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(54) SHEET STACKER AND METHOD FOR FORMING SHEETS STACKS OF STAGGERED SHEETS BUNDLES

BOGENSTAPELVORRICHTUNG UND VERFAHREN ZUR BILDUNG VON GESTAPELTEN VERSETZTEN BOGENBÜNDELN

EMPILEUR DE FEUILLES ET PROCÉDÉ POUR FORMER DES PILES DÉCALÉES DE FEUILLES

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Description

FIELD OF THE INVENTION

[0001] The invention relates to sheet stacking devices and methods, useful for the formation of stacks of corrugated board sheets, such as, but not limited to, corrugated board sheets. In particular, the invention concerns sheet stacking devices and methods for the production of stacks comprised of staggered bundles of sheets.

BACKGROUND ART

[0002] In the paper industry, corrugated board sheets are manufactured starting from a continuous web-like corrugated board material, which is slit longitudinally and divided into strips. Each strip is further divided transversely to generate a plurality of sheets of desired length. Sheets thus obtained are delivered to a so-called stacker or stacking apparatus, which forms stacks or bundles of sheets. The stacks are subsequently delivered to the final user, for example for the manufacturing of corrugated board boxes or the like. Small bundles can be combined into larger stacks before shipping.

[0003] Fast advancing sheets must be carefully piled up to form stacks of regular shape. Known stacking apparatuses usually comprise a sheet conveyor arrangement which receives a substantially continuous flow of sheets which are shingled and delivered onto a stacking surface in a stacking bay.

[0004] In some cases, each stack is formed by staggered bundles, each bundle containing a predetermined number of sheets. During formation of the stack, the first bundle of a stack rests on a stacker platform. Each subsequent bundle rests on a respective previously formed bundle. Since adjacent bundles are staggered with respect to one another, a portion of each bundle overhangs on one side from the previously formed bundle, on which the subsequent bundle rests. The length of the overhanging bundle portion is given by the amount of mutual staggering, i.e. is the staggering pitch. In order for the stack to be sufficiently stable, the staggering pitch, i.e. the amount by which each bundle can project in an overhanging manner from the previous bundle, on which it rests, must be relatively small.

[0005] TW-M423688U, US2014/0353119 and US2009/0169351 disclose sheet stackers configured and controlled for forming stacks of mutually staggered bundles of corrugated board sheets. In order to mutually stagger neighboring bundles of the stack, said stack is formed on a horizontally movable stacker platform. The reciprocating staggering motion is in a direction substantially parallel to the feed direction of the corrugated board sheets. Each bundle of a stack is formed against a single stop plate or a dual stop plate, which are arranged in two positions which are staggered along the direction of arrival of the corrugated board sheets. Staggering of neighboring bundles is obtained by means of a reciprocating motion of the stacker platform in a horizontal direction. Moving the entire stacker platform is difficult and requires strong actuators and a particularly sturdy structure.

[0006] TW-M423688 U discloses a known stacker platform comprising a conveyor belt, forming a stacking surface. The conveyor belt has a horizontal conveying motion, orthogonal to the reciprocating staggering motion of the stacker platform. The conveyor belt is used to evacuate the formed stack from the stacking bay according to an evacuation direction which is substantially orthogonal to the direction of arrival of the corrugated board sheets in the stacking bay.

[0007] CN204057396U and CN203255778U disclose further embodiments of stackers designed and configured for producing stacks of sheets, each formed by a plurality of staggered bundles. Staggering is obtained by using two mutually spaced apart stop plates. The distance between the stop plates is equal to the staggering of neighboring bundles. In addition to moving the stop plates, the sheet discharge end of the sheet conveyor must also be reciprocatingly moved back and forth in a direction parallel to the feed direction, to achieve correct staggering of adjacent bundles.

[0008] Staggered bundles are individually bound with a cord or a string applied around the bundle portion which overhangs from the previous and next bundle in the stack. It would be desirable to have a large overhanging portion in order to better tie the sheets of each bundle together.

[0009] US 2014/0035218 discloses staggering of neighbouring sheet bundles, wherein the staggering pitch is adjustable according to sheet lengths.

[0010] A further sheet stacker is disclosed in JP S 48105270 U.

SUMMARY OF THE INVENTION

[0011] According to embodiments disclosed herein, a sheet stacker is provided, which comprises:

- a sheet conveyor arrangement, configured for feeding a plurality of sheets in succession in a sheet feeding direction, said sheet conveyor arrangement having a sheet discharge end;
- a stacking bay, wherein sheets delivered by the sheet conveyor arrangement at the sheet discharge end thereof are formed into stacks; the stacking bay comprising a stacker platform, the sheet discharge end and the stacker platform being provided with a mutual approaching and distancing movement.

[0012] The stacker platform comprises a stacking surface, whereon the stacks are formed. The stacker platform further comprises an actuator adapted to reciprocatingly move (i.e. to move back-and-forth) the stacking surface in a staggering direction, substantially parallel to the sheet feeding direction in the stacking bay. The reciprocating movement has a staggering pitch. The stag-

gering pitch is adjustable according to at least one production parameter. The at least one production parameter can include the dimension of the sheets in the direction along which the bundles are mutually staggered. It is thus possible, for instance, to maximize the staggering pitch, without impairing the stability of the stack. Longer sheets, i.e. sheets having a longer dimension in the sheet feeding direction in the stacking bay, can be staggered according to a larger staggering pitch, shorter sheets are staggered according to a smaller staggering pitch.

[0013] Each bundle can thus have an overhanging bundle portion which is always the largest, based upon the dimension of the sheets, such that the bundles can be easily tied with a cord or strip, without impairing the stability of the stack.

[0014] While the staggering pitch can be adjusted manually, in some embodiments the sheet stacker can further comprise a control unit, which is adapted to control the actuator to perform a staggering pitch according to at least one production parameter, which may depend upon said sheet dimension. The staggering pitch can be e.g. inputted by the user through a user interface, such as a keyboard, a touch screen or the like. In other embodiments, the length of the sheets forming each bundle, i.e. the dimension of the sheet bundles in the staggering direction, can be inputted.

[0015] The control unit can be adapted to determine the staggering pitch based upon sheet length data.

[0016] Other production parameters can be used to modify or adjust the staggering pitch, in addition to the sheet dimension in the sheet feeding direction. For instance stability of the stack may be influenced by the number of bundles, the thickness of the sheets, the grammage, the sheet dimension in the direction orthogonal to the feeding direction F, and the like.

[0017] According to some embodiments, one or more of said additional parameters can be taken into account while calculating the optimal staggering pitch.

[0018] For instance, all other parameters remaining the same, the higher the stack, the smaller the staggering pitch, and vice-versa, since a higher stack is less stable. Similarly, a larger transverse dimension, i.e. a sheet length in the direction orthogonal to feeding direction, can contribute to stability of the stack, such that all other parameters being the same, a larger cross-machine dimension of the sheets may allow a larger staggering pitch.

[0019] As known to those skilled in the art of corrugated board manufacturing, corrugated boards may be formed by a variable number of alternated flat and fluted paper sheets glued together. Fluted paper sheets are paper sheets which have been permanently deformed to form corrugations (flutes) therein. Flat paper sheets, also referred to as "liners", of different grammage (g/m^2) can be used, for instance. Fluted paper sheets of different shape and grammage can be used as well. Fluted paper sheets can vary for instance as far as grammage, flute pitch (and thus the number of flutes per meter), and flute height are concerned.

[0020] Each corrugated board sheet may comprise flat paper sheets which are identical to one another or different from one another. Each corrugated board sheet can also comprise fluted paper sheets which are all identical to one another, or different from one another. For instance, a corrugated board sheet can include two outer liners and an intermediate fluted sheet, or two outer liners and a plurality (e.g. two or more) intermediate fluted sheets, with a liner interposed between each pair of adjacent fluted sheets. The two or more fluted sheets can be identical to one another or may differ from one another, e.g. as far as the height and/or the pitch of the flutes are concerned.

[0021] The corrugated board sheets may have mechanical properties, e.g. rigidity, compliance, resistance to crunching, etc. which may depend upon the above mentioned paper sheet parameters and features. The stability of a stack of sheet bundles may therefore vary also depending upon one or more features of each corrugated board sheet, such as grammage of each paper sheet forming it, number of liners, number of fluted sheets, height of the flutes, flute pitch, etc. For instance, flexural rigidity may heavily depend upon the total number of sheets and the shape of the flutes of the fluted sheets. All other parameter remaining the same, a higher the flexural rigidity results in a more stable the stack, and vice-versa. Thus, the staggering pitch can e.g. be adjusted as a function of the sheet length in the feed direction and as a further function of the sheet rigidity, or of one or more parameters (number if fluted sheets, number of liners, etc.) which contribute to the rigidity of the sheets.

[0022] According to some embodiments of the method disclosed herein, therefore, the staggering pitch can be defined based upon at least two production parameters, one of which is the length of the cardboard sheets in the direction of staggering. At least one further production parameter may be indicative of the flexural rigidity of the sheet. The at least one further parameter can be selected from the group consisting of: grammage of one or more paper sheets forming the corrugated board sheet; total number of paper sheets per corrugated board sheet; total number of liners per corrugated board sheet; total number of fluted sheets per corrugated board sheet; flute height; flute pitch; a combination of two or more of the these parameters.

[0023] In some embodiments, the stacker platform can support a stack conveyor which forms the stacking surface.

[0024] In embodiments disclosed herein the stack conveyor is movable in a direction parallel to a feeding direction of the sheets in the stacking bay. The conveyor can be configured and controlled to perform a reciprocating staggering motion to form staggered bundles of sheets, and to further perform an evacuation motion, to remove a completed stack from the stacking bay. Thus, the evacuation motion is performed in a direction parallel to the staggering motion, i.e. in the same direction of the

staggering motion, or in the opposite direction. This results in a particularly simple, compact and economic machine.

[0025] In other embodiments, the evacuation direction can be orthogonal to the staggering direction. In such case, the stacker platform can comprise a conveyor, which forms the stacking surface and which has a conveying movement orthogonal to the sheet feeding direction in the stacking bay. The conveyor can in turn be provided with a reciprocating movement in a direction parallel to the staggering direction. For instance the conveyor may include rollers, belts or the like, which move in the evacuation direction, and which are supported on a frame which is movable in the staggering direction, orthogonal to the evacuation direction.

[0026] In yet further embodiments, the stacker platform can be provided with a combined conveyor arrangement, which is configured to perform a staggering motion and an evacuation motion in two mutually orthogonal directions, the staggering motion being parallel to the sheet feeding direction in the stacking bay.

[0027] According to some embodiments, the stacker platform can be provided with a vertical lifting and lowering movement with respect to a stationary supporting structure, such that the sheet stacker will be a so-called down-stacker, i.e. a stacker where the stacks are formed by moving the stacker platform downwardly. Formation of the stacks is thus made easier and more regular. Also, a faster operation can be obtained. According to other embodiments, an arrangement of the sheet stacker can be provided, wherein the stacking platform is stationary and the sheet discharge end of the sheet conveyor arrangement is controlled to gradually lift while the sheet stack grows on the stacking platform. The sheet stacker will in this case be configured as a so-called up-stacker. Mixed or intermediate embodiments may be envisaged, wherein both the stacking platform as well as the sheet discharge end of the sheet conveyor arrangement move with respect to a stationary structure, to accommodate the growing stack of sheets.

[0028] To orderly arrange the sheets of each stack and of each bundle, a stop plate can be provided, which can be positioned in the stacking bay above the stacker platform, and can be adapted to stop the sheets delivered by the sheet conveyor arrangement to the stacking bay. To facilitate the formation of staggered bundles, the stop plate can have a reciprocating vertical movement, which is synchronized with the formation of staggered bundles of sheets.

[0029] For a smoother operation, the sheet discharge end of the sheet conveyor arrangement can be combined with an actuator, which controls a lifting and lowering movement of the sheet discharge end, which movement is synchronized with the reciprocating staggering motion of the stack conveyor.

[0030] In some embodiments, it is beneficial for the evacuation motion of said stack conveyor to be oriented such that the completed stack is moved from the stacking bay under the sheet conveyor arrangement, where an evacuation conveyor can be arranged. A faster operation and a more compact system having a reduced footprint is thus obtained.

[0031] The stack conveyor can comprise a single conveyor member, e.g. an endless conveyor member. In other embodiments, the stack conveyor can comprise a first stack conveyor member and a second stack conveyor member, which are sequentially arranged one after the other in a direction parallel to the direction of the evacuation motion. The first stack conveyor member and the second stack conveyor member can be arranged and controlled such that a stack is formed on the first stack conveyor member and, upon formation thereof, the completed stack is moved by the first stack conveyor member to the second stack conveyor member and sequentially by the second stack conveyor member outside the stacking bay.

[0032] The sheet discharge end can be combined with a bundle retaining device, which is configured and arranged for retaining the top-most bundle of the stack when the stack conveyor performs the staggering motion in a direction away from the sheet discharge end. Undesired displacements of the top-most sheet of a bundle upon starting formation of a subsequent, staggered bundle, are thus reduced or eliminated. The bundle retaining device can comprise at least one resilient sheet braking member, arranged under the sheet discharge end, between the sheet discharge end and the stack being formed on the stacker platform.

[0033] According to a further aspect, the invention also concerns a method of forming sheet stacks on a stacking surface, comprising the following steps:

feeding a plurality of sheets along a sheet conveyor arrangement towards a stacking bay, the sheet conveyor arrangement having a sheet discharge end, wherefrom the sheets are discharged in the stacking bay and formed into stacks on a stacking surface supported by a stacker platform arranged in the stacking bay;

while the sheet stack gradually grows on the stacking surface, moving the stacker platform and the sheet discharge end of the sheet conveyor arrangement away from one another;

during formation of the stack, dividing the stack in mutually superposed and staggered bundles of sheets by reciprocatingly moving the stack conveyor according to a back-and-forth. i.e. reciprocating staggering motion, in a direction parallel to a feeding direction of the sheets in the stacking bay.

[0034] The staggering motion is performed according to an adjustable pitch. The method can comprise a step of setting the pitch of the reciprocating, i.e. back-and-forth staggering motion according to at least one produc-

tion parameter. The at least one production parameter can be a dimension of the sheets forming the bundles measured in the direction of feed of the sheets in the stacking bay, and therefore in the staggering direction. It is thus possible to maximize the staggering pitch without impairing stability of the stack.

