



(51) International Patent Classification:

A01K 61/95 (2017.01) B07B 13/07 (2006.01)
B07B 1/14 (2006.01)

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(21) International Application Number:

PCT/NO2019/050020

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(22) International Filing Date:

25 January 2019 (25.01.2019)

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

20180789 08 June 2018 (08.06.2018) NO

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(54) Title: FISH SORTING ARRANGEMENT

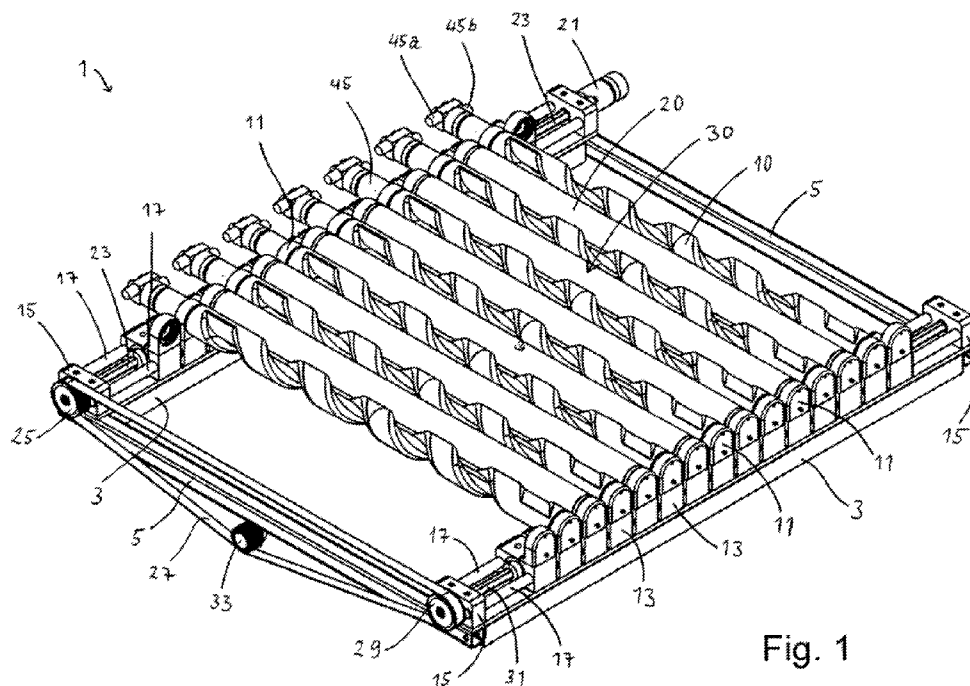


Fig. 1

(57) Abstract: A fish sorting arrangement (1) comprising a first exit (1a) and a second exit (1b). It has a fish sorting surface (30) configured to guide fish of a first size range or a first shape towards the first exit, and to guide fish of a second size range or fish of a second shape towards the second exit. The fish sorting surface has a plurality of rotating rollers (10) arranged next to each other in substantially one plane, wherein the rotating rollers comprise a helix structure (105). The helix structure comprises an outermost face (107) that extends in a helical pattern along the axial direction of the rotating roller (10), and an innermost face (109) that extends in a helical pattern along the axial direction of the rotating roller. The outermost face (107) comprises a flat surface.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

FISH SORTING ARRANGEMENT

Technical Field

[0001] The present invention relates to a fish sorting arrangement.

Background Art

[0002] Machines developed for automatic sorting of fish are known, often referred to as fish grading machines or sorting machines. They differ in mode of operation. One type uses a set of rollers that are supported in rotating bearings, so that slim fishes will fall down in the space between two adjacent rollers while the bigger fishes will not. By orienting the rollers with an inclination, the larger fishes will move past the rollers, in a direction parallel to the rollers.

[0003] One example of such a sorting apparatus is known from publication CN202918934U. This apparatus has a plurality of rollers that are arranged parallel to each other. Their mutual distance, i.e. the space between each roller, can be adjusted. In this manner, the machine can be adapted to the desired size of the fish that shall be sorted out.

[0004] Another similar machine is disclosed in JPS5317200A, wherein the rollers can be aligned with a fan shaped configuration. In this manner, small fishes will fall through the rollers close to the input side of the machine, while larger fishes will fall through the rollers closer to the exit side. With such a configuration, one single sorting machine can sort the fishes into more than one output size. E.g. the fishes can be sorted into small, medium, large and extra large sizes. Such a configuration is also disclosed in JPH0226486U.

[0005] Common for these known sorting machines is that they sort the fishes based on the size of the fish, and not based on the shape of the fish. Consequently, if inputting two different types of fishes, where a first type is long and slim, and the second type is short and thick, then the machine will not be able to sort the two types if the thickness of the fishes are similar.

[0006] Publication ES2239899 describes a machine for sorting products, such as mussels, oysters, cockles, fruits of rounded shapes, eggs, olives, etc. The machine has a plurality of rotating bars. Between the rotating bars, there are arranged calibrating bars having varying diameters. The varying diameters result in varying distance between the rotating bars and the interposed calibrating bars, thereby making the machine able to sort products according to different size ranges. The rotating bars have helical fins so that the products advance along them when the bars are rotated.

[0007] An object of the present invention may thus be to provide a fish sorting arrangement that is configured to performing sorting of fishes based on the fish shape. I.e. a sorting machine that is not limited to sort the fishes based on the thickness of the fish.

[0008] Another object of the present invention may be to provide a fish sorting arrangement that is configured to remove water from the fish as one process step before a succeeding process step.

[0009] The present invention may further meet other objects.

Summary of invention

[0010] According to a first aspect of the present invention, there is provided a fish sorting arrangement comprising a first exit and a second exit. The arrangement further comprises a fish sorting surface configured to guide fish of a first size range and/or a first shape towards the first exit, and to guide fish of a second size range, being smaller than the first size range, and/or fish of a second shape, being different than the first shape, towards the second exit. The fish sorting surface comprises a plurality of rotating rollers arranged next to each other in substantially one plane. The rotating rollers comprise a helix structure. The helix structure comprises an outermost face that extends in a helical pattern along the axial direction of the rotating roller, and an innermost face that extends in a helical pattern along the axial direction of the rotating roller. According to the first aspect of the present invention, the outermost face comprises a flat surface.

[0011] It shall be understood that with the term flat surface, is herein meant a surface that is sufficiently flat so that it will not harm a fish that is supported by the surface. Hence, it shall be understood that the flat surface may have some curvature. In some embodiments of the invention, however, the outermost face may be substantially flat or nearly perfectly, or perfectly flat.

[0012] According to a further aspect of the invention, the said outermost face is defined as a surface recognizable between two edges. As will be discussed in more detail in the presentation of example embodiments below, such edges may be edges defined at the interface between radially extending faces and the outermost face.

[0013] In some embodiments of the present invention, the area of the outermost face may constitute at least 15 %, preferably at least 25 %, or even more preferred at least 40 % of the radially facing surface of the rotating rollers.

[0014] Having a relatively large outermost face will contribute in preventing harm to the fish and thus maintaining fish welfare.

[0015] Advantageously, the innermost face may have an end portion where the radius of the innermost face is larger than the radius of the innermost face at a location at a distance from the end portion.

[0016] During operation of the fish sorting arrangement according to the invention, a fish may become caught between adjacent rotating rollers, or between a rotating roller and other means, such as a roller bar. Such a fish may be caught in the space between two adjacent parts of the outermost face, i.e. in the position of the innermost face. Such a fish may be too small to remain on top of the outermost faces, thus

falling onto the innermost face. The fish may, however, be too large to fall completely through the fish sorting arrangement. During rotation of the rotating rollers, such a fish will be transported forwards in the arrangement, towards the end of the rotating rollers. The end portion having a larger radius will, at the end portion of the rotating roller, lift the caught fish out from such a captured position. This will prevent such a fish from being squeezed.

[0017] In embodiments as discussed above, where the innermost face has an end portion with a larger radius, the transition between the radius of the innermost face at the location of the end portion and radius of the innermost face at a mid-portion of the rotating roller is smooth.

[0018] I.e. there is a transition between the end portion of the innermost face and the end portion of the innermost face, which is without steps. A stepped transition could cause harm to a fish. With a smooth transition, however, a caught fish will be lifted out gently.

[0019] By using rotating rollers that have a helix structure on them, the operator may, in embodiments that also involve the roller motors, use their rotation for moving fish located on the fish sorting surface. In some applications, it may be possible to move fish along the fish sorting surface even without providing an inclination to the fish sorting surface.

[0020] It shall be understood that although the rotating rollers are arranged next to each other, there may in some embodiments be arranged other elements in-between them. For instance, roller bars may be arranged in-between the rotating rollers. Thus, in some embodiments, the rotating rollers are arranged next to each other, without being arranged directly adjacent each other.

[0021] Furthermore, it shall be understood that the one or more roller motors may be connected directly to each separate rotating roller. In other embodiments, the roller motors may for instance be connected with the rotating rollers at a distance, with a mechanical rotating link between the motors and the rotating rollers. In further embodiments, there may be for instance one roller motor that is connected to a plurality of rotating motors over a transmission arrangement.

[0022] According to an embodiment of the present invention, the fish sorting surface can further comprise roller bars between the rotating rollers, wherein the roller bars have another configuration than the rotating rollers. Roller bars, as discussed herein, may in some embodiments be free to rotate about their longitudinal axes, however without being motorized. In some embodiments though, both the rotating rollers and the roller bars can be motorized.

