, the nose 82 of the gripper 8 slides and is guided within the groove 428, that is along the flat surface 426, so that the ramp 83 comes into contact with the yarn portion 102 received within volume V4. Because of the orientation of the ramp 83 and of the value of angle α, this ramp guides this yarn portion 102 toward the bite portion 88. During this movement, the ramp 83 urges the yarn portion 102 against the surface of metallic blade 44 oriented toward the flat surface 426, which defines the upper limit of the volume V4, on either side of the slot 449. During this movement, the gripper 8 crosses the slot 449, as visible by the comparison of figures 7 and 8.

[0077] In other words, because of its tension and/or because it comes into contact with metallic blade 44, the yarn portion 102 slides along the gripper 8, on its upper edge formed by the bite portion 88, toward its back end 84. The metallic blade 44 and particularly the arc-shaped portion 444 form a guiding portion for the warp yarn portion 102.

[0078] During its sliding movement along the ramp 83 and along the bite portion 88, between the nose 82 and the tip 882, the yarn portion 102 is subjected to an effort resulting from its tension and/or the action of the metallic blade 44 which urges this yarn portion 102 toward the back surface 868 and the adjacent surface 892 of the shank 89. At the end of its sliding movement along the bite portion 88, the yarn portion 102 reaches the entry opening 866 of the cavity 86, so that it automatically falls within this cavity, in particular because of the its tension between the clamps 43 and 45. Moreover, this yarn portion 102 abuts against the shoulder 85, at the level of the back surface 868 of the cavity 86, which efficiently prevents this yarn portion 102 from further progressing toward the back end 84 of the gripper 8 during the forward movement of the gripper 8. This is due to the orientation of this back surface 868 with respect to X8, in particular the value of angle β.

[0079] During the further forward movement of gripper 8, in the direction of arrow F, portion 102 of yarn 100 is pushed by the back surface 868 of the cavity 86 to the front, up to when the yarn gripper 8 reaches its first position represented on figure 9. The value of angle β guarantees that the yarn portion 102 does not accidentally escape from the cavity 86 during this further forward movement. In particular, the complementarity of the materials of the yarn portion 102 and the back surface 868 and the inherent friction conditions, when they are in contact during the forward motion of the gripper 8, are satisfactory. In particular, this complementarity and these friction conditions to facilitate holding of the yarn portion 102 along the back surface 868 within the gripper cavity 86.

[0080] As a summary, transfer of the yarn portion 102 into the cavity 86 occurs within a transfer zone Z4, located between the front edge of the body 42 and the proximity sensor 46, while this yarn portion 102 is maintained within the volume V4 by the metallic blade 44. Transfer of the yarn portion occurs when the yarn portion falls into the cavity 86 through the opening 866.

[0081] When the entry opening 866 of the cavity 86 reaches the transfer zone Z4, between the positions respectively represented on figures 8 and 9, due to the value of angle φ, the axis A44 crosses this entry opening 866 and the back surface 868. Thus, arc-shaped portion 444 naturally tends to push the yarn portion 102 into the entry opening 866 and toward the back surface 868.

[0082] The groove 428 guides the gripper 8 in particular in the transfer zone Z4.

[0083] d8 denotes the vertical projection, in the plane of axes X8 and Z8, of a distance between one of surfaces S445A and S445B, on the one side, and surface 892, on the other side. Distance d8 is chosen equal to, or smaller than, width W862. Thus, when yarn portion 102 is guided by arc-shaped portion 444 into cavity 86, this yarn portion is not blocked on the rear tip 882 of the bite portion 88 so that the yarn portion cannot be damaged by the rear tip.

[0084] As visible on figure 7, during its movement along the drawing-in path X2 in the forward direction F, the nose 82 reaches a position located in front of the arc-shaped portion 444 of the metallic blade 44, in other words a position located beyond the arc-shaped portion 44 with respect to the forward direction F of the gripper. Actually, while continuing this forward movement, and as can be deduced from the comparison of figures 8 and 9, the back surface 868 of the cavity 86 also reaches a position located in front of this arc-shaped portion and the gripper nose 82 reaches a position beyond the tab 447.

[0085] In the configuration of figure 9, where the gripper 8 is in its first position, the leg 445A of the metallic blade 44 extends along the longitudinal side of the gripper 8 visible on figure 2, at the level of its cavity 86 along axes X2, X4, X8 and X44. The back surface 868 of the cavity 86 has reached the metallic blade 44 along the drawing-path and prevents the yarn portion 102 to move backward out of the cavity. In addition, the leg 445B extends along the longitudinal side of the gripper 8 visible on figure 6, at the same level. In this configuration, the bite portion 88 is located beyond the tab 447 along axis X2, in the forward direction F, and the surfaces S445A and S445B of the legs 445A and 445B are oriented toward the yarn portion 102 received in the cavity 86. They prevent this yarn portion 102 from exiting this cavity through the entry opening 866. Thus, the surfaces S445A and S445B close the volume V4 in a direction going away from the flat surface 426, that is upwardly, on both longitudinal sides of the entry opening 866. The closing surfaces secure the yarn portion in the yarn-receiving cavity in the transfer zone Z4. In other words the yarn portion is secured, blocked, locked, maintained, contained, retained, hold, kept, safeguarded or clamped in the cavity 86 of the gripper 8 by the metallic blade 44, so that the yarn portion cannot exit from the cavity through the opening 866 in the transfer zone Z4.

[0086] The closing surfaces S445A and S445B are located on the two longitudinal sides of the gripper 8. This means that the closing surfaces S445A and S445B are situated at relative small distance of the gripper with respect to an axis parallel to axis Y8 or in the vicinity of the gripper lateral sides. Thus, the possible contact of the closing surfaces on the yarn portion 102 improve the positioning of the yarn and the locking of its portion 102 within the cavity 86. The looseness of the stretched yarn does not permit the yarn to exit the cavity 86 of the gripper after the yarn has been transferred into the cavity, as long as the closing surfaces S445A and S445B are on the sides of the gripper. In other words, the closing surfaces S445A and S445B are close by, alongside, next to, at the side of or beside the gripper 8 at least when the gripper is in the first position. Thus, no exit movement of the yarn portion 102 through the opening 866 can take place in this position. The metallic blade 44 forms a closing member and particularly the surfaces S445A and S445B form closing surfaces of the closing member for the warp yarn portion.

[0087] This implies that the yarn portion 102 is efficiently kept within the cavity 86, without a need of adding a moving portion on the gripper 8.

[0088] In alternative, in particular if there is no tab 447, the branches 446A and 446B are designed to close the opening 866 and prevent the exit movement of the yarn through the cavity opening in first position. In such a case, surfaces S446A and S446B also form closing surfaces for cavity 86.

[0089] Therefore, the metallic blade 44 fulfills a closing function for closing upwardly the yarn-receiving cavity 86 at the level of the volume V4 aligned with the cavity 86, in register with the entry opening 866 and on both longitudinal sides of the gripper 8, when the gripper is in its first position represented on figure 9.

[0090] Actually, because of the geometry of the blade 44, this closing function is also obtained earlier, when the gripper 8 is travelling between the position of figure 8 and the position of figure 9, as soon as the shoulder 85 crosses the slot 449.

[0091] When the gripper 8 is in its first position represented on figure 9, the lower part of the arc-shaped portion 444 converges toward the gripper nose 82.

[0092] From the position of figure 9, gripper 8 starts a backward movement along axis X2, as represented by arrow B on figures 9, 10 and 11. Because of this movement, the yarn portion 102 moves freely within the cavity 86 from the vicinity of the back surface 868 toward a dead end 862A of the branch 862 defining the yarn-receiving cavity, opposite to the back surface 868, so that the yarn portion is neither squeezed nor harmed, but secured in the cavity. As a result, and as visible on figure 10, the bite portion 88 efficiently holds the yarn portion 102 within the cavity 86 and the yarn portion is trapped within the cavity but not compressed.

[0093] When leaving the first position, as shown in the configuration of figures 10 and 11, the gripper 8 escapes from the action of the metallic blade 44. Thus, the metallic blade 44 does not close anymore upwardly the volume V4, at the level of the entry opening 866, on the longitudinal sides of the gripper 8. This is not a problem since, at that time, the yarn portion 102 is already blocked at the level of the dead end 862A of the longitudinal branch 862 of the cavity 86.

[0094] Because of the relationship between the lengths L88 and L866, the risk of the yarn portion 102

moving out of the cavity 86, after the gripper has left the yarn unit 4, is very low.

[0095] Actually, the metallic blade 44 cooperates with the gripper 8 only when this gripper is in the transfer zone Z4 and this represent a small percentage of the total length of the drawing in path along axis X2. The metallic blade 44, and particularly its closing surfaces S445A and S445B, secure the yarn portion in the cavity in the transfer zone Z4. Preferably, the length of the transfer zone Z4 along axis X2 is at most 10% of the total length of the drawing-in path along axis X2, between the first and second positions of the gripper.

[0096] Then, one of the clamps 43 or 45 can be released and the gripper 8 can follow the drawing-in path, along axis X2, from the first position of figure 9 to an intermediate position of figure 2 and up to the fully retracted position of its path. With this backward movement, the gripper 8 draws the yarn 100 successively through eyelets 172 and 162 and through one of the reed gaps 152. The yarn portion 102 exits from the cavity 86 with non-represented guiding means in the retracted position, before processing another drawing-in cycle with another warp yarn 100. Advantageously, there is no need to open the gripper 8 during the reward motion, such that the yarn is free to be conducted in the vicinity of the back surface 868 and through the opening 866, at the end a drawing-in cycle, in order to be released.

[0097] When travelling within channel 68, gripper 8 does not risk to damage the yarn 100, even if this yarn is heavy or boucle, because of the beveled orientation of edges 632 and 652.

[0098] The succession of steps described here above correspond to the case where the ramp 83 moves the yarn portion 102 away from the surface 426, toward the external surface of the bite portion 88, as shown on figures 7 and 8.

[0099] In case the ramp 83 is not efficient for the nose 82 to move the yarn portion 102 away from the surface 426, the nose 82 pushes this yarn portion 102 under the metallic blade 44, along axis X2 and within the volume V4 into the transfer zone Z4, up to the position of figure 13, where the yarn portion 102 abuts against the tab 447. The tab 447 forms a stop to the displacement of this portion 102, along axis X2, in the forward direction F. In this configuration, the gripper 8 and the yarn portion 102 together exert onto the metallic blade 44 an effort, which results in an elastic deformation of this blade represented by arrows A2 and A3 on figure 13, in a direction of separation of the arc-shaped portion 444 from the flat surface 426. In other words, in the configuration of figure 13, the metallic blade 44 takes a flexed shape and deforms in a direction opposite to the entry opening 866 of the yarn-receiving cavity 86. When the gripper 8 continues its forward movement toward its first position, going further than the tab 447, the yarn portion 102 remains blocked along axis X2 by the tab 447 and this yarn portion is forced by the tab 447 to move along the bite portion 88 toward its tip 882 and toward the entry opening 866. When reaching the entry opening 866, the portion 102 is urged toward the flat surface 426 by the metallic blade 44, which tends to take back its nominal shape, as represented by arrows A4 and A5 on figure 14. This pushes the yarn portion 102 into the cavity 86 through the entry opening 866. With this movement, metallic blade 44 starts to close the volume V4 on both sides of the gripper 8, when the further forward movement of the gripper 8 brings it to its first position represented on figure 9. In other words, the metallic blade 44 takes a flexed shape under the effort exerted by the yarn 100 and reaches back its nominal shape when the yarn portion 102 is received in the cavity 86.

