(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 524 071 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.03.2025 Bulletin 2025/12

(21) Application number: **23197323.1**

(22) Date of filing: **14.09.2023**

(51) International Patent Classification (IPC):
B65H 3/04 *(2006.01)* ***B65H 3/12*** *(2006.01)*
B65H 3/56 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B65H 3/56; B65H 3/042; B65H 3/126;
B65H 2404/311; B65H 2404/623; B65H 2701/176

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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(54) FEEDER MODULE FOR A CONVERTING MACHINE

(57) The present invention relates to a feeder module (10) comprising a loading surface (26) configured to receive a stack (S) of blanks(2). The feeder module (10) comprising an upper feeder assembly (22) and a lower feeder assembly (24). The upper feeder assembly (22) comprises a dented chain (44) provided with a plurality of teeth (52), and wherein the teeth (52) are configured to enter into the stack (S) in-between the blanks (2).

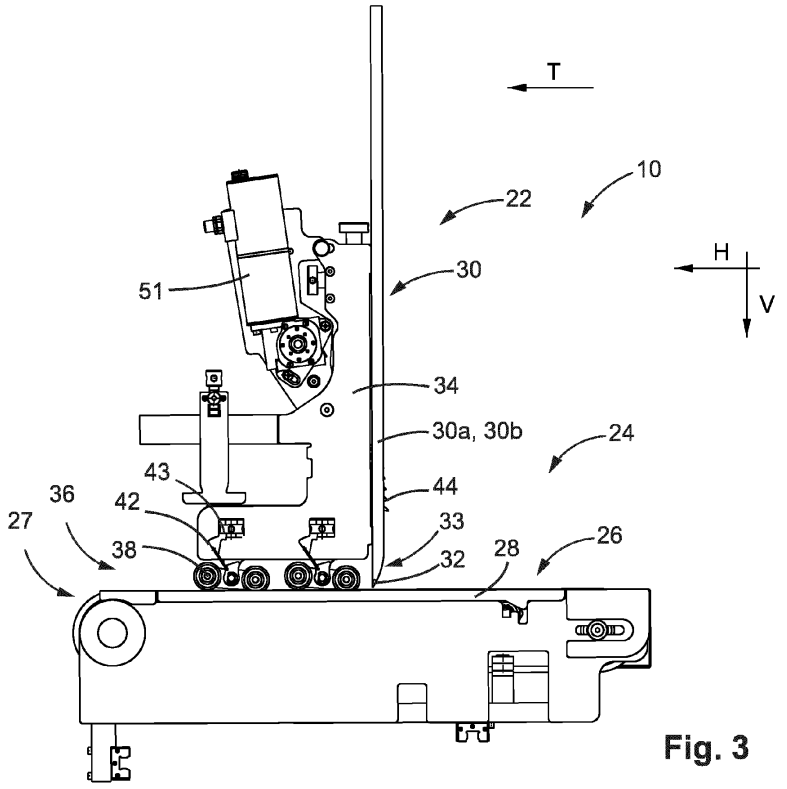

Fig. 3

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Description

Field of the invention

[0001] The present invention relates to a converting machine for producing packaging items such as paper and cardboard boxes. In particular, the invention relates to a feeder module configured to discharge sheets or blanks one by one into the converting machine.

Background

[0002] Converting machines such as folder-gluers are used in the production of packaging items such as paperboard and cardboard boxes. These machines are configured to receive sheets or cut-to-shaped blanks and then fold and glue them to form folding boxes or other similar packaging containers.

[0003] A feeder module is arranged at an inlet of the converting machine. The feeder module comprises a loading surface configured to receive a stack of sheets or cut-to-shaped blanks. The feeder module further comprises a gauge and a discharge conveyor which is configured to drive the lowermost positioned blank in the stack through a clearance defined between the gauge and the discharge conveyor.

[0004] In order to provide a correct discharge of sheets, there is a need to ensure that the blank is directed underneath the gauge. The blanks need to be pressed against the discharge conveyor to establish a sufficient contact; however, an excessive pressure may create deformation marks on the blanks. The height and thus the weight of the stack varies during production and this causes different contact pressures between the discharge conveyor and the blanks.

Summary

[0005] It is an object of the present invention to ensure a correct adherence between the blanks and the feeder discharge conveyor.

[0006] This object is solved by a feeder module according to claim 1.

[0007] According to an aspect of the present invention, there is provided a feeder module for a converting machine. The feeder module comprises an upper feeder assembly and a lower feeder assembly, wherein the lower feeder assembly comprises a loading surface configured to receive a stack of blanks, and a discharge conveyor configured to grasp a lowermost positioned blank in the stack and convey it forward in a direction of transportation.

[0008] The upper feeder assembly comprises at least one gauge configured to abut against a front side of the stack, and wherein a tip of the at least one gauge is arranged at a distance from the discharge conveyor, said distance defining a clearance for the lowermost positioned blank.

[0009] The upper feeder assembly further comprises a dented chain provided with a plurality of teeth, and wherein the teeth are configured to enter into the stack in-between the blanks.

[0010] The invention is based on a realization that the weight of the stack can be maintained constant if the weight of an upper part of the stack is supported by a protruding surface such as a tooth of a chain. In such a way, the friction may be maintained constant and calibrated to avoid scratching the blanks.

[0011] Within the context of this application, the term "blank" may refer to both cut-to-shaped blanks and sheets. The sheets may have a rectangular or square shape.

[0012] In an embodiment, the teeth comprise an upper contact surface configured to abut against a bottom surface of the blanks. In such a way, the weight of blanks located in an upper portion of the stack above the teeth can be supported.

[0013] In an embodiment, the upper contact surface of the teeth is downwardly sloping in in the vertical direction.

[0014] In an embodiment, the teeth comprise an upper contact surface, a lower contact surface and a crest, said contact surfaces being defined from a trough to the crest, and wherein the upper contact surface is longer than the lower contact surface, whereby the upper contact surface is downwardly sloping in the vertical direction.

[0015] In an embodiment, the lower contact surface has an extension which coincides with the extension of the top surface of the blanks. Preferably, the lower contact surface has a horizontal extension.

[0016] In an embodiment, the teeth comprise a lower contact surface configured to abut against a top surface of the blanks and to apply a downwardly directed force on the blanks.

