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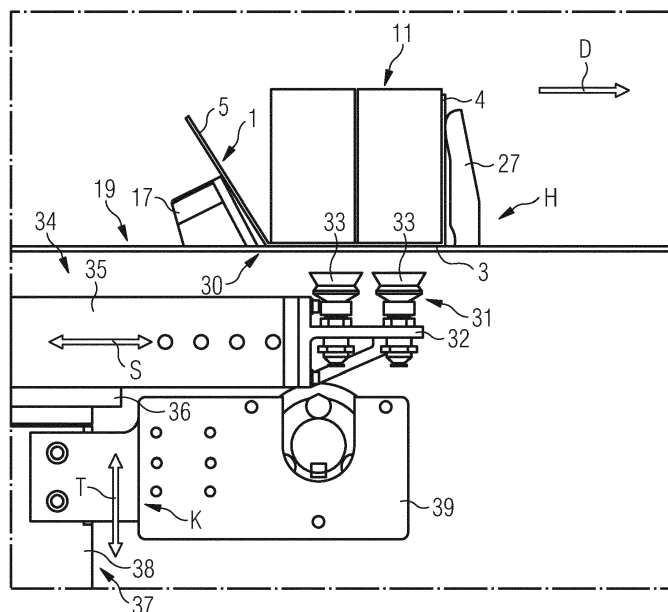
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A FOLDING APPARATUS FOR FOLDING SHEET PACKAGING ELEMENTS

(57) A folding apparatus for folding a sheet packaging element (1) comprises a conveyor (13) for advancing along an advancing direction (D) said sheet packaging element (1) together with a group of packages (11) to be packed in said sheet packaging element (1), said conveyor (13) comprising a folding arrangement (22) for folding said sheet packaging element (1), said folding apparatus further comprising a suction device (30) that acts on said sheet packaging element (1) to keep said sheet packaging element (1) on said conveyor at least when said folding arrangement (22) folds said sheet packaging element (1).

FIG 5



Description

[0001] The present invention relates to a folding apparatus for folding sheet packaging elements, in particular cardboard blanks designed to be transformed into packaging boxes. The packaging boxes house groups of packages - the so-called multipacks - and are adapted to be delivered to sales outlets.

[0002] The present invention may be advantageously but not exclusively used in plants for packaging pourable food products, such as beverages, milk, wine, tomato sauce, etc., in sealed packages, containers or the like, which are then packed in groups into the above-mentioned packaging boxes.

[0003] The present description refers to this specific field, although this is in no way intended to limit the scope of protection as defined by the accompanying claims.

[0004] As known, sealed packages are formed, filled and sealed in a machine or a combination of machines and are then conveyed to a folding apparatus, in which the sealed packages are packed in groups into packaging boxes.

[0005] Conveniently, the packaging boxes are formed from respective sheet packaging elements, which are stored in a magazine and picked up from the latter to be then subjected to folding operations in the folding apparatus.

[0006] The sheet packaging elements are typically defined by flat, rectangular or square blanks, which, in some cases, may also be provided with handles to ease transportation of the resulting packaging boxes.

[0007] Each sheet packaging element comprises a central portion, a first side portion and a second side portion. The central portion is arranged between the first side portion and the second side portion. A first weakening line, or first crease line, is interposed between the central portion and the first side portion. A second weakening line, or second crease line, is interposed between the central portion and the second side portion.

[0008] The sheet packaging element is folded in the folding apparatus so as to form a packaging box, or a tray. In particular, the base portion of the sheet packaging element defines a base panel of the packaging box, the first side portion of the sheet packaging element defines a first side panel of the packaging box and the second side portion of the sheet packaging element defines a second side panel of the packaging box.

[0009] The folding apparatus comprises a conveyor that receives the sheet packaging element to be folded and the packages to be packed. The sheet packaging element is folded whilst being advanced by the conveyor in an advancing direction.

[0010] In particular, during operation, the sheet packaging element is supplied to the conveyor in a flat configuration and is advanced in such a way that the first side portion precedes the central portion in the advancing direction and the central portion precedes the second side portion in the advancing direction.

[0011] During operation, the packages are placed on the central portion and the first side portion is folded, along the first weakening line, so as to be arranged in a substantially vertical configuration.

5 **[0012]** Subsequently, folding members of the folding apparatus fold the sheet packaging element, along the second weakening line, so that the second side portion is arranged in a substantially vertical configuration.

10 **[0013]** During folding of the second side portion, the packages standing on the central portion - due to their weight - push the sheet packaging element on the conveyor.

15 **[0014]** A drawback of the known folding apparatus is that the folding members, when folding the second side portion, can lift the sheet packaging element and move it away from the conveyor. The risk is particularly high in case of small, and therefore light, packages. In this case, in fact, the weight of the packages may be not enough to withstand the action of the folding members and to

20 keep the sheet packaging element on the conveyor.
[0015] Undesired lifting of the sheet packaging element prevents the second side portion from being folded and, therefore, the packaging box from being properly formed. In addition, in case the packages resting on the

25 folding apparatus are overturned and fall down, a jam may occur, which causes a stop in the production cycle of the folding apparatus.

30 **[0016]** An object of the invention is to improve the known folding apparatus.
[0017] Another object of the invention is to provide a folding apparatus for folding sheet packaging elements in which the sheet packaging elements are kept on a conveyor of the folding apparatus all over the folding operation.

35 **[0018]** Another object of the invention is to provide a folding apparatus for folding sheet packaging elements in which the sheet packaging elements are kept on a conveyor of the folding apparatus even when packing small and light packages.