[0100] Figures 13 and 14 represent alternative steps of the drawing-in process and guarantee that the yarn portion 102 is pushed into the cavity 86 by the metallic blade 44, even if the yarn portion 102 does not slide along the ramp 83 when the gripper is moving in the forward direction F, between the positions of figures 6 and 7. In such a case, the steps represented on figures 13 and 14 take place, between the steps represented on figures 6 and 9, instead of the step represented on figures 7 and 8. Afterwards, the steps represented on figures 9 to 11 take place.

[0101] In the configuration of figure 13, the tab 447 forms a stop that limits a movement of the yarn portion 102 in the forward direction F, before the yarn portion 102 is guided into the yarn-receiving cavity 86. In addition, as can be deduced from figure 9 and irrespective of whether the steps of figures 7 and 8 or the steps of figures 13 and 14 take place, the tab 447 limits a movement of the yarn 100 in the forward direction after the yarn portion 102 has been guided into the yarn receiving cavity 86. This may occur if, in the first position, the yarn portion 102 received within the cavity 86 moves away from the back surface 868.

[0102] The two examples given here-above with respect to the steps respectively represented on figures 7 and 8, on the one side, and on figures 13 and 14, on the other side, represent extreme situations. In reality, the warp yarn can reach the cavity entry opening 866 by a combination of the phenomena's explained in connection to figures 7, 8 and 13, 14.

[0103] According to the second embodiment of a drawing-in machine partly represented on figure 15, the metallic blade 44 can be made of two separate blade parts 44A and 44B, including each a proximal bracket 442, with a through hole 442A or 442B, a distal arc-shaped portion 444, a leg 445A or 445B and a branch 446A or 446B joining parts 442 and 445A or 442 and 445B. Surfaces S445A, S445B, S446A and S446B are defined as in the first embodiment. This embodiment does not include a nose similar to nose 443 of the first embodiment and the slot 449 opens upwardly, at the end of the arc-shaped portion 444 opposed to legs 445A and 445B. Apart from that, this metallic blades is made as the one of the first embodiment and works in the same way, within a non-further represented drawing-in machine.

[0104] In all embodiments, the drawing-in machine 2 of the invention and the drawing-in process implemented with this machine are particularly suited for heavy or bouclé yarns, for tapes and for ribbons whose width is smaller than, or more or less the same as, the entry opening dimension L866, and since they guarantee efficient transferring of the yarn material within the cavity 86 of the gripper 8 with little risk of damaging this yarn material.

[0105] The metallic blade 44 can participate in guiding the yarn portion 102 into the cavity entry opening 866 and toward the back surface 868, with flexibility. The metallic blade 44 keeps the yarn portion 102 within the cavity 86 by closing the volume V4 on both longitudinal sides of the gripper 8 at the level of the cavity entry opening 866. In particular, the metallic blade 44 helps in maintaining and securing the yarn 100 within the cavity 86 during the end of the forward movement of the gripper 8 toward its first position, in this first position and at the beginning of the backward movement of the gripper. Moreover, when the tab 447 is used as a stop, as explained in conjunction with figures 13 and 14, the metallic blade 44 participates in stopping the yarn 100 along the drawing-in path, in the forward direction, before it is transferred into the cavity 86.

[0106] The geometry of the gripper 8 allows it to efficiently guide the yarn portion 102 along its ramp 83 and its bite portion 88, up to the entry opening 866. The geometry and the orientation of the back surface 868 helps confining the yarn in the cavity 86 and hinders an accidental yarn release at the end of the forward movement of the gripper 8. The well-defined geometry of this back surface 868 guarantees an accurate positioning of the yarn portion 102 along the longitudinal axis X8 of the gripper 8, during the forward movement in the direction of arrow F. Moreover, the geometry of the cavity 86 helps guiding the yarn portion 102 into its branch 862, between the two parallel surfaces 884 and 892 of the bite portion 88 and the shank 89. This contributes to maintaining the yarn portion 102 in the cavity 86 during the backward movement of the gripper, toward its second position, through the harness elements 170, 160 and 150.

[0107] An efficient drawing-in process can be implemented, without harpooning, ripping or missing a warp yarn and without mixing two yarns together. Because of the simple structure of the gripper 8, no synchronization between two moving parts must be implemented and the drawing-in machine 2 can work at higher speed than the ones of the prior art, while the thickness of the warp yarns to be drawn-in can be increased with respect to the known techniques. Moreover, different yarns or yarns with different thicknesses can be mixed in successive drawing-in operations. The gripper 8 and the metallic blade 44 are economic, simple and light. They do not need any energy input or control in order to work efficiently. With the machine and the process of the invention weaving preparation can be performed semi-automatically. The drawing-in steps are realized automatically, as explained here-above, but the heddle and drop wire selection, the yarn separation and the reed displacement can be made either manually or automatically.

[0108] In the example mentioned here-above, dimensions, axes and directions W8, X2, X8, F, B, Y8, etc. are defined in parallel to the flat surface 426 and dimensions, axes and directions H8, Z8,160.... are defined in parallel to the vertical. However, alternative orientations of the machine and its components are possible.

[0109] According to a non-represented and alternative embodiment of the invention, the body 42 does not form a yarn support. The yarn unit 4 only includes a gripper guide for guiding the gripper 8 and positioning means similar to clamps 43 and 45.

[0110] According to another alternative embodiment, which is not represented, instead of using a tab 447 integral with the metallic blade 44 as a stopper, one can use a pin or another vertical obstacle coupled to the body 42 and extending upwardly toward or through the metallic blade 44. According to another non-represented alternative of the invention, the metallic blade 44 can be provided with two tabs 447, on either side of the plane P44.

[0111] Alternative guiding means, like pneumatic, hydraulic or electronic active means can be secured to the yarn unit 4 and replace the metallic blade 44 in order to guide the yarn portion 102 into the cavity 86 of the gripper 8.

[0112] According to an alternative embodiment of the invention which is not represented, the ribbon 10 can be replaced by other means for driving the gripper 8 along axis X2, in particular a rod. The part of the drive means incorporated within drawing-in station 6 can be an engine with transmission means for transforming the rotary motion of its output shaft into a linear motion.

[0113] The invention is represented when the drawing-in path goes through three different elements 150, 160 and 170 of a weaving harness. In a variant, the number of weaving harness elements can be different, depending on the configuration of the weaving loom to be equipped.

[0114] The invention is represented when the metallic blade 44 has a closing surface S445A or S445B on both longitudinal sides of the gripper 8 in the first position. However, it is possible that this metallic blade has one closing surface on one longitudinal side only of this gripper.

[0115] The embodiments, variants and alternative embodiments of the invention may be combined to generate new embodiments of the invention, in the framework of the attached set of claims.

Claims

1. A drawing-in gripper (8) for drawing warp yarns (100) of a warp (200) into elements (150, 160, 170) of a weaving harness along a drawing-in path (X2), the gripper extending longitudinally along a main axis (X8) between a gripper nose (82) and a coupling rear end (84) for coupling the gripper to a linear drive (6,

10), the gripper defining a yarn-receiving cavity (86) which extends, between the gripper nose and the coupling read end, through the gripper along a transverse axis (Y8) perpendicular to the main axis, the gripper forming a bite portion (88), which extends longitudinally at the rear of the gripper nose, and an entry opening (866) of the yarn-receiving cavity being defined between a rear tip (882) of the bite portion and a rectilinear back surface (868) of the yarn receiving cavity, **characterized in that**:

- in a longitudinal plane (X8, Z8) perpendicular to the transverse axis (Y8), the yarn-receiving cavity (86) is L-shaped and
- an angle (β), defined between the main axis (X8) and the rectilinear back surface (868) and measured in the longitudinal plane and within the yarn-receiving cavity (86), is between 90° and 105°, preferably equal to 90°.

2. The drawing-in gripper of claim 1, **characterized in that**, along the main axis (X8), the bite portion (88) is at least as long as the entry opening (866) of the yarn receiving cavity (86).

3. The drawing-in gripper of one of claims 1 and 2, **characterized in that** the bite portion (88) extends longitudinally in parallel to the main axis (X8) and **in that** the bite portion has an interior surface (884), which extends between the gripper nose (82) and the bite portion rear tip (882), which delimits the yarn-receiving cavity (86) and which is parallel to the main axis.

4. A drawing-in machine (2) for drawing-in warp yarns (100) of a warp (200) into elements (150, 160, 170) of a weaving harness along a drawing-in path (X2), said drawing machine including:

- a drawing-in gripper (8),
- a drawing-in station (6) belonging to a linear drive (6, 10) for driving the drawing-in gripper along the drawing-in path, in a backward direction (B) between a first position (Fig 9) and a second position and also in a forward direction (F) between the second position and the first position,
- a yarn unit (4) including yarn positioning means (42, 43, 45) for positioning a portion (102) of a yarn to be drawn-in a transfer zone (Z4) located on the drawing path, near the first position,

characterized in that:

- the drawing-in gripper (8) is according to one of claims 1 to 3; and
- the yarn unit (4) includes a closing member (44) provided with at least one closing surface (S445A, S445B) located on at least one longitudinal side of the gripper, at least when the gripper is in the first position, these closing surfaces being oriented toward a yarn portion (102) received in the yarn-receiving cavity (86) and designed for preventing an exit movement of the yarn portion out of the yarn-receiving cavity and through the entry opening (866), at least when the gripper is in the first position.

5. The drawing-in machine of claim 4, **characterized in that**, at least when the gripper (8) is in the first position, the closing surfaces (S445A, S445B) of the closing member (44) extend at a distance (d8) of a longitudinal surface (892) of the gripper, which delimits the yarn-receiving cavity (86) and is opposite to its entry opening (866), this distance being equal to, or smaller than, a width (W862) of the yarn-receiving cavity (86) measured in the cavity between this longitudinal surface (892) and a longitudinal surface (884) of the bite portion (88).

6. The drawing-in machine of one of claims 4 and 5, **characterized in that** the closing member (44) includes a guiding portion (444) which extends in the continuation of the closing surfaces (S445A, S445B), toward the front of the closing member, and **in that** this guiding portion converges toward the gripper nose (82) in the forward direction (F), at least when the gripper (8) is in the first position.

7. The drawing-in machine of claim 6, characterized, along an axis (X4) parallel to the main axis (X8) of the gripper (8), the closing surfaces (S445A, S445B) of the closing member (44) are at least as long (L445) as the entry opening (866) of the yarn receiving cavity (86) of the gripper (8) and in that the guiding portion (444) is bent around a bending axis (Y44) which forms, with a longitudinal axis (X2) of the drawing-in path (X2), an angle (γ) between 80° and 100°.

8. The drawing-in machine of one of claims 4 to 7, **characterized in that** the yarn unit (4) includes a yarn support member (42), which includes a groove (428) extending along the drawing in path (X2) for guiding the gripper (8) in the transfer zone (Z4) and **in that** the closing member (44) is secured to the yarn support member.

9. The drawing-in machine of one of claims 4 to 8, **characterized in that** the yarn unit (4) is provided with a stop (447) extending perpendicularly to the drawing-in path (X2), at a rear end of at least one of the closing surfaces (S445A, S445B) along the drawing-in path, configured to stop a movement of a yarn portion (102) in the forward direction (F), this stop being preferably made in one piece with the closing member (44).