[0023] Advantageously, in some embodiments, the rotating rollers may have the shape of cylindrical, straight bars with a circular cross section.

[0024] Furthermore, in some embodiments, the rotating rollers can comprise a center rod and the helix structure can be arranged radially outside the center rod.

Advantageously, the material of the helix structure can be softer than the material of the center rod.

[0025] The helix structure can have a transition face between the outermost face and the innermost face. Advantageously, in some embodiments an edge interface between the outermost face and the transition face can have a rounded shape.

[0026] In some embodiments of the present invention, a plurality of rotating rollers can be arranged directly next to each other and two adjacent rotating rollers can rotate in opposite rotational directions.

[0027] In such embodiments, the outermost faces of the helix structure of two adjacent rotating rollers can advantageously be rotationally aligned with each other.

[0028] In this manner, the outermost faces of the helix structure will move along in a forward direction while remaining aligned with each other. Simultaneously, an aperture created by two facing innermost faces will also move axially forwards. To retain such alignment over time, the two rotating rollers may be mechanically interconnected to each other, such as with a toothed wheel, a belt, or the like. In this way, they will rotate with the same angular velocity and consequently remain rotationally aligned.

[0029] In some embodiments, the fish sorting apparatus according to the invention may constitute a part of a fish delousing process line.

[0030] The mutual distance between rotating rollers and/or between rotating rollers and roller bars can in some embodiments be adjustable.

[0031] In some embodiments, the fish sorting arrangement according to the invention may further comprise one or more roller motors connected to the rotating rollers. The one or more roller motors can be configured to rotate the rotating rollers about their respective longitudinal axes.

[0032] With such embodiments, the rotating rollers can be purposely made to rotate. By such deliberate rotation, fish can be moved along the fish sorting surface, in particular if the fish sorting surface is installed with an inclination with respect to the horizontal.

Brief description of drawings

[0033] While various features of the present invention have been discussed in general terms above, a more detailed and non-limiting example of embodiment will be presented in the following with reference to the drawings, in which

Fig. 1 is a perspective view of a fish sorting arrangement according to the present invention;

Fig. 2 is a top view of the fish sorting arrangement shown in Fig. 1, shown in a contracted state;

- Fig. 3 is a side view of the fish sorting arrangement shown in Fig. 1;
- Fig. 4 is a side view of the fish sorting arrangement shown in Fig. 1, however shown in an expanded state;
- Fig. 5 is a side view of the fish sorting arrangement shown in Fig. 4;
- Fig. 6 is an enlarged cross section side view showing a portion of the fish sorting arrangement;
- Fig. 7 is an enlarged top view showing an edge portion of the fish sorting arrangement;
- Fig. 8 is an enlarged perspective view showing a corner portion of the fish sorting arrangement in a contracted state;
- Fig. 9 is an enlarged perspective view showing another corner portion in a contracted state;
- Fig. 10 is a perspective view of a rotating roller having a helix structure;
- Fig. 11 is a side view of the rotating roller shown in Fig. 10;
- Fig. 12 is a cross section view through the rotating roller shown in Fig. 11;
- Fig. 13 is an enlarged cross section view through a portion of the rotating roller shown in Fig. 12;
- Fig. 14 is a portion of a fish sorting surface having rotating rollers and roller bars;
- Fig. 15 is a top cross section view through a fish sorting surface having rotating rollers arranged adjacent each other without intermediate roller bars;
- Fig. 16 is a top view of a fish sorting surface according to the fish sorting surface shown in Fig. 15;
- Fig. 17 is a schematic illustration of a process line where the fish sorting arrangement is applied in connection with a delousing apparatus;
- Fig. 18a to Fig. 18c depict schematic views of various profiles of the external faces of the rotating rollers.

Detailed description of the invention

[0034] Fig. 1 depicts a perspective view of a fish sorting arrangement 1 according to an embodiment of the present invention. The fish sorting arrangement 1 comprises two parallel support beams 3, which are attached to each other by two orthogonally arranged and parallel connection beams 5. Together, the support beams 3 and connection beams 5 form a rectangular shape.

[0035] Extending between the two support beams 3 is a plurality of rotating rollers 10. Each rotating roller 10 is supported in its respective opposite end in a roller support 11. The roller supports 11 are attached to a sliding guide 13 that abuts an upper face of the support beam 3.

[0036] The rotating rollers 10 form part of a fish sorting surface 30. During use, the fish that shall be sorted will be positioned on the fish sorting surface 30.

[0037] At each respective end of each support beam 3, there is arranged an end flange 15. Between each opposite end flange 15 there extend two guide rods 17, in parallel with the support beam 3. As will be discussed in detail further below, the sliding guides 13 have two sliding guide bores 43, through which the two guide rods 17 extend. In this manner the sliding guides 13 can slide along the longitudinal extension of the support beam 3.

[0038] In the embodiment shown in Fig. 1, the fish sorting arrangement 1 further comprises a plurality of roller bars 20. One roller bar 20 is arranged between each of the rotating rollers 10. As with the rotating rollers 10, each of the roller bars 20 is supported in a roller support 11, which connects to a sliding guide 13. Thus, the roller bars 20 are also configured to slide along the longitudinal direction of the support beam 3.

[0039] In the shown embodiment, the rotating rollers 10 and the roller bars 20 together form the fish sorting surface 30.

[0040] Fig. 2 and Fig. 3 depict the fish sorting arrangement 1 in a top view and side view respectively. In the mode shown in Fig. 1, Fig. 2 and Fig. 3, the rotating rollers 10 and roller bars 20 are arranged in a contracted state. In the contracted state, the rotating rollers 10 and the roller bars 20 have been moved towards each other.

[0041] Fig. 4 and Fig. 5 depict the fish sorting arrangement 1 with a top view and a side view, in an expanded state. As appears from Fig. 4, the slit 19 between the rotating rollers 10 and the roller bars 20 is significantly larger in the expanded state than in the contracted state, as shown in Fig. 2.

[0042] An adjustment motor 21 is arranged at one of the end flanges 15. The adjustment motor can advantageously be a hydraulic motor or an electric motor. The adjustment motor 21 drives an adjustment shaft 23, which is arranged between the two guide rods 17. The adjustment shaft 23 is rotatably supported in the two opposite end flanges 15. The adjustment shaft 23 is at one end connected to the adjustment motor 21, while its other opposite end is connected to a toothed synchronization wheel 25. The toothed synchronization wheel 25 is arranged at an outer face of the end flange 15, so that there is room for a toothed transmission belt 27 on it.

[0043] It shall be appreciated that instead of the adjustment motor 21, a manually operated wheel or handle can be arranged for rotation of the adjustment shaft 23.

[0044] As appears from Fig. 1, the toothed transmission belt 27 transfers mechanical power from the adjustment motor 21, the adjustment shaft 23, and the toothed synchronization wheel 25, to an auxiliary synchronization wheel 29. The auxiliary synchronization wheel 29 is connected to an auxiliary adjustment shaft 31, which is supported between two end flanges 15. As with the adjustment shaft 23, the auxiliary adjustment shaft 31 is also extended through the sliding guides 13.

[0045] A tension pulley 33 is arranged to maintain an appropriate tension in the toothed transmission belt 27.

[0046] As the skilled reader now will appreciate, operation of the adjustment motor 21 will result in a rotation of the adjustment shaft 23 and an identical rotation of the auxiliary adjustment shaft 31.

[0047] In an alternative embodiment, the adjustment shaft 23 and the auxiliary adjustment shaft 31 are driven with a respective motor, such as the adjustment motor 21 shown in Fig. 1. These two motors, of which one is arranged to each of the adjustment shafts 23, 31, will then be synchronized, such that they operate correspondingly. These two motors can typically also be hydraulic motors or electric motors.

[0048] In alternative embodiments, the adjustment shaft 23 and the auxiliary adjustment shaft 31 are not synchronized, so that one may expand one side of the fish sorting surface more or less than the other side.

[0049] Reference is now made to Fig. 6, which is an enlarged cross section side view through a portion of the adjustment shaft 23 and three sliding guides 13 and roller supports 11.

[0050] The adjustment shaft 23 can advantageously have a polygonal cross section, for instance as a bar with a square cross section.

[0051] A plurality of leading screws 35 are arranged on the adjustment shaft 23. The leading screws 35 have a through bore 37 with a polygonal cross section that fits with the cross section of the adjustment shaft 23. Thus, when the adjustment shaft 23 is rotated, the leading screws 35 will rotate along with the adjustment shaft.

[0052] At each respective end portion of the leading screws 35, there is a right-threaded portion 39a and a left-threaded portion 39b. The right- and left-threaded portions 39a, 39b each engages an engagement element 41 of a sliding guide bore 43 extending through adjacent sliding guides 13. That is, one leading screw 35 engages two adjacent / neighboring sliding guides 13.

[0053] Consequently, upon rotation of the adjustment shaft 23 in an expanding rotational direction, adjacent sliding guides 13 will move away from each other, due to the right and left threading on the leading screws 35. Upon rotation of the adjustment shaft 23 in a contracting rotational direction, which is opposite to the expanding rotational direction, adjacent sliding guides 13 will move towards each other.

[0054] It will be appreciated that the leading screws 35 are free to slide axially on the adjustment shaft 23.

[0055] To protect the leading screws 35, the adjustment shaft 23, and the threaded engagement 39a, 39b, 41 from water and other foreign objects, a bellows 47 is arranged between each adjacent sliding guide 13, and surrounding the leading screws 35. The bellows 47 are at each of their respective ends fixed to a sliding

guide, and are configured to expand or collapse according to the mutual movements of the adjacent sliding guides 13.