[0017] In an embodiment, the dented chain is a loop comprising an exposed portion and a return portion, and wherein the dented chain is arranged such that only an exposed portion is in contact with the blanks.

[0018] The gauge may be provided with an opening through which the exposed portion of the dented chain horizontally extends.

[0019] In an embodiment, the opening is located above an angled or rounded inlet portion of the gauge.

[0020] In an embodiment, the dented chain comprises an internal engagement surface, and wherein the internal engagement surface is in contact with a plurality of idle rollers and a motorized drive roller.

[0021] In an embodiment, at least one idle roller is configured as a diverting roller, and wherein the diverting roller is configured to position the dented chain such as to produce a horizontal projection in the exposed portion of the dented chain. Preferably, the protruding portion horizontally projects through the opening in the gauge.

[0022] In an embodiment, a plurality of teeth is in contact with the blanks and wherein a lowermost positioned tooth in the exposed portion has a shorter horizontal extension than the upper teeth located in the exposed

portion.

[0023] In an embodiment, the dented chain is made from a flexible material, such that it is forming a flexible loop. The material may comprise a polymer, Thermoplastic Polyurethane or rubber. In a preferred embodiment, the dented chain is made in one piece. In other words, the dented chain is deprived from mechanical connectors such as fasteners or links.

Brief description of the drawings

[0024] The invention will now be described with reference to the appended drawings, in which like features are denoted with the same reference numbers and in which:

- Figure 1 is a schematic view of a converting machine in the configuration of a folder gluer;
- Figures 2a and 2b are top views of a blank and a folding box, respectively;
- Figure 3 is a schematic cross-sectional view of a feeder module according to an embodiment of the present invention;
- Figure 4 is a schematic perspective view of an upper feeder assembly according to an embodiment of the present invention;
- Figure 5 is schematic cross-sectional view of the upper feeder assembly and a stack of blanks;
- Figure 6a is a schematic cross-sectional view of a dented feeder chain according to an embodiment of the present invention;
- Figure 6b is detailed planar view of the tooth structure of the feeder chain of figure 6a;
- Figure 6c is a detailed schematic perspective view of the feeder chain of figure 6a; and
- Figures 7a and 7b are schematic perspective views of a feeder chain assembly from a first side and a second side, respectively.

Detailed description

[0025] Referring to the figures and in particular to figure 1 which illustrates a converting machine 1 in the form of a folder-gluer machine 1, and figures 2a and 2b which illustrate a blank 2 to be processed in the converting machine 1 and a folding box 2'. The folder-gluer machine 1 is configured to receive a cut to shaped blank 2 as the one illustrated in figure 2b, and then fold and glue the blank 2 to form a folding box 2' or another folded and glued packaging container 2'. Alternatively, the converting machine 1 may be provided with a cutting and creasing module, whereby the converting machine 1 itself transforms a square or rectangular sheet into a cut-to-shaped blank. Such a cutting and creasing arrangement is described in document EP4157625.

[0026] The present folder-gluer machine 1 comprises a series of different workstations in the form of modules. The modules may include, from an inlet to an outlet of the converting machine 1, and in a direction of transportation T: a feeder module 10, an alignment module 11, a fold pre-breaking module 12, a gluing module 14 and a folding module 16. The folder-gluer machine 1 may further comprise a main user interface 15 and a quality control system 18.

[0027] After the gluing and folding modules, a delivery module and conditioning section 21 can be provided in order to count and separate a shingled stream of folding boxes 2' into separate batches.

[0028] The converting machine 1 further comprises a conveyance system 19 comprising conveyors such as endless belts and rollers configured to transport the blanks 2 in a direction of transportation T. The converting machine 1 also comprises a central control circuitry 20 configured to control the operation of the converting machine 1.

[0029] The feeder module 10 is configured to feed the blanks 2 one by one into the converting machine 1. As illustrated in figure 3, the feeder module 10 comprises an upper feeder assembly 22 and a lower feeder assembly 24, in-between which the blanks 2 are conveyed.

[0030] The lower feeder assembly 24 comprises a loading surface 26 configured to receive a stack S of blanks 2. The loading surface 26 is provided with a discharge conveyor 28 configured to drive the lowermost positioned blank 2 in the stack S forward in the direction of transportation T. The discharge conveyor 28 preferably comprises a plurality of conveyor belts located side-by side and having their longitudinal extension coinciding with the direction of transportation T. Alternatively, in non-illustrated embodiments, the discharge conveyor 28 may comprise drive elements in the shape of rollers or a single discharge conveyor.

[0031] In another, non-illustrated embodiment, the loading surface 26 may further comprise a movable support surface comprising a plurality of elongated rods positioned in-between the plurality of conveyor belts. The movable support surface moves up and down such that the lowermost positioned blank 2 is in an alternating way brought into contact with and then distanced from the plurality of discharge conveyor belts.

[0032] The upper feeder assembly 22 comprises a front stopper 30 in the form of at least one gauge 30, preferably the front stopper comprises two gauges 30a, 30b. The discharge conveyor 28 is arranged at a distance C (see figure 5) from a vertical tip 32 of the at least one gauge 30a, 30b. Hence, the distance C defines a clearance C, through which the lowermost positioned blank 2 in the stack S passes. The clearance C is a distance which is less than the combined height of two blanks 2 in

the vertical direction V. However, preferably the clearance C corresponds to the height of one blank 2 in in the vertical direction V. This clearance C ensures that only one blank 2 can be conveyed into the converting machine 1 at a time. The gauge 30 may be slidably connected to a chassis 34 of the upper feeder assembly 22 such that the vertical position of the tip 32 of the at least one gauge 30a, 30b can be adjusted by moving the at least one gauge 30a, 30b in the vertical direction V. In such a way, the clearance C can be modified when the vertical thickness of the blank 2 changes.

[0033] The discharge conveyor 28 of the lower feeder assembly 24 may extend from the loading surface 26 to an outlet 27 of the feeder module located downstream of the gauge 30. The discharge conveyor 28 is preferably accelerated and decelerated. In such a way, the blanks 2 are discharged in a stream and with a predefined spacing between each other.