10. The drawing-in machine of claim 9, **characterized in that** the linear drive (6, 10) is configured to drive the gripper (8) along the drawing-in path (X2) in the forward direction (F), such that the bite portion (88) of the gripper reaches a position located beyond the stop (447) of the yarn unit (4) in the forward direction.

11. The drawing-in machine of one of claims 4 to 10, **characterized in that** the closing member (44) is provided with a slit (449) centered on the drawing-in path (X2), this slit separating two closing surfaces (S445A, S445B) of the closing member (44) and preferably having a width (W449) large enough to be crossed by the gripper (8) travelling in the forward direction (F) or in the backward direction (B), near or through the transfer zone (Z4).

12. The drawing-in machine of one of claims 4 to 11, **characterized in that** the drawing-in station (6) includes a channel (68) forming a guide for the gripper (8), **in that** this channel is provided with a lateral slit (682) and **in that** the two longitudinal edges (632, 652) of this slit are beveled and diverge in a direction away from the channel.

13. The drawing-in machine of one of claims 4 to 12, **characterized in that** the closing member (44) cooperates with the yarn portion (102) in the transfer zone (Z4) and **in that** the length of the transfer zone along the drawing-in path (X2) represents at most 10% of the length of the total drawing-in path of the gripper (8), between the first and second positions.

14. A process for drawing-in warp yarns into elements (150, 160, 170) of a weaving harness along a drawing-in path (X2), implemented on a drawing-in machine which includes:

- a drawing-in gripper (8),
- a drawing-in station (6) belonging to a linear drive (6, 10) for driving the drawing-in gripper along the drawing-in path, in a backward direction (B) between a first position (Fig 9) and a second position and also in a forward direction (F) between the second position and the first position,
- a yarn unit (4) including yarn positioning means (42, 43, 45) for positioning a portion (102) of a yarn to be drawn-in a transfer zone (Z4) located on the drawing path, near the first position,

the process including at least the following steps consisting in :

a) positioning a portion (102) of a yarn to be drawn-in in the transfer zone (Z4);
b) transferring the yarn portion into a yarn-receiving cavity (86) of the yarn gripper (8);

characterized in that the process includes at least a step implemented after step b) at least when the gripper is in the first position and consisting in:
c) securing the yarn portion (102) in the yarn-receiving cavity (86) by preventing, with a closing member (44) secured to the yarn unit, an exit movement of the yarn portion out of the yarn receiving cavity through the entry opening (866).

15. The process of claim 14, **characterized in that**, when the gripper (8) travels in the forward direction (F) after step b), a back surface (868) of the gripper (8), which defines the yarn-receiving cavity, pushes the yarn portion in the forward direction.

16. The process of claim 15 , **characterized in that** step c) is implemented when the back surface (868) of the yarn receiving cavity reaches the closing member (44) along the drawing-in path, near the first position (Fig 9).

17. The process of one of claims 14 to 16, **characterized in that**, prior to step b), the yarn portion (102) is pushed by the gripper (8) and a displacement of the yarn portion in the forward direction (F), is limited by a stop member (447)

18. The process of one of claims 14 to 17, **characterized in that** the closing member (44) is flexible, and elastically deformable (A2, A3, A4, A5) between a nominal shape and a flexed shape, this closing member being preferably in the form of a metallic blade, and **in that** the closing member bends from a flexed shape to its nominal shape during step b).

Amended claims in accordance with Rule 137(2) EPC.

1. A drawing-in gripper (8) for drawing warp yarns (100) of a warp (200) into elements (150, 160, 170) of a weaving harness along a drawing-in path (X2), the gripper extending longitudinally along a main axis (X8) between a gripper nose (82) and a coupling rear end (84) for coupling the gripper to a linear drive (6, 10), the gripper defining a yarn-receiving cavity (86) which extends, between the gripper nose and the coupling read end, through the gripper along a transverse axis (Y8) perpendicular to the main axis, the gripper forming a bite portion (88), which extends longitudinally at the rear of the gripper nose, and an entry opening (866) of the yarn-receiving cavity being defined between a rear tip (882) of the bite portion and a rectilinear back surface (868) of the yarn receiving cavity, **characterized in that**:

- in a longitudinal plane (X8, Z8) perpendicular to the transverse axis (Y8), the yarn-receiving

cavity (86) is L-shaped and
- an angle (β), defined between the main axis (X8) and the rectilinear back surface (868) and measured in the longitudinal plane and within the yarn-receiving cavity (86), is between 90° and 105°, preferably equal to 90°.

2. The drawing-in gripper of claim 1, **characterized in that**, along the main axis (X8), the bite portion (88) is at least as long as the entry opening (866) of the yarn receiving cavity (86).

3. The drawing-in gripper of one of claims 1 and 2, **characterized in that** the bite portion (88) extends longitudinally in parallel to the main axis (X8) and **in that** the bite portion has an interior surface (884), which extends between the gripper nose (82) and the bite portion rear tip (882), which delimits the yarn-receiving cavity (86) and which is parallel to the main axis.

4. A drawing-in machine (2) for drawing-in warp yarns (100) of a warp (200) into elements (150, 160, 170) of a weaving harness along a drawing-in path (X2), said drawing machine including:

- a drawing-in gripper (8),
- a drawing-in station (6), said drawing-in station being part of a linear drive (6, 10) for driving the drawing-in gripper along the drawing-in path, in a backward direction (B) between a first position (Fig 9) and a second position and also in a forward direction (F) between the second position and the first position,
- a yarn unit (4) including yarn positioning means (42, 43, 45) for positioning a portion (102) of a yarn to be drawn-in a transfer zone (Z4) located on the drawing path, near the first position,

characterized in that:

- the drawing-in gripper (8) is according to one of claims 1 to 3; and
- the yarn unit (4) includes a closing member (44) provided with at least one closing surface (S445A, S445B) located on at least one longitudinal side of the gripper, at least when the gripper is in the first position, these closing surfaces being oriented toward a yarn portion (102) received in the yarn-receiving cavity (86) and designed for preventing an exit movement of the yarn portion out of the yarn-receiving cavity and through the entry opening (866), at least when the gripper is in the first position.

5. The drawing-in machine of claim 4, **characterized in that**, at least when the gripper (8) is in the first position, the closing surfaces (S445A, S445B) of the closing member (44) extend at a distance (d8) of a longitudinal surface (892) of the gripper, which delimits the yarn-receiving cavity (86) and is opposite to its entry opening (866), this distance being equal to, or smaller than, a width (W862) of the yarn-receiving cavity (86) measured in the cavity between this longitudinal surface (892) and a longitudinal surface (884) of the bite portion (88).

6. The drawing-in machine of one of claims 4 and 5, **characterized in that** the closing member (44) includes a guiding portion (444) which extends in the continuation of the closing surfaces (S445A, S445B), toward the front of the closing member, and **in that** this guiding portion converges toward the gripper nose (82) in the forward direction (F), at least when the gripper (8) is in the first position.

7. The drawing-in machine of claim 6, characterized, along an axis (X4) parallel to the main axis (X8) of the gripper (8), the closing surfaces (S445A, S445B) of the closing member (44) are at least as long (L445) as the entry opening (866) of the yarn receiving cavity (86) of the gripper (8) and in that the guiding portion (444) is bent around a bending axis (Y44) which forms, with a longitudinal axis (X2) of the drawing-in path (X2), an angle (γ) between 80° and 100°.

8. The drawing-in machine of one of claims 4 to 7, **characterized in that** the yarn unit (4) includes a yarn support member (42), which includes a groove (428) extending along the drawing in path (X2) for guiding the gripper (8) in the transfer zone (Z4) and **in that** the closing member (44) is secured to the yarn support member.

9. The drawing-in machine of one of claims 4 to 8, **characterized in that** the yarn unit (4) is provided with a stop (447) extending perpendicularly to the drawing-in path (X2), at a rear end of at least one of the closing surfaces (S445A, S445B) along the drawing-in path, configured to stop a movement of a yarn portion (102) in the forward direction (F), this stop being preferably made in one piece with the closing member (44).

10. The drawing-in machine of claim 9, **characterized in that** the linear drive (6, 10) is configured to drive the gripper (8) along the drawing-in path (X2) in the forward direction (F), such that the bite portion (88) of the gripper reaches a position located beyond the stop (447) of the yarn unit (4) in the forward direction.

11. The drawing-in machine of one of claims 4 to 10, **characterized in that** the closing member (44) is provided with a slit (449) centered on the drawing-in path (X2), this slit separating two closing surfaces (S445A, S445B) of the closing member (44) and

preferably having a width (W449) large enough to be crossed by the gripper (8) travelling in the forward direction (F) or in the backward direction (B), near or through the transfer zone (Z4).

12. The drawing-in machine of one of claims 4 to 11, **characterized in that** the drawing-in station (6) includes a channel (68) forming a guide for the gripper (8), **in that** this channel is provided with a lateral slit (682) and **in that** the two longitudinal edges (632, 652) of this slit are beveled and diverge in a direction away from the channel.

13. The drawing-in machine of one of claims 4 to 12, **characterized in that** the closing member (44) cooperates with the yarn portion (102) in the transfer zone (Z4) and **in that** the length of the transfer zone along the drawing-in path (X2) represents at most 10% of the length of the total drawing-in path of the gripper (8), between the first and second positions.

14. A process for drawing-in warp yarns into elements (150, 160, 170) of a weaving harness along a drawing-in path (X2), implemented on a drawing-in machine which includes:

- a drawing-in gripper (8),
- a drawing-in station (6) belonging to a linear drive (6, 10) for driving the drawing-in gripper along the drawing-in path, in a backward direction (B) between a first position (Fig 9) and a second position and also in a forward direction (F) between the second position and the first position,
- a yarn unit (4) including yarn positioning means (42, 43, 45) for positioning a portion (102) of a yarn to be drawn-in a transfer zone (Z4) located on the drawing path, near the first position,

the process including at least the following steps consisting in :

a) positioning a portion (102) of a yarn to be drawn-in in the transfer zone (Z4);
b) transferring the yarn portion into a yarn-receiving cavity (86) of the yarn gripper (8);