[0035] In some embodiments, the staggering pitch can be directly provided to the control unit. E.g. the staggering pitch can be calculated outside the control unit. For instance, the user can determine the staggering pitch based on one or more production parameters and then input the staggering pitch in the control system of the sheet stacker.

[0036] According to some embodiments, the method can comprise the step of providing the at least one production parameter to the control unit and this latter can perform a step of selecting or calculating the staggering pitch on the basis of the at least one production parameter. The control unit thereafter controls the staggering motion on the basis of the staggering pitch thus determined.

[0037] The control unit can calculate the staggering pitch on the basis of the at least one production parameter provided to the control unit. For instance an algorithm can be provided to calculate the staggering pitch on the basis of the at least one production parameter. In a simple embodiment, the length of the corrugated board sheets in the staggering direction is used as the sole production parameter. The staggering pitch can be calculated as a percentage (X%) of said length. To prevent excessive staggering pitches in case of particularly long sheets, a maximum limit can be imposed for the staggering pitch, i.e. the staggering pitch is determined as an X% of the length, but with a maximum staggering pitch limit, e.g. not exceeding Y cm.

[0038] In more complex systems, the flexural rigidity of the board sheets can be taken into consideration, for instance. The rigidity can be determined on the basis of one or more of the following: the total number of liners, total number of fluted sheets, sheet grammage, flute dimension, flute pitch. The rigidity of the sheets can be easily determined experimentally. A database of staggering pitches for each possible combination of two or more of the above mentioned parameters can be provided, e.g. stored in a storage memory accessible to the control unit. For instance, a set of "product recipes" can be stored, each associated to a staggering pitch. The user will then select the recipe required for a given job and the control unit will be able to retrieve from the database all production parameters, including the staggering pitch, without the need to provide complex calculations. As used herein the "product recipe" can be understood as the combination of parameters required to define a final product.

[0039] The method can further comprise a step of evacuating the stack from the stacking bay, upon completion of the stack, by moving the stack conveyor in an evacuation direction. In particularly advantageous embodiments the evacuation direction is parallel to the staggering motion. The evacuation direction can be preferably oriented such that the formed stacked is transferred under the sheet conveyor arrangement. In this manner a much simpler arrangement can be obtained, since one and the same conveyor arrangement can be used to stagger superposed bundles and to evacuate the stack.

[0040] In other embodiments, the method comprises the step of evacuating the stacks in a direction substantially orthogonal to the staggering direction.

[0041] The method can be performed in a downstacker mode of operation, i.e. the step of moving the stacker platform and the sheet discharge end away from one another comprises the step of lowering the stacker platform with respect to a stationary supporting structure.

[0042] The method can further comprise the step of lifting the sheet discharge end from the top of the stack under formation on the stacker platform when the stack under formation is moved by the stack conveyor towards the sheet discharge end during the back-and-forth staggering motion of the stack conveyor.

[0043] The method can further comprise a step of abutting the sheets coming from the sheet conveyor arrangement against a stationary stop plate arranged above the stacker platform, to perform a better alignment of the sheets. The stop plate can be reciprocatingly moved in a vertical direction in synchronism with the back-and-forth staggering motion of the stack conveyor.

[0044] When the stack conveyor comprises a first stack conveyor member and a second stack conveyor member sequentially arranged along the direction of motion of the stack conveyor; the method can be such that:

a first stack of sheets comprised of staggered bundles is formed on the first stack conveyor member;

upon completion thereof, the first stack is moved from the first stack conveyor member to the second stack conveyor member;

the first stack is evacuated from the stacking bay by the second stack conveyor member and formation a second stack of staggered bundles starts on the first stack conveyor member.

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the first stack is evacuated from the stacking bay by the second stack conveyor member and formation a second stack of staggered bundles starts on the first stack conveyor member.

[0045] Other features and advantages of the invention

will be better appreciated from the following detailed description of exemplary embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] A more complete appreciation of the disclosed embodiments of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig.1 illustrates a side view of a sheet stacker according to the invention;

Fig.2 illustrates an enlargement of the sheet stacker of Fig.1, showing the end of the sheet conveyor arrangement and the stacking bay;

Fig.3 illustrates an enlargement of the sheet discharge end of the sheet conveyor arrangement;

Figs.4(A)-4(I) illustrate a sequence of steps of a stack-forming cycle;

Figs.5 and 6 illustrate a detail of a bundle retaining device in two different operating positions;

Fig.7 illustrates a different mode of operation of the stacker of Figs. 1-6;

Fig.8 illustrates a further embodiment of a stacker according to the invention;

Fig.9 illustrates a different mode of operation of the stacker of Fig. 8;

Fig.10 illustrates a further embodiment of a stacker according to the invention;

Fig.11 illustrates a further embodiment of a stacking bay for a stacker;

Fig.12 illustrates a schematic top view of a bi-directional conveyor for a stacker platform in a further embodiment;

Figs 13A, 13B illustrate two stacked of staggered bundles, with different staggering pitches;

Fig. 14 schematically illustrates a flow chart summarizing embodiments of the method disclosed herein.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0047] The following detailed description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Additionally, the drawings are not necessarily drawn to scale. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

[0048] Reference throughout the specification to "one embodiment" or "an embodiment" or "some embodiments" means that the particular feature, structure or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrase "in one embodiment" or "in an embodiment" or "in some embodiments" in various places throughout the specification is not necessarily referring to the same embodiment(s). Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

[0049] A first embodiment and different modes of operation of a stacker will now be described, reference being made to Figs. 1 to 7.

[0050] Referring now to Fig.1, a sheet stacker 1 for the formation of stacks of sheets is globally labeled 1. The sheet stacker 1 comprises a sheet conveyor arrangement 3 and a stacking bay 5. According to some embodiments, as shown in Fig.1, the sheet conveyor arrangement 3 comprises a plurality of sequentially arranged sheet conveyors 3A, 3B, 3C, which define a sheet delivery path. Each sheet conveyor 3A-3C can be comprised of one or more endless flexible members, such as belts or the like, which are entrained around idle and motor-driven rollers to advance the sheets towards the stacking bay 5. The sheet conveyor arrangement 3 can be supported by a stationary supporting structure comprised of uprights 7, 9. The stationary supporting structure can further include uprights 11 and a cross member 13 surrounding the stacking bay 5.

[0051] The sheet conveyor arrangement 3 has a sheet inlet side 15 and a sheet discharge end 17. Sheets, e.g. corrugated board sheets coming from a slitter-scorer or other upstream section (not shown) of the manufacturing line, enter the sheet conveyor arrangement 3 at the sheet inlet side 15 and are advanced according to a feeding direction F towards the sheet discharge end 17, where the sheets are discharged in the stacking bay 5 to form stacks of sheets as will be described later on.

[0052] Referring now to Fig.2, with continuing reference to Fig.1, the stacking bay 5 comprises a stacker platform 19 which can move vertically up and down according to arrow f19, e.g. by means of an electric motor (not shown). The stacker platform 19 can be supported by chains 20, or other lifting members, which are acted upon by an electric motor 22 to move the stacker platform 19 in a vertical up-and-down direction according to double arrow f19. The stacker platform 19 can be vertically guided by guides 21, 23 formed on uprights 9, 11. As shown in Figs 1 and 2 the stacker platform 19 supports a stack conveyor 25. The latter can be comprised of one

or more endless flexible members entrained around rollers 27, 29, one of which at least is motor-driven, while the other can be idle. The stack conveyor 25 forms a stacking surface whereon stacks of sheets are formed, as described here after in more detail.

[0053] In some embodiments the stack conveyor 25 can extend underneath the sheet discharge end 17 of the sheet conveyor arrangement 3. I.e. the upstream end (referred to the direction of advancement of the sheets) of the stack conveyor is arranged upstream of the sheet discharge end 17.

[0054] The stack conveyor 25 is controlled to move back-and-forth in a substantially horizontal direction f25, parallel to the stacker platform 19 and approximately parallel to a feeding direction F according to which the sheets enter the stacking bay 5. It shall be understood that the actual feeding direction F of the sheets upon leaving the sheet conveyor arrangement 3 can be inclined to some extent with respect to the horizontal direction, such that the sheet feeding direction F can have an upwardly or downwardly oriented speed component when the sheets first enter the stacking bay 5. However, the sheets enter the stacking bay 5 according to a direction F which lays in a vertical plane parallel to Figs 1 and 2 and thus parallel to the direction of motion of the stack conveyor 25. The sheets will be stacked, i.e. piled up on the stacker platform 19 in a horizontal direction. Thus the feeding direction of the sheets in the final portion of the feeding path is generally horizontal and generally parallel to the direction of motion f25 of the stack conveyor 25.

[0055] Along the cross member 13 a carriage 31 can be slidingly mounted. The carriage 31 can move along guides 33 according to double arrow f31 under the control of a motor 35, e.g. through a rack-and-pinion transmission system or the like. The carriage 31 supports a stop plate 37 which can extend in a general vertical direction. The stop plate 37 can move vertically up and down according to double arrow f37 under the control of a suitable actuator, such as a cylinder-piston actuator 38, an electric or hydraulic motor, or the like.

[0056] Referring now to Fig.3, with continuing reference to Figs. 1 and 2, according to some embodiments, the sheet discharge end 17 of the sheet conveyor arrangement 3 can comprise, in a manner known to those skilled in the art, a bottom roller 41 and a top roller 45, which define in combination a sheet discharge nip, where through the sheets conveyed by the sheet conveyor arrangement 3 are discharged in the stacking bay 5. The bottom roller 41 can be a motorized roller which controls the movement of the most downstream conveyor 3C of the sheet conveyor arrangement 3. Reference number 47 designates by way of example an electric motor which controls the motion of the most downstream conveyor 3C through rotation of the bottom roller 41.

[0057] The sheet discharge end 17 of the sheet conveyor arrangement 3 can be movable in a vertical direction according to double arrow f17, e.g. under the control of a linear actuator, such as a cylinder-piston actuator schematically shown at 51, for the purpose which will become clear from the description of the sequence of operations shown in Figs. 4(A)-4(I).

[0058] Turning now back to Fig.1, under the last portion of the sheet conveyor arrangement, an evacuation conveyor 53 can be arranged, which can be positioned near the ground level G.

[0059] The operation of the sheet stacker described so far will now be described with reference to the sequence of Figs. 4(A)-4(I). According to the operation cycle described here below, the sheet stacker 1 is configured and controlled to produce stacks S of corrugated board sheets C, wherein each stack S is in turn divided into bundles B, each bundle comprising a certain number of corrugated board sheets C. The number of sheets of each bundle B of a stack S can be constant. As best shown in Fig. 4(A) for instance, the corrugated board sheets C advance in a shingled arrangement along the sheet conveyor arrangement 3 and are individually fed through the nip 45 into the stacking bay 5. A stack S is being formed on the horizontal surface defined by the stack conveyor 25 supported on the stacker platform 19. The bundles B of sheets which form the stack S are staggered by a staggering pitch P. The number of sheets per bundle B, the number of bundles B per stack S and the staggering pitch P can be set by the user, e.g. through an interface of the control unit 26. For instance, a keyboard, a touch screen or any other suitable user interface 261 can be used. According to some embodiments, the user can input production data, including the staggering pitch P. As will be described in more detail later on, the staggering pitch P can be determined based on the length of the sheets in the feeding direction of the sheet in the stacking bay, i.e. in the staggering direction. In other embodiments, the optimum staggering pitch P can be calculated by the control unit 26, which can be suitably configured for that purpose. Calculation of the optimum staggering pitch P can be based on one production parameter only, in particular the length of the sheets in the sheet feeding direction F. In other embodiments additional sheet production parameters can be added in the calculation, as mentioned above. Instead of through calculation, the staggering pitch can be retrieved from a database, which contains recipes for the production of the corrugated board sheets C. A look-up table can be provided for that purpose, for instance.

[0060] The control unit 26 can be functionally coupled to at least one actuator which controls motion of the stacking conveyor 25. In some embodiments the actuator can comprise an electric motor 28 (see in particular Fig.2).

[0061] The bundles B are staggered in the direction F of feed of the corrugated board sheets C in the stacking bay 5, i.e. in the direction of motion f25 of the stack conveyor 25. Thus, staggering of mutually superposed bundles B is obtained by means of a back-and-forth, i.e. a reciprocating staggering motion of the stack conveyor 25 according to double arrow f25.

[0062] During stacking, the stop plate 37 is located at

a distance from the sheet discharge end 17 of the sheet conveyor arrangement 3, which is determined by the dimension of the corrugated board sheets C in the direction F. In this way, each corrugated board sheet C delivered into the stacking bay 5 will advance until reaching the stop plate 37, and all the sheets C will thus be aligned with their most advanced edges abutting against the stop plate 37.

[0063] In order to stagger the bundles B in the direction f25, once the desired number of corrugated board sheets C forming a bundle B has been piled up, the stack conveyor 25 moves by a pitch P alternatively towards the sheet conveyor arrangement 3 and away therefrom. Starting from Fig. 4(A), once the top-most bundle, labeled B1 in Fig.4(A), has been completed, the stack S under formation is moved on the left according to arrow fx, such that the stack S moves slightly underneath the sheet discharge end 17 of the sheet conveyor arrangement 3. Fig.4(B) shows the stack S in the new position, after the staggering movement according to fx has been performed.

[0064] In order to allow the trailing edges of the sheets (i.e. the most upstream edges of the corrugated board sheets C with respect to the direction of feed F) of the last formed bundle B to move under the sheet discharge end 17, the stacker platform 19 can be lowered, or the sheet discharge end 17 of the sheet conveyor arrangement 3 can be lifted, or a combination of the two movements can be performed. According to presently preferred embodiments, the sheet discharge end 17 is lifted (arrow f17, Fig. 4(B)) by means of the actuator 51 and then lowered again (arrow f17, Fig. 4(C)). This movement can be quicker than a lowering movement involving the stacker platform 19, as the sheet discharge end is lighter than the stacker platform 19, which also supports the weight of the stack S under formation.