[0056] Fig. 7 is a top view showing the ends of rotating rollers 10 and roller bars 20. For clarity, the bellows 47 are omitted in this view.

[0057] Fig. 8 is an enlarged perspective view of a corner portion of the fish sorting arrangement 1. In Fig. 8 one can appreciate the square cross section of the adjustment shaft 23.

[0058] In the embodiment discussed herein, the rotating rollers 10 are rotated with a roller motor 45. The roller motor 45 is advantageously a hydraulic motor. Shown in Fig. 8 is a hydraulic input 45a and a hydraulic output 45b.

[0059] Advantageously, the hydraulic output 45b of one roller motor 45 can be connected to the hydraulic input 45a of an adjacent roller motor 45 with a flexible hose (not shown). In this manner, all roller motors 45 can be operated with one single hydraulic line (not shown).

[0060] In some embodiments, the roller bars 20 can be fixed in a non-rotating manner. In other embodiments, the roller bars 20 may be free to rotate, but without a roller motor.

[0061] In yet another embodiment, there are not arranged roller bars 20 between the rotating rollers 10. In such embodiments, the rotating rollers 10 may be arranged directly adjacent each other, i.e. without any roller bars in-between. As the skilled person will appreciate though, a slit 19 may be present. In such embodiments, the fish sorting surface 30 can be made up of rotating rollers 10 only.

[0062] Fig. 9 depicts another corner portion of the fish sorting arrangement 1, at the position of the auxiliary adjustment shaft 31.

[0063] As appears from the figures of the embodiment discussed above, the rotating rollers 10 of the fish sorting surface 30 have a helix configuration. A perspective view of a rotating roller 10 is shown in Fig. 10.

[0064] At each end, the rotating roller 10 has a support member 101. One of the support members 101 are configured to receive rotational force from a roller motor 45, for the provision of a rotational movement of the rotating roller 10. The other support member 101 can be rotationally supported in a roller support 11.

[0065] Both support members 101 are visible in Fig. 11, which depicts the rotating roller 10 with a side view.

[0066] As appears from the cross-section view of Fig. 12, the two support members 101 are connected with a center rod 103. The center rod 103 is preferably relatively rigid and can be made of a metal or another solid material, such as a rigid plastic. The center rod 103 provides the structural integrity of the rotating roller 10, when supported between two opposite roller supports 11.

[0067] As further shown with the cross-section view of Fig. 12, the helix structure 105 of the rotating roller 10 is provided with a helix material on the outside of the center rod 103. Advantageously, the material of the helix structure 105 can comprise a material that is significantly softer than the material of the center rod 103. Such a material can for instance be polyurethane. Using a soft outer material in the helix structure 105, on the outside of the center rod 103, will enhance the welfare of the fish during handling in the fish sorting arrangement 1.

[0068] Reference is made to Fig. 13, which is an enlarged cross section side view of a portion of the rotating roller 10. As appears from this view, the helix structure 105 comprises no sharp outwardly facing edges. In other words, the helix structure 105 is provided by means of rounded edges.

[0069] The helix structure 105 comprises an outermost face 107, which has the largest radius of the helix structure 105, and an innermost face 109, which has the smallest radius of the helix structure 105. The transition between the outermost face 107 and the innermost face 109 is provided with a transition face 111. As appears from Fig. 13, the edge interface 112 between the transition face 111 and the outermost face 107 is rounded, so that a fish contacting this portion of the rotating roller 10 will not be harmed.

[0070] The edge interfaces 112 define the width of the outermost face 107. The outermost face 107 extends along a helical pattern about the center axis of the rotating roller 10, between the parallel edge interfaces 112.

[0071] The innermost face 109 is arranged between the lower end edges of the transition faces 111.

[0072] At both or at one end portion 109a, the innermost face 109 has a larger radius than at a location further away from the end portion 109a, such as for instance at the mid portion of the rotating roller 10. The increased radius of the end portion 109a appears perhaps best from Fig. 7, Fig. 10 and Fig. 13.

[0073] In some embodiments, the fish sorting arrangement 1 may be without the roller bars 20. In some of such embodiments, there may be substantially no slit 19 between the rotating rollers 10. That is, in such embodiments, the rotating rollers may be arranged substantially abutting each other. In such embodiments, the only aperture through which a fish may fall, is in the aperture that is provided by the helix configuration, i.e. by the recess in the rotating rollers 10 provided by the helix recess.

[0074] The helix structure 105 will, with its outermost faces 107 and its lowermost faces 109, create apertures between the rotating rollers 10 and roller bars 20, alternatively between adjacent rotating rollers 10 if the roller bars 20 are not used, so that short fishes may fall through the apertures.

[0075] Such an aperture 113 is indicated in Fig. 14, which is an enlarged top view of a fish sorting surface 30, showing a part of two rotating rollers 10 and one roller bar 20. While no fish will be able to fall into the slit 19, which is relatively small, a relatively short fish will be able to fall through the aperture 113. As is evident from

Fig. 13, the aperture 113 is much wider than the slit 19. A longer fish, however, will not fall into the aperture 113, since it will bridge the length of the aperture 113 in the axial direction (i.e. the longitudinal direction of the rotating rollers 10).

[0076] In some cases, it may occur that a fish gets caught in the aperture 113 without falling through the fish sorting arrangement 1. The fish may be stuck in the aperture 113 and will be transported towards the end of the rotating rollers 10 during rotation of the rotating rollers. Due to the increased radius of the end portion 109a of the innermost face 109, such a fish will be lifted out of its position. Without such an increase of radius of the end portion 109a, the fish could become squeezed when reaching the end of the rotating roller 10.

[0077] During use of the fish sorting arrangement 1, fish will take an orientation in parallel with the axial direction of the rotating rollers 10. The direction of rotation of the rotating rollers 10 can advantageously be in such a direction that the fish will be moved forward due to the helix structure 105. In other words, a fish resting on fish sorting surface 30, i.e. the outmost face 107 of the rotating rollers 10, will be moved forwards by rotating the rotating rollers 10 in such direction that the outermost face 10 will move forwards and not backwards.

[0078] Fig. 15 depicts a cross section top view through a portion of a fish sorting surface 30 made up of rotating rollers 10, and without the roller bars 20. From Fig. 15 it is clearly appreciated how the apertures 113 are significantly wider than the slits 19, even when the rotating rollers 10 are in a contracted state.

[0079] The top view shown in Fig. 16 depicts a fish sorting surface 30 corresponding to the one shown in Fig. 15.

[0080] In the embodiment shown in Fig. 15 and Fig. 16, pairs of adjacent rotating rollers 10, provided with the helix structure 105, can advantageously be rotationally aligned, as shown. Thus, the axial position of the outermost faces 107 of two adjacent rotating rollers 10 are then aligned. A consequence of this is that the apertures 113 are provided between aligned lowermost faces 109, thereby providing relatively wide apertures 113.

[0081] The fish sorting arrangement 1 disclosed herein will be applicable within many areas where fish shall be sorted. One such application is within the salmonoid farming industry, where it has become common to use smaller fish to remove lice from the farmed fish. Such smaller fish, which typically can be lumpfish (*cyclopterus lumpus*), are typically not only smaller than the salmonids, but can also have a significantly different shape. While the salmonids are fairly long and slim, the smaller fish can typically be short and thick.

[0082] Fig. 17 schematically depicts a process line 200 for delousing salmonoid fish. A fish sorting arrangement 1 according to the invention is schematically illustrated at the left-hand side. Fishes of different size and / or different shape enters the fish sorting arrangement 1 from the left-hand side, as illustrated with the large and small arrow. Exiting at a first exit 1a on the right-hand side of the fish sorting arrangement 1

are fish of a first size and/or a first shape, namely the salmonoid fish that has sufficient size (and/or corresponding shape). This is illustrated with the larger exit arrow. Exiting at a second exit 1b, out of the fish sorting arrangement 1 in a downwards direction are fish of a smaller second size and/or a second shape. This is illustrated with the smaller exit arrow.

[0083] From the fish sorting arrangement 1, the fish exiting at the position of the larger exit arrow are salmonoid fish that shall be conveyed through a delousing assembly. Such a delousing assembly may advantageously comprise a first delousing machine 201 where the salmonoid fishes are flushed with water, and a second delousing machine 202 where they are brushed, to remove the lice from the fish.

[0084] By sorting the smaller, lice-eating fish from the salmonids before the salmonids enter the lice removal apparatus, one prevents the smaller fish from being exposed to the lice removal treatment.

[0085] Fig. 18a, Fig. 18b, and Fig. 18c depict schematic views of various profiles of the external faces of the rotating rollers 10. In the profile depicted in Fig. 18a, the transition face 111, which extends between the outermost face 107 and the innermost face 109, extends in a radial direction. I.e. the transition face 111 faces in an axial direction. The outermost face 107 extends between two edge interfaces 112. The edge interfaces 112 define the interface between the transition face 111 and the outermost face 109.

[0086] In the embodiment shown in Fig. 18b, the transition face 111 is inclined.

[0087] In the embodiment shown in Fig. 18c, the transition face 111 is inclined, and the outermost face 107 has a curved shape. Still, the edge interfaces 112 are recognizable at the location where the transition face 111 and the outermost face 107 meet.