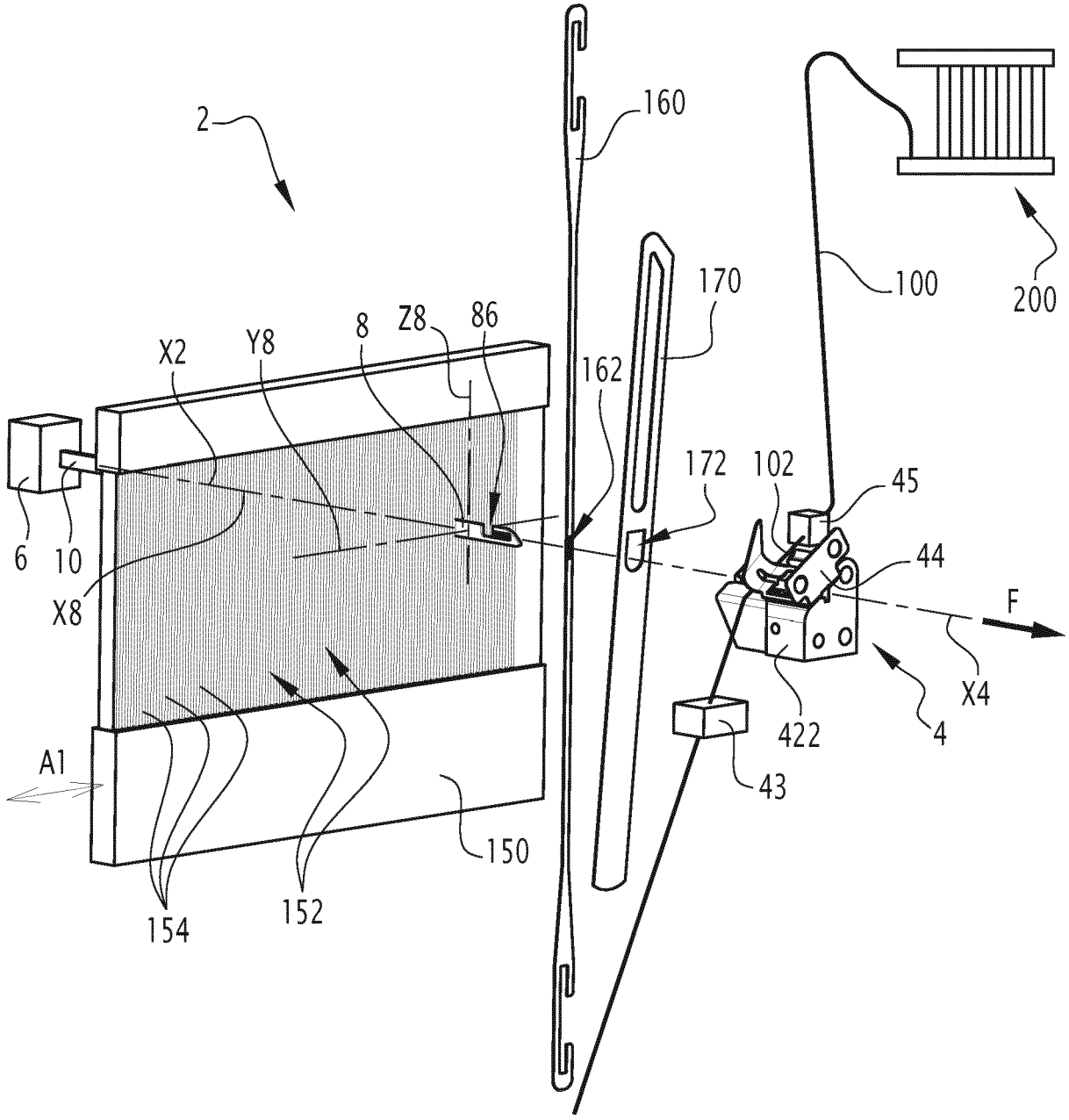
characterized in that the process includes at least a step implemented after step b) at least when the gripper is in the first position and consisting in:
c) securing the yarn portion (102) in the yarn-receiving cavity (86) by preventing, with a closing member (44) secured to the yarn unit, an exit movement of the yarn portion out of the yarn receiving cavity through the entry opening (866).

15. The process of claim 14, **characterized in that**, when the gripper (8) travels in the forward direction (F) after step b), a back surface (868) of the gripper (8), which defines the yarn-receiving cavity, pushes the yarn portion in the forward direction.

16. The process of claim 15 , **characterized in that** step c) is implemented when the back surface (868) of the yarn receiving cavity reaches the closing member (44) along the drawing-in path, near the first position (Fig 9).

17. The process of one of claims 14 to 16, **characterized in that**, prior to step b), the yarn portion (102) is pushed by the gripper (8) and a displacement of the yarn portion in the forward direction (F), is limited by a stop member (447)

18. The process of one of claims 14 to 17, **characterized in that** the closing member (44) is flexible, and elastically deformable (A2, A3, A4, A5) between a nominal shape and a flexed shape, this closing member being preferably in the form of a metallic blade, and **in that** the closing member bends from a flexed shape to its nominal shape during step b).


2
160
170
100
200
X2
Y8
8
Z8
86
162
172
102
45
44
F
X4
4
422
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6
10
X8
A1
150
154
152