[0065] The stop plate 37 can remain stationary in this step of the stacking process, such that when formation of the subsequent bundle B2 starts, the most advance, i.e. the leading edges of the corrugated board sheets C will advance until the stop plate 37, thus reaching the same position with respect to the stacking bay 5. Since the stack S has been shifted (arrow fx) towards the left by a pitch P, the next bundle B2 will be staggered by a distance P along direction F with respect to the previously formed bundle B1.

[0066] Fig.4(C) shows the initial phase of formation of the next bundle B2, while Fig.4(D) shows the subsequent phase, where the next bundle B2 has been completed. At this stage a new bundle B3, which is staggered by a pitch P with respect to bundle B2 and aligned with the bundle B1, must be formed. For this purpose, the stack conveyor 25 is actuated and moves the stack S under formation according to arrow fy (Fig.4(E)) from the left to the right by a pitch P. The most downstream edge (i.e. the leading edge) of the bundle B2 just formed must move horizontally beyond the stop plate 37. The cylinder-piston actuator 38 thus lifts the stop plate 37 in order to allow the bundle B2 to move there under.

[0067] Once the stack S has been moved by one pitch P in the direction fy, formation of the next bundle B3 can start, as shown in Fig. 4(F). The stop plate 37 has been lowered again, such that the corrugated board sheets C are correctly positioned by abutting with their leading edges against the stop plate 37. The stop plate 37 is thus controlled by the actuator 38 to perform a vertical reciprocating motion which is synchronized with the formation of staggered bundles of sheets.

[0068] In the next Fig.4(G) the subsequent bundle B3 is almost completed.

[0069] During the above described sequence, the stacker platform 19 gradually lowers to accommodate the stack S on top of the stack conveyor 25, such that the sheet discharge end 17 of the sheet conveyor arrangement 3 can remain substantially at the same height, except for the small up and down stroke according to arrow f17, which is performed by the sheet discharge end 17 each time the stack S is moved according to arrow fx to displace the trailing edge of the top-most bundle under the sheet discharge end 17. The sheet stacker is thus configured as a so-called down-stacker, i.e. the stack is formed by lowering the stack such that the upper surface thereof remains substantially around a constant position.

[0070] In order for the stack conveyor 25 to perform the bundle staggering movement, a gap in the flow of corrugated board sheets 3 on the sheet conveyor arrangement 3 must be generated, which separates the last corrugated board sheet C of one bundle from the first corrugated board sheet C of the next bundle. The gap can be created in anyone of the know methods used to create gaps in the flow of corrugated board sheets C. The dimension of the gap can be controlled on the basis of several operation parameters of the stacker 1, for instance the speed of advance of the corrugated board sheets C, their length and so on.

[0071] The gap can be formed e.g. acting upon the speed of the various conveyors 3A, 3B, 3C forming the sheet conveyor arrangement 3.

[0072] The number of corrugated board sheets C per bundle B can be counted in a rotary shear used to cut a continuous longitudinal corrugated board web, each cut corresponding to one sheet. The last sheet of a bundle is then tracked by means of suitable encoders, for instance, along the path up to the stacking bay 5.

[0073] Once the required number of bundles B forming a stack S has been formed as described above, the stack S must be evacuated from the stacking bay 5. The evacuation step is illustrated in Figs 4(H) to 4(I). The flow of incoming corrugated board sheets C from the sheet conveyor arrangement 3 is interrupted by creating therein a gap in any one of different possible ways, known to those skilled in the art. During the time made available by the gap the formed stack S is moved downwards by lowering the stacker platform 19, as shown in Fig.4(H), until the upper surface of the stack conveyor 25 is substantially at the same level as the evacuation conveyor 53, while

the stack conveyor 25 can remain inoperative, such that the stack S only moves vertically. Once this position has been achieved, the stack conveyor 25 can be activated again, to perform an evacuation motion and displace the stack S towards the evacuation conveyor 53, as shown in Fig. 4(I).

[0074] As soon as the stack S has cleared off the stacker platform 19, the latter can be lifted again, in the initial position where the formation of a new stack can start, as shown in Fig. 4(I). The time required for evacuating the stack S is extremely short, since the distance the stack S must travel substantially corresponds to the dimension of the stack in the direction F.

[0075] If the stack S has not been properly cleared off the stacker platform, e.g. if a part thereof remains on the stacker platform 19, when the latter is lifted, the remaining sheets which are still erroneously placed on the stacker platform 19 will cause an unexpected lifting movement of the sheet discharge end 17 of the conveyor 3C. This unexpected movement can be detected by a sensor, e.g. a micro-switch, which can trigger an alarm.

[0076] According to some embodiments, in order to ensure a correct piling up of the corrugated board sheets C and of the bundles B, a bundle retaining device can be arranged at the sheet discharge end 17 of the sheet conveyor arrangement 3. Figs. 5 and 6 illustrate details of the bundle retaining device, globally labeled 60. In some embodiments, the bundle retaining device 60 comprises one or preferably a plurality of resilient members, for instance resilient leaf blades 61, e.g. made of metal. In other embodiments, the resilient members may include resilient pads, such as pads made of foam resin or the like. The resilient leaf blades 61 or any other set of resilient members form a sheet braking member, which prevents or reduces undesired displacements of the corrugated board sheets of the last formed bundle.

[0077] The resilient leaf blades 61 may each have a terminal bent appendage 61X, which form a surface facing the bundles B being formed. The appendages 61X can be housed in indentations 63 formed in a transverse bar 65, which can be arranged adjacent the bottom roller 41, around which the most downstream sheet conveyor 3C is entrained. The bottom of each resilient leaf blade 61 can be provided with a high-friction pad 67, e.g. made of natural or synthetic rubber, plastic material, synthetic foam material, or any other material suitable to apply a grip against the upper surface of the top-most bundle B, when the trailing edge thereof is moved under the bottom roller 41, i.e. under the sheet discharge end 17 of the sheet conveyor arrangement 3.

[0078] The operation of the bundle retaining device 60 can be best understood looking at Figs. 5 and 6 with continuing reference to the sequence of Figs. 4(A)-4(I). In Fig.5 the sheet discharge end 17 of the sheet conveyor arrangement 3 has been lifted (arrow f17, Fig. 5) in the lifted position, in order to allow the stack under formation to move according to arrow fx, such that the last-formed bundle B1 is moved with the trailing edge thereof under the sheet discharge end 17. In this position the resilient leaf blades 61 project under the bar 65. Once the stack S has been displaced such that the bundle B1 is partly under the roller 41, i.e. the trailing edge of the bundle B1 is under the sheet discharge end 17, the latter can be lowered according to arrow f17 in Fig.6, such that the high-friction pads 67 are pressed against the upper surface of the last sheet forming the bundle B1. Formation of the next bundle B2 can start, as shown in Fig. 6, with the trailing edges of the corrugated board sheets C, and thus the trailing edge of the bundle B2, abutting against the bar 65.

[0079] The corrugated board sheets C are fed according to arrow F and slide along the upper surface of the previously formed bundle B1. Friction between the corrugated board sheets C and the underneath bundle B1 could cause an undesired displacement of the last corrugated board sheets C of bundle B1 in direction F, dragged by the next corrugated board sheets C belonging to the next bundle B2. The pressure applied by the resilient laminar leafs 61 prevent the top corrugated board sheet of bundle B1 from moving in direction F. When the bundle B2 has been completed, the lifting movement (arrow f17, Fig.5) of the sheet discharging end 17 of the sheet conveyor arrangement 3 releases the bundle B1, allowing the stack S to move according to fx or fy as required.

[0080] While the above description concerns a mode of operation of the sheet stacker 1 for the formation of stacks S, each formed by staggered bundles B, the same sheet stacker can also produce smooth stacks S, i.e. formed by smoothly aligned corrugated board sheets C, rather than staggered bundles.

[0081] Figs. 7(A)-7(C) illustrate the final phase of formation of a smooth stack S. In order to produce smooth stacks S, the stack conveyor 25 remains stationary for the time required to pile up the desired total number of corrugated board sheets C forming the stack S on the stacker platform 19, such that no staggering is provided between adjacent sheets. Fig. 7(A) shows a step in which the last corrugated board sheets C are placed on top of the almost completed stack S. Since during the whole stacking process the stack conveyor 25 remained stationary, all the corrugated board sheets C have been aligned against the stop plate 37, and are thus ordered to form a smooth stack S. Upon reaching the desired number of corrugated board sheets C, a gap is formed in the sheet flow along the sheet conveyor arrangement 3 and the stacker platform 19 is lowered, see Fig. 7(B), arrow f19. The lowering motion brings the stacking surface, defined by the upper branch of the stack conveyor 25, in alignment with the evacuation conveyor 53.

[0082] Once this positon has been achieved, the stack conveyor 25 can be activated to perform an evacuation motion, moving the stack S in an evacuation direction fE, see Fig. 7(C), thus transferring the stack S onto the evacuation conveyor 53 and clearing the stacker platform 19. This latter can be lifted again (arrow f19, Fig.7(C)), at the

level of the sheet discharge end 17 of the sheet conveyor arrangement 3, to start the formation of a new stack S.

[0083] Irrespective of the kind of stack S formed (either smooth or formed by staggered bundles B), once the stack S is on the evacuation conveyor 53, there is sufficient time to remove the stack S from the sheet stacker 1, while the next stack S is formed in the stacking bay 5. The evacuation conveyor 53 can be designed in a known manner, such that evacuation of the stack S therefrom can be in a direction orthogonal to the direction F. For instance, conveyor rollers can be arranged with their rotation axes orthogonal to direction F, to move the stack under the conveyor 3C, while endless belts can be arranged between pairs of adjacent rollers, the endless belts being designed to move the stacks in a horizontal direction orthogonal to arrow fE.

[0084] In the embodiments disclosed so far, the stack conveyor 25 is formed by an endless conveyor member, which extends along the entire length of the stacking bay 5, between the two opposed rollers 27, 29. A single actuator, e.g. a single electric motor can be used to control the movement of the stack conveyor 25. In other embodiments, a different configuration of the stack conveyor 25 can be provided, e.g. the stack conveyor 25 can be comprised of sequentially arranged stack conveyor members, at least some of which are controlled by separate actuators, e.g. separate electric motors. Fig.8 schematically illustrates an embodiment wherein the stack conveyor 25 is comprised of a first stack conveyor member 25A and a second conveyor member 25B, arranged in sequence in the direction of the evacuation motion. The remaining parts, elements and components of the sheet stacker 1 of Fig.8 can be the same as described above and shown in Figs. 1-7, and will thus not be described again.

[0085] In the embodiment of Fig. 8, an auxiliary conveyor 71 is arranged on the side of the stacking bay 5 opposite the sheet conveyor arrangement 3. Depending upon the mode of operation of the sheet stacker 1, the auxiliary conveyor 71 can be used as an evacuation conveyor, or as an additional conveyor, e.g. to deliver stacking pallets or the like on the stacker platform 19. As understood herein a pallet is any means whereon the stack S of corrugated board sheets C can be formed, e.g. for transportation purposes, or for other logistic reasons whatsoever.

[0086] In Fig. 8, this latter mode of operation is shown. Single pallets 73 are fed according to arrow f73 on the second stack conveyor member 25B, while the first stack conveyor member 25A is operated in quite the same way as described above, to produce stacks S of staggered bundles B (Figs. 4(A)-4(I)), or alternatively smooth stacks S (Figs. 5, 6).

[0087] Once the stack S has been completed, the first stack conveyor member 25A performs an evacuation motion, thus transferring the stack S on the evacuation conveyor 53. At the same time, or subsequently, the pallet 73, which is waiting on the second stack conveyor member 25B, can be transferred from the latter on the first conveyor member 25A. Lifting of the stacker platform 19 can start as soon as the stack S has been cleared off the first stack conveyor member 25A and/or a new pallet 73 has been transferred from the auxiliary conveyor 71 on the second stack conveyor member 25B.

[0088] In the embodiments disclosed so far, the stacks S are cleared off the stacker platform 19 by means of a clearing movement according to a direction fE which is opposite the direction F of arrival of the corrugated board sheets C in the stacking bay 5, such that the stacks S are moved on the evacuation conveyor 53, which is located under the sheet conveyor arrangement 3. As mentioned above, this is particularly advantageous since it reduces the time needed to clear the stacker platform 19, thus improving the overall production rate of the sheet stacker 1. Moreover, since the evacuation conveyor 53 is arranged under the sheet conveyor arrangement 3, the overall footprint of the sheet stacker 1 is reduced.

[0089] The sheet stacker 1 of Fig. 8 can also operate in a different mode, by evacuating the stacks S from the stacking bay 5 onto the auxiliary conveyor 71, which thus performs the function of an evacuation conveyor. This mode of operation is schematically shown in Fig. 9. A completely formed stack S is shown in three subsequent positions, labeled S1, S2 and S3, respectively. It shall be noted that the above situation does normally not arise and is provided only for the sake of explanation of this mode of operation, since when a stack S is present in position S2, on the second stack conveyor member 25B, the first conveyor member 25A is cleared off.

[0090] Once the stack S1 has been completed and the stacker platform 19 is in the lower position, at the level of the auxiliary conveyor 71, the first stack conveyor member 25A and second stack conveyor member 25B can be acted upon to evacuate the stack S, moving the latter sequentially from position S1 to position S2 (arrow fS1) and from position S2 to position S3 (arrow fS2). As soon as the stack S has cleared off the second stack conveyor member 25B, the stacker platform 19 can be lifted again, to start the formation of the next stack.

[0091] The time required for clearing off the stacker platform 19 is longer than in the previously described modes of operation, since the stroke which the stack S has to travel is longer.

[0092] In both modes of operation of Figs. 8 and 9 the stacks S are formed by a plurality of superimposed and mutually staggered bundles B. It shall be understood, however, that the sheet stacker of this embodiment can be controlled to produce smooth stacks as well.

[0093] In yet further embodiments, not shown, the sheet stacker 1 can be configured as shown in Figs 8 and 9, i.e. with an auxiliary conveyor 71 possibly operating as an evacuation conveyor arranged on the side opposite the sheet conveyor arrangement, but having a stack conveyor formed by a single conveyor member 25, as illustrated in Figs. 1 to 7.

[0094] In Figs. 8 and 9 the sheet stacker 1 is provided

with the evacuation conveyor 53 arranged under the sheet conveyor arrangement 1, such that the sheet stacker 1 can operate also according to any one of the mode of operations described in connection with Figs. 1 to 7. In other embodiments, however, the evacuation conveyor 53 can be omitted.