Claims

1. A fish sorting arrangement (1) comprising a first exit (1a) and a second exit (1b), and further comprising a fish sorting surface (30) configured to guide fish of a first size range and/or a first shape towards the first exit, and to guide fish of a second size range, being smaller than the first size range, and/or fish of a second shape, being different than the first shape, towards the second exit, wherein the fish sorting surface (30) comprises a plurality of rotating rollers (10) arranged next to each other in substantially one plane, wherein the rotating rollers (10) comprise a helix structure (105), wherein the helix structure (105) comprises an outermost face (107) that extends in a helical pattern along the axial direction of the rotating roller (10), and an innermost face (109) that extends in a helical pattern along the axial direction of the rotating roller,

characterized in that the outermost face (107) comprises a flat surface.

2. A fish sorting arrangement (1) according to claim 1, **characterized in** that the area of the outermost face (107) constitutes at least 15 %, preferably at least 25 %, even more preferred at least 40 % of the radially facing surface of the rotating rollers (10).

3. A fish sorting arrangement (1) according to claim 1 or claim 2, **characterized in** that the innermost face (109) has an end portion (109a) where the radius of the innermost face (109) is larger than the radius of the innermost face (109) at a location at a distance from the end portion.

4. A fish sorting arrangement (1) according to claim 3, **characterized in** that the transition between the radius of the innermost face at the location of the end portion (109a) and radius of the innermost face at a mid-portion of the rotating roller (10) is smooth.

5. A fish sorting arrangement (1) according to one of claims 1 to 4, **characterized in** that the rotating rollers (10) comprise a center rod (103) and that the helix structure (105) is arranged radially outside the center rod (103), wherein the material of the helix structure (105) is softer than the material of the center rod (103).

6. A fish sorting arrangement (1) according to one of the preceding claims, **characterized in** that the helix structure (105) further comprises a transition face (111) between the outermost face (107) and the innermost face (109), and that an edge interface (112) between the outermost face (107) and the transition face (111) is rounded.
7. A fish sorting arrangement (1) according to one of the preceding claims, **characterized in** that the fish sorting surface (30) further comprises roller bars (20) between the rotating rollers (10), wherein the roller bars (20) have another configuration than the rotating rollers (10).
8. A fish sorting arrangement (1) according to one of the preceding claims, **characterized in** that a plurality of rotating rollers (10) are arranged directly next to each other and that two adjacent rotating rollers rotate in opposite rotational directions.
9. A fish sorting apparatus (1) according to one of the preceding claims, **characterized in** that the outermost faces (107) of the helix structure (105) of two adjacent rotating rollers are rotationally aligned with each other.
10. A fish sorting apparatus (1) according to any one of the preceding claims, **characterized in** that it constitutes a part of a process line (200) configured for delousing salmonoid fish.
11. A fish sorting apparatus (1) according to one of the preceding claims, **characterized in** that the mutual distance between rotating rollers (10) is adjustable.
12. A fish sorting arrangement (1) according to one of the preceding claims, **characterized in** that the fish sorting arrangement (1) further comprises one or more roller motors (45) connected to the rotating rollers (10), wherein the roller motors are configured to rotate the rotating rollers about their respective longitudinal axes.

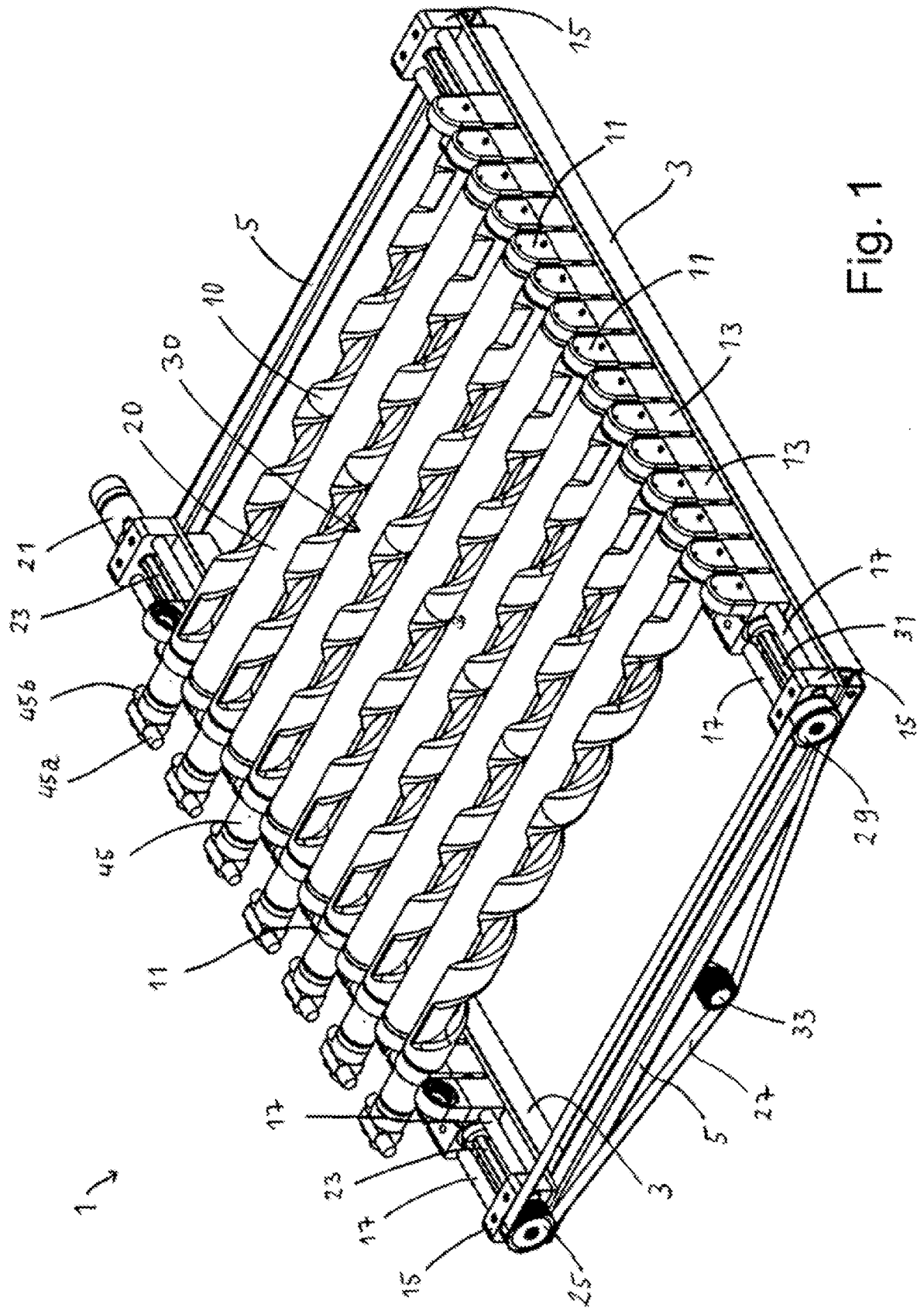


Fig. 1

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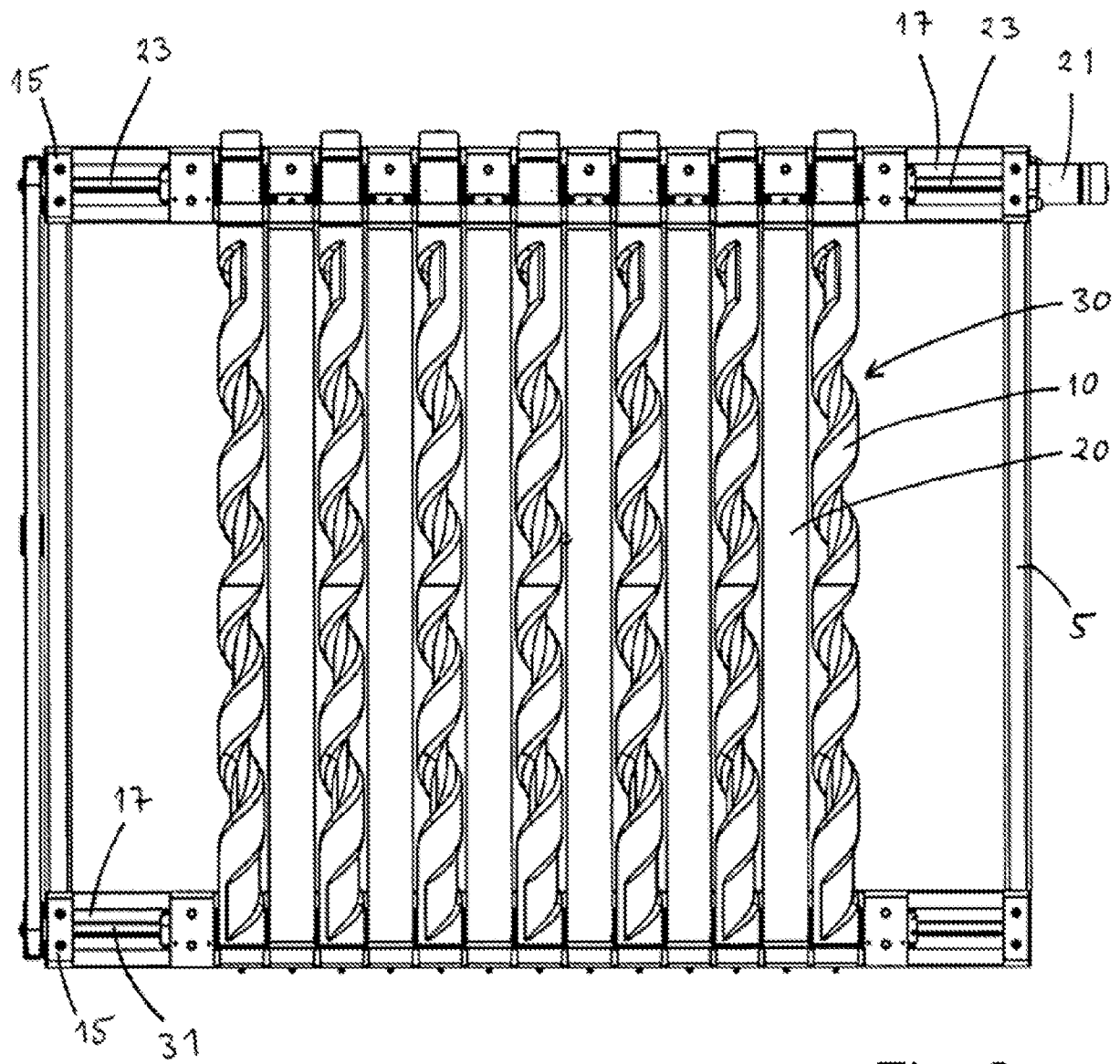