FIG.1

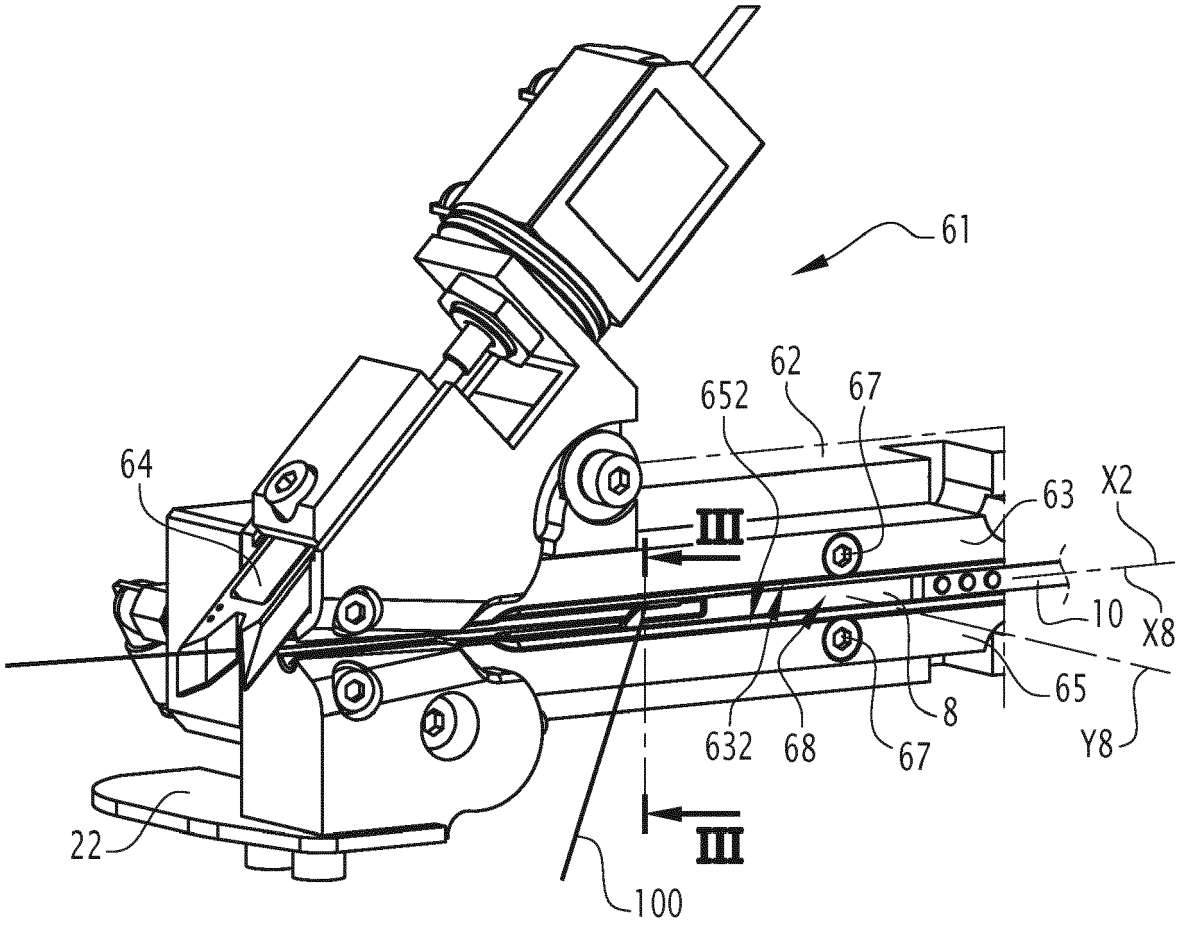


FIG.2

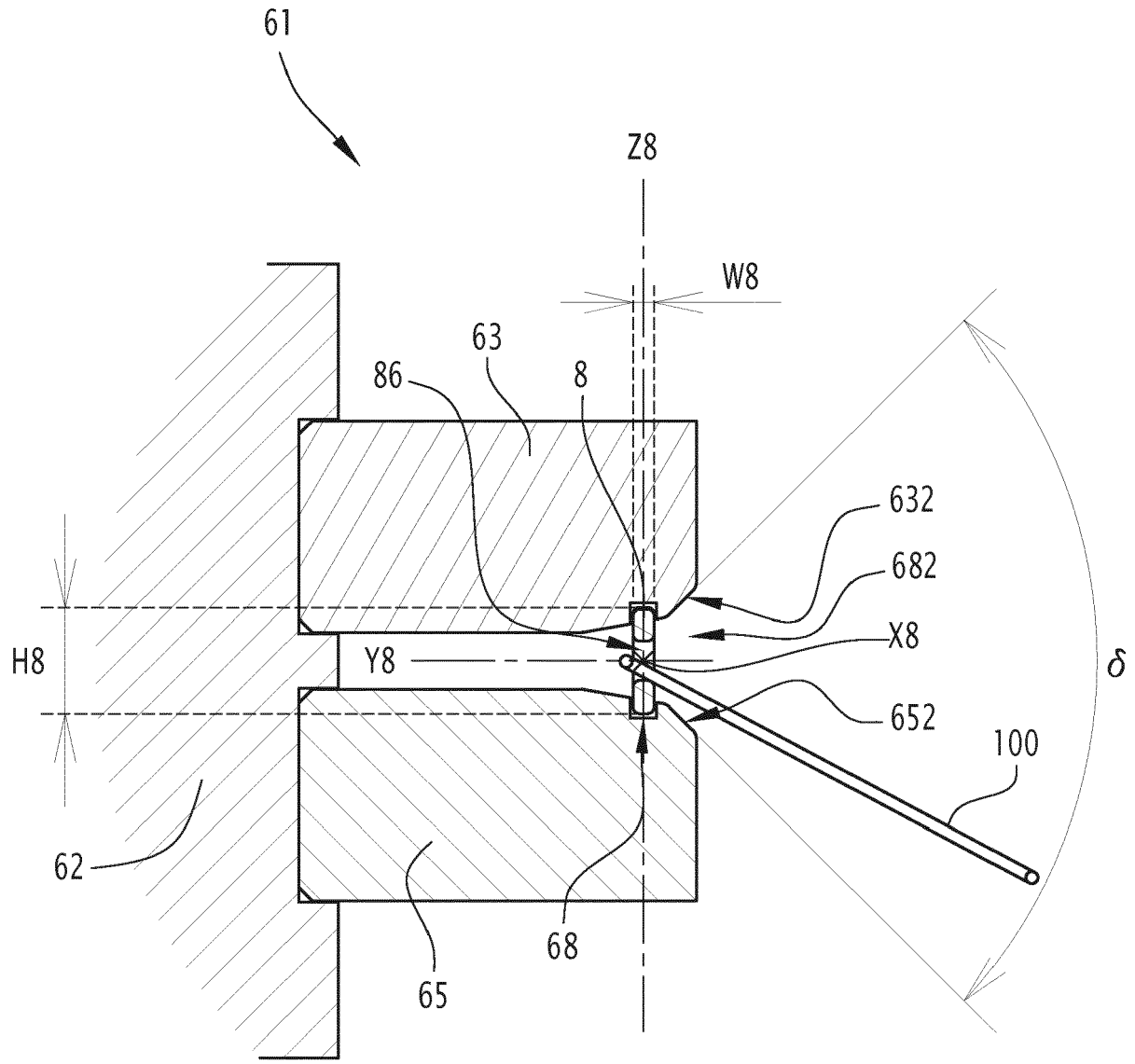


FIG.3

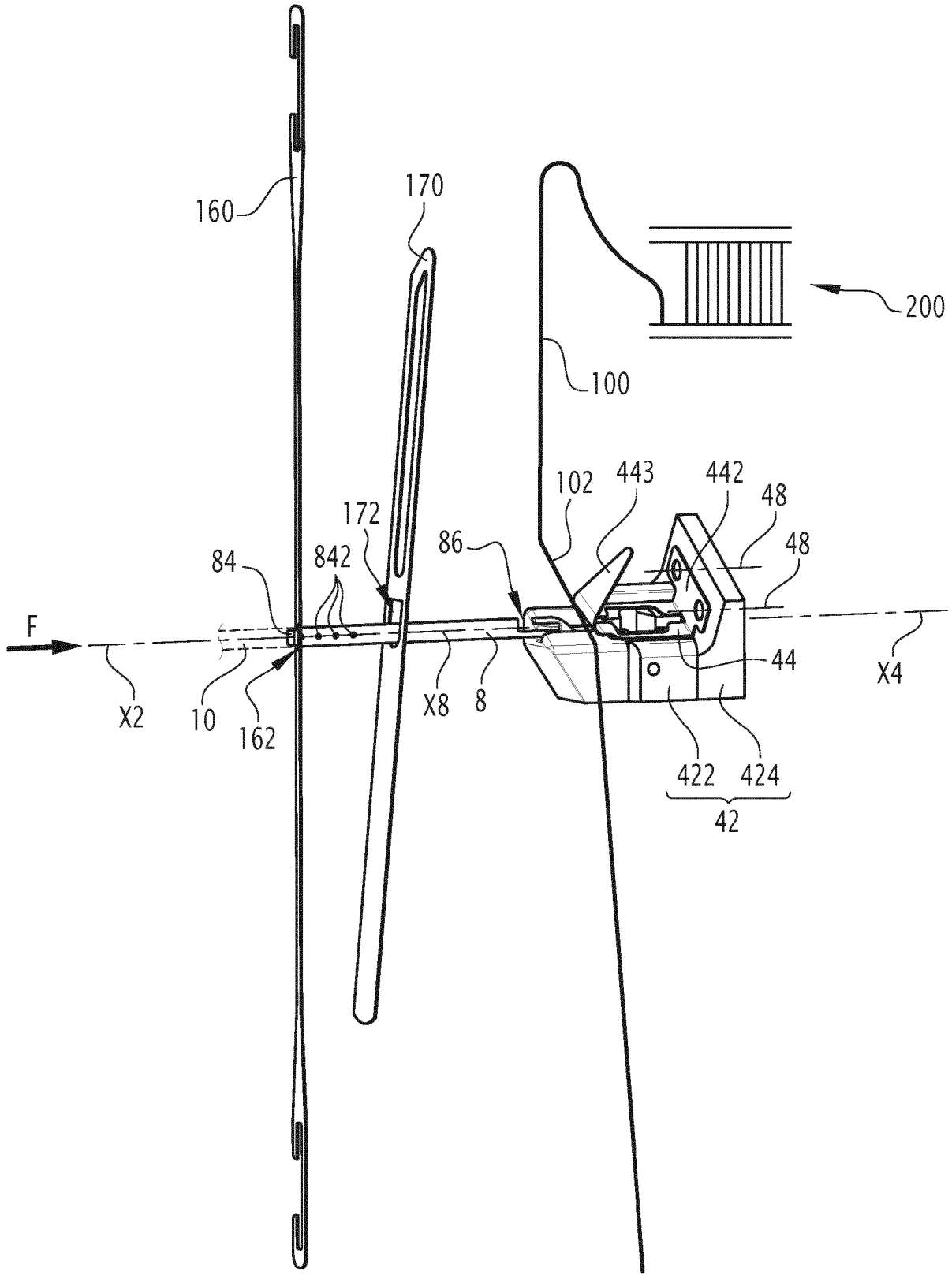

160
170
200
100
102
443
442
48
48
172
86
84
842
F
X2
10
162
X8
8
44
X4
422
424
42

FIG.4

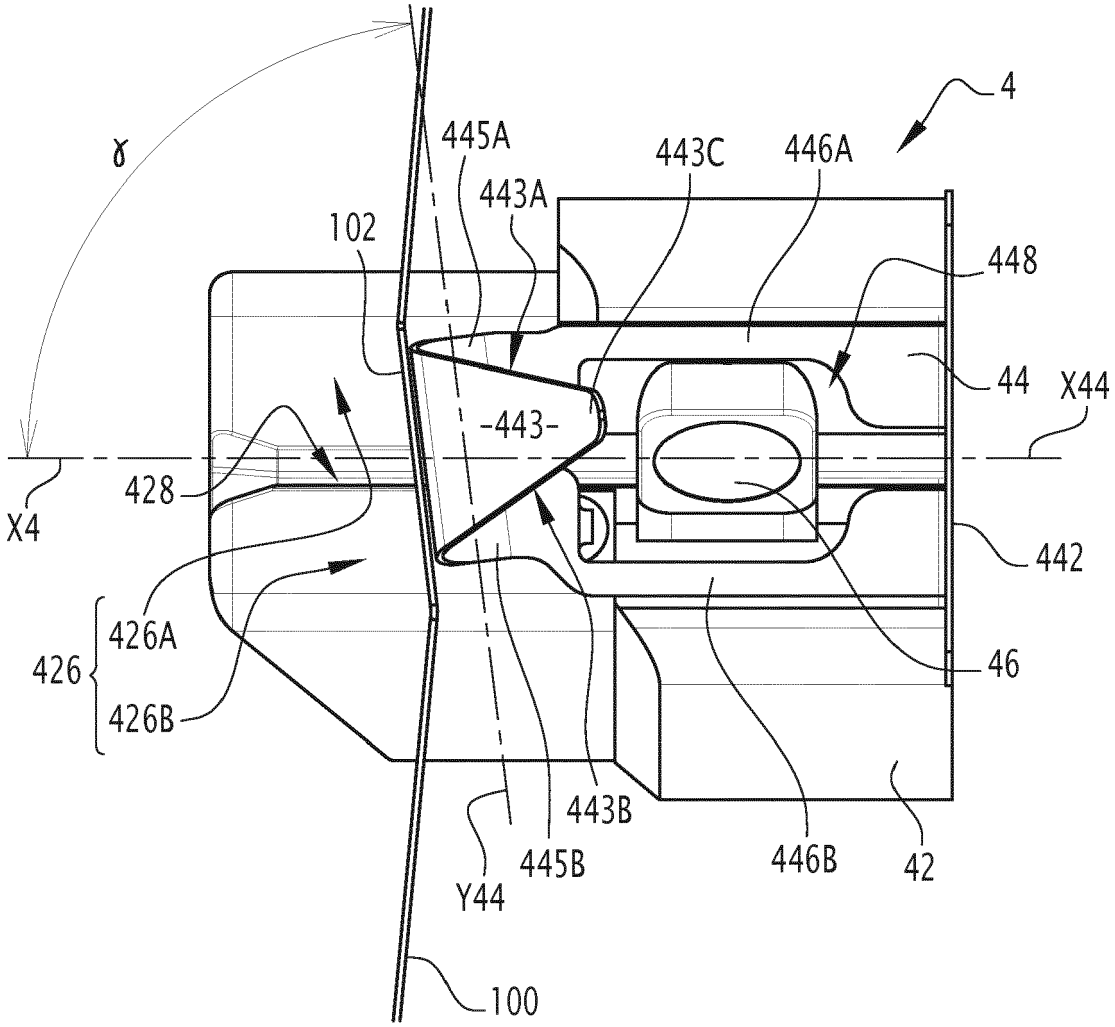

γ
4
445A
443C
446A
443A
102
448
44
X44
-443-
X4
428
442
426A
426
426B
46
443B
445B
446B
42
Y44
100

FIG.5

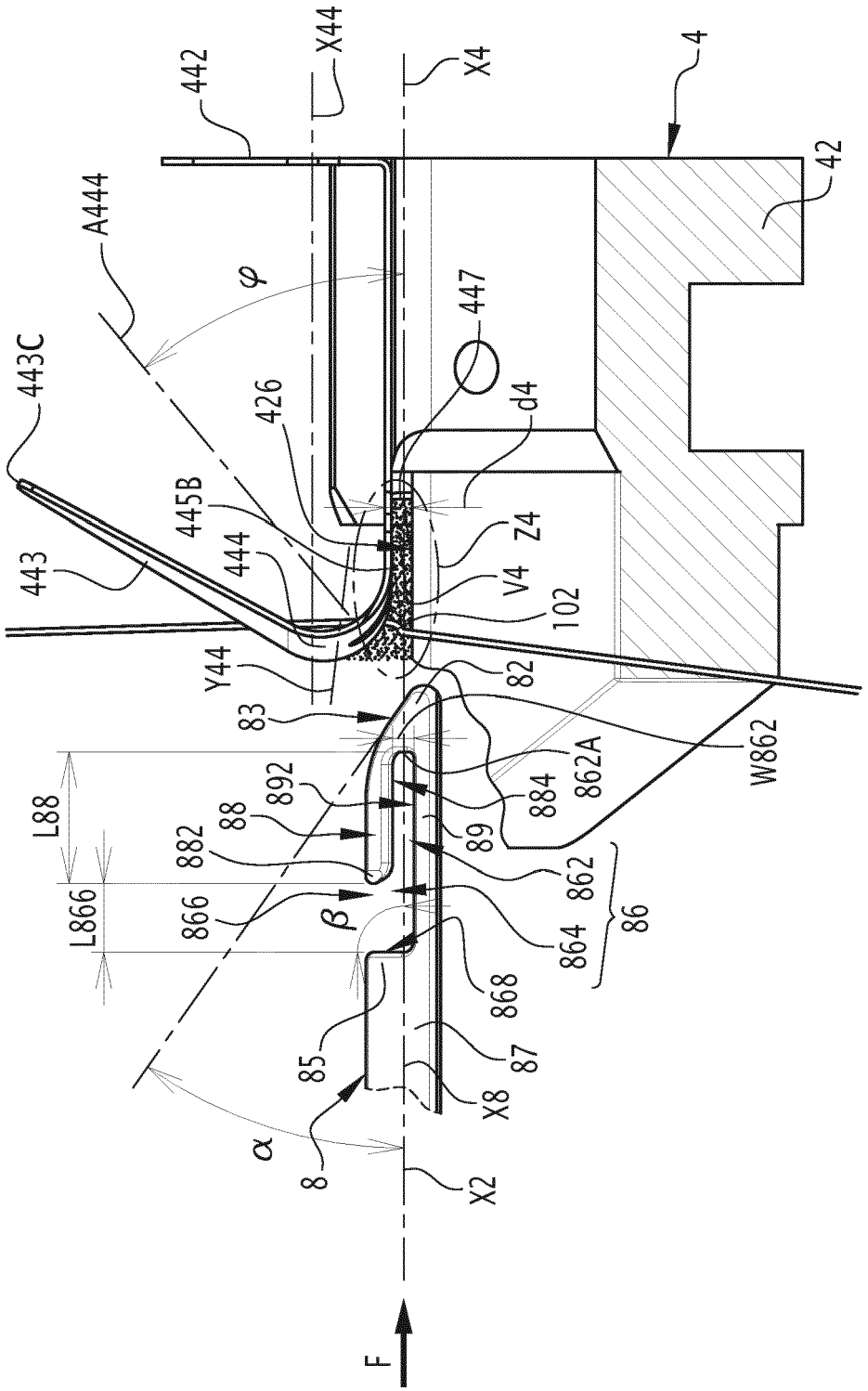

442
X44
X4
4
42
A444
φ
447
443C
426
d4
445B
444
Z4
V4
102
443
Y44
82
83
W862
862A
884
892
88
89
882
862
L88
L866
866
β
86
864
868
85
87
X8
α
8
X2
F