[0095] Fig.10 illustrates a further embodiment of a sheet stacker according to the present invention. The same reference number designate the same or equivalent parts, elements or components as already described in connection with the remaining figures and which will not be described again.

[0096] The sheet stacker 1 of Fig. 10 comprises an auxiliary conveyor 81 arranged on the side of the stacking bay 5 opposite the sheet conveyor arrangement 3. The auxiliary conveyor 81 can be hinged at one end around a horizontal pivoting axis 83, which is substantially orthogonal to the direction F along which the corrugated board sheets are delivered in the stacking bay 5, such that the auxiliary conveyor can pivot according to double arrow f81. In the embodiment of Fig. 10 the stack conveyor 25 is divided into first stack conveyor member 25A and second stack conveyor member 25B. In other embodiments, the stack conveyor 25 can be a one-piece stack conveyor as shown e.g. in Figs. 1-3. The sheet stacker of Fig. 10 is configured to produce bundles B1, B2, B of corrugated board sheets C, which are individually downloaded from the stacking bay 5 on the auxiliary conveyor 81, which operates as an evacuation conveyor.

[0097] In Fig. 10 formation of a new bundle of corrugated board sheets C has started, while the last formed bundle B2 has been transferred from the first stack conveyor member 25A on the second stack conveyor member 25B. The second last bundle B1 has been previously transferred from the second stack conveyor member 25B to the auxiliary conveyor 81.

[0098] The pivoting movement according to f81 of the auxiliary conveyor 81 allows the upstream end thereof, i.e. the end arranged near the stacking bay 5 and opposite the end pivoted at 83, to follow the upwards and downwards movement of the stack conveyor 25, such that processing of the bundles B1, B2 becomes faster. Formation of a new bundle on the first stack conveyor member 25A can start as soon as the last formed bundle B2 has cleared off the first stack conveyor member 25A and has moved on the second stack conveyor member 25B. Therefrom, the last bundle B2 can subsequently be moved onto the auxiliary conveyor 81, the upstream end whereof follows the up and down movement performed by the stack conveyor 25 to allow the next bundle to grow on the first stack conveyor member 25A.

[0099] In the above described embodiments the stack conveyor 25 is configured and arranged such that the stacks S are evacuated in an evacuation direction which is substantially parallel to the sheet feeding direction F and to the staggering direction. This is particularly beneficial in terms of production speed and machine simplification. Specifically, the formed stack can be removed quite quickly from the stacking bay, such that formation of a subsequent stack or set of stacks can start again. However, some of the advantageous features of the present disclosure can be provided also in combination with a stacking bay wherein the evacuation direction is oriented at 90° with respect to the sheet feeding direction F. Fig. 11 illustrates an embodiment wherein the evacuation direction is orthogonal to the feeding direction F. The same elements, components or parts as already disclosed in connection with Figs. 1 to 10 are labeled with the same reference numbers and will not be described again.

[0100] In Fig.11 a stacker platform 19 is provided with a stack conveyor 25 having a conveyor direction orthogonal to feeding direction F. The stacker platform 19 can be comprised of a platform frame 19.1 which is supported on a stationary structure, e.g. on uprights 9 and 11. The platform frame 19.1 can be capable of reciprocatingly moving according to a staggering direction parallel to arrow F. For instance, the platform frame 19.1 can be guided along stationary guides 9.1 and 11.1 mounted on uprights 9 and 11. Shoes 19.2 and 19.3 mounted on platform frame 19.1 can slidingly engage the guides 9.1 and 11.1.

[0101] According to some embodiments an actuator 28, for instance an electric motor can be arranged and configured to control the movement of the platform frame 19.1 along guides 9.1 and 11.1. As already disclosed with reference to the previous figures, the stroke performed by the stack platform 19 can be controlled by the control unit 26, e.g. based on the length of the sheet bundles along feeding direction F, such that the staggering pitch P be optimized.

[0102] Fig. 12 illustrates a schematic top view of a combined stack conveyor 25, which can be used in a further embodiment of the stacker disclosed herein. The combined stack conveyor 25 comprises conveyor rollers 32 and conveyor belts 34, which are arranged such that the conveyor motion f34 of the conveyor belts f34 is orthogonal to the conveyor motion f32 of the conveyor rollers 32. In some embodiments, the conveyor belts 34 can be provided with a lifting and lowering movement, such that they can be brought alternatively in an upper, operative position, and in a lower, idle position, wherein the belts are arranged below the surface of the roller conveyor. Thus, the conveyor rollers 32 can be used to evacuate the stacks S in direction f34 after completion of the stacks, while the conveyor belts 34 can be used to impart the reciprocating staggering motion to the stacks being formed. A reverse arrangement, with the rollers 34 being used for staggering purposes and the belts for evacuation is not excluded.

[0103] The purpose of adjusting the staggering pitch based on the length of the sheets in the sheet feeding direction F will become more apparent from Figs. 13A and 13B. In these two figures, respective stacks S of bundles B are shown. In Fig. 13A the sheets forming the stack S have a length L1 in the sheet feeding direction

F. The staggering pitch is labeled P1. In Fig. 13B the sheets forming the stack S have a length L2 in the sheet feeding direction F. The staggering pitch is labeled P2. The sheet length L1 is smaller than L2 and the staggering pitch P1 is smaller than the staggering pitch P2. A staggering pitch P2 could not be used with sheets having a length LI, since the stack S would become unstable, as each bundle of sheets would project from the bundle underneath to such an extent that it will not be sufficiently supported.

[0104] Each bundle B is tied with a respective tying cord or strip T on the side of the bundle which overhangingly projects from the adjacent bundles, as shown in Figs. 13A, 13B. In order to better tie the bundle, the tying strip or cord T should be positioned distant from the edge of the bundle. Therefore, the longer the overhangingly projecting portion of the bundle, i.e. the longer the staggering pitch P1 or P2, the better the bundle will be tied by the tying cord or strip. Since, however, staggering may impair the stability of the stack S, the staggering pitch PI, P2 shall be preferably maximized taking into consideration the stability constraints. A longer sheet (length L2) allows a larger staggering pitch P2, as can be appreciated by comparing Figs. 13A and 13B. At the same time, the longer the sheets are, the more important becomes the distance of the tying position from the edge of the bundle.

[0105] The method disclosed herein, which takes into account production parameters, including the length (L1, L2) of the sheets in the sheet feeding direction in order to maximize the staggering pitch (PI, P2), allows to produce a better stack S of staggered bundles.

[0106] Fig. 14 illustrates a flow chart summarizing the method disclosed herein. When a production job shall start (block 101) the parameter(s) determining the staggering pitch P are inputted (block 102). They can be provided by the user directly through an interface 261, or can be retrieved e.g. from a database. The user in this case provides data to enable the control unit 26 to retrieve the necessary information from the database. As understood herein production parameter(s) also include any data which can be used for retrieving further information or data from a database.

[0107] As noted above the production parameters can directly include the staggering pitch P, P1, P2, or other data, based upon which the control unit will determine the optimized staggering pitch.

[0108] When the staggering pitch P, P1, P2 has been set, manufacturing can start (block 103).

[0109] While the invention has been described in connection with what is presently considered to be the most practical and preferred examples, it is to be understood that the invention is not to be limited to the disclosed examples, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

Claims

1. A sheet stacker (1) comprising:

- a sheet conveyor arrangement (3), configured for feeding a plurality of sheets (C) in succession in a sheet feeding direction (F), said sheet conveyor arrangement (3) having a sheet discharge end (17);
- a stacking bay (5), wherein sheets (C) delivered by the sheet conveyor arrangement (3) at the sheet discharge end (17) thereof are formed into stacks (S); the stacking bay (5) comprising a stacker platform (19), the sheet discharge end (17) and the stacker platform (19) being provided with a mutual approaching and distancing movement; wherein the stacker platform (19) comprises a stacking surface whereon the stacks are formed;

wherein the stacker platform (19) further comprises an actuator (28) adapted to reciprocatingly move the stacking surface in a staggering direction, substantially parallel to the sheet feeding direction (F) in the stacking bay (5); and the reciprocating movement has a staggering pitch (P; PI; P2), the sheet stacker being **characterized in that** it adjusts the staggering pitch (P; PI; P2) according to at least one production parameter of the sheets (C).

2. The sheet stacker (1) of claim 1, wherein the at least one production parameter comprises a dimension of the sheets (C) in the staggering direction.

3. The sheet stacker (1) of claim 1 or 2, further comprising a control unit (26), adapted to control the actuator (28) to perform a reciprocating movement according to a staggering pitch (P; PI; P2) defined as a function of said at least one production parameter.

4. The sheet stacker (1) of claim 1 or 2 or 3, wherein the stacker platform (19) supports a stack conveyor (25) movable in a direction parallel to a feeding direction (F) of the sheets in the stacking bay (5), configured and controlled to perform a reciprocating staggering motion to form staggered bundles (B) of sheets, and to further perform an evacuation motion, to remove a completed stack (S) from the stacking bay (5) in the staggering direction.

5. The sheet stacker (1) of any one of the preceding claims, wherein the stacker platform (19) is provided with a vertical lifting and lowering movement (f19) with respect to a stationary supporting structure (11) of the sheet conveyor arrangement (3)

6. The sheet stacker (1) of any one of the preceding claims, further comprising a stop plate (37), posi-

tioned in the stacking bay (5) above the stacker platform (19), arranged and configured for stopping the sheets delivered by the sheet conveyor arrangement (3) to the stacking bay (5); and wherein preferably the stop plate (37) has a reciprocating vertical movement, which is synchronized with the formation of staggered bundles (B) of sheets.

7. The sheet stacker (1) of any one of the preceding claims that includes claim 4, wherein the sheet discharge end (17) of the sheet conveyor arrangement (3) is combined with an actuator, which controls a lifting and lowering movement of the sheet discharge end (17), which is synchronized with the reciprocating staggering motion of the stack conveyor (25).

8. The sheet stacker (1) of claim 4, wherein the evacuation motion of said stack conveyor (25) is oriented such that the completed stack (S) is moved from the stacking bay (5) under the sheet conveyor arrangement (3).

9. The sheet stacker (1) of claim 4, wherein said stack conveyor (25) comprises a first stack conveyor member (25A) and a second stack conveyor member (25B), which are sequentially arranged one after the other in a direction parallel to the direction (fE) of the evacuation motion; and wherein preferably the first stack conveyor member (25A) and the second stack conveyor member (25B) are arranged and controlled such that a stack (S) is formed on the first stack conveyor member (25A) and, upon formation thereof, the completed stack is moved by the first stack conveyor member (25A) to the second stack conveyor member (25B) and sequentially by the second stack conveyor member (25B) outside the stacking bay (5).

10. The sheet stacker (1) of any one of the preceding claims that includes claim 4, wherein the sheet discharge end (17) is combined with a bundle retaining device (60), which is configured and arranged for retaining the top-most bundle (B) of the stack (S) when the stack conveyor (25) performs the staggering motion in a direction away from the sheet discharge end (17); and wherein preferably the bundle retaining device (60) comprises at least one resilient sheet braking member, arranged under the sheet discharge end (17), between the sheet discharge end (17) and the stack (S) being formed on the stacker platform (19).

11. The sheet stacker (1) of any one of the preceding claims, configured as a down-stacker, wherein during formation of a stack (S) the stacker platform (19) moves gradually downwardly to accommodate the forming stack (S) of sheets thereon.

12. A method of forming sheet stacks (S) on a stacking surface, comprising the following steps:

- feeding a plurality of sheets (C) along a sheet conveyor arrangement (3) towards a stacking bay (5), the sheet conveyor arrangement (3) having a sheet discharge end (17), wherefrom the sheets (C) are discharged in the stacking bay (5) and formed into stacks (S) on a stacking surface supported by a stacker platform (19) arranged in the stacking bay (5);
- while the sheet stack (5) gradually grows on the stacking surface, moving the stacker platform (19) and the sheet discharge end (17) of the sheet conveyor arrangement (3) away from one another;
- -during formation of the stack (S), dividing the stack in mutually superposed and staggered bundles (B) of sheets by reciprocatingly moving the stacking surface according to a reciprocating staggering motion, in a direction (f25) parallel to a feeding direction (F) of the sheets (C) in the stacking bay (5);

the method being **characterized by** the staggering motion having an adjustable pitch (P; PI; P2) which is determined on the basis of at least one production parameter of said sheets (C).

13. The method of claim 12, comprising the step of determining said pitch (P; PI; P2) as a function of at least a length (L1; L2) of said sheets in the direction (f25) of the staggering motion; and preferably of at least one additional production parameter.

14. The method of claim 12 or 13, wherein said sheets (C) are corrugated board sheets comprised of at least one liner and at least one fluted paper sheet, and wherein the additional production parameter is selected from the group consisting of: grammage of one or more paper sheets forming the corrugated board sheet; total number of paper sheets per corrugated board sheet; total number of liners per corrugated board sheet; total number of fluted sheets per corrugated board sheet; flute height of at least one fluted paper sheet forming the corrugated board sheet; flute pitch of at least oen fluted paper sheet forming the corrugated board sheet; a combination of two or more of the these parameters.

15. The method of any one of claims 12 to 14, wherein said stacking surface is formed by a stack conveyor (25).

16. The method of claim 15, further comprising the step of evacuating the stack (S) from the stacking bay (5) upon completion of the stack, by moving the stack conveyor (25) in an evacuation direction (fE), parallel to the staggering motion thereof; and wherein pref-

erably the evacuation direction (fE) is oriented such that the formed stack (S) is transferred under the sheet conveyor arrangement (3).

17. The method of any one of claims 12 to 16, wherein the step of moving the stacker platform (19) and the sheet discharge end (17) away from one another comprises the step of lowering the stacker platform (19) with respect to a stationary supporting structure (11).

18. The method of any one of the preceding claims that includes claim 15, further comprising the step of lifting the sheet discharge end (17) from the top of the stack (S) under formation on the stacker platform (19) when the stack (S) under formation is moved towards the sheet discharge end (17) during the reciprocating staggering motion of the stack conveyor (25).

19. The method of any one of the preceding claims that includes claim 15, further comprising the step of abutting the sheets (C) coming from the sheet conveyor arrangement (3) against a stationary stop plate (37) arranged above the stacker platform (19); and preferably further comprising the step of reciprocatingly moving the stop plate (37) in a vertical direction in synchronism with the back-and-forth staggering motion of the stack conveyor (25).