Fig. 2

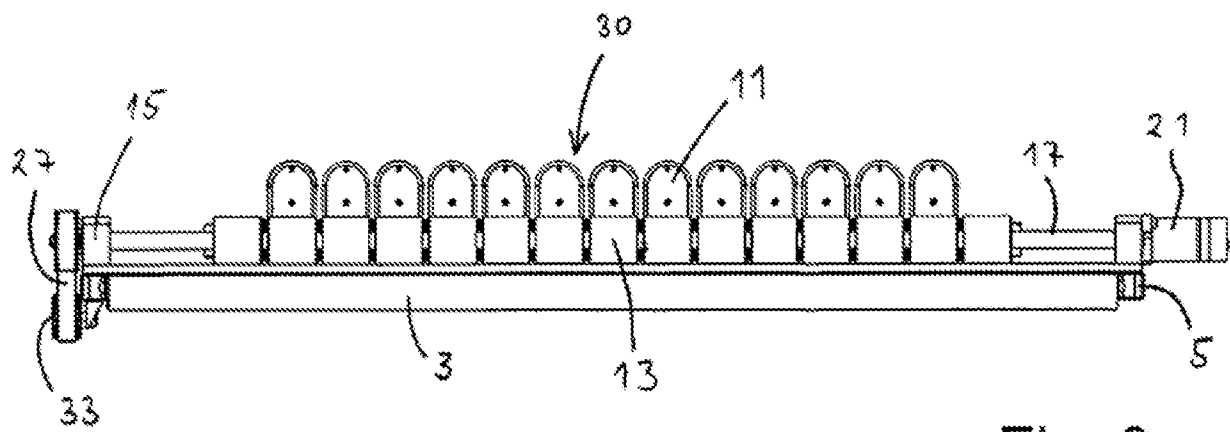


Fig. 3

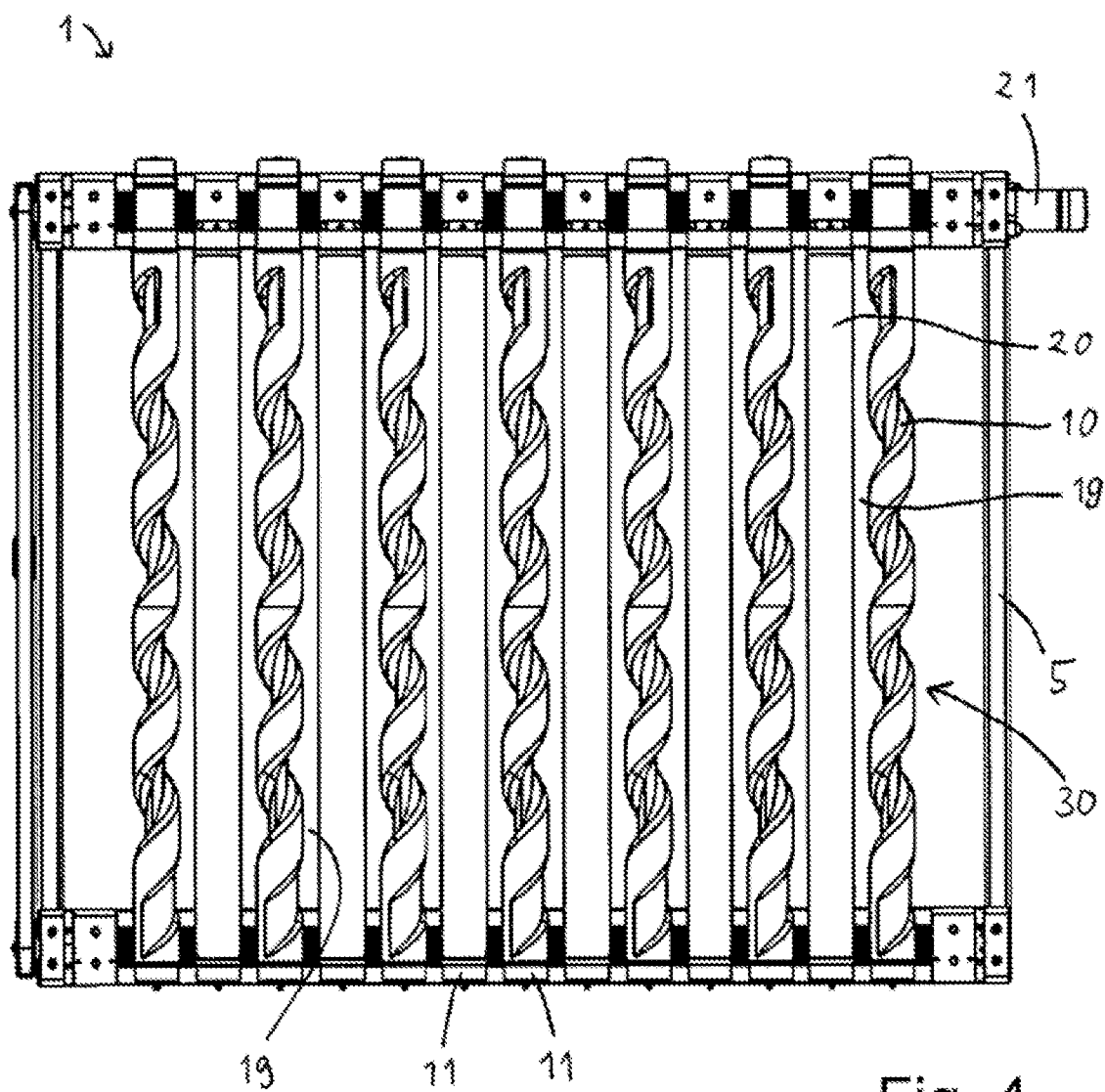


Fig. 4

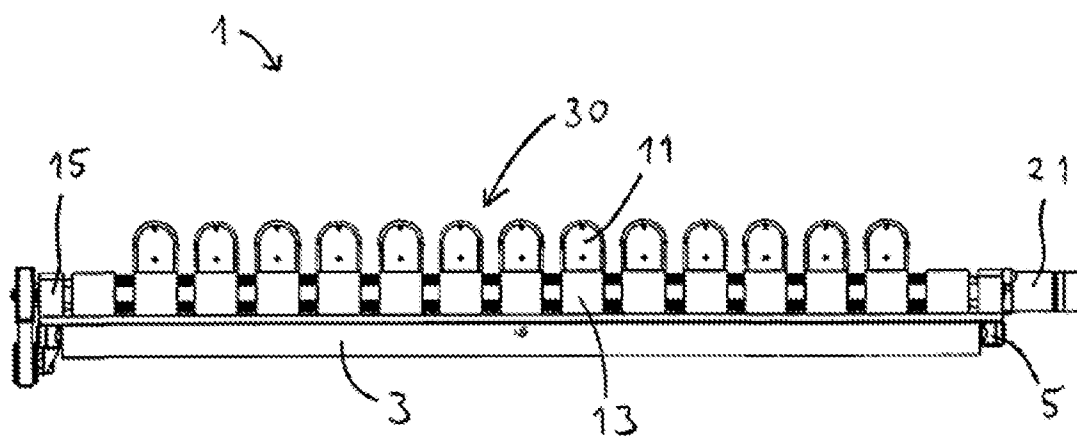


Fig. 5