40 **[0019]** According to the invention, there is provided a folding apparatus for folding a sheet packaging element, comprising a conveyor for advancing along an advancing direction said sheet packaging element together with a group of packages to be packed in said sheet packaging element, said conveyor comprising a folding arrangement for folding said sheet packaging element, characterized in that said folding apparatus further comprises a suction device that acts on said sheet packaging element to keep said sheet packaging element on said conveyor at least when said folding arrangement folds said sheet packaging element.

45 **[0020]** Owing to the invention, the vacuum generated by the suction device prevents the folding arrangement from lifting the sheet packaging element and moving away the sheet packaging element from the conveyor. In this way, the folding apparatus can properly fold the sheet packaging element also in case the sheet packaging element is used to pack small and light packages.

[0021] A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a perspective side view of a folding apparatus for folding sheet packaging elements;
 Figure 2 is another perspective side view of the folding apparatus of Figure 1;
 Figure 3 is a further perspective side view of the folding apparatus of Figure 1;
 Figure 4 is a still further perspective side view of the folding apparatus of Figure 1;
 Figure 5 is a side view of the folding apparatus of Figure 1.

[0022] With reference to Figures 1, 2 and 5 there is shown a sheet packaging element 1 designed to be folded so as to form a packaging box 2, or a tray, configured to receive a group of packages 11. In the embodiment shown the group of packages 11 comprises a pattern of two by six packages. It is to be intended that the group of packages 11 can be formed by patterns comprising a different number of rows and lines of packages.

[0023] The sheet packaging element 1 may be a cardboard blank.

[0024] The sheet packaging element 1 comprises a central portion 3, a first side portion 4 and a second side portion 5. The central portion 3 is arranged between the first side portion 4 and the second side portion 5. A first weakening line 6, or first crease line, is interposed between the central portion 3 and the first side portion 4. A second weakening line 7, or second crease line, is interposed between the central portion 4 and the second side portion 5.

[0025] The packaging box 2 obtained by folding the sheet packaging element 1 comprises a base panel 8 defined by the central portion 3, a first side panel 9 defined by the first side portion 4 and a second side panel 10 defined by the second side portion 5.

[0026] In another version, the sheet packaging element may comprise a further portion, projecting from the first side portion (or from the second side portion). In this case, a further weakening line, or a further crease line, is interposed between the first side portion (or the second side portion) and the further portion. The further portion, once the sheet packaging element is folded, forms a top panel of the packaging box that is arranged above the base panel and is substantially parallel to the base panel. In other words, the top panel defines a cover of the packaging box.

[0027] Once the sheet packaging element 1 has been folded, the group of packages 11 is housed within the packaging box 2, in particular the group of packages 11 rests on the base panel 8 and is surrounded by the first side panel 9 and the second side panel 10.

[0028] With reference to Figures 1 to 5, there is disclosed a folding apparatus 12 comprising a conveyor 13 that advances the sheet packaging element 1 and the

group of packages 11 in an advancing direction D.

[0029] The sheet packaging element 1 is advanced by the conveyor 13 in such a way that the first side portion 4 precedes the central portion 3 in the advancing direction D and the central portion 3 precedes the second side portion 5 in the advancing direction D.

[0030] The conveyor 13 comprises a supporting arrangement 19 that receives the sheet packaging element 1 and the group of packages 11. In particular, the supporting arrangement 19 supports the sheet packaging element 1 and the group of packages 11 whilst the sheet packaging element 1 and the group of packages 11 are advanced in the advancing direction D. Moreover, the supporting arrangement 19 supports the sheet packaging element 1 and the group of packages 11 whilst the sheet packaging element 1 is folded to form the packaging box 2.

[0031] The conveying arrangement 19 comprises a first guide arrangement 20 and a second guide arrangement 21.

[0032] The first guide arrangement 20 comprise a first guide element 20a and a further first guide element 20b. The first guide element 20a and the further first guide element 20b are parallel to the advancing direction D and are spaced apart in a further direction perpendicular to the advancing direction D.

[0033] The second guide arrangement 21 comprise a second guide element 21a and a further second guide element 21b. The second guide element 21a and the further second guide element 21b are parallel to the advancing direction D and are spaced apart in the above-mentioned further direction perpendicular to the advancing direction D.

[0034] The second guide element 21a and the further second guide element 21b are interposed between the first guide element 20a and the further first guide element 20b.

[0035] The conveyor 13 comprises a folding arrangement 22 that folds the second portion 5 along the second weakening line 7.

[0036] In addition, the folding arrangement 22 pushes the sheet packaging element 1 and the group of packages 11 in the advancing direction D.

[0037] The folding arrangement 22 has a couple of first flexible conveying arrangements 14.

[0038] The couple of first flexible conveying arrangements 14 is positioned below the supporting arrangement 19, in particular below the first guide arrangement 20 and the second guide arrangement 21.

[0039] The couple of first flexible conveying arrangements 14 comprises a first chain 15 and a further first chain 16.

[0040] In particular, the first chain 15 is associated to the first guide element 20a and the further first chain 16 is associated to the further first guide element 20b.

[0041] The first chain 15 has the shape of a loop and is wound around a couple of sprockets.

[0042] Similarly, the second chain 16 has the shape of

a loop and is wound around a further couple of sprockets.

[0043] The first chain 15 is arranged in a vertical plane and comprises a straight upper branch, a straight lower branch and a couple of rounded branches interposed between the straight upper branch and the straight lower branch.

[0044] Similarly, the second chain 16 is arranged in a further vertical plane and comprises a straight upper branch, a straight lower branch and a couple of rounded branches interposed between the straight upper branch and the straight lower branch.

[0045] The first chain 15 and the further first chain 16 are parallel to each other and to the advancing direction D. The first chain 15 and the further first chain 16 are spaced apart from each other perpendicularly to the advancing direction D.