[0034] As best seen in figures 3 and 5, the gauge 30 is configured to abut against a front side of the stack S such as to restrict the horizontal movement of the upper blanks 2 in the stack. The upper portion of the gauge 30 is preferably provided with a vertical contact surface. In such a way, the upper portion of the stack S is maintained vertical.

[0035] The lower distal end, i.e. the tip 32 of the gauge 30 may be provided with an angled portion 33. The angled portion 33 is arranged at an angle α in relation to the vertical axis V. The angle α is configured to define a downwardly sloping surface in the direction of transportation T.

[0036] The angled portion 33 enables the lowermost positioned blank 2 to be positioned further downstream in the direction of transportation T than the following blank 2, which is located on top of the lowermost positioned blank 2. Optionally, the angled portion 33 of the gauge 30 may also be rounded. The rounded portion 33 smoothly directs the front edges of the blanks 2 under the front stopper 30.

[0037] As best seen in figures 3 and 4, the upper feeder assembly 22 comprises an upper conveyor 36 configured to contact the upper side of the blanks 2. In such a way, the vertical position of the blanks 2 can be controlled. The blanks 2 is received in-between the upper feeder assembly 22 and the lower feeder assembly 24 and are guided such that they are fed into the converting machine 1 in a straight manner without warps.

[0038] The upper conveyor 36 may comprise a plurality of rollers 38. A spring 42 is acting on the rollers such as to bias the rollers 38 against the blank 2. An actuator 43 is operatively connected to the rollers 38 and is configured to provide a variable force such that the pressure of the rollers 38 can be modified. The actuator 43 may be a pneumatic or hydraulic actuator.

[0039] The upper feeder assembly 22 further comprises a dented chain 44. The dented chain 44 is a loop which comprises a plurality of teeth 52. The teeth 52 are configured to enter into the stack S in-between the blanks 2.

[0040] As best seen in figure 6b, the teeth 52 are defined by a crest 55, an upper contact surface 54 and a lower contact surface 56. Each tooth is defined by a crest 55 located between two troughs 57.

[0041] The dented chain 44 may have a zig-zag shape. In a preferred embodiment, each tooth 52 is non-symmetrical around a center line Lc through the crest 55. The length L1 of the upper contact surface 54 is thus longer than the length L2 of the lower contact surface 56. The difference in length between L1 and L2 provides a skewed zig-zag shape.

[0042] The peak-to-peak distance P1 between the crests 55 of directly adjacent teeth may be selected to correspond to the thickness of one blank 2. In this embodiment, there is one sheet 2 between each tooth 52.

[0043] However, in a preferred embodiment, the peak-to-peak distance P1 between the adjacent crests 55 is selected to exceed a maximum thickness of one blank 2. This is advantageous if the same dented chain 44 is used for different types of blanks 2 with variable thicknesses. The teeth 52 of the chain may be introduced between each blank 2 in the stack. Alternatively, for thinner blanks 2, there are several blanks 2 present between the adjacent crests 55 of the dented chain 44. In an advantageous embodiment, the peak-to-peak distance is between 5-15 mm, preferably about 11 mm. To increase the peak-to-peak distance P1, there may be a flat distance 53 between each trough 57 of the adjacent teeth 52. The distance between the troughs may be between 0 and 10 mm, preferably about 5 mm.

[0044] The upper contact surface 54 of the teeth 52 is configured to contact a lower side of the blanks 2. As best seen in figures 5, 7a and 7b, the dented chain 44 has an exposed portion E which is in contact with the blanks 2. Preferably, the exposed portion E is located at the inlet portion I of the gauge 30.

[0045] In such a way, an upper part of the stack S1 which is located above the teeth 52 in the exposed portion E is held by the dented chain 44. The dented chain 44 is configured to at least partly support the weight of the upper portion S1 of the stack S.

[0046] Additionally, the lower contact surface 56 of the teeth 52 may be configured to grasp the front edges of the blanks 2 and guide them vertically downwards against the lower discharge conveyor 28.

[0047] The lower contact surface 56 of each tooth 52 is preferably designed such that the lower contact surface 56 has an extension which coincides with the top surface of the blanks 2. This extension preferably coincides with the horizontal direction H. In such a way, the teeth 52 are provided with a flat surface which pushes against the blanks 2, and the risk of creating cut marks can be avoided. Preferably, the lower contact surface has a length of between 3 to 8 mm, preferably about 4 to 5 mm.

[0048] Optionally, the weight of the lower part of the stack S2 can be used to create a passive pressure and the pressure applied by the dented chain 44 can be

reduced while still obtaining a calibrated contact pressure between the lowermost positioned blank 2 and the discharge conveyor 28.

[0049] The exposed portion E comprises a plurality of teeth 52 which are simultaneously in contact with the blanks 2. Hence, the dented chain 2 is in contact with a plurality of blanks 2. In the illustrated embodiment, there are three teeth 52 which project into the stack S. However, the number of teeth 52 simultaneously engaging with the blanks 2 may be variable.

[0050] The at least one gauge 30a, 30b may be provided with an opening 46 through which the exposed portion E of the dented chain 44 extends. The opening 46 is preferably located above the inlet portion I of the gauge 30. Ideally, a lower part 46a of the opening 46 is positioned at between 50 to 80 mm, preferably about 65 mm from the tip 33 the gauge 30. This allows a precise conveyance of the blanks 2 as they are positioned at the inlet path to the clearance C. Each tooth 52 may have a lateral length of between 30 % to 50% of the width of the gauge. This lateral length may be between 10 mm and 20 mm.

[0051] Alternatively, in a non-illustrated embodiment, the feeder chain 44 is located laterally of the gauge 30. The dented chain 44 may be attached to a separate frame member.

[0052] The dented chain 44 preferably also applies a force F to the blanks 2 such that the contact pressure between the lowermost positioned blank 2 and the loading surface 26 is sufficient for the lower discharge conveyor 28 to grasp and drive the lowermost positioned blank 2 forward in the direction of transportation. The force F may be in the range of between 20 to 180 Newton.

[0053] The dented chain 44 may thus be configured to both apply a pressure on the lower part S2 of the stack, while supporting the weight of the upper portion S1 of the stack.