20. The method of any one of the preceding claims that includes claim 15, wherein the stack conveyor (25) comprises a first stack conveyor member (25A) and a second stack conveyor member (25B) sequentially arranged along the direction of motion (f25) of the stack conveyor (25); and wherein:

a first stack (S) of sheets (C) comprised of staggered bundles (B) is formed on the first stack conveyor member (25A);
upon completion thereof, the first stack (S) is moved from the first stack conveyor member (25A) to the second stack conveyor member (25B);
the first stack (S) is evacuated from the stacking bay (5) by the second stack conveyor member (25B) and formation a second stack (S) of staggered bundles (B) starts on the first stack conveyor member (25A).

Patentansprüche

1. Bogenstapelvorrichtung (1), umfassend:

- eine Bogenförderanordnung (3), die dafür konfiguriert ist, aufeinanderfolgend eine Mehrzahl von Bögen (C) in einer Bogenzuführrichtung (F) zuzuführen, wobei die Bogenförderanordnung (3) ein Bogenausgabeende (17) aufweist,
- einen Stapelschacht (5), wo aus Bögen (C), die durch die Bogenförderanordnung (3) an dem Bogenausgabeende (17) angeliefert werden, Stapel (S) ausgebildet werden, wobei der Stapelschacht (5) eine Stapelplattform (19) umfasst, wobei das Bogenausgabeende (17) und die Stapelplattform (19) zur Bewegung aufeinander zu und voneinander weg ausgebildet sind, wobei die Stapelplattform (19) eine Stapelfläche aufweist, auf der die Stapel ausgebildet werden, wobei die Stapelplattform (19) ferner ein Stellglied (28) umfasst, das dafür ausgebildet ist, die Stapelfläche in einer Versatzrichtung im Wesentlichen parallel zu der Bogenzuführrichtung (F) in dem Stapelschacht (5) hin und her zu bewegen; und wobei die Hin- und Herbewegung über einen Versatzabstand (P; P1; P2) erfolgt,

wobei die Bogenstapelvorrichtung **dadurch gekennzeichnet ist, dass** der Versatzabstand (P; P1; P2) gemäß mindestens einer Herstellungskenngröße der Bögen (C) angepasst wird.

2. Bogenstapelvorrichtung (1) nach Anspruch 1, wobei die mindestens eine Herstellungskenngröße eine Abmessung der Bögen (C) in der Versatzrichtung ist.

3. Bogenstapelvorrichtung (1) nach Anspruch 1 oder 2, wobei diese ferner eine Steuereinheit (26) umfasst, die dafür ausgebildet ist, das Stellglied (28) derart zu steuern, dass es eine Hin- und Herbewegung gemäß einem Versatzabstand (P; P1; P2) ausführt, der in Abhängigkeit von der mindestens einen Herstellungskenngröße festgelegt ist.

4. Bogenstapelvorrichtung (1) nach Anspruch 1 oder 2 oder 3, wobei die Stapelplattform (19) einen Stapelförderer (25) trägt, der in einer Richtung parallel zu einer Zuführrichtung (F) der Bögen (F) in dem Stapelschacht (5) bewegbar ist, wobei er dafür konfiguriert ist und gesteuert wird, eine versetzende Hin- und Herbewegung auszuführen, um zueinander versetzte Bündel (B) aus Bögen auszubilden, und um weiter eine Abtransportbewegung auszuführen, um einen fertigen Stapel (S) in der Versatzrichtung aus dem Stapelschacht (5) zu entfernen.

5. Bogenstapelvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei die Stapelplattform (19) für eine vertikale Hub- und Senkbewegung (f19) in Bezug auf eine stationäre Tragstruktur (11) der Bogenförderanordnung (3) ausgebildet ist.

6. Bogenstapelvorrichtung (1) nach einem der vorhergehenden Ansprüche, ferner umfassend eine An-

schlagplatte (37), die oberhalb der Stapelplattform (19) in dem Stapelschacht (5) angeordnet ist und dafür ausgebildet und konfiguriert ist, die von der Bogenförderanordnung (3) zu dem Stapelschacht (5) gelieferten Bögen (C) zu stoppen, und wobei die Anschlagplatte (37) vorzugsweise eine vertikale Hin- und Herbewegung ausführt, die mit dem Ausbilden von versetzten Bündeln (B) aus Bögen synchronisiert ist.

7. Bogenstapelvorrichtung (1) nach einem der vorhergehenden Ansprüche, Anspruch 4 einschließend, wobei das Bogenausgabeende (17) der Bogenförderanordnung (3) mit einem Stellglied kombiniert ist, das eine Hub- und Absenkbewegung des Bogenausgabeendes (17) steuert, die mit der versetzenden Hin- und Herbewegung des Stapelförderers (25) synchronisiert ist.

8. Bogenstapelvorrichtung (1) nach Anspruch 4, wobei die Abtransportbewegung des Stapelförderers (25) derart ausgerichtet ist, dass der fertige Stapel (S) unterhalb der Bogenfördereranordnung (3) aus dem Stapelschacht (5) heraus bewegt wird.

9. Bogenstapelvorrichtung (1) nach Anspruch 4, wobei der Stapelförderer (25) ein erstes Stapelförderelement (25A) und ein zweites Stapelförderelement (25B) umfasst, die hintereinander in einer Richtung parallel zu der Richtung (fE) der Abtransportbewegung angeordnet sind, und wobei vorzugsweise das erste Stapelförderelement (25A) und das zweite Stapelförderelement (25B) derart angeordnet sind und gesteuert werden, dass auf dem ersten Stapelförderelement (25A) ein Stapel (S) ausgebildet wird, und wenn dieser ausgebildet ist, der fertige Stapel von dem ersten Stapelförderelement (25A) zu dem zweiten Stapelförderelement (25B) bewegt wird und danach durch das zweite Stapelförderelement (25B) außerhalb des Stapelschachts (5) bewegt wird.

10. Bogenstapelvorrichtung (1) nach einem der vorhergehenden Ansprüche, Anspruch 4 einschließend, wobei das Bogenausgabeende (17) mit einer Bündelrückhalteeinrichtung (60) kombiniert ist, die zum Zurückhalten des obersten Bündels (B) des Stapels (S) konfiguriert und ausgebildet ist wenn der Stapelförderer (25) die Versetzungsbewegung in einer Richtung von dem Bogenausgabeende (17) hinweg ausführt; und wobei die Bündelrückhalteeinrichtung (60) vorzugsweise mindestens ein elastisches Bogenbremselement umfasst, das unter dem Bogenausgabeende (17) zwischen dem Bogenausgabeende (17) und dem gerade auf der Stapelplattform (S) ausgebildeten Stapel (S) angeordnet ist.

11. Bogenstapelvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei diese als Abwärtsstapler konfiguriert ist, wobei die Stapelplattform (19) während des Ausbildens eines Stapels (S) allmählich nach unten bewegt wird, um den sich bildenden Stapel (S) aus Bögen aufzunehmen.

12. Verfahren zum Ausbilden von Bogenstapeln (S) auf einer Stapelfläche, mit folgenden Schritten:

- Zuführen einer Mehrzahl von Bögen (C) entlang einer Bogenförderanordnung (3) zu einem Stapelschacht (5), wobei die Bogenförderanordnung (3) ein Bogenausgabeende (17) aufweist, von dem aus die Bögen (C) in den Stapelschacht (5) abgeladen werden und auf einer Stapelfläche, die von einer in dem Stapelschacht (5) angeordneten Stapelplattform (19) getragen wird, zu Stapeln (S) geformt werden,
- während der Bogenstapel (5) auf der Stapelfläche allmählich anwächst, Bewegen der Stapelplattform (19) und des Bogenausgabeendes (17) der Bogenförderanordnung (3) voneinander weg,
- während des Ausbildens des Stapels (S), Unterteilen des Stapels in übereinander liegende und zueinander versetzte Bündeln (B) aus Bögen durch Hin- und Herbewegen der Stapelfläche gemäß einer versetzenden Hin- und Herbewegung in einer Richtung (f25) parallel zu einer Zuführrichtung (F) der Bögen (C) in dem Stapelschacht (5),

wobei das Verfahren **dadurch gekennzeichnet ist, dass** die Versetzungsbewegung über einen anpassbaren Abstand (P; P1; P2) erfolgt, der auf Grundlage mindestens einer Herstellungskenngröße der Bögen (C) festgelegt wird.

13. Verfahren nach Anspruch 12, umfassend den Schritt des Festlegens des Abstands (P; P1; P2) in Abhängigkeit von mindestens einer Länge (L1; L2) der Bögen in der Richtung (f25) der Versetzungsbewegung und vorzugsweise von mindestens einer weiteren Herstellungskenngröße.

14. Verfahren nach Anspruch 12 oder 13, wobei die Bögen (C) Wellpappebögen sind, die aus mindestens einem Deckbogen und mindestens einem geriffelten Papierbogen bestehen, und wobei die weitere Herstellungskenngröße ausgewählt wird aus der Gruppe bestehend aus:

Grammgewicht eines oder mehrerer Papierbögen, aus denen der Wellpappebogen besteht; Gesamtanzahl der Papierbögen pro Wellpappebogen; Gesamtanzahl der Deckbögen pro Wellpappebogen; Gesamtanzahl der geriffelten Bögen pro Wellpappebogen; Riffelhöhe mindestens eines geriffelten Papierbogens, aus denen

der Wellpappebogen besteht;
Riffelabstand mindestens eines geriffelten Papierbogens, aus denen der Wellpappebogen besteht; einer Kombination zweier oder mehrerer dieser Parameter.

15. Verfahren nach einem der Ansprüche 12 bis 14, wobei die Stapelfläche durch einen Stapelförderer (25) gebildet wird.

16. Verfahren nach Anspruch 15, ferner umfassend den Schritt des Abtransportierens des Stapels (S) aus dem Stapelschacht (5) nach Fertigstellung des Stapels durch Bewegen des Stapelförderers (25) in einer Abtransportrichtung (fE) parallel zu dessen Versetzungsbewegung, und wobei vorzugsweise die Abtransportrichtung (fE) derart ausgerichtet ist, dass der gebildete Stapel (S) unterhalb der Bogenfördereranordnung (3) befördert wird.

17. Verfahren nach einem der Ansprüche 12 bis 16, wobei der Schritt des Bewegens der Stapelplattform (19) und des Bogenausgabeendes (17) voneinander weg den Schritt des Absenkens der Stapelplattform (19) in Bezug auf eine stationäre Tragstruktur (11) umfasst.

18. Verfahren nach einem der vorhergehenden Ansprüche, Anspruch 15 einschließend, ferner umfassend den Schritt des Anhebens des Bogenausgabeendes (17) von der Oberseite des gerade auf der Stapelplattform (19) ausgebildeten Stapels, wenn der gerade ausgebildete Stapel (S) während der versetzenden Hin- und Herbewegung des Stapelförderers (25) in Richtung des Bogenausgabeendes (17) bewegt wird.

19. Verfahren nach einem der vorhergehenden Ansprüche, Anspruch 15 einschließend, ferner umfassend den Schritt des In-Anschlag-Bringens der von der Bogenförderanordnung (3) kommenden Bögen (C) an einer stationären Anschlagplatte (37), die oberhalb der Stapelplattform (19) angeordnet ist, und vorzugsweise weiter umfassend den Schritt des Hin- und Herbewegens der Anschlagplatte (37) in einer vertikalen Richtung in Synchronisation mit der versetzenden Vor- und Zurückbewegung des Stapelförderers (25).

20. Verfahren nach einem der vorhergehenden Ansprüche, Anspruch 15 einschließend, wobei der Stapelförderer (25) ein erstes Stapelförderelement (25A) und ein zweites Stapelförderelement (25B) umfasst, die hintereinander entlang der Bewegungsrichtung (f25) des Stapelförderers (25) angeordnet sind, und wobei:

ein erster Stapel (S) von Bögen (C), der aus zueinander versetzten Bündeln (B) besteht, auf dem ersten Stapelförderelement (25A) ausgebildet wird,
der erste Stapel (S) nach seiner Fertigstellung von dem ersten Stapelförderelement (25A) zu dem zweiten Stapelförderelement (25B) bewegt wird,
der erste Stapel (S) durch das zweite Stapelförderelement (25B) aus dem Stapelschacht (5) abtransportiert wird, und das Ausbilden eines zweiten Stapels (S) aus zueinander versetzten Bündeln (B) auf dem ersten Stapelförderelement (25A) beginnt.

Revendications

1. Un empileur de feuilles (1) comprenant :

- un appareil de transport de feuilles (3), configuré pour faire avancer une pluralité de feuilles (C) successivement dans une direction d'avancement de feuilles (F), ledit appareil de transport de feuilles (3) ayant une extrémité de déchargement de feuilles (17) ;
- une station d'empilement (5), dans laquelle des feuilles amenées par l'appareil de transport de feuilles (3) à son extrémité de déchargement de feuilles (17) sont disposées sous forme de piles (S) ; la station d'empilement (5) comprenant une plateforme d'empilement (19), l'extrémité de déchargement de feuilles (17) et la plateforme d'empilement (19) étant animées d'un mouvement de rapprochement et d'éloignement l'une de l'autre ; la plateforme d'empilement (19) comprenant une surface d'empilement sur laquelle les piles sont formées ;

dans lequel la plateforme d'empilement (19) comprend en outre un organe d'actionnement (28) apte à déplacer en va-et-vient la surface d'empilement dans une direction de décalage, sensiblement parallèle à la direction d'avancement des feuilles (F) dans la station d'empilement (5) ; et le mouvement de va-et-vient a une valeur de décalage (P ; P1 ; P2) ;
l'empileur de feuilles étant **caractérisé en ce qu'**il règle la valeur de décalage (P ; P1 ; P2) en fonction d'au moins un paramètre de production des feuilles (C).

2. L'empileur de feuilles (1) selon la revendication 1, dans lequel le ou les paramètres de production comprend/comprennent une dimension des feuilles (C) dans la direction de décalage.

3. L'empileur de feuilles (1) selon la revendication 1 ou 2, comprenant en outre une unité de commande (26)

apte à commander l'organe d'actionnement (28) pour effectuer un mouvement de va-et-vient suivant une valeur de décalage (P ; P1 ; P2) définie en fonction d'au moins un paramètre de production.