[0046] The first chain 15 supports a plurality of folding elements 17. The folding elements 17 are arranged on the first chain 15 at a constant pitch.

[0047] The folding elements 17 associated to the upper branch of the first chain 15 extend beyond the supporting arrangement 19, in particular beyond the first guide arrangement 20 and the second guide arrangement 21, to interact with the sheet packaging element 1.

[0048] Similarly, the further first chain 16 supports a plurality of folding elements 17. The folding elements 17 are arranged on the further first chain 16 at a constant pitch.

[0049] The folding elements 17 associated to the upper branch of the further first chain 16 extend beyond the supporting arrangement 19, in particular beyond the first guide arrangement 20 and the second guide arrangement 21, to interact with the sheet packaging element 1.

[0050] The first chain 15 and the further first chain 16 are positioned in such a way that each folding element 17 of the first chain 15 is aligned, in the advancing direction D, with a corresponding folding element 17 of the further first chain 16.

[0051] The conveyor 13 is further provided with a couple of second flexible conveying arrangements 24.

[0052] The couple of second flexible conveying arrangements 24 is positioned below the supporting arrangement 19, in particular below the first guide arrangement 20 and the second guide arrangement 21.

[0053] The couple of second flexible conveying arrangements 24 comprises a second chain 25 and a further second chain 26.

[0054] In particular, the second chain 25 is associated to the second guide element 21a and the further second chain 26 is associated to the further second guide element 21b.

[0055] The second chain 25 has the shape of a loop and is wound around a couple of sprockets.

[0056] Similarly, the further second chain 26 has the shape of a loop and is wound around a further couple of sprockets.

[0057] The second chain 25 is arranged in a vertical plane and comprises a straight upper branch, a straight

lower branch and a couple of rounded branches interposed between the straight upper branch and the straight lower branch.

[0058] Similarly, the further second chain 26 is arranged in a further vertical plane and comprises a straight upper branch, a straight lower branch and a couple of rounded branches interposed between the straight upper branch and the straight lower branch.

[0059] The second chain 25 and the further second chain 26 are parallel to each other and to the advancing direction D. The second chain 25 and the further second chain 26 are spaced apart from each other perpendicularly to the advancing direction D.

[0060] The second chain 25 and the further second chain 26 are parallel to the first chain 15 and the further chain 16.

[0061] The second chain 25 supports a plurality of abutting elements 27. The abutting elements 27 are arranged on the second chain 25 at a constant pitch.

[0062] The abutting elements 27 associated to the upper branch of the second chain 25 extend beyond the supporting arrangement 19, in particular beyond the first guide arrangement 20 and the second guide arrangement 21, to interact with the sheet packaging element 1.

[0063] Similarly, the further second chain 26 supports a plurality of abutting elements 27. The abutting elements 27 are arranged on the further second chain 26 at a constant pitch.

[0064] The abutting elements 27 associated to the upper branch of the further second chain 26 extend beyond the supporting arrangement 19, in particular beyond the first guide arrangement 20 and the second guide arrangement 21, to interact with the sheet packaging element 1.

[0065] The second chain 25 and the further second chain 26 are positioned in such a way that each abutting element 27 of the second chain 25 is aligned, in the advancing direction D, with a corresponding abutting element 27 of the further second chain 26.

[0066] The folding apparatus 12 further comprises a suction device 30 that acts on the sheet packaging element 1 to keep the sheet packaging element 1 on the conveyor 13 at least when the folding arrangement 22 folds the packaging element 1, in particular when the folding arrangement 22 folds the second portion 5 along the second weakening line 7.

[0067] The suction device 30 is arranged below the supporting arrangement 19, in particular below the first guide arrangement 20 and the second guide arrangement 21.

[0068] The suction device 30 comprises a suction cup arrangement 31 arranged to interact with a bottom face of the central portion 3.

[0069] The suction cup arrangement 31 is supported by a supporting element 32 and is connected to a vacuum source (not shown).

[0070] The suction cup arrangement 31 comprises a plurality of suction cups 33 mounted on the supporting

element 32.

[0071] The suction cup arrangement 31 is driven by an actuator 34 along a moving direction S parallel to the advancing direction D.

[0072] The actuator 34 comprises a cylinder 35 and a piston (not shown) slidable inside the cylinder 34 and supporting the supporting element 32.

[0073] The actuator 34 is movable between a retracted position H, in which the piston is received within the cylinder 35, and an extended position (not shown), in which the piston extends from the cylinder 35.

[0074] The cylinder 35 is mounted on a supporting body 36.

[0075] The actuator 34 can be a pneumatic actuator.

[0076] The actuator 34, and therefore the suction cup arrangement 31 connected thereto, is driven by a further actuator 37 along a further moving direction T transverse to the moving direction S (and transverse to the advancing direction D). In particular the further moving direction T is perpendicular to the moving direction S (and perpendicular to the advancing direction D).

[0077] The further actuator 37 comprises a further cylinder 38 and a further piston (not shown) slidable inside the further cylinder 38 and supporting the supporting body 36.

[0078] The further actuator 37 is movable between a lowered position K, in which the further piston is received within the further cylinder 38, and a raised position (not shown), in which the further piston extends from the further cylinder 38.

[0079] The further cylinder 38 is mounted on a supporting structure 39 connected to a frame of the folding apparatus 12. The further cylinder 38 therefore is kept in a fixed position during operation of the folding apparatus 12.

[0080] The further actuator 37 can be a pneumatic actuator.

[0081] The suction cup arrangement 31 is movable in the moving direction S, i.e. parallel to the advancing direction D, and in the further moving direction T, i.e. transverse to the advancing direction D, so as to move together with the sheet packaging element 1 when the sheet packaging element 1 is advanced along the conveyor 13.