FIG.6

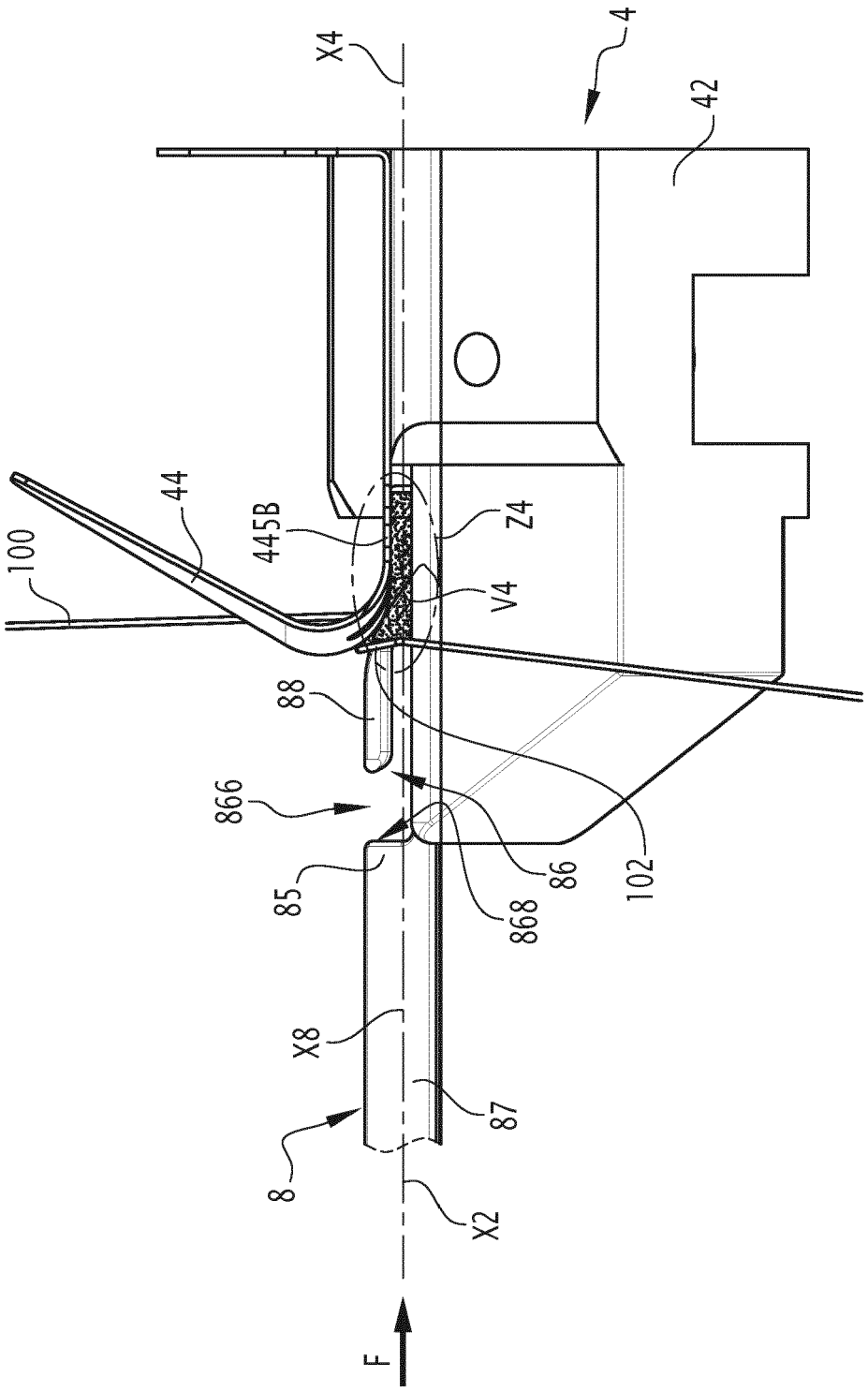


FIG.7

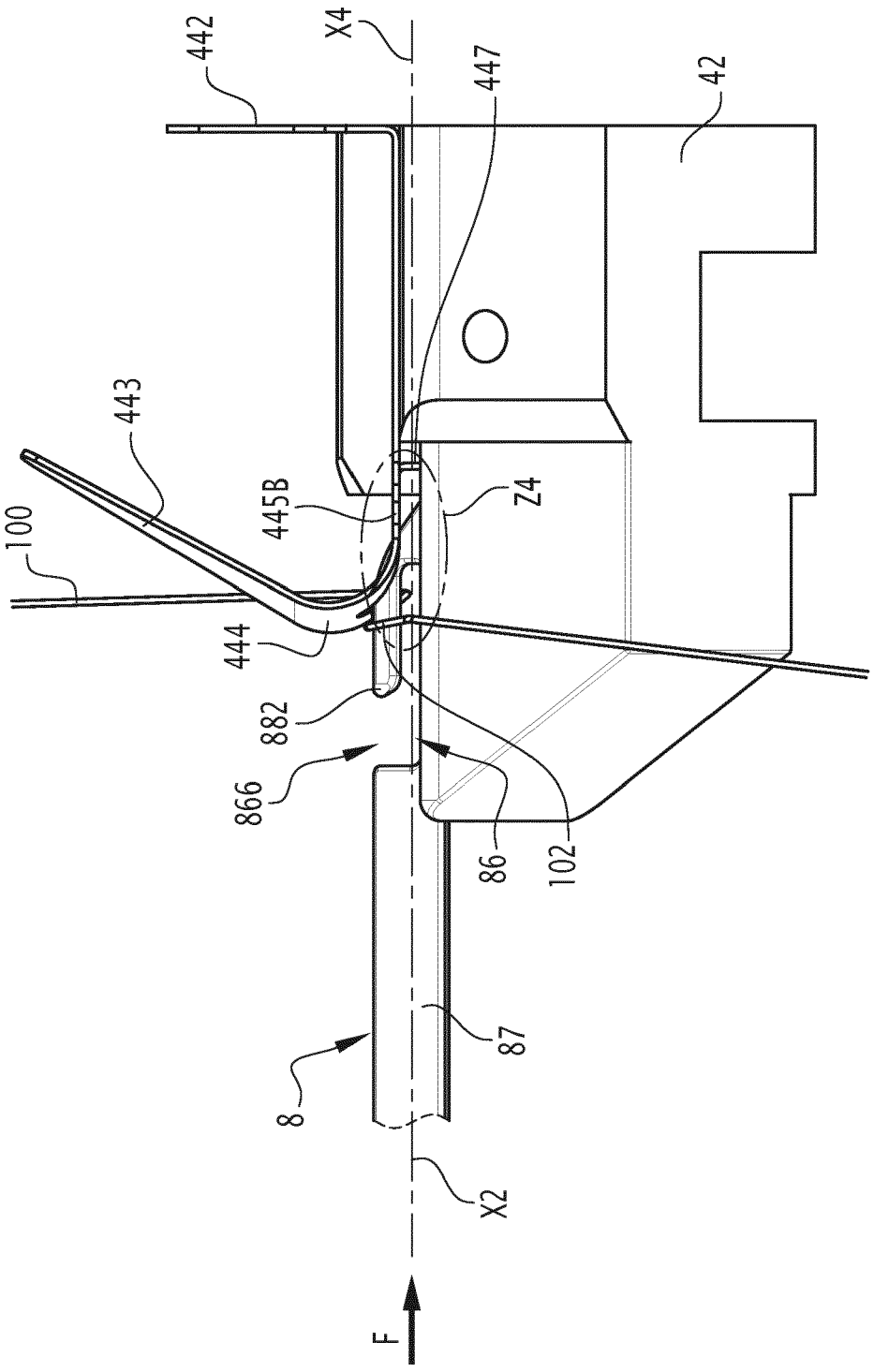


FIG.8

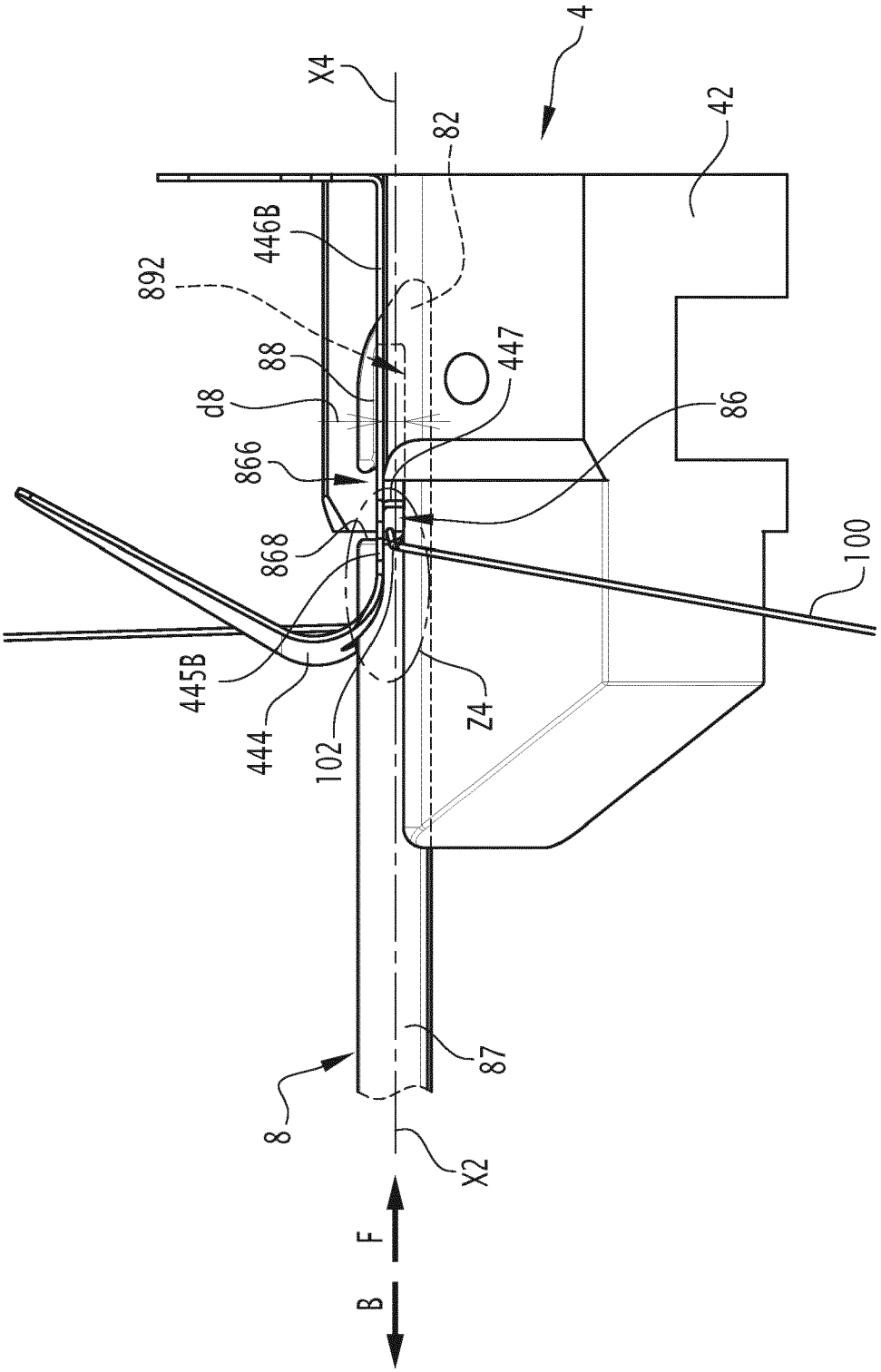
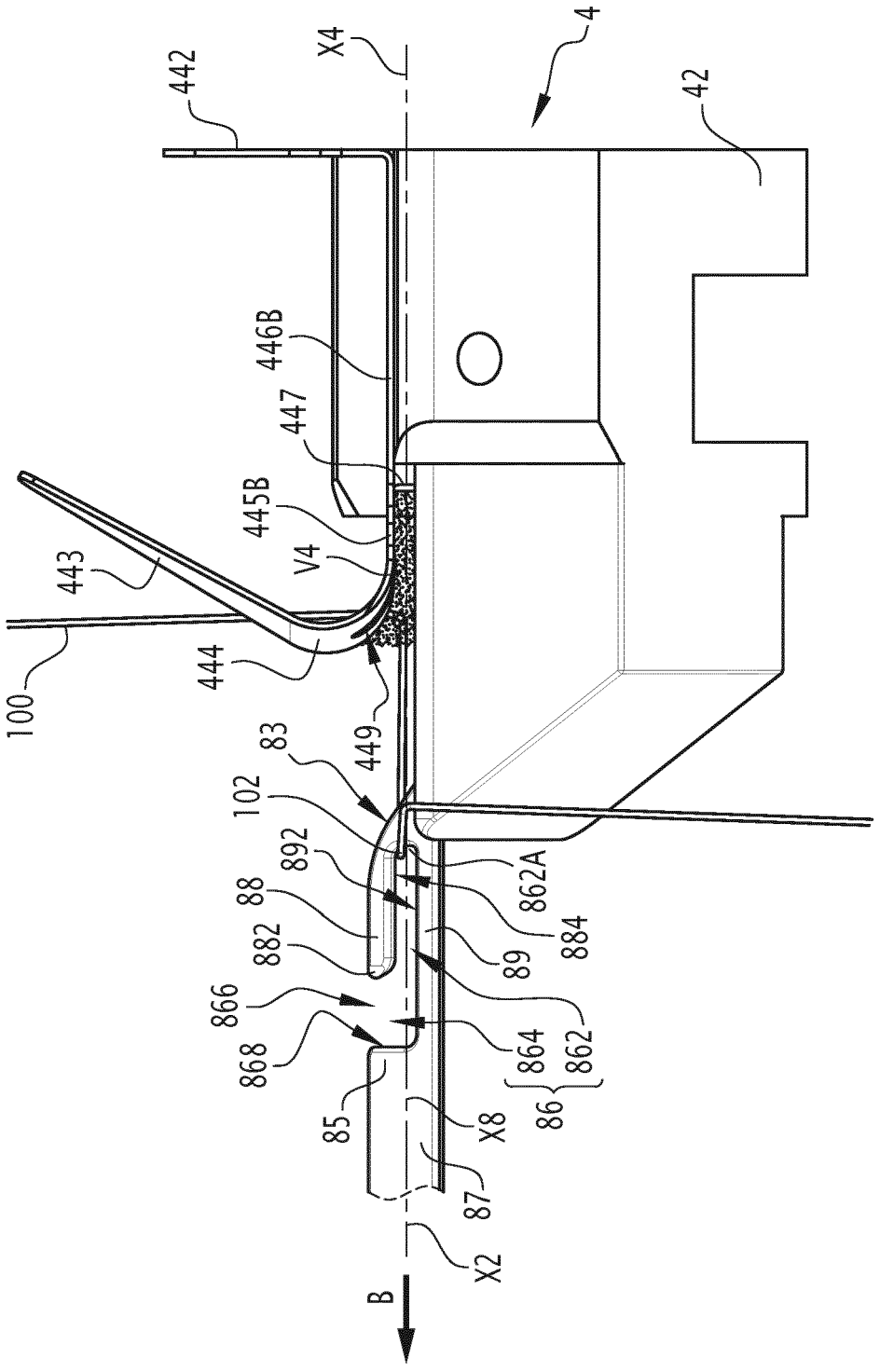

4
X4
82
42
446B
892
88
447
d8
86
866
868
100
445B
444
102
Z4
87
8
X2
F
B