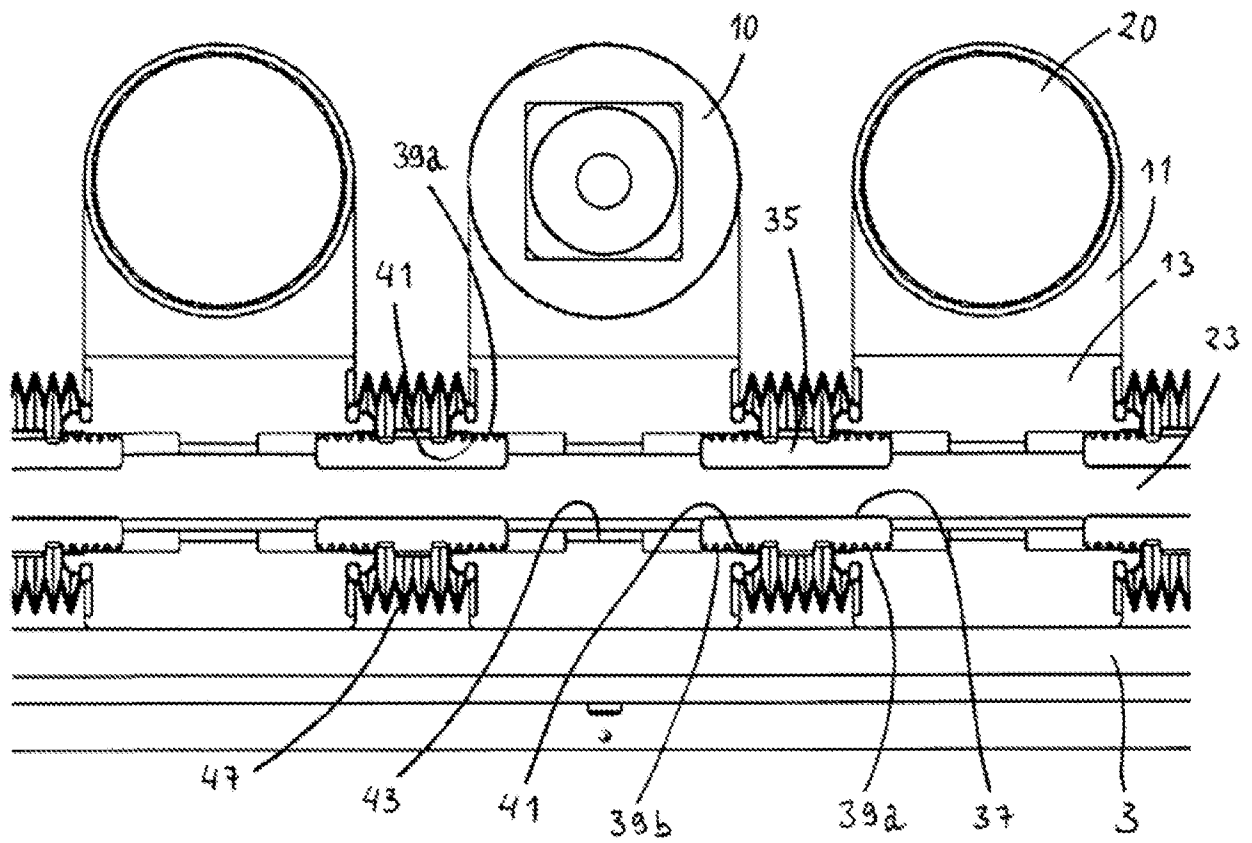


Fig. 6

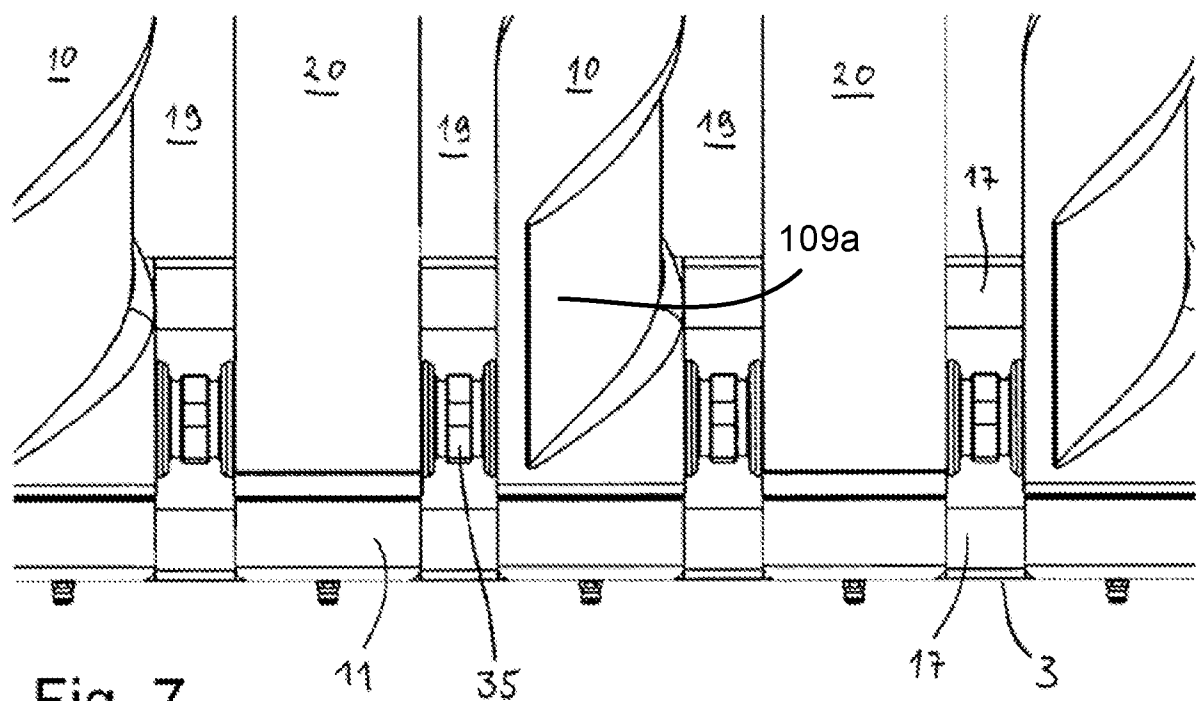


Fig. 7

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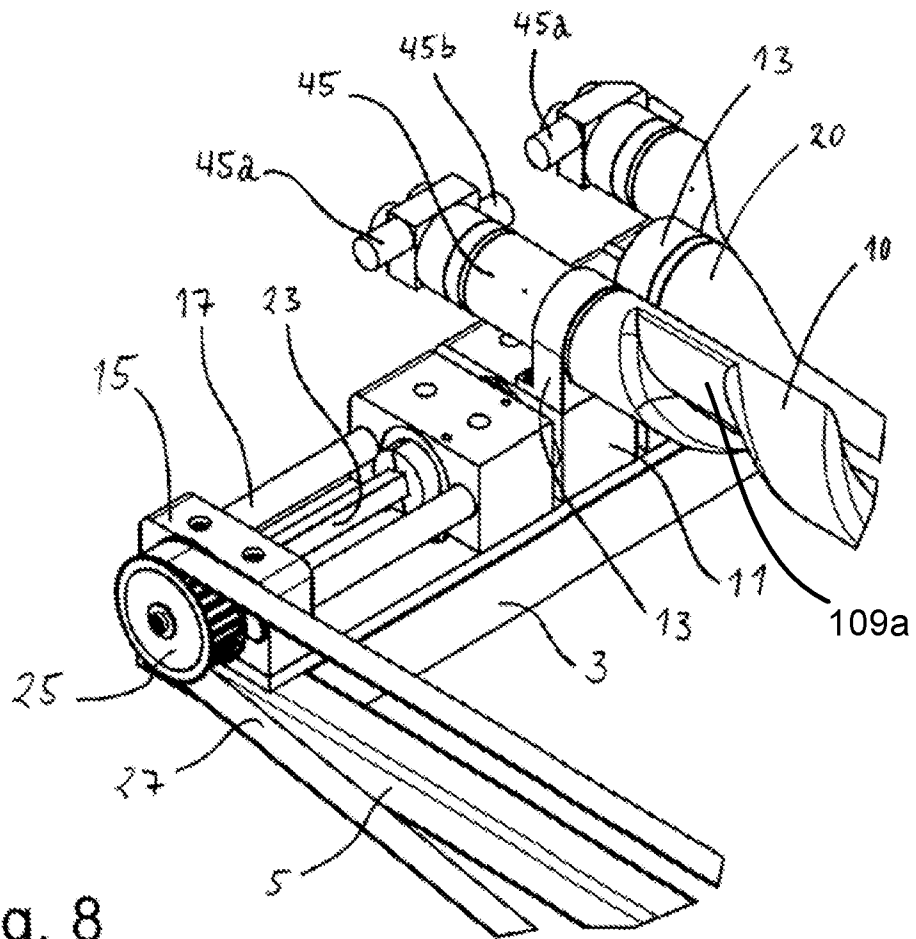