[0082] During operation a supplying device (not shown) supplies a sheet packaging element 1 at an input station 40 of the conveyor 13.

[0083] At the input station 40 the sheet packaging element 1 rests on supporting plates 41 so that a plane defined by the packaging element 1 is sloped with respect to a further plane defined by the supporting arrangement 19. In particular, the central portion 3 rests on the supporting plates 41 and the first side portion 4 is arranged downstream of the second side portion 5 with respect to the advancing direction D. Moreover, the first side portion 4 is arranged above supporting arrangement 19, i.e. above the first guide arrangement 20 and the second guide arrangement 21, and the second side portion 5 is arranged below the supporting arrangement 19, i.e. be-

low the first guide arrangement 20 and the second guide arrangement 21.

[0084] Subsequently, a pushing device (not shown) pushes a group of packages 11 on the conveyor 13.

[0085] The group of packages 11 interacts with the sheet packaging element 1 causing the folding of the first side portion 4 against a couple of abutting element 27. In other words, the group of packages 11 moves along the advancing direction D and is received on the central portion 3. At the same time, the group of packages 11 pushes the sheet packaging element 1 against the abutting elements 27 so causing the folding of the first side portion 4 along the first weakening line 6.

[0086] The further actuator 37 moves from the lowered position K to the raised position.

[0087] The actuator 34 is in the retracted position H.

[0088] The suction cup arrangement 31 interacts with the sheet packaging element 1. In particular, the suction cups 33 are in contact with the sheet packaging element 1 and the vacuum source is activated so that the sheet packaging element 1 is retained by the suction cups 33.

[0089] The folding elements 27 interact with the sheet packaging element 1, in particular with the second side portion 5, and fold the second side portion 5 along the second crease line.

[0090] At the same time, the folding elements 17 push the sheet packaging element 1 and the group of packages 11 resting thereon, i.e. the packaging box 2, in the advancing direction D.

[0091] The actuator 34 is deactivated and so the sheet packaging element 1 pulls the further piston in the advancing direction D. In this way, the actuator 34 moves from the retracted position H to the extended position.

[0092] The further actuator 37 remains in the raised position while the actuator 34 moves from the retracted position H to the extended position.

[0093] When the actuator 34 reaches the extended position the vacuum source is deactivated and the sheet packaging element 1 and the group of packages 11 packed therein, i.e. the packing box 2, are released from the suction device 30 and keep moving along the conveyor 13 in the advancing direction D.

[0094] The further actuator 37 moves from the raised position to the lowered position K.

[0095] The actuator 34 is activated and the piston is received within the cylinder 35. In this way, the actuator 34 moves from the extended position to the retracted position H.

[0096] Since the suction cup arrangement 31 pulls the sheet packaging element 1 towards the conveyor 13 at least during folding of the second side portion 5, the risk that the folding elements 17 lift the sheet packaging element 1 from the conveyor 13 is highly reduced with respect to the known folding apparatus.

[0097] In particular, the folding apparatus according to the invention is able to properly handle also small packages since the sheet packaging element 1 is kept on the conveyor 13 not only by the weight of the packages, but

also by the suction device 30.

[0098] Clearly, changes may be made to the folding apparatus as described herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0099] In particular, the first chain, the further first chain, the second chain and the further second chain may be replaced by other types of endless transport elements, such as belts.

Claims

1. Folding apparatus for folding a sheet packaging element (1), comprising a conveyor (13) for advancing along an advancing direction (D) said sheet packaging element (1) together with a group of packages (11) to be packed in said sheet packaging element (1), said conveyor (13) comprising a folding arrangement (22) for folding said sheet packaging element (1), **characterized in that** said folding apparatus further comprises a suction device (30) that acts on said sheet packaging element (1) to keep said sheet packaging element (1) on said conveyor at least when said folding arrangement (22) folds said sheet packaging element (1).
2. Folding apparatus according to claim 1, wherein said conveyor comprises a supporting arrangement (19) that supports said sheet packaging element (1) and said group of packages (11) whilst said sheet packaging element (1) and said group of packages (11) are advanced in said advancing direction (D), and wherein said suction device (30) is arranged below said supporting arrangement (19).
3. Folding apparatus according to claim 2, wherein said suction device (30) comprises a suction cup arrangement (31) connected to a vacuum source and arranged to interact with a bottom face of said sheet packaging element (1).
4. Folding apparatus according to claim 3, wherein said suction cup arrangement (31) comprises a plurality of suction cups (33).
5. Folding element according to claim 3, or 4, wherein said suction cup arrangement (31) is movable in a moving direction (S) parallel to said advancing direction (D) and in a further moving direction (T) transverse to said advancing direction (D).
6. Folding apparatus according to claim 4, wherein said suction device (30) comprises an actuator (34) movable between a retracted position (H) and an extended position, which moves said suction cup arrangement (31) in said moving direction (S), and wherein said suction device (30) further comprises a further actuator (37) movable between a lowered position (H) and a raised position, which moves said suction cup arrangement in said further moving direction (T).
7. Folding apparatus according to claim 6, wherein said actuator (34) supports said suction cup arrangement (31) and said further actuator (37) supports said actuator (34).
8. Folding apparatus according to any one of claims 2 to 7, wherein said folding arrangement (22) comprises a couple of first flexible conveying arrangements (14) that are positioned below said supporting arrangement (19).
9. Folding arrangement according to claim 8, wherein said couple of first flexible conveying arrangements (14) comprises a first chain (15) and a further first chain (16), said first chain (15) having the shape of a loop and being wound around a couple of sprockets, said second chain (16) having the shape of a loop and being wound around a further couple of sprockets, said first chain (15) being arranged in a vertical plane and comprising a straight upper branch, said second chain (16) being arranged in a further vertical plane and comprising a straight upper branch, said first chain (15) and said further first chain (16) being parallel to each other and to said advancing direction (D), said first chain (15) and said further first chain (16) being spaced apart from each other perpendicularly to said advancing direction (D).
10. Folding arrangement according to claim 9, wherein said first chain (15) supports a plurality of folding elements 17, said folding elements (17) being arranged on said first chain (15) at a constant pitch, the folding elements (17) associated to said upper branch of said first chain (15) extending beyond said supporting arrangement (19) to interact with said sheet packaging element (1), and wherein said further first chain (16) supports a plurality of folding elements (17), said folding elements (17) being arranged on said further first chain (16) at a constant pitch, the folding elements (17) associated to said upper branch of said further first chain (16) extending beyond said supporting arrangement (19) to interact with said sheet packaging element (1).
11. Folding arrangement according to claim 10, wherein said first chain (15) and said further first chain (16) are positioned in such a way that each folding element (17) of said first chain (15) is aligned, in said advancing direction D, with a corresponding folding element (17) of said further first chain (16).
12. Folding arrangement according to any one of claims 8 to 11, wherein, said conveyor (13) is further pro-