4. L'empileur de feuilles (1) selon la revendication 1 ou 2 ou 3, dans lequel la plateforme d'empilement (19) supporte un convoyeur de piles (25) déplaçable dans une direction parallèle à la direction d'avancement (F) des feuilles dans la station d'empilement (5), configuré et commandé pour effectuer un mouvement de décalage en va-et-vient pour former des paquets de feuilles décalés (B), et pour effectuer en outre un mouvement d'évacuation, pour retirer une pile complète (S) de la station d'empilement (5) dans la direction de décalage.

5. L'empileur de feuilles (1) selon l'une quelconque des revendications précédentes, dans lequel la plateforme d'empilement (19) est animée d'un mouvement vertical de soulèvement et d'abaissement (f19) par rapport à une structure de support stationnaire (11) de l'appareil de transport de feuilles (3).

6. L'empileur de feuilles (1) selon l'une quelconque des revendications précédentes, comprenant en outre une plaque d'arrêt (37), positionnée dans la station d'empilement (5) au-dessus de la plateforme d'empilement (19), agencée et configurée pour arrêter les feuilles amenées par l'appareil de transport de feuilles (3) à la station d'empilement (5) ; et dans lequel de préférence la plaque d'arrêt (37) effectue un mouvement de va-et-vient vertical, qui est synchronisé avec la formation des paquets de feuilles décalés (B).

7. L'empileur de feuilles (1) selon l'une quelconque des revendications précédentes qui inclue la revendication 4, dans lequel l'extrémité de déchargement des feuilles (17) de l'appareil de transport de feuilles (3) est combiné avec un organe d'actionnement, lequel commande un mouvement de soulèvement et d'abaissement de l'extrémité de déchargement des feuilles (17), lequel est synchronisé avec le mouvement de décalage en va-et-vient du convoyeur de piles (25).

8. L'empileur de feuilles (1) selon la revendication 4, dans lequel le mouvement d'évacuation dudit convoyeur de piles (25) est orienté de telle sorte que la pile complète (S) soit déplacée de la station d'empilement (5) sous l'appareil de transport de feuilles (3).

9. L'empileur de feuilles (1) selon la revendication 4, dans lequel le convoyeur de piles (25) comprend un premier organe de convoyeur de piles (25A) et un second organe de convoyeur de piles (25B), lesquels sont agencés en série l'un après l'autre dans une direction parallèle à la direction (fE) du mouvement d'évacuation ; et dans lequel de préférence le premier organe de convoyeur de piles (25A) et le second organe de convoyeur de piles (25B) sont agencés et commandés de telle sorte qu'une pile (S) soit formée sur le premier organe de convoyeur de piles (25A) et, qu'après sa formation, la pile complète soit déplacée par le premier organe de convoyeur de piles (25A) vers le second organe de convoyeur de piles (25B) et ensuite par le second organe de convoyeur de piles (25B) à l'extérieur de la station d'empilement (5).

10. L'empileur de feuilles (1) selon l'une quelconque des revendications précédentes incluant la revendication 4, dans lequel l'extrémité de déchargement des feuilles (17) est combinée avec un dispositif de retenue de paquets (60), lequel est configuré et agencé pour retenir le paquet le plus élevé (B) de la pile (S) lorsque le convoyeur de piles (25) effectue le mouvement de décalage dans une direction s'éloignant de l'extrémité de déchargement de feuilles (17) ; et dans lequel de préférence le dispositif de retenue de paquets (60) comprend au moins un organe de freinage de feuilles élastique, agencé sous l'extrémité de déchargement de feuilles (17), entre l'extrémité de déchargement de feuilles (17) et la pile (S) en cours de formation sur la plateforme d'empilement (19).

11. L'empileur de feuilles (1) selon l'une quelconque des revendications précédentes, configuré comme un empileur vers la bas, durant la formation d'une pile (S), la plateforme d'empilement (19) se déplaçant progressivement vers le bas pour recevoir sur elle la pile en cours de formation (S).

12. Un procédé de formation de piles de feuilles (S) sur une surface d'empilement, comprenant les étapes suivantes consistant à :

- faire avancer une pluralité de feuilles (C) le long d'un appareil de transport de feuilles (3) vers une station d'empilement (5), l'appareil de transport de feuilles (3) ayant une extrémité de déchargement de feuilles (17), de laquelle les feuilles (C) sont déchargées dans la station d'empilement (5) et sont disposées sous forme de piles (S) sur une surface d'empilement supportée par une plateforme d'empilement (19) agencée dans la station d'empilement (5) ;
- pendant que la pile de feuilles (5) croît progressivement sur la surface d'empilement, éloigner l'une de l'autre la plateforme d'empilement (19) et l'extrémité de déchargement des feuilles (17) de l'appareil de transport de feuilles (3) ;
- durant la formation des piles (S), diviser la pile en paquets de feuilles (B) superposés et décalés

les uns par rapport aux autres en déplaçant en va-et-vient la surface d'empilement suivant un mouvement de décalage en va-et-vient, dans une direction (f25) parallèle à la direction d'avancement (F) des feuilles (C) dans la station d'empilement (5) ;

ce procédé étant **caractérisé en ce que** le mouvement de décalage a une valeur réglable (P ; P1 ; P2) qui est déterminée sur la base d'au moins un paramètre de production desdites feuilles (C).

13. Le procédé selon la revendication 12, comprenant l'étape consistant à déterminer ladite valeur (P ; P1 ; P2) en fonction d'au moins une longueur (L1 ; L2) desdites feuilles dans la direction (f25) du mouvement de décalage ; et de préférence d'au moins un paramètre de production supplémentaire.

14. Le procédé selon la revendication 12 ou 13, dans lequel lesdites feuilles (C) sont des feuilles de carton ondulé constituées d'au moins une doublure et d'au moins une feuille de papier cannelé et dans lequel le paramètre de production supplémentaire est choisi dans le groupe constitué par : le grammage d'au moins une feuille de papier formant la feuille de carton ondulé ; le nombre total de feuilles de papier par feuille de carton ondulé ; le nombre total de doublures par feuille de carton ondulé ; le nombre total de feuilles cannelées par feuille de carton ondulé ; la hauteur des cannelures d'au moins une feuille de papier cannelé formant la feuille de carton ondulé ; une combinaison d'au moins deux de ces paramètres.

15. Le procédé selon l'une quelconque des revendications 12 à 14, dans lequel ladite surface d'empilement est formée par un convoyeur de piles (25).

16. Le procédé selon la revendication 15, comprenant en outre l'étape consistant à évacuer la pile (S) de la station d'empilement (5) après le complètement de la pile, en déplaçant le convoyeur de piles (25) dans une direction d'évacuation (fE) parallèle au mouvement de décalage de celui-ci, et dans lequel de préférence la direction d'évacuation (fE) est orientée de telle sorte que la pile formée (S) soit transférée sous l'appareil de transport de feuilles (3).

17. Le procédé selon l'une quelconque des revendications 12 à 16, dans lequel l'étape d'éloignement de la plateforme d'empilement (19) et de l'extrémité de déchargement des feuilles (17) l'une de l'autre comprend l'étape d'abaissement de la plateforme d'empilement (19) par rapport à une structure de support stationnaire (11).

18. Le procédé selon l'une quelconque des revendications précédentes qui inclue la revendication 15, comprenant en outre l'étape de soulèvement de l'extrémité de déchargement des feuilles (17) par rapport au sommet de la pile (S) en cours de formation sur la plateforme d'empilement (19) lorsque la pile (S) en cours de formation est déplacée vers l'extrémité de déchargement des feuilles (17) durant le mouvement de décalage en va-et-vient du convoyeur de piles (25).

19. Le procédé selon l'une quelconque des revendications précédentes qui inclue la revendication 15, comprenant en outre l'étape consistant à mettre les feuilles provenant de l'appareil de transport de feuilles (3) en butée contre une plaque d'arrêt stationnaire (37) agencée au-dessus de la plateforme d'empilement (19) ; et comprenant de préférence en outre l'étape consistant à déplacer en va-et-vient la plaque d'arrêt (37) dans une direction verticale en synchronisation avec le mouvement de décalage en va-et-vient du convoyeur de piles (25).

20. Le procédé selon l'une quelconque des revendications précédentes qui inclue la revendication 15, dans lequel le convoyeur de piles (25) comprend un premier organe de convoyeur de piles (25A) et un second organe de convoyeur de piles (25B) agencés en série le long de la direction de déplacement (f25) du convoyeur de piles (25), et dans lequel :

une première pile (S) de feuilles (C) constituée de paquets décalés (B) est formée sur le premier organe de convoyeur de piles (25A) ;
après sa formation, la première pile (S) est déplacée du premier organe de convoyeur de piles (25A) au second organe de convoyeur de piles (25B) ;
la première pile (S) est évacuée de la station d'empilement (5) par le second organe de convoyeur de piles (25B) et la formation d'une seconde pile (S) de paquets décalés (B) débute sur le premier organe de convoyeur de piles (25A).

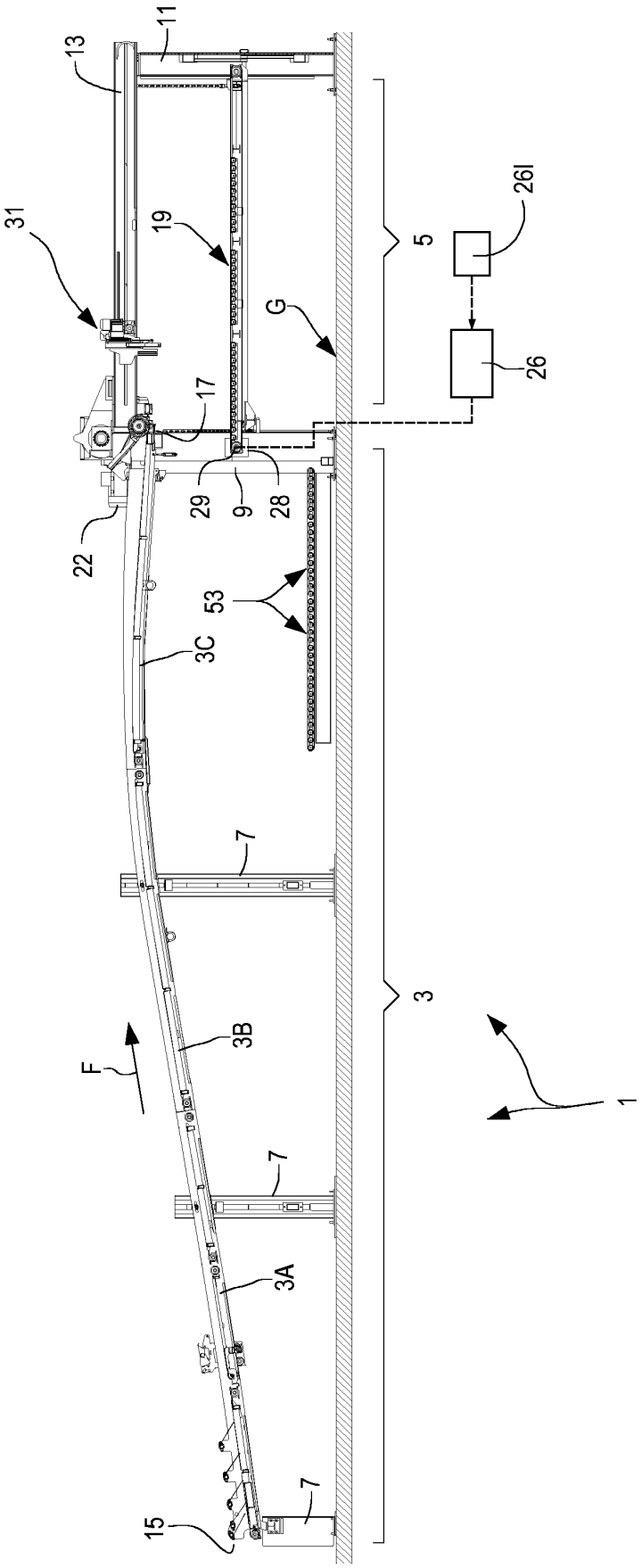

Fig.1

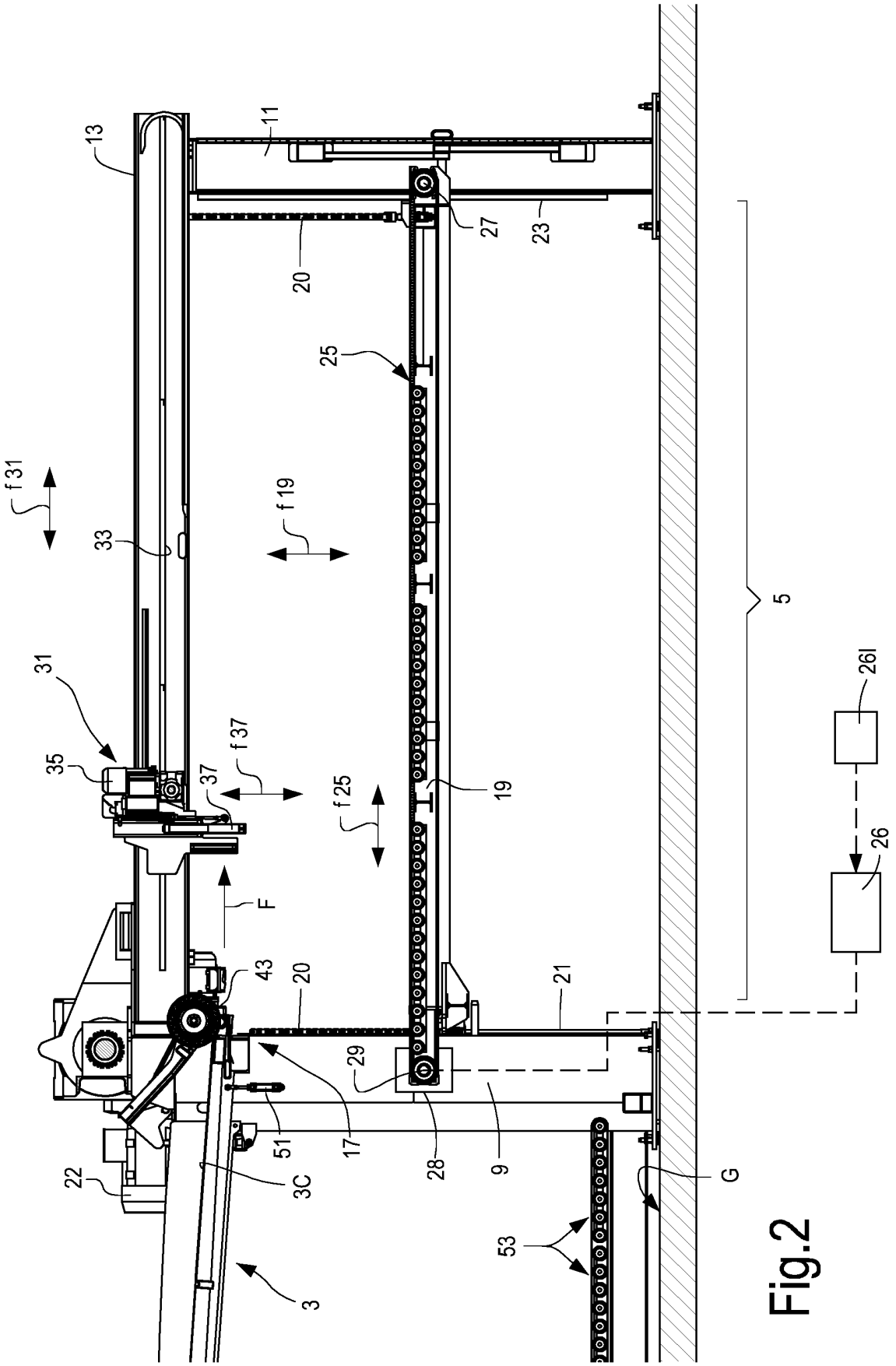
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Fig.2