Fig. 8

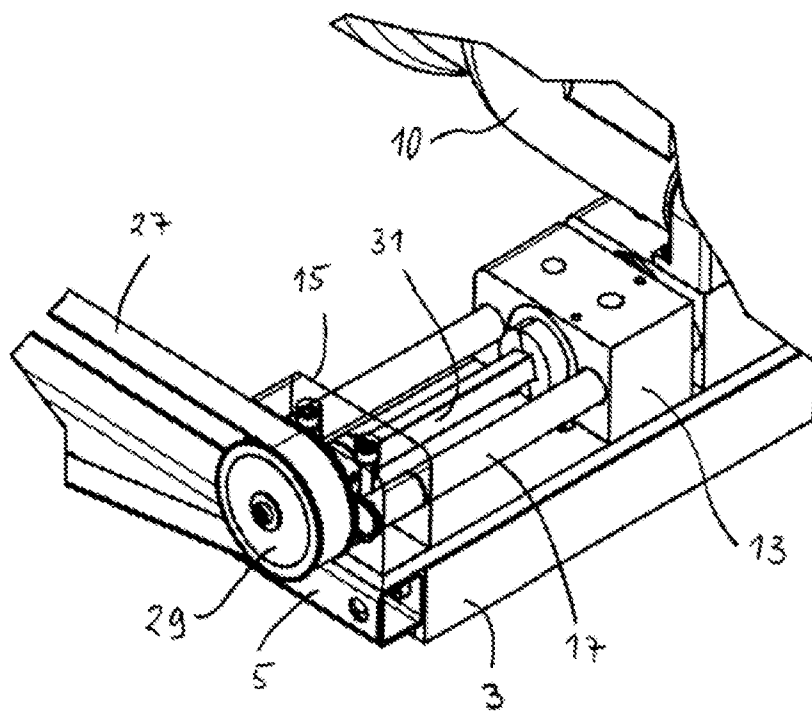


Fig. 9

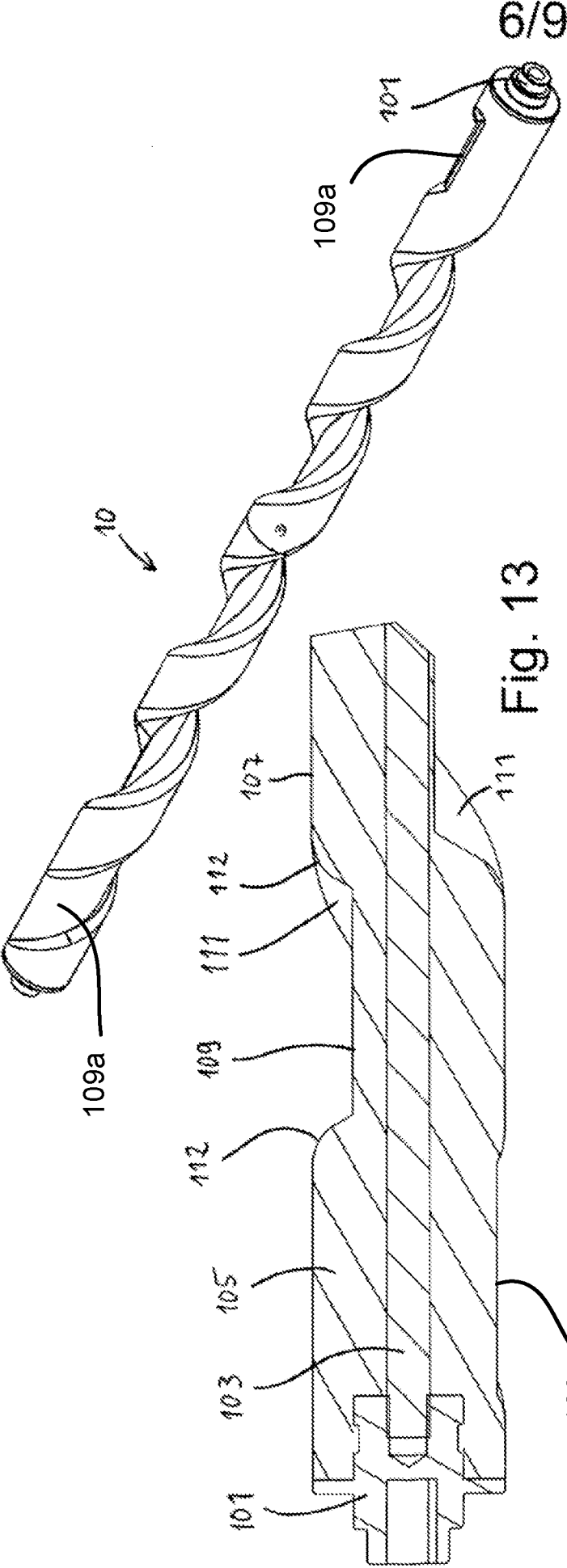


Fig. 10

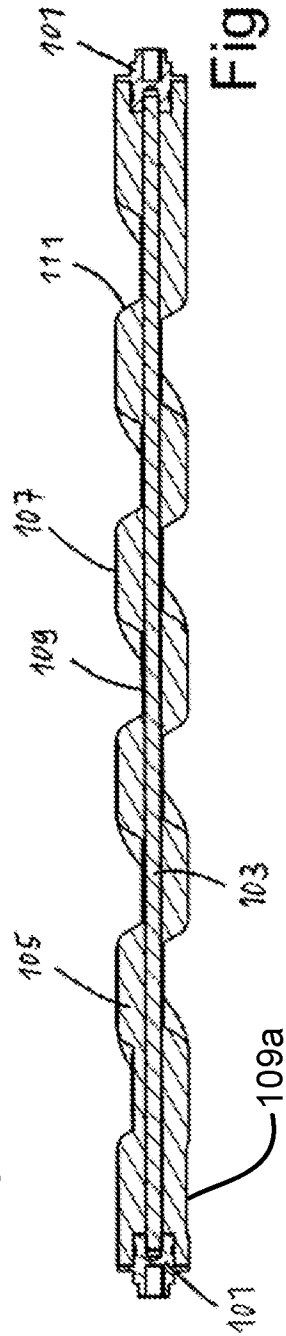


Fig. 12

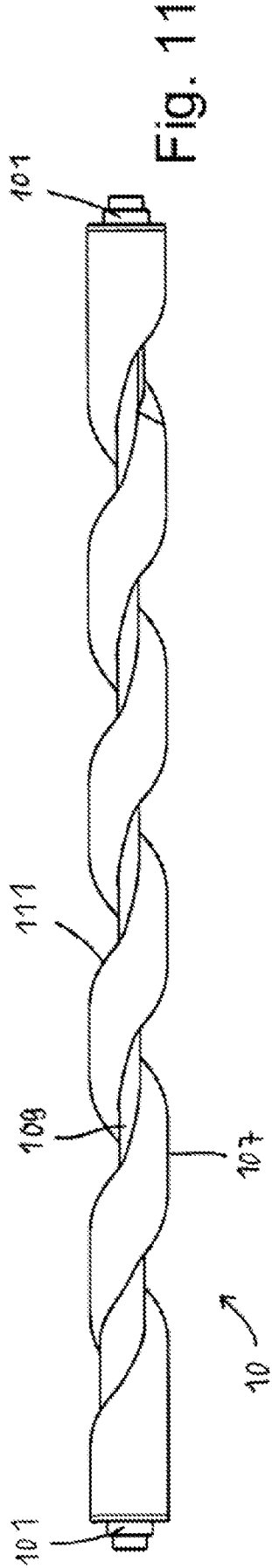
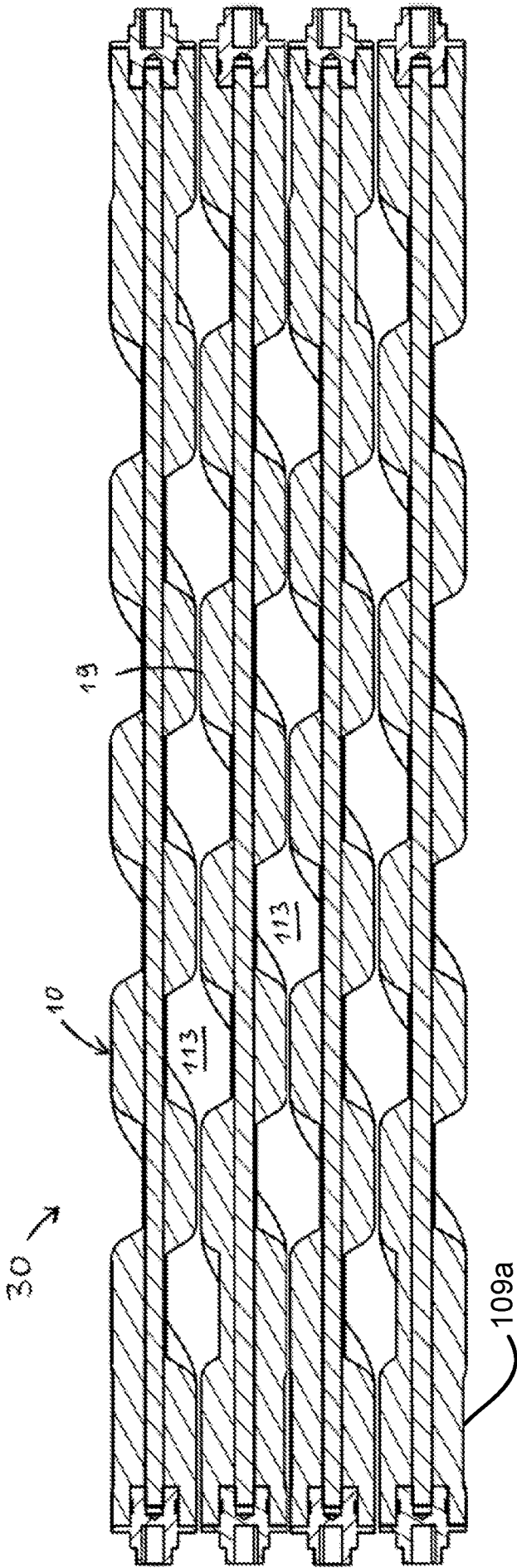
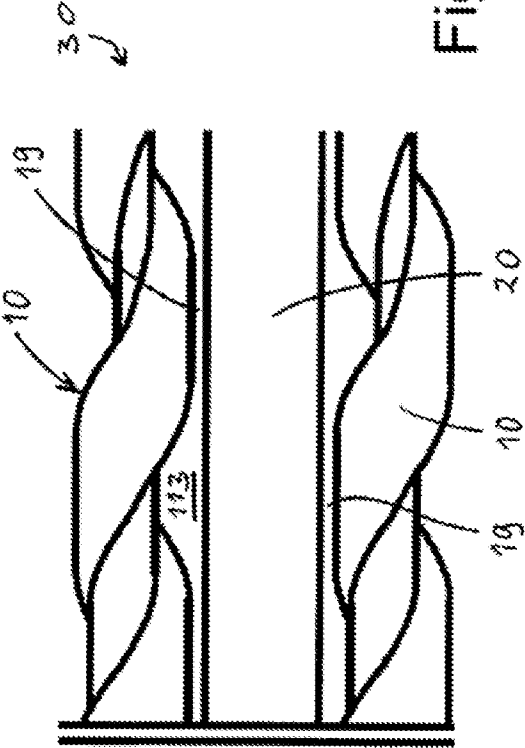