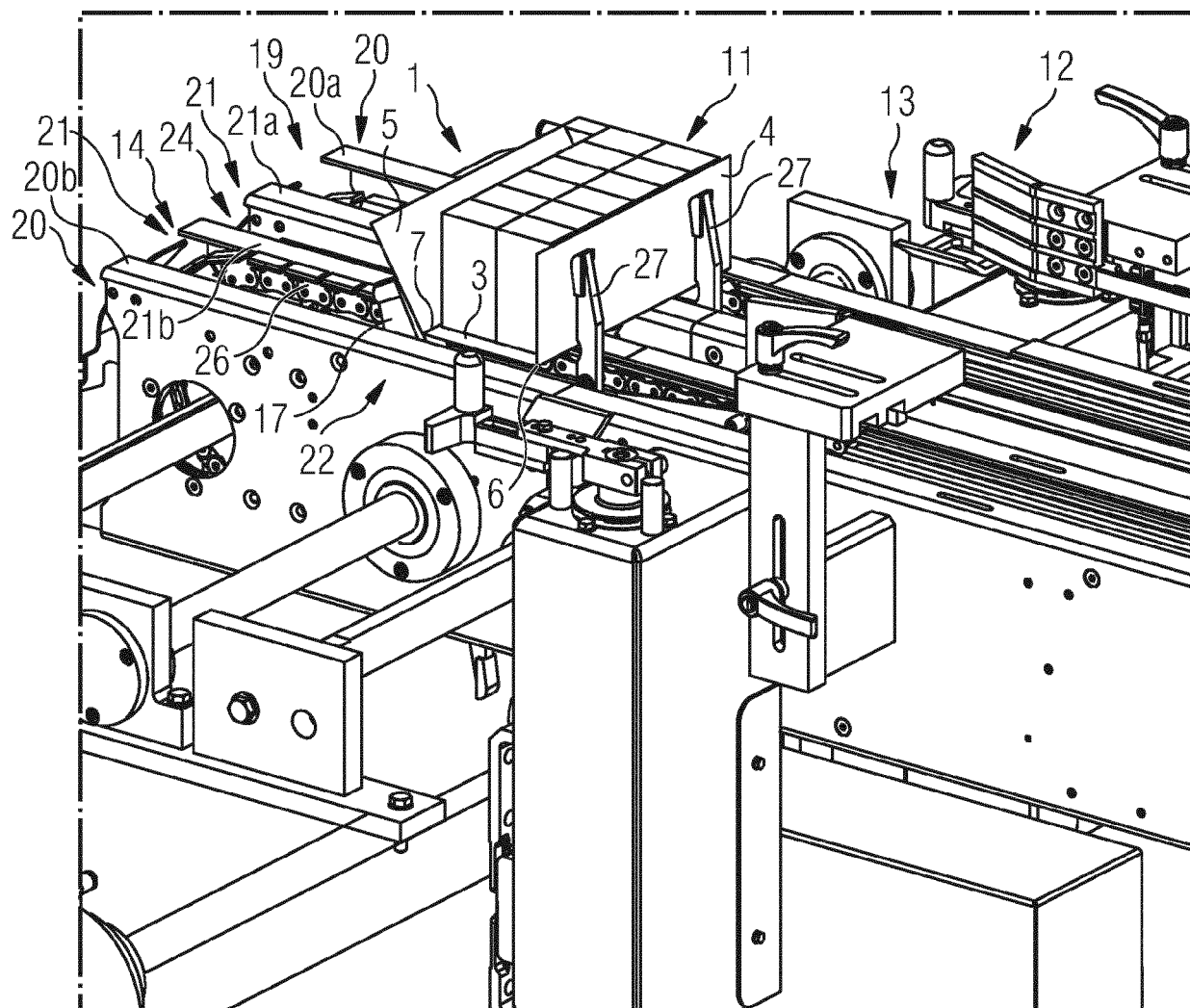
vided with a couple of second flexible conveying arrangements (24), said second flexible conveying arrangements (24) being positioned below said supporting arrangement (19).