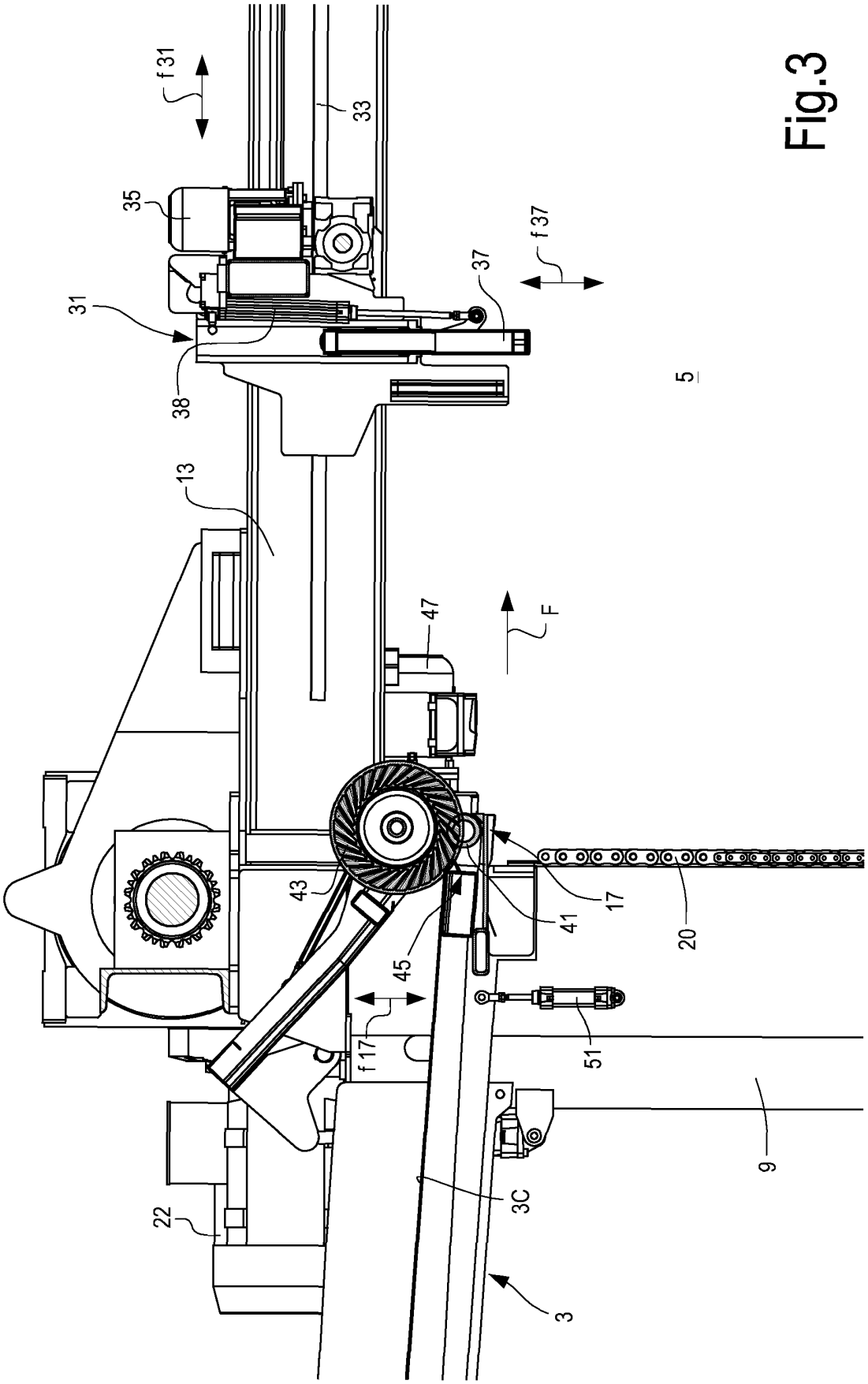

Fig.3

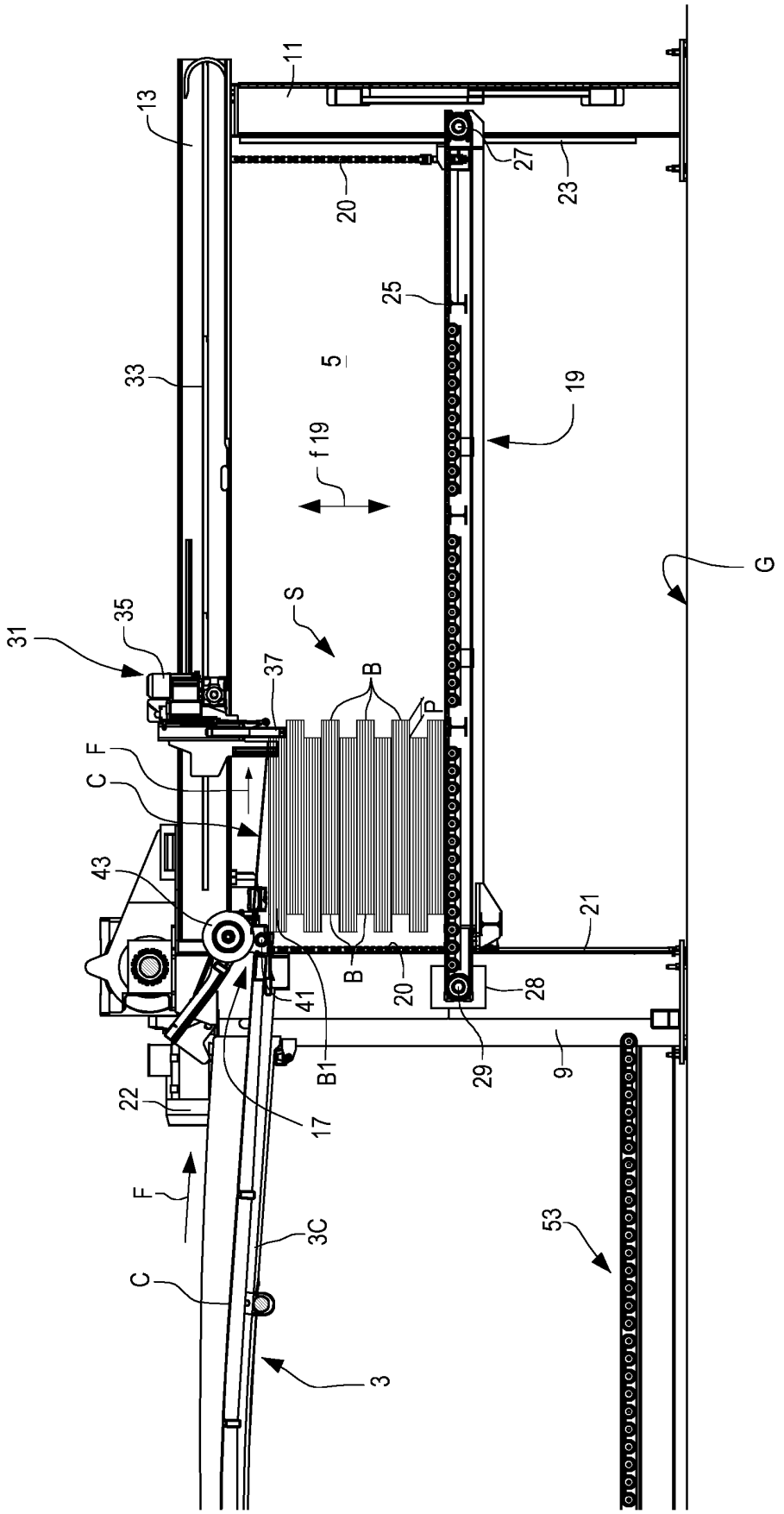
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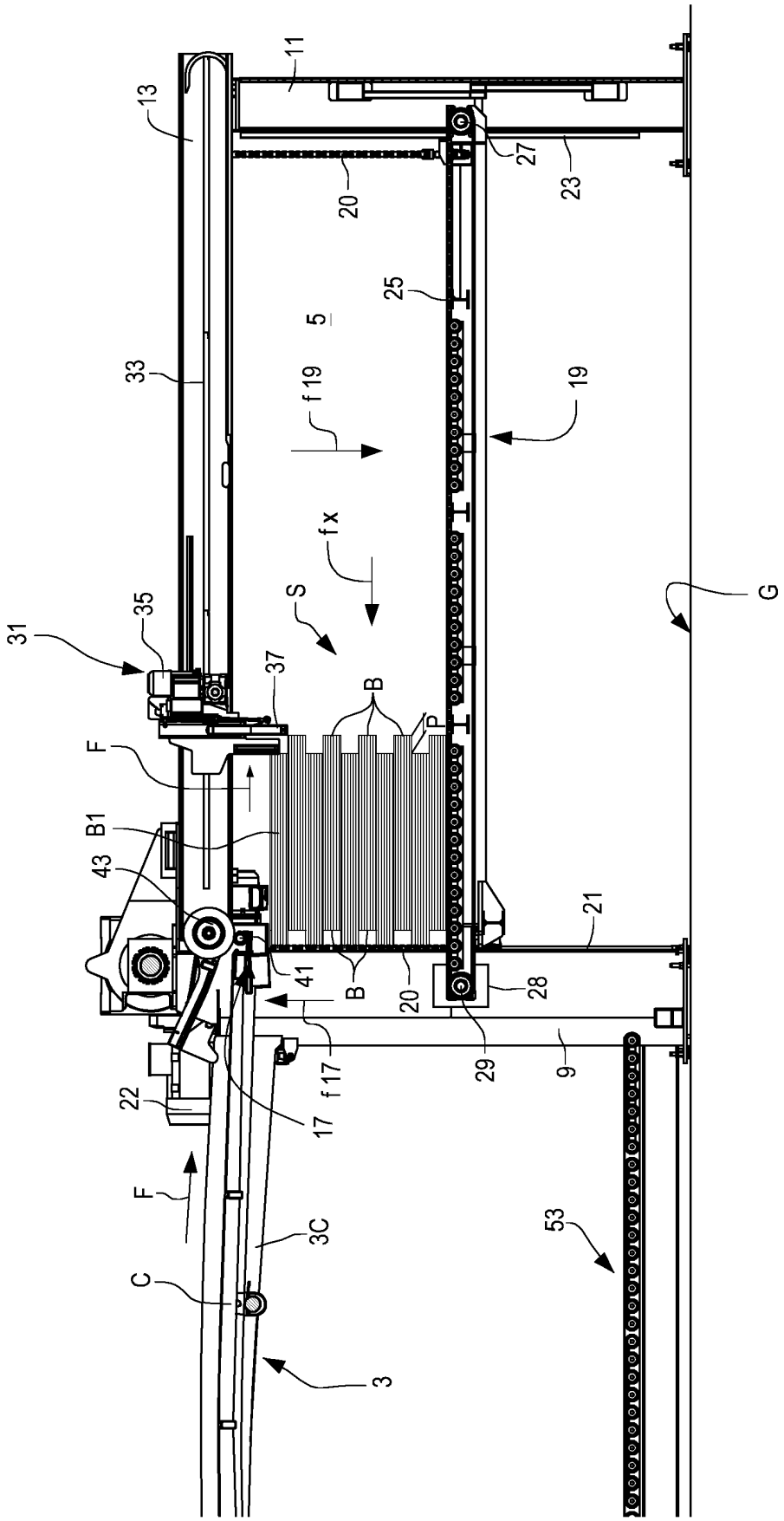
Fig.4(A)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3C
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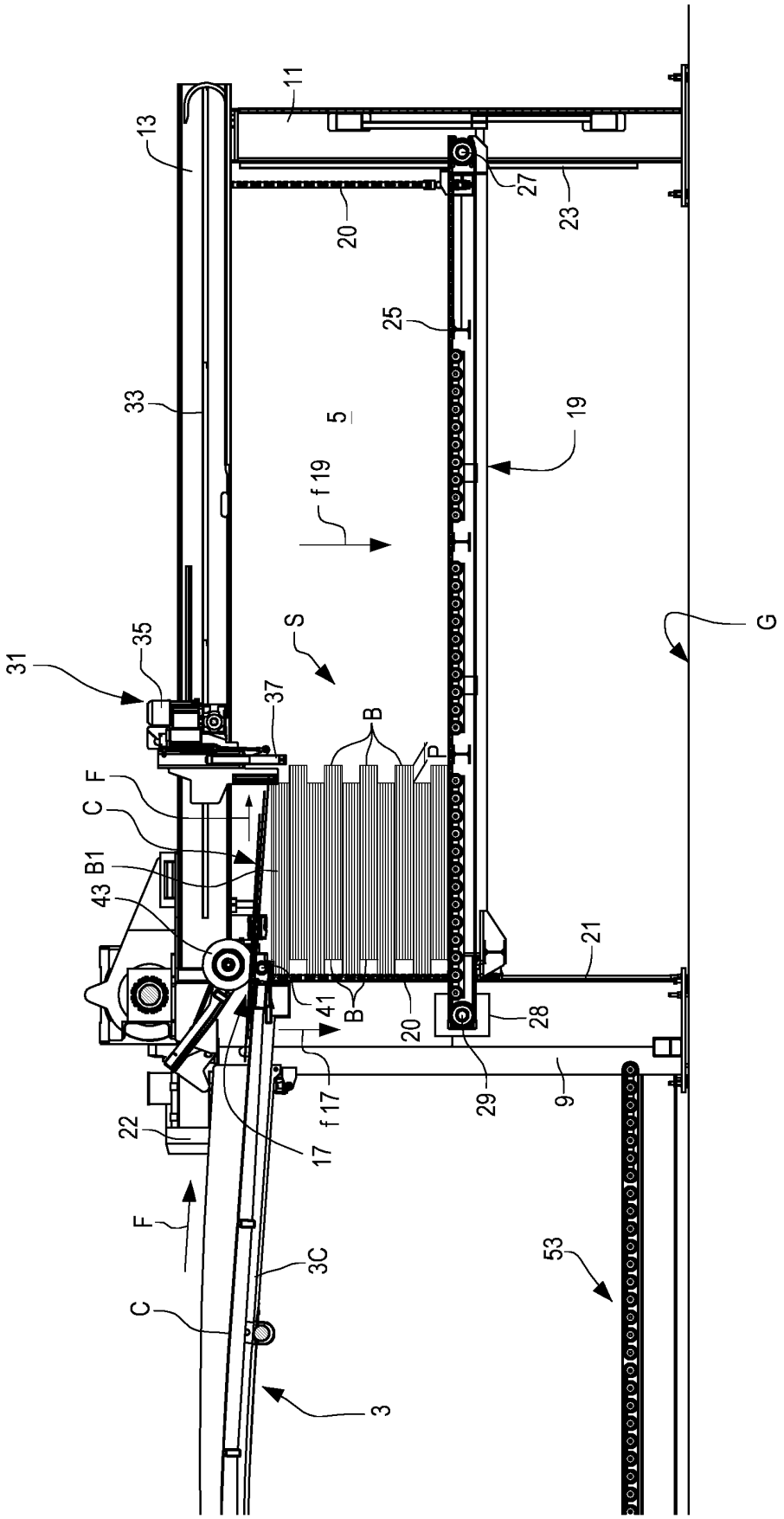
Fig.4(B)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3C
53
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Fig.4(C)