Fig. 11



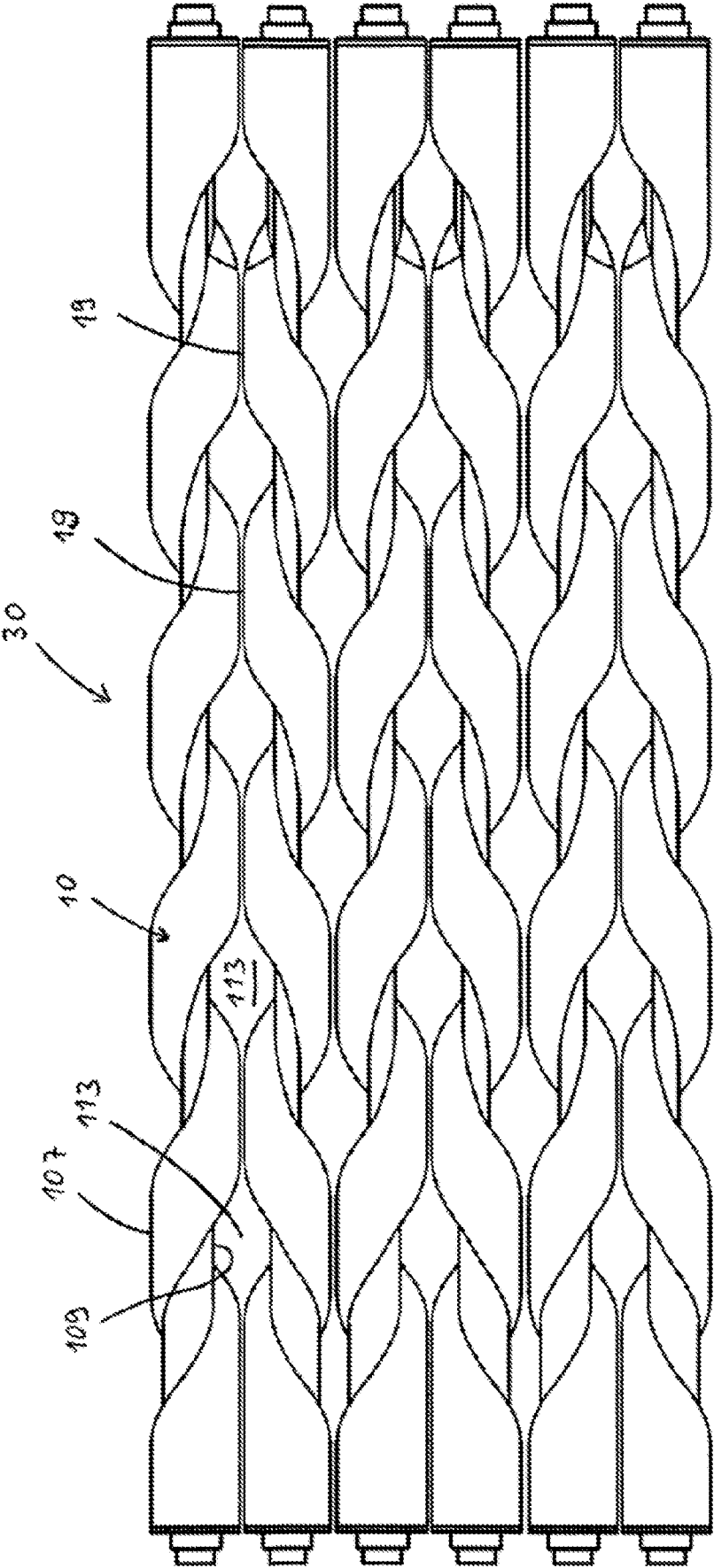


Fig. 16

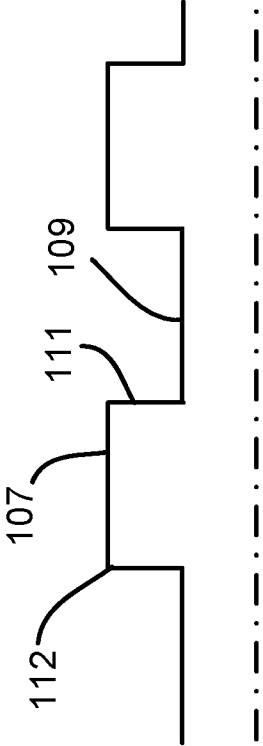
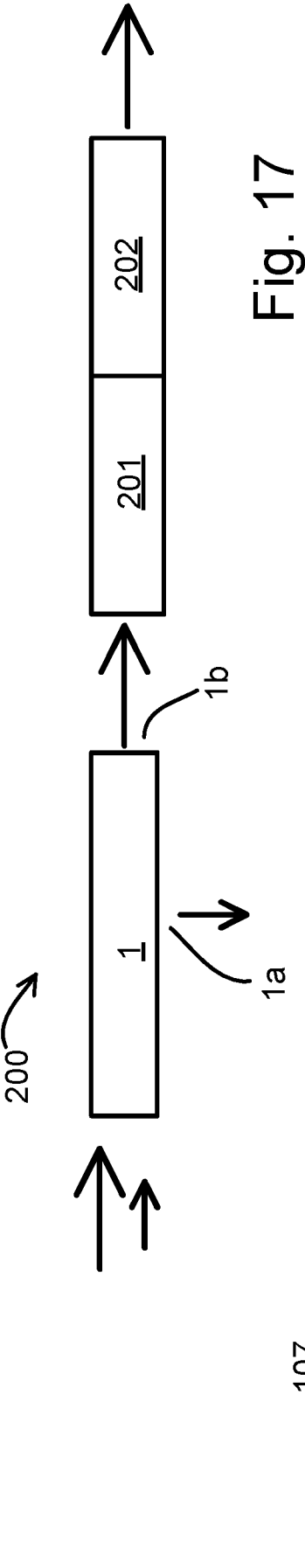


Fig. 18a

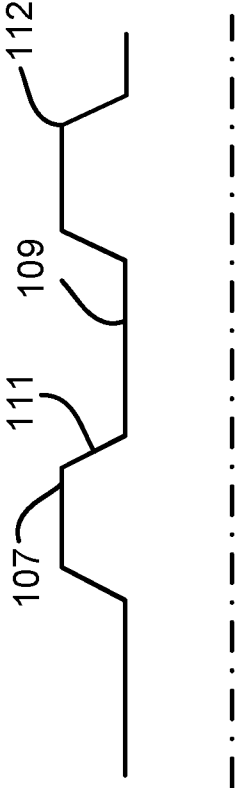


Fig. 18b

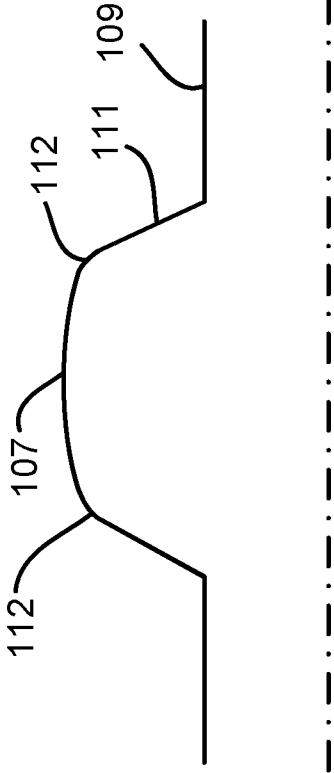


Fig. 18c

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2019/050020

A. CLASSIFICATION OF SUBJECT MATTER A01K 61/95 (2017.01), B07B 1/14 (2006.01), B07B 13/07 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A01K, B07B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched DK, NO, SE, FI: Classes as above. Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC, WPI, FULL TEXT: ENGLISH, GERMAN; NPL		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2351888 A1 (SCHELL PETER W) 2002.12.27, whole document	1, 2, 5-12
A		3, 4
X	CN 203095090 U (UNIV HEBEI AGRICULTURE) 2013.07.31, EPO abstract, figures	1, 5, 6, 8-12
A		2-4, 7
X	CN 106140600 A (UNIV HEBEI AGRICULTURE) 2016.11.23, EPO abstract, figures	1, 2, 5, 6, 8-12
A		3, 4, 7
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed “T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family		
Date of the actual completion of the international search 25/03/2019		Date of mailing of the international search report 29/03/2019
Name and mailing address of the ISA Nordic Patent Institute Helgeshøj Allé 81 DK - 2630 Taastrup, Denmark. Facsimile No. + 45 43 50 80 08		Authorized officer Olav Bergheim Telephone No. +47 22 38 73 76

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/NO2019/050020

Patent document cited in search report / Publication date	Patent family member(s) / Publication date
CA 2351888 A1 2002.12.27	NONE
CN 203095090 U 2013.07.31	NONE
CN 106140600 A 2016.11.23	NONE