FIG.9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X4
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42
446B
447
445B
V4
443
100
444
449
83
102
892
862A
88
884
882
89
866
868
864
862
86
85
X8
87
X2
B

FIG.10

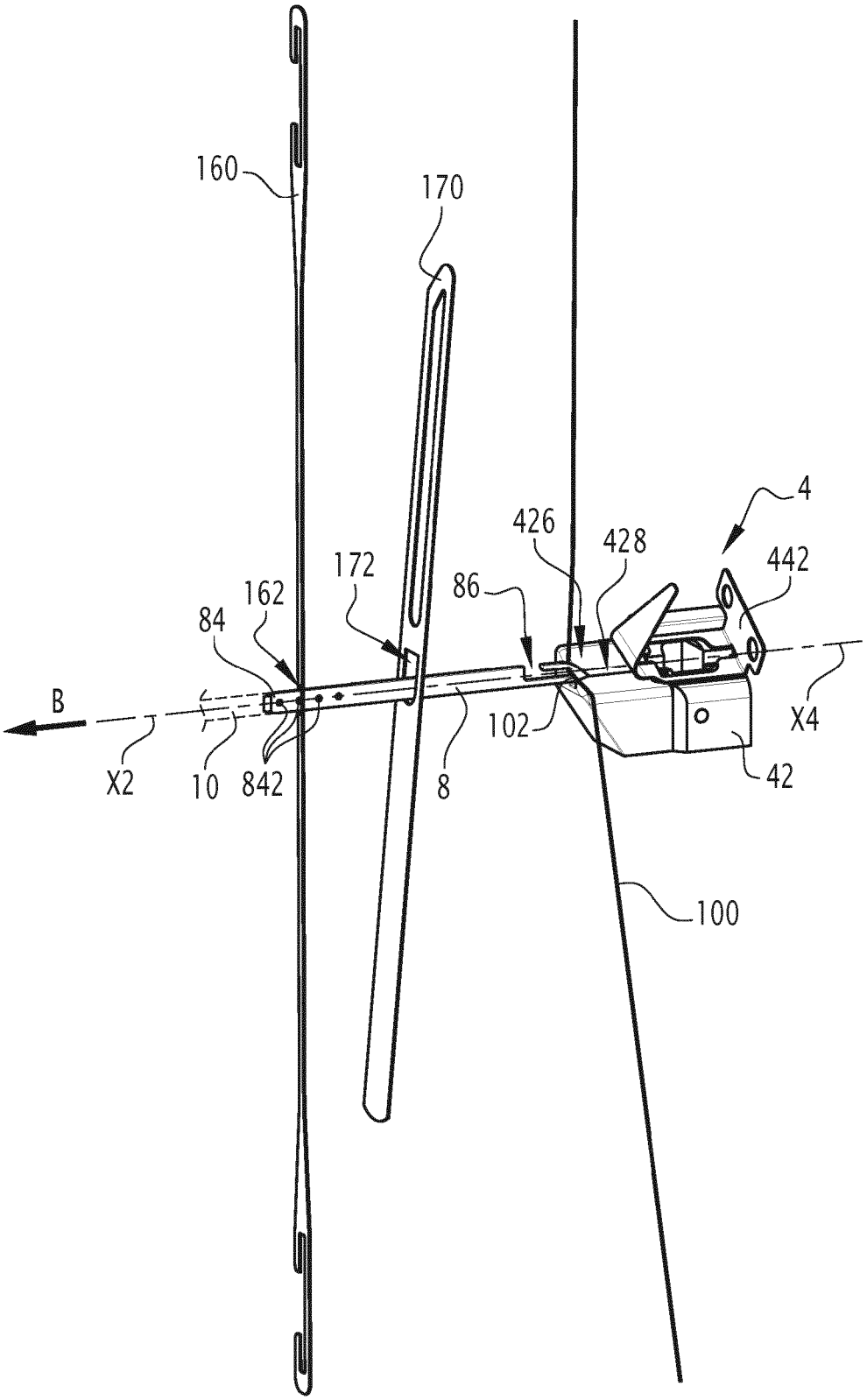
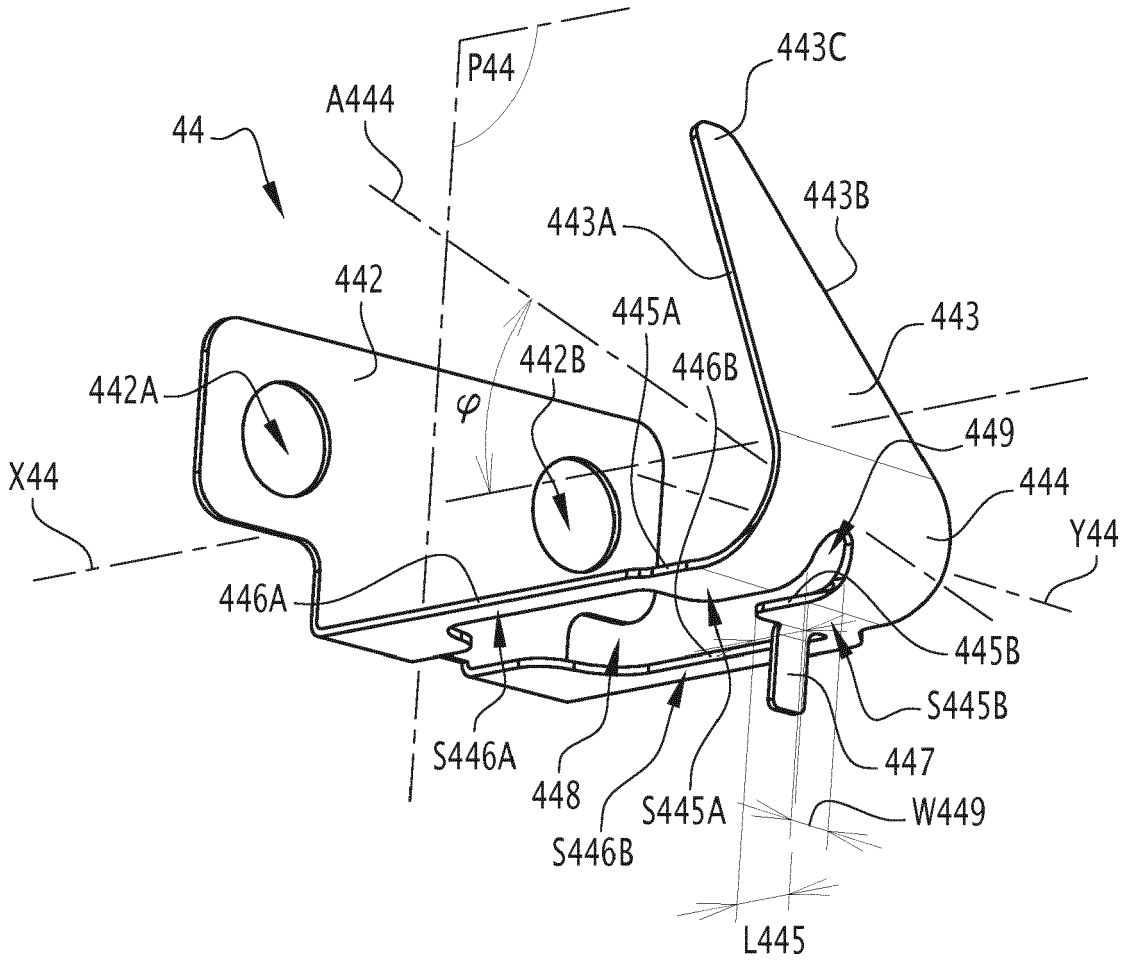