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13. Folding arrangement according to claim 12, wherein said couple of second flexible conveying arrangements (24) comprises a second chain (25) and a further second chain (26), said second chain (25) having the shape of a loop and being wound around a couple of sprockets, said further second chain (26) having the shape of a loop and being wound around a further couple of sprockets, said second chain (25) being arranged in a vertical plane and comprising a straight upper branch, said further second chain (26) being arranged in a further vertical plane and comprising a straight upper branch, said second chain (25) and said further second chain (26) being parallel to each other and to said advancing direction (D), said second chain (25) and said further second chain (26) being spaced apart from each other perpendicularly to said advancing direction (D), said second chain (26) and said further second chain (26) being parallel to said first chain (15) and said further chain (16).
14. Folding arrangement according to claim 13, wherein said second chain (25) supports a plurality of abutting elements (27), said abutting elements (27) being arranged on said second chain (25) at a constant pitch, the abutting elements (27) associated to said upper branch of said second chain (25) extending beyond said supporting arrangement (19) to interact with said sheet packaging element (1), and wherein said further second chain (26) supports a plurality of abutting elements (27), said abutting elements (27) being arranged on said further second chain (26) at a constant pitch, the abutting elements (27) associated to said upper branch of said further second chain (26) extending beyond said supporting arrangement (19) to interact with said sheet packaging element (1).
15. Folding arrangement according to claim 14, wherein said second chain (25) and said further second chain (26) are positioned in such a way that each abutting element (27) of said second chain (25) is aligned, in said advancing direction (D), with a corresponding abutting element 27 of said further second chain (26).