[0054] Due to the trajectory of the dented chain 44, the lowermost positioned tooth 52 has a slope angle which is higher than the uppermost positioned tooth 52. Additionally, the lowermost positioned tooth 52 which is in contact with the blanks 2 has a smaller horizontal projection P than the teeth 52 in contact with the blanks 2 and located vertically above. The difference is horizontal projection P is achieved with the trajectory of the dented chain 44. In such a way, the blanks 2 can disengage from the upper contact surface 54 of the teeth 52 and become positioned under the lower contact surface 56 of the teeth 52.

[0055] The dented chain 44 has a contact side 47a and a motorized engagement side 47b. The motorized engagement side 47b is located inside the loop defined by the dented chain 44. The contact side 47a is in contact with the blanks 2 in the stack S. The dented chain 44 has a direction of movement M such that the teeth 52 are moving vertically downwards in the exposed portion E.

[0056] As illustrated in figures 7a and 7b, the dented chain 44 is guided by a series of idle dented rollers 48 and a motorized drive roller 50. The motorized drive roller 50 is driven in rotation by a motor 51. The motor 51 may be configured to change the torque such that the pressing force F against the blanks 2 can be modified. In such a way, the force can be adapted to the material and geometry of the blanks 2.The idle rollers 48 and the drive roller 50 are provided with gears configured to engage with a corresponding internal dented engagement surface 47 on the dented chain 44.

[0057] At least one idle roller 48a is configured as a diverting roller 48a. The diverting roller 48a is positioned outside of an axis A defined by a straight line extending through the center of the drive roller to the center of the distal lowermost positioned idle roller 48b. The diverting roller 48a changes direction of the dented chain 44 such as to produce a protruding portion P which horizontally projects from the opening 31 in the gauge 30.

[0058] An axis B of the exposed portion E can be defined through a line extending through the rotational axis of the diverting roller 48a and the lowermost positioned idle roller 48b.

[0059] The axis of the exposed portion E can be adjusted in the horizontal direction such as to vary the position of the length of the horizontal projection P. This allows an adaptation of the position of the teeth 52 and adapt to material characteristics, such as paperboard or corrugated cardboard.

[0060] The dented chain 44 can be produced in one piece without joints. In a preferred embodiment, the dented chain 44 is made from a flexible material. The material may comprise a polymer such as Thermoplastic Polyurethane or rubber.

[0061] The manufacturing process of the dented chain may be by molding or sintering. However, it is advantageous to use an additive manufacturing process, i.e. a 3D printing process.

Claims

1. A feeder module (10) for a converting machine (1), the feeder module comprising an upper feeder assembly (22) and a lower feeder assembly (24), wherein the lower feeder assembly comprises a loading surface (26) configured to receive a stack (S) of blanks (2), and a discharge conveyor (28) configured to grasp a lowermost positioned blank (2) in the stack and convey it forward in a direction of transportation (T),
the upper feeder assembly comprising at least one gauge (30) configured to abut against a front side of the stack, and wherein a tip (32) of the at least one gauge is arranged at a distance from the discharge conveyor, said distance defining a clearance (C) for the blank, **characterized in that** the upper feeder assembly further comprises a dented chain (44) provided with a plurality of teeth (52), and wherein the teeth are configured to enter into the stack in-between the blanks.

2. The feeder module according to claim 1, wherein the teeth comprise an upper contact surface (54) configured to abut against a bottom surface of the blanks.

3. The feeder module according to claim 1 or 2, wherein the teeth comprise a lower contact surface (56) configured to abut against a top surface of the blanks and to apply a downwardly directed force (F) on the blanks.

4. The feeder module according to claim 2 or 3, wherein the upper contact surface of the teeth is downwardly sloping in the vertical direction (V).

5. The feeder module according to claim 4, wherein the shape of the teeth comprises an upper contact surface (54), a lower contact surface (56) and a crest (55), said contact surfaces being defined from a trough (57) to the crest, and wherein the upper contact surface is longer than the lower contact surface.

6. The feeder module according to the preceding claim, wherein the lower contact surface has an extension which coincides with the extension of the top surface of the blanks.

7. The feeder module according to any one of the preceding claims, wherein the dented chain is a loop comprising an exposed portion (E) and a return portion, and wherein the dented chain is arranged such that only an exposed portion is in contact with the blanks.

8. The feeder module according to the preceding claim, wherein the gauge is provided with an opening (46) through which an exposed portion of the dented chain horizontally extends.

9. The feeder module according to the preceding claim, wherein the opening is located above an angled or rounded inlet portion (I) of the gauge.

10. The feeder module according to the preceding claim, wherein the dented chain comprises an internal engagement surface, and wherein the engagement surface is in contact with a plurality of idle rollers (48a, 48b) and a motorized drive roller (50).

11. The feeder module according to the preceding claim, wherein at least one idle roller (48b) is configured as a diverting roller (48b), and wherein the diverting roller is configured to position the dented chain such as to produce a horizontal projection (P) in the exposed portion of the dented chain.

12. The feeder module according to the preceding claim, wherein the horizontal projection projects through the opening (46) in the gauge.

13. The feeder module according to the preceding claim, wherein a plurality of teeth is in contact with the blanks and wherein a lowermost positioned tooth in the protruding portion has a shorter horizontal extension than the upper teeth located in the exposed portion (E).

14. The feeder module according to any one of the preceding claims, wherein the dented chain is made from a flexible material, and wherein the dented chain is forming a flexible loop.

15. The feeder module according to the preceding claim, wherein the flexible material comprises a polymer, Thermoplastic Polyurethane or rubber.