FIG.11


P44
443C
A444
44
443B
443A
442
445A
443
442B
446B
442A
φ
449
X44
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Y44
446A
445B
S445B
S446A
447
448
S445A
W449
S446B
L445

FIG.12

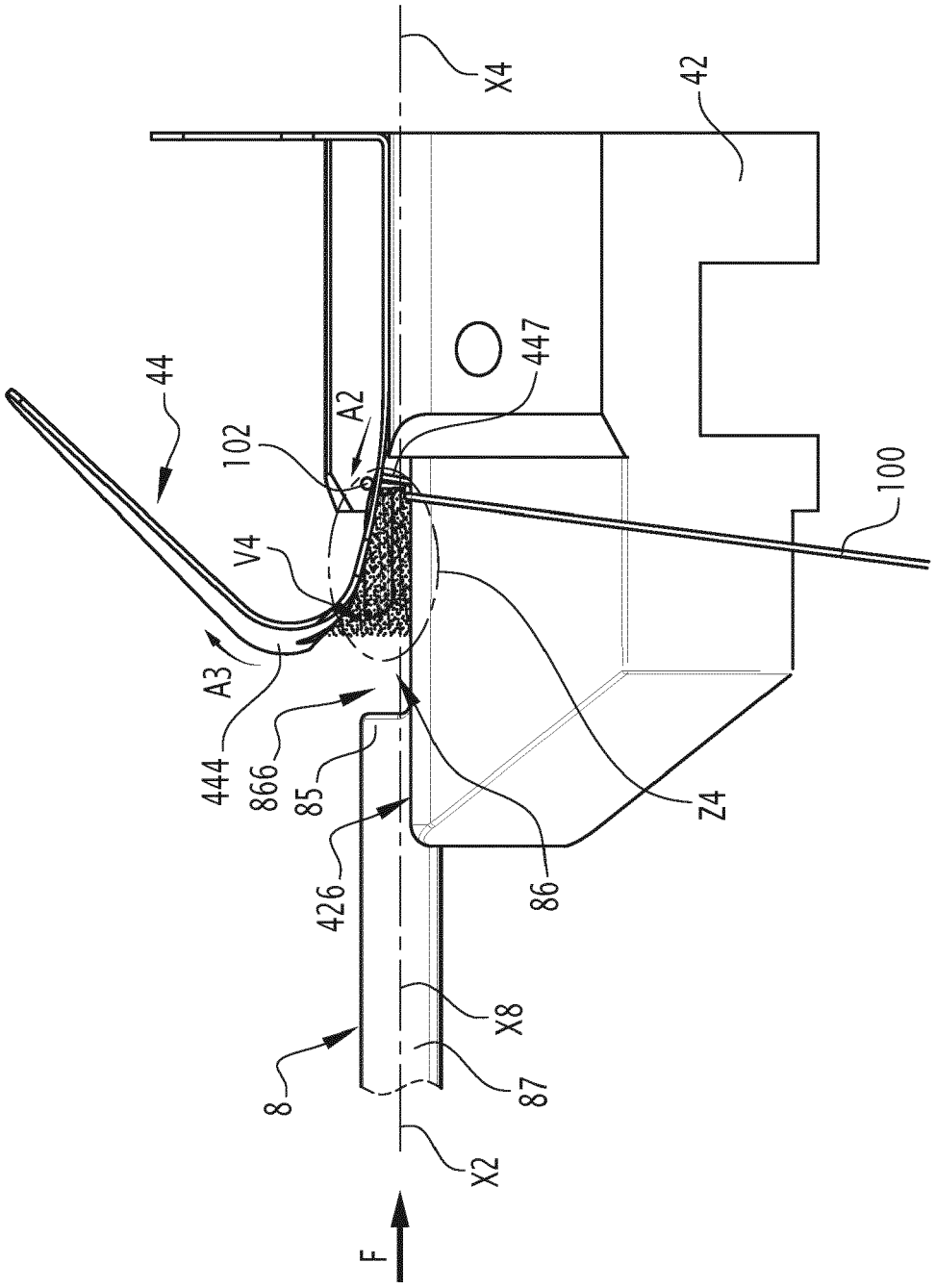

FIG.13

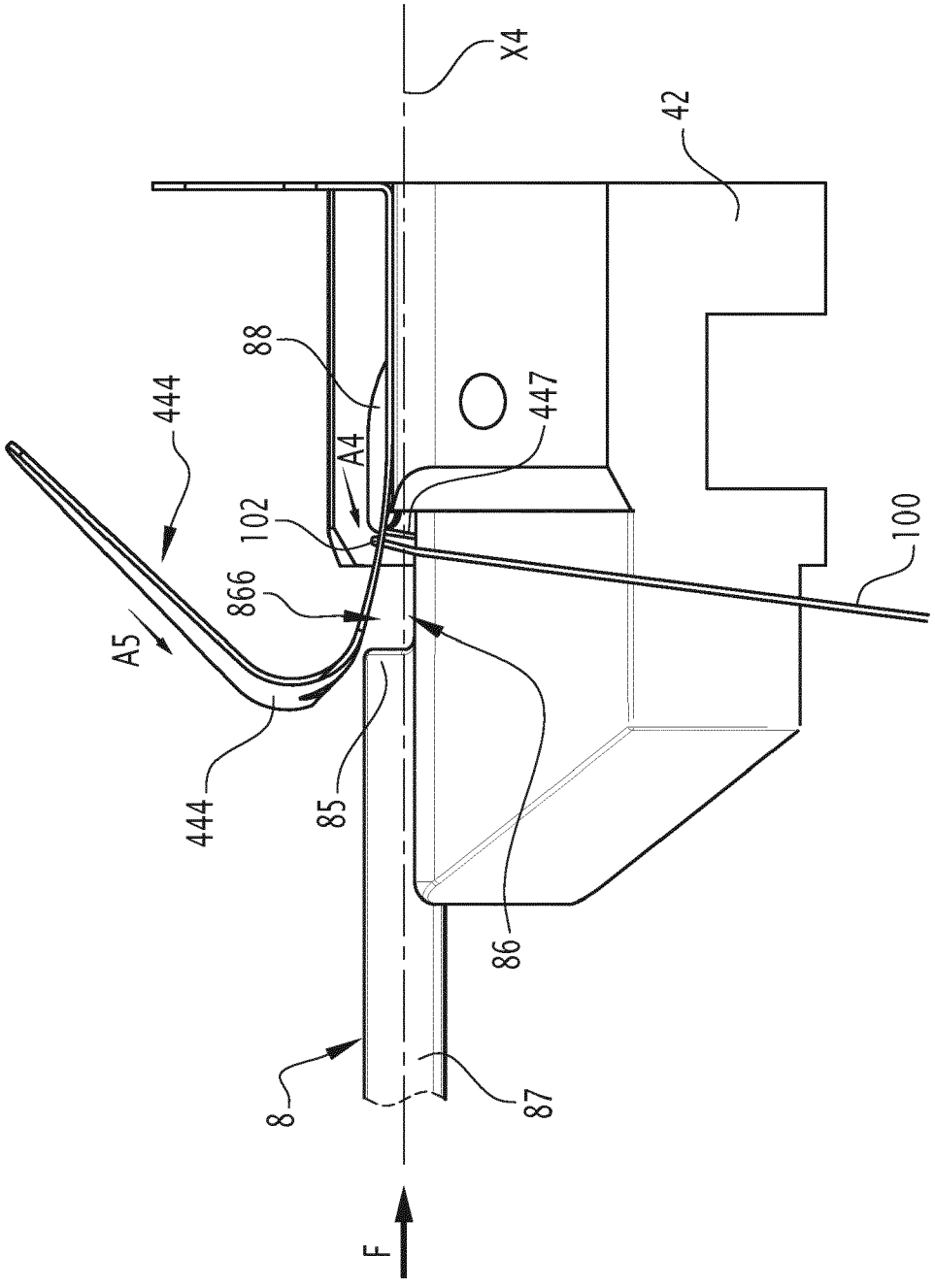

FIG.14

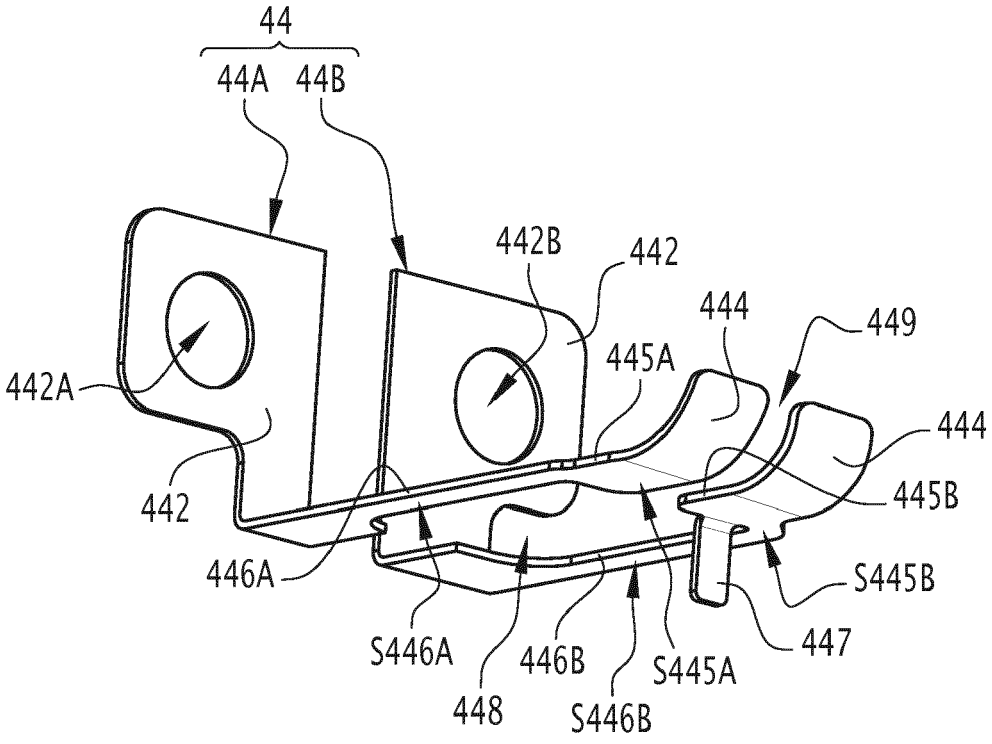
44
44A
44B
442B
442
444
449
445A
442A
444
445B
442
446A
S445B
447
S446A
446B
S445A
448
S446B

FIG.15

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EUROPEAN SEARCH REPORT

Application Number
EP 19 19 0024

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC) D03J D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 January 2020	Heinzelmann, Eric

CATEGORY OF CITED DOCUMENTS

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15-01-2020

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