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FIG 1



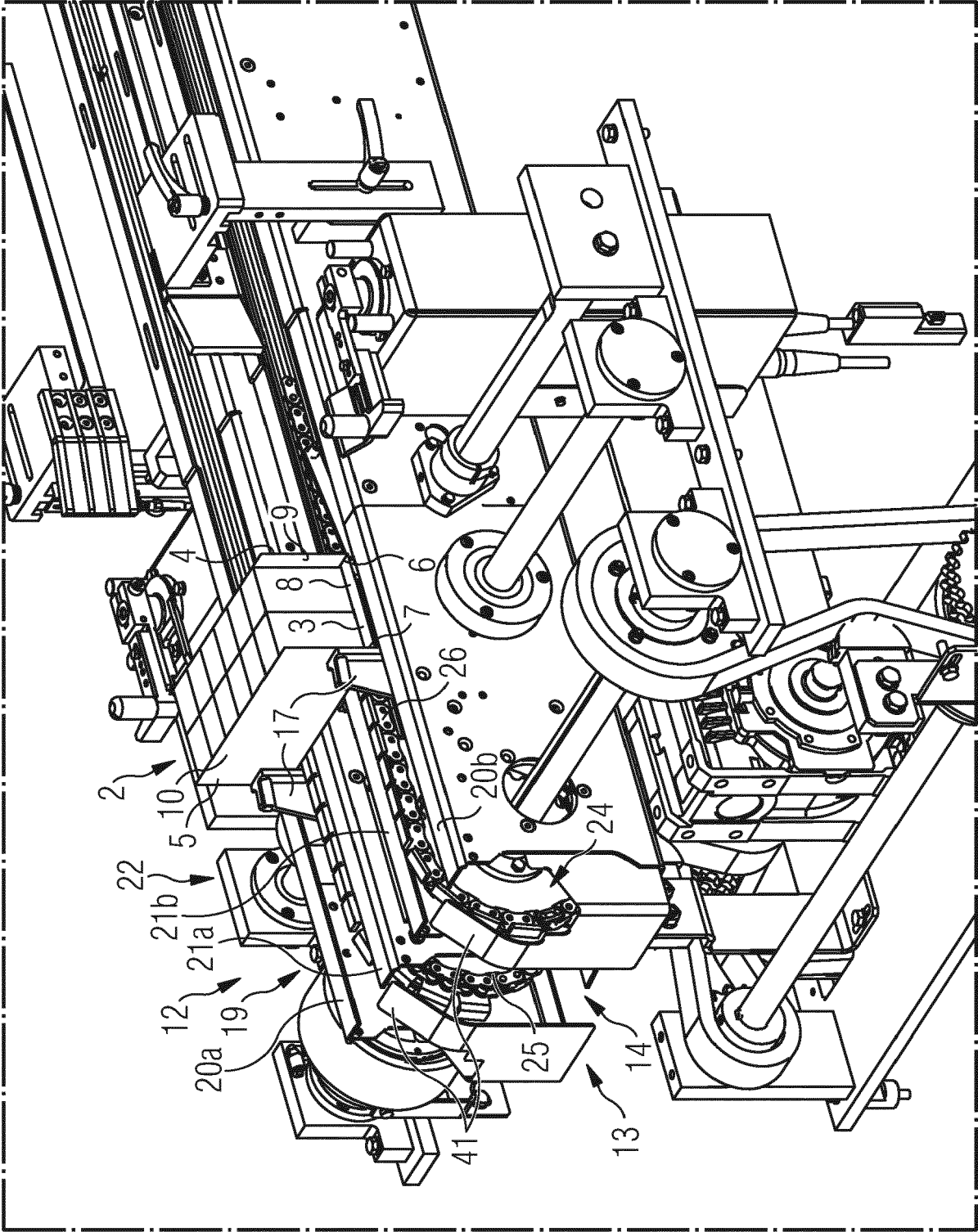


FIG 2

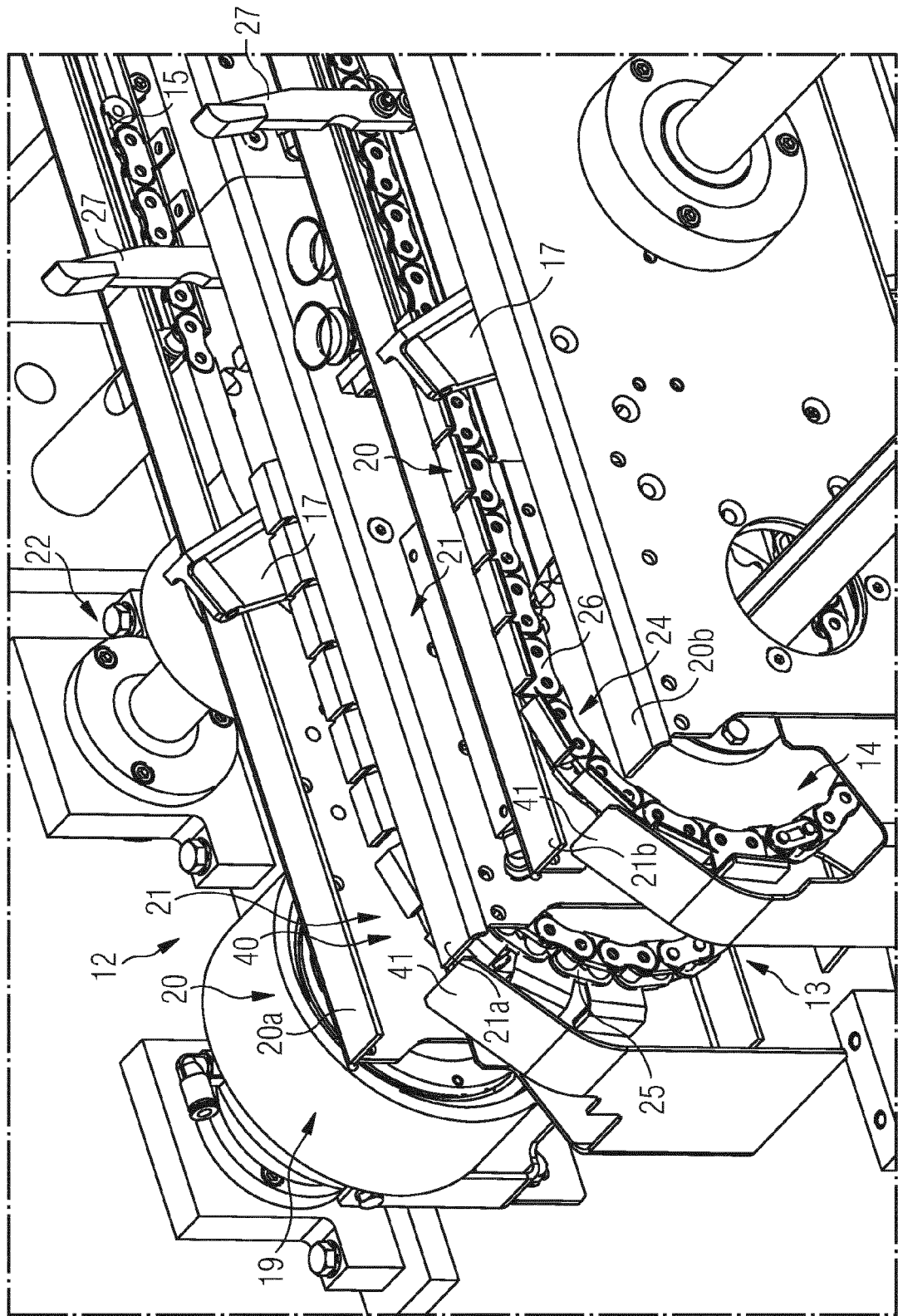


FIG 3

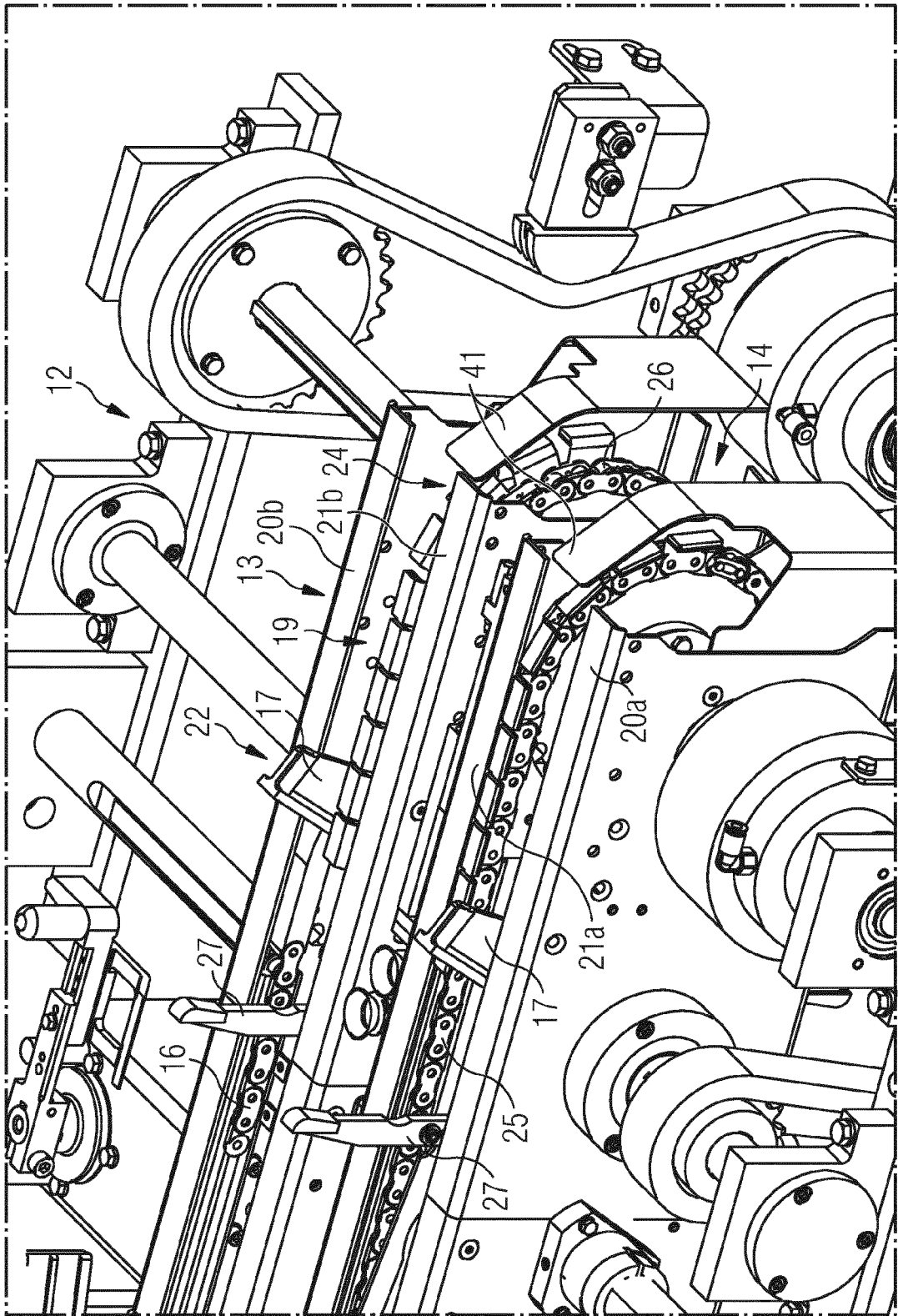