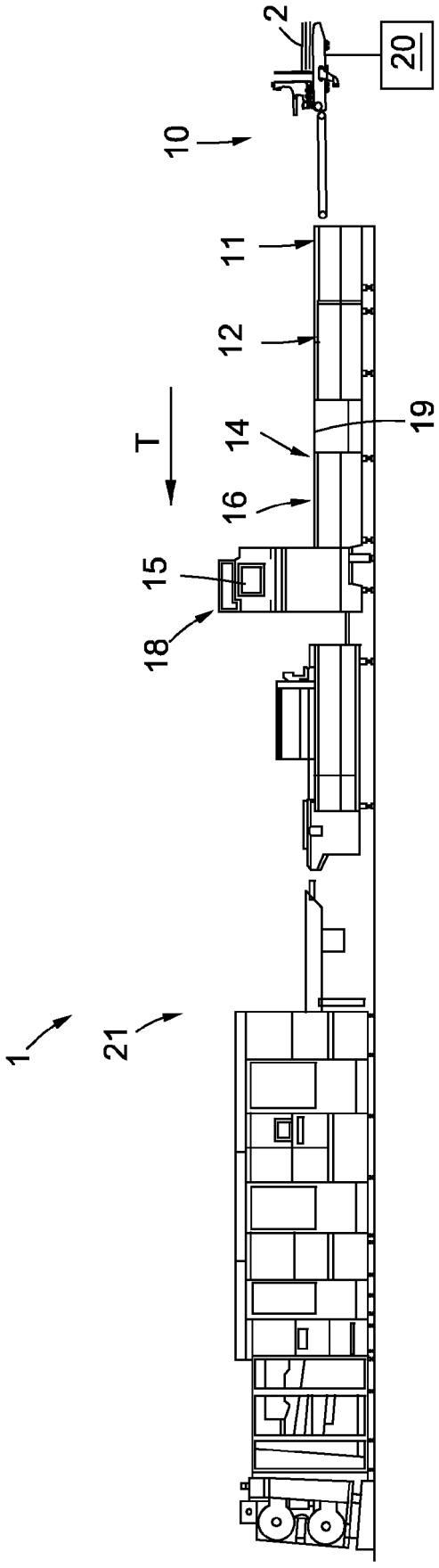

Fig. 1

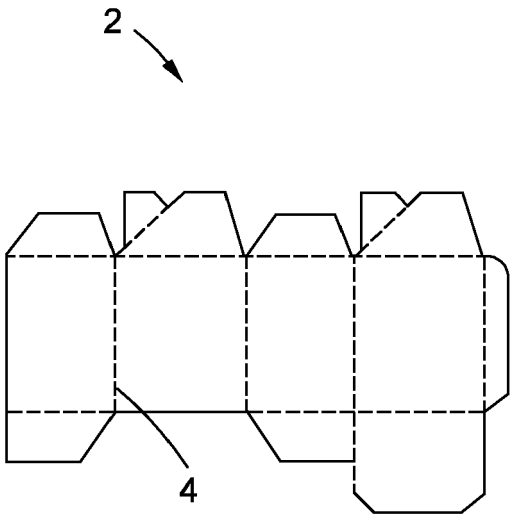

Fig. 2a

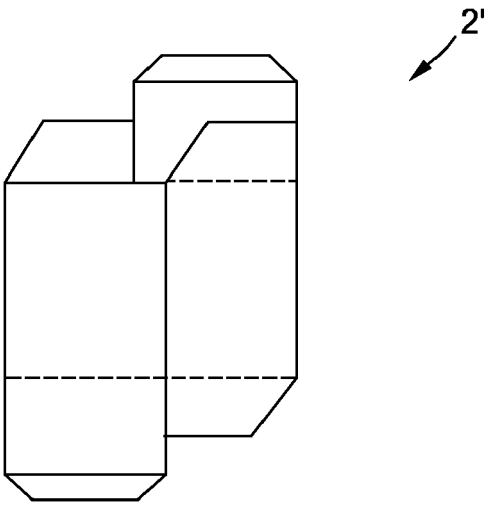

Fig. 2b

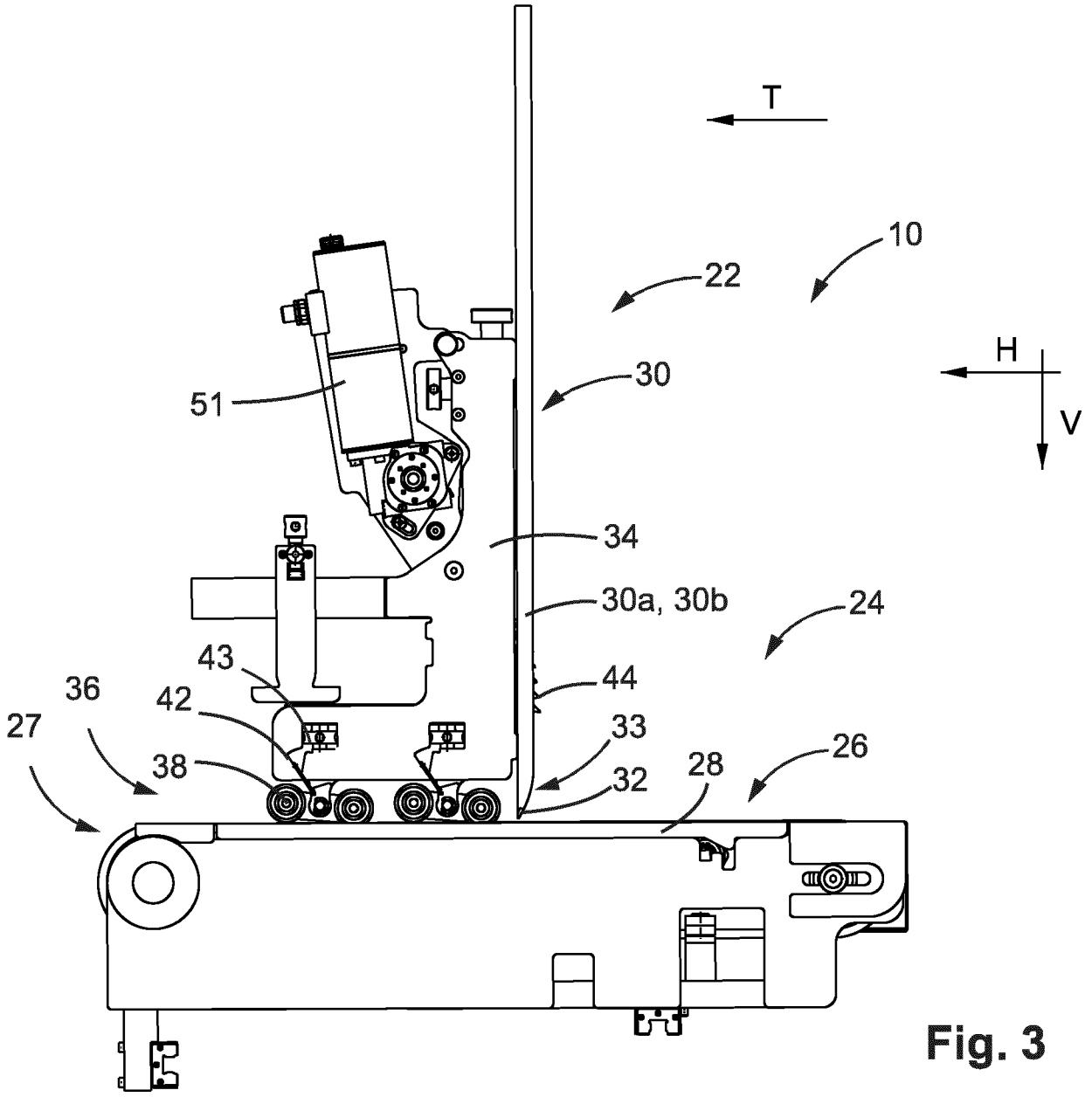

Fig. 3

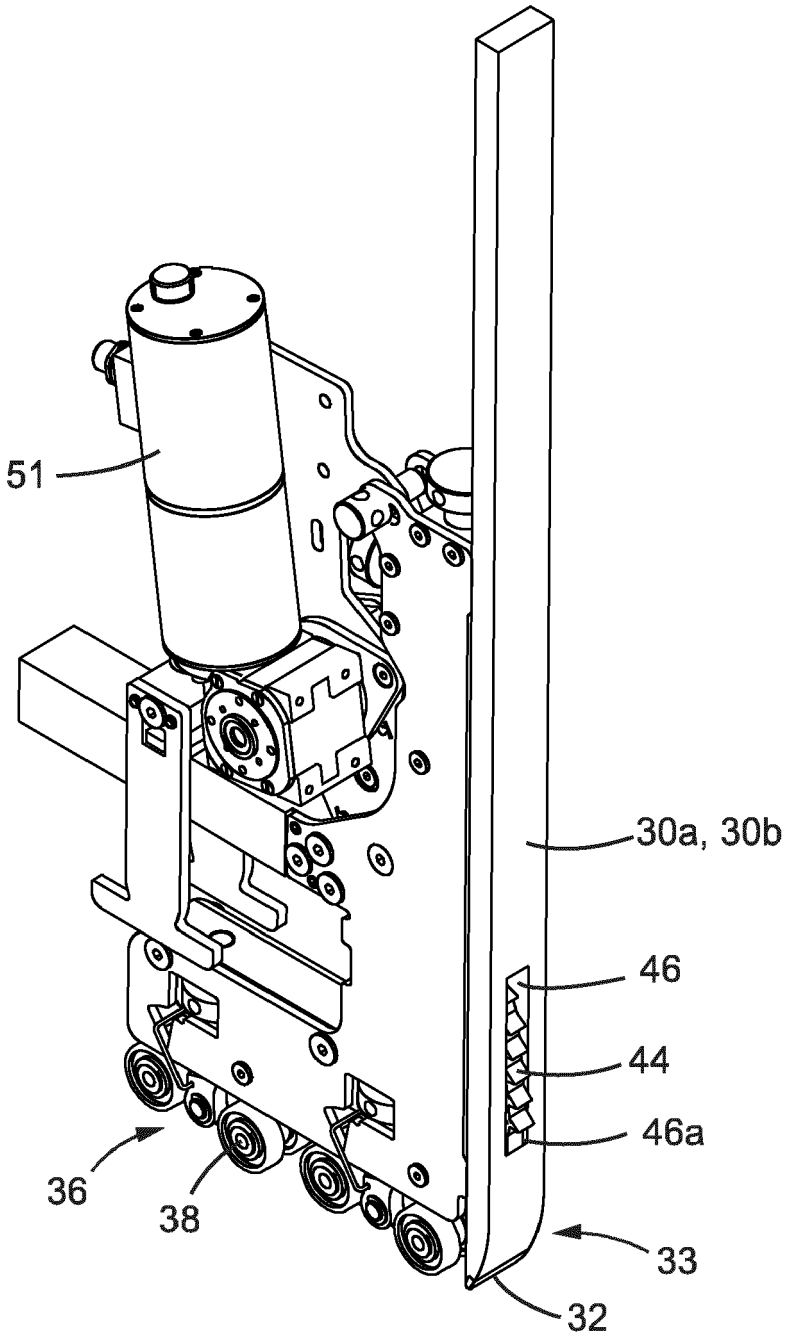

Fig. 4

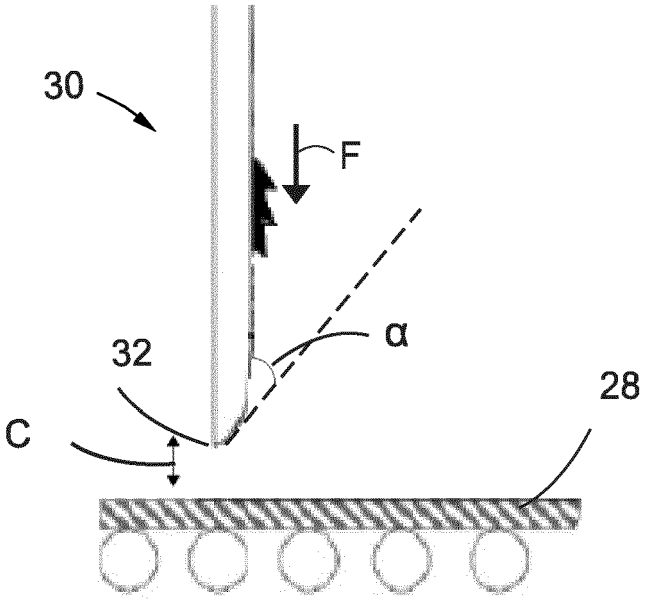

Fig. 5a

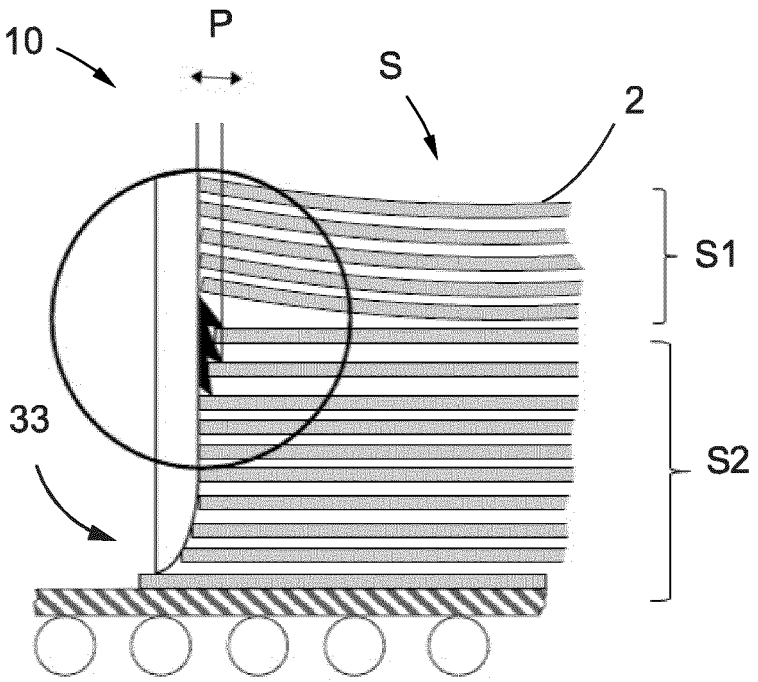