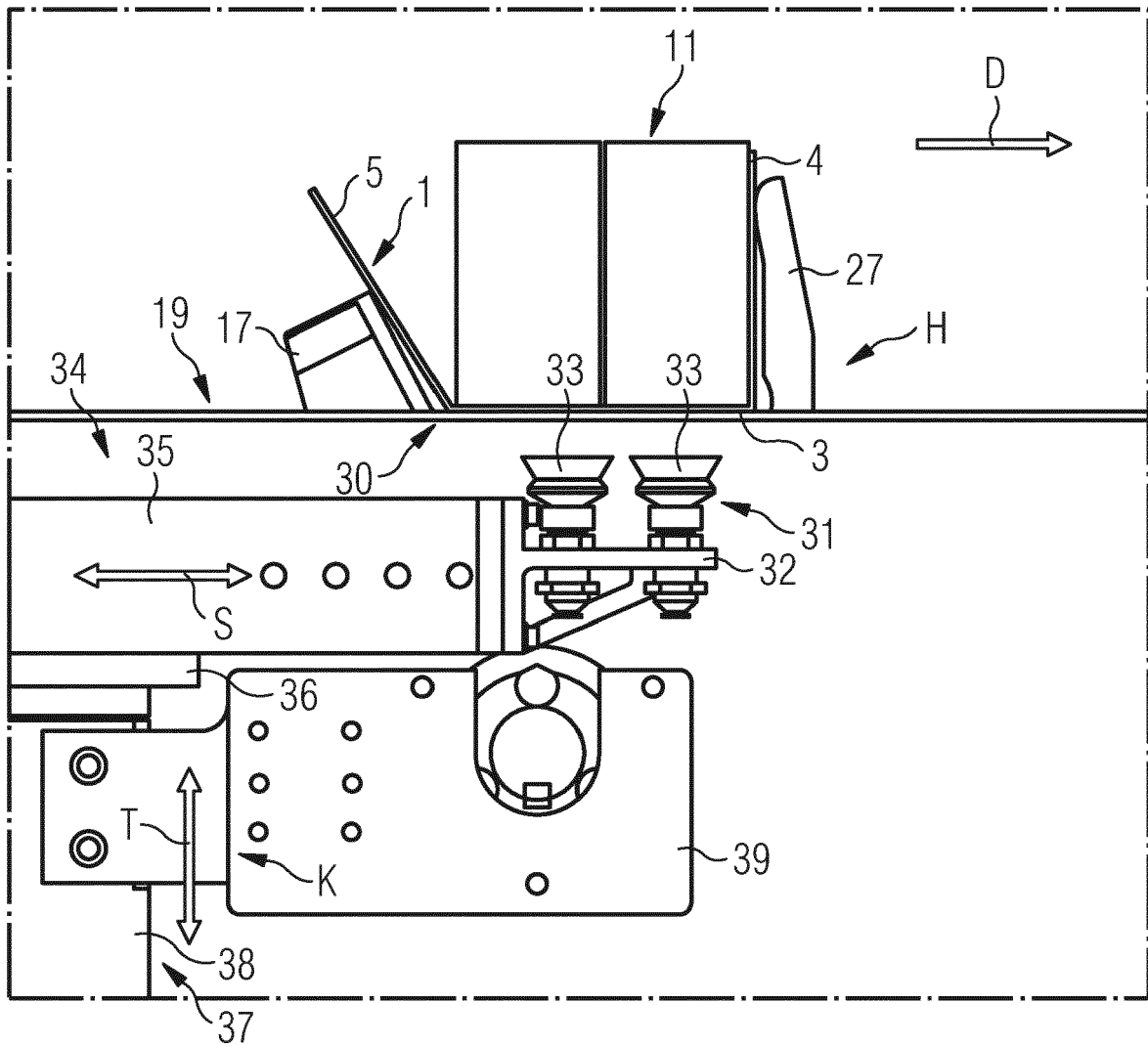


FIG 4

FIG 5





EUROPEAN SEARCH REPORT

Application Number
EP 16 20 0424

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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