Fig. 5b

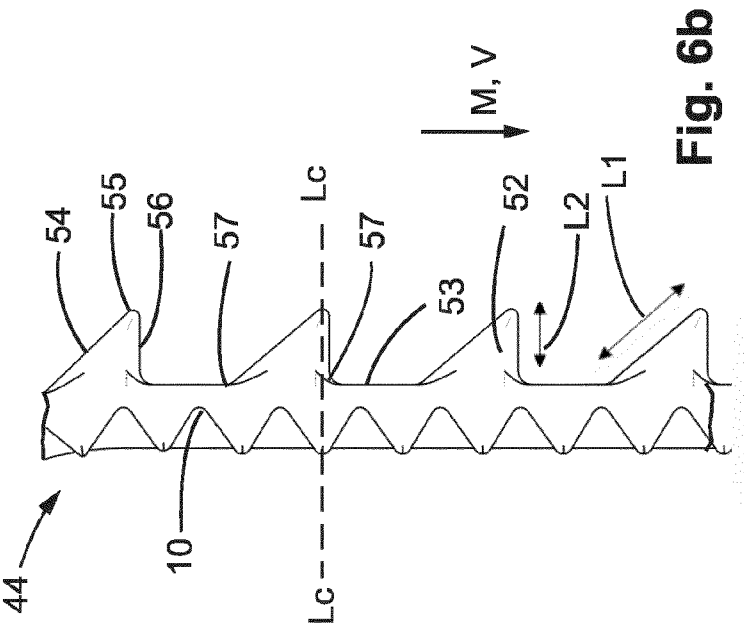

Fig. 6b

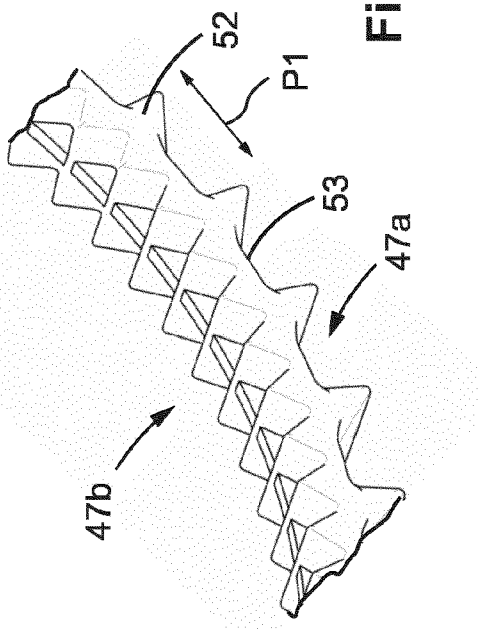

Fig. 6c

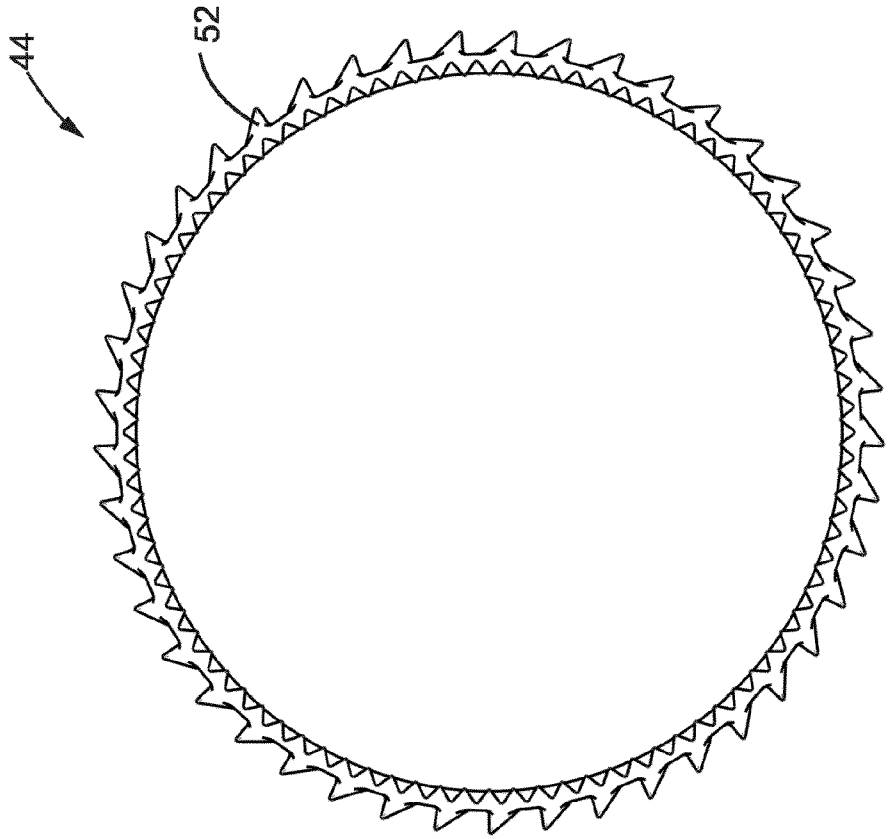

Fig. 6a

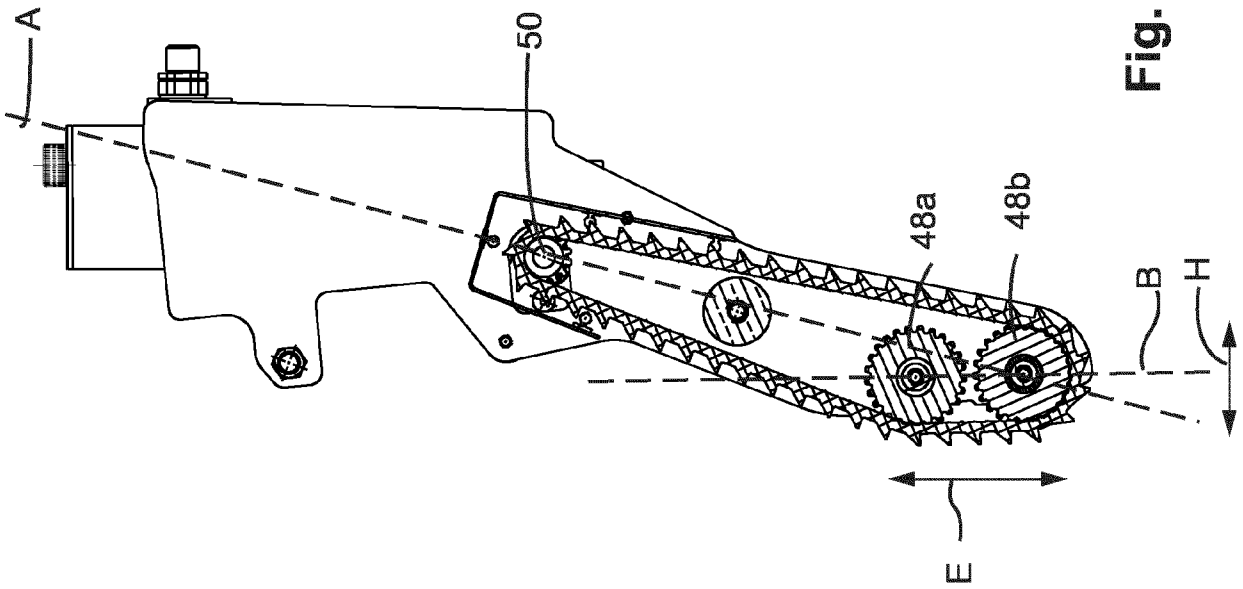

Fig. 7b

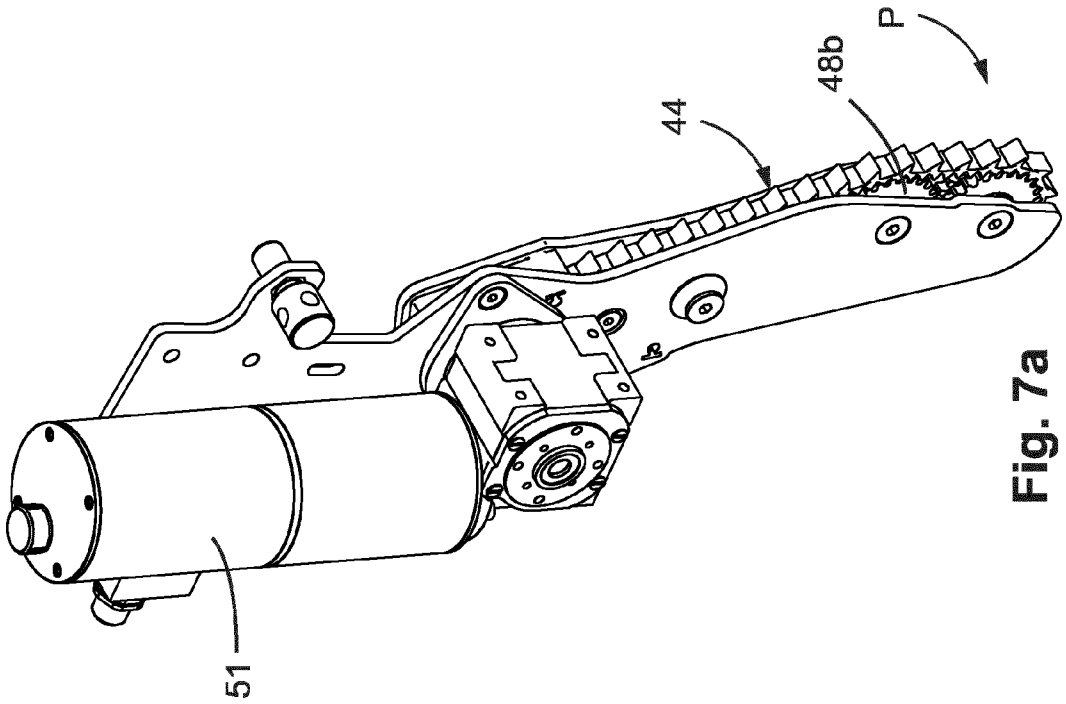

Fig. 7a

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 19 7323

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP S60 6863 B2 (TANABE SHIKOU KIKAI SEIZOU KK) 21 February 1985 (1985-02-21)	1-4,7-15	INV. B65H3/04
A	* the whole document *	5,6	B65H3/12 B65H3/56
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A	US 1 948 362 A (STAUDE EDWIN G) 20 February 1934 (1934-02-20) * the whole document *	1-15	
A	US 10 370 208 B2 (INDAG POUCH PARTNERS GMBH [DE]) 6 August 2019 (2019-08-06) * the whole document *	1	
A	US 11 685 619 B1 (TSUKASAKI MASAHIRO [JP]) 27 June 2023 (2023-06-27) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 February 2024	Athanasiadis, A

CATEGORY OF CITED DOCUMENTS

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