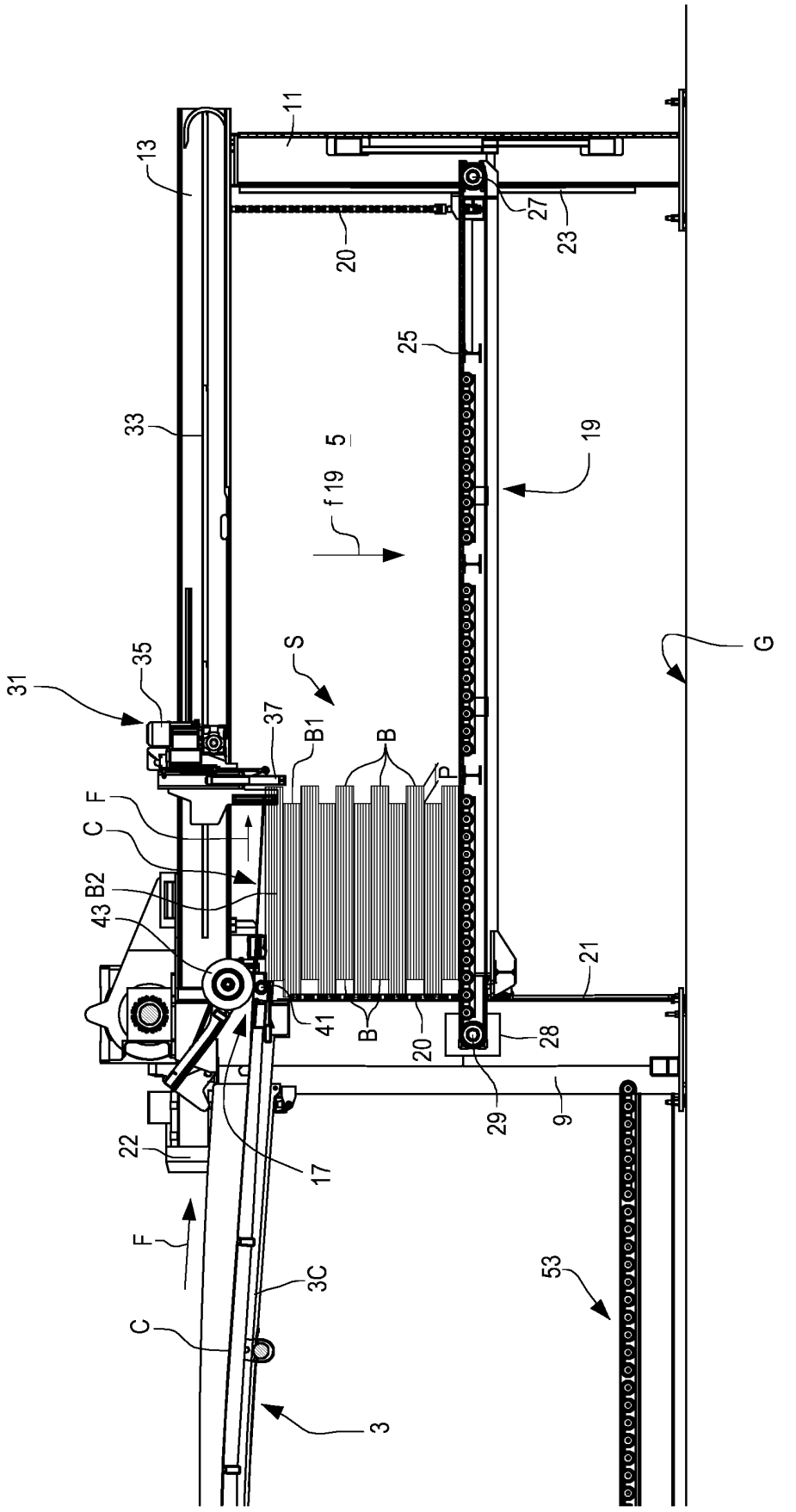
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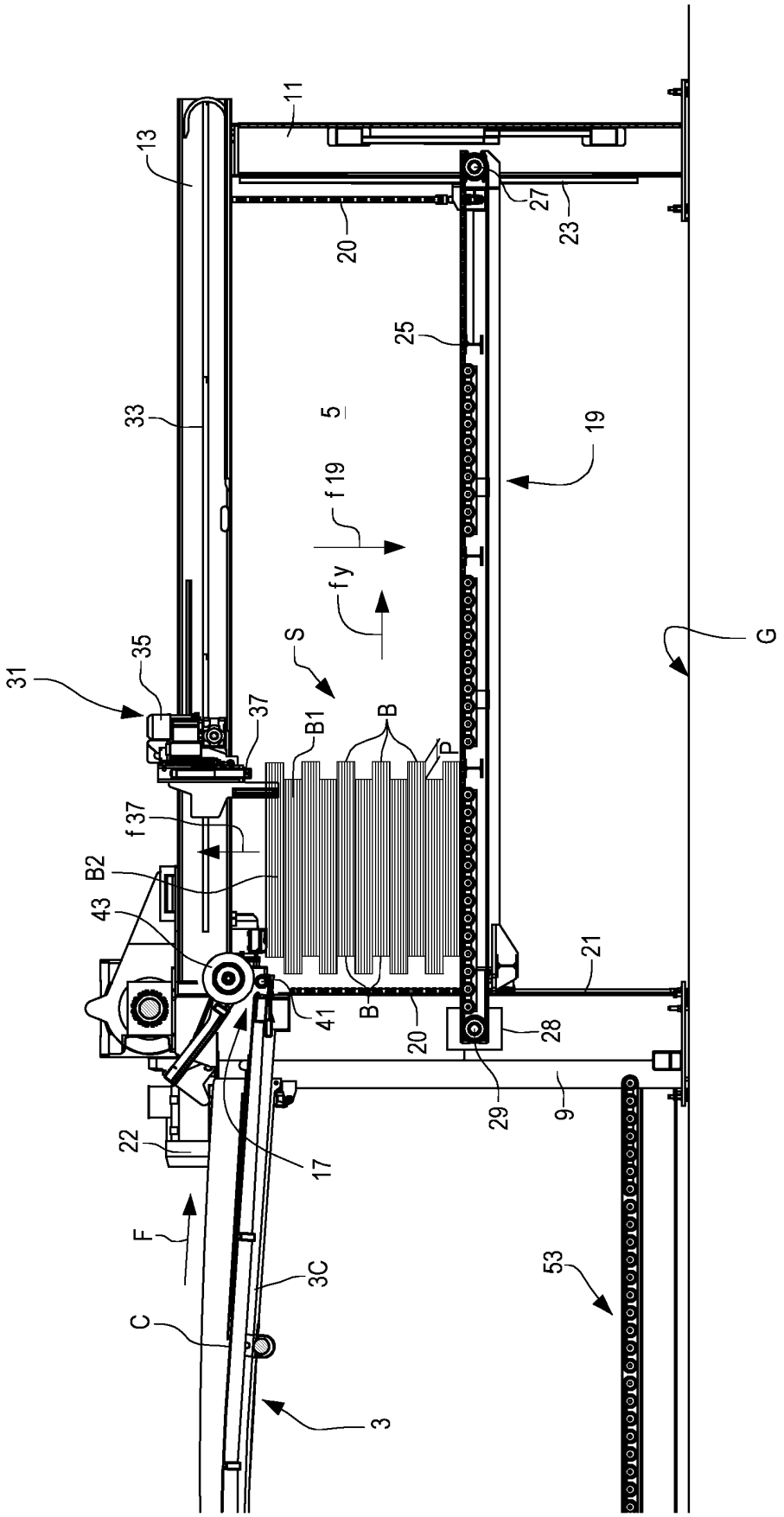
Fig.4(D)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3C
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Fig.4(E)

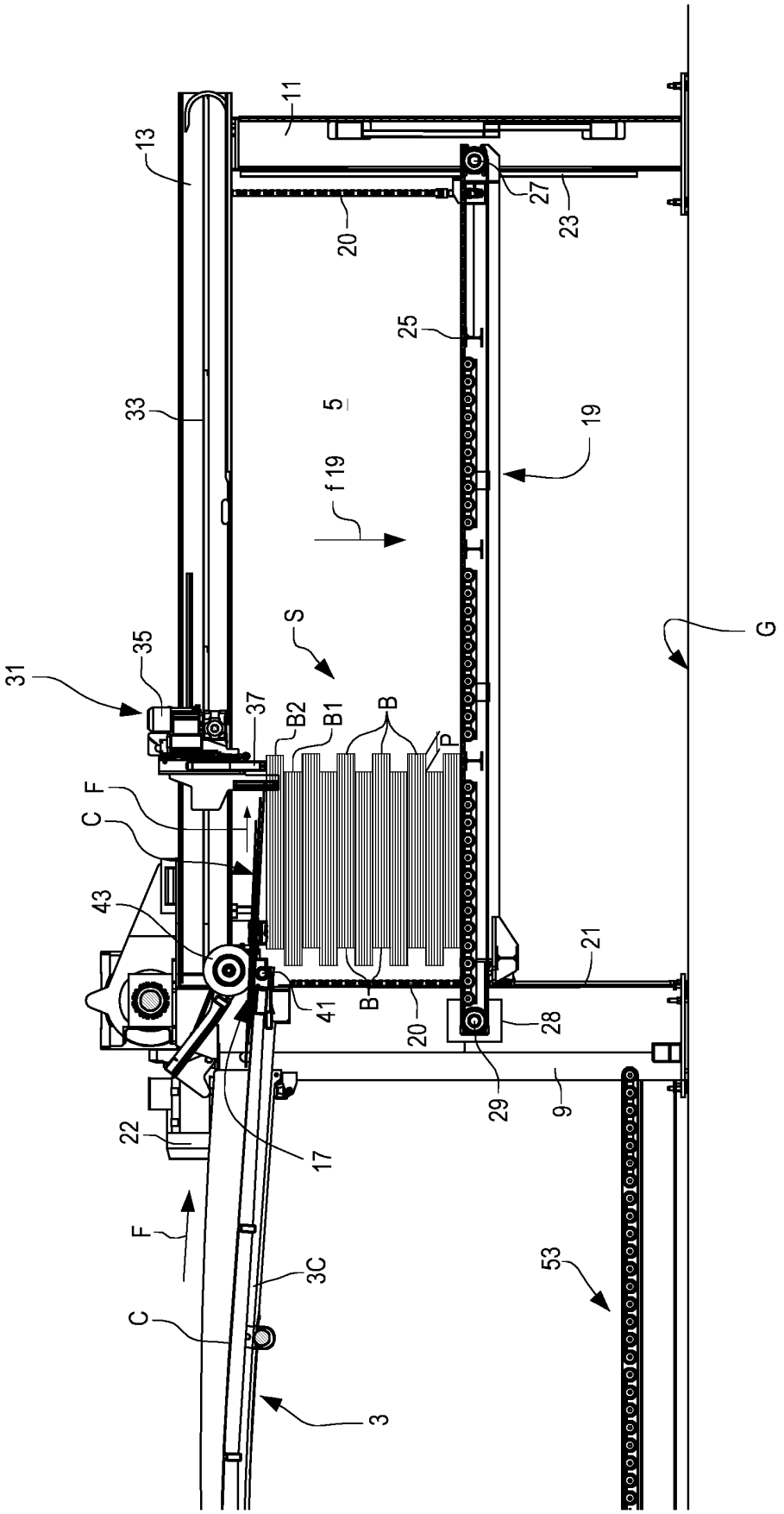
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Fig.4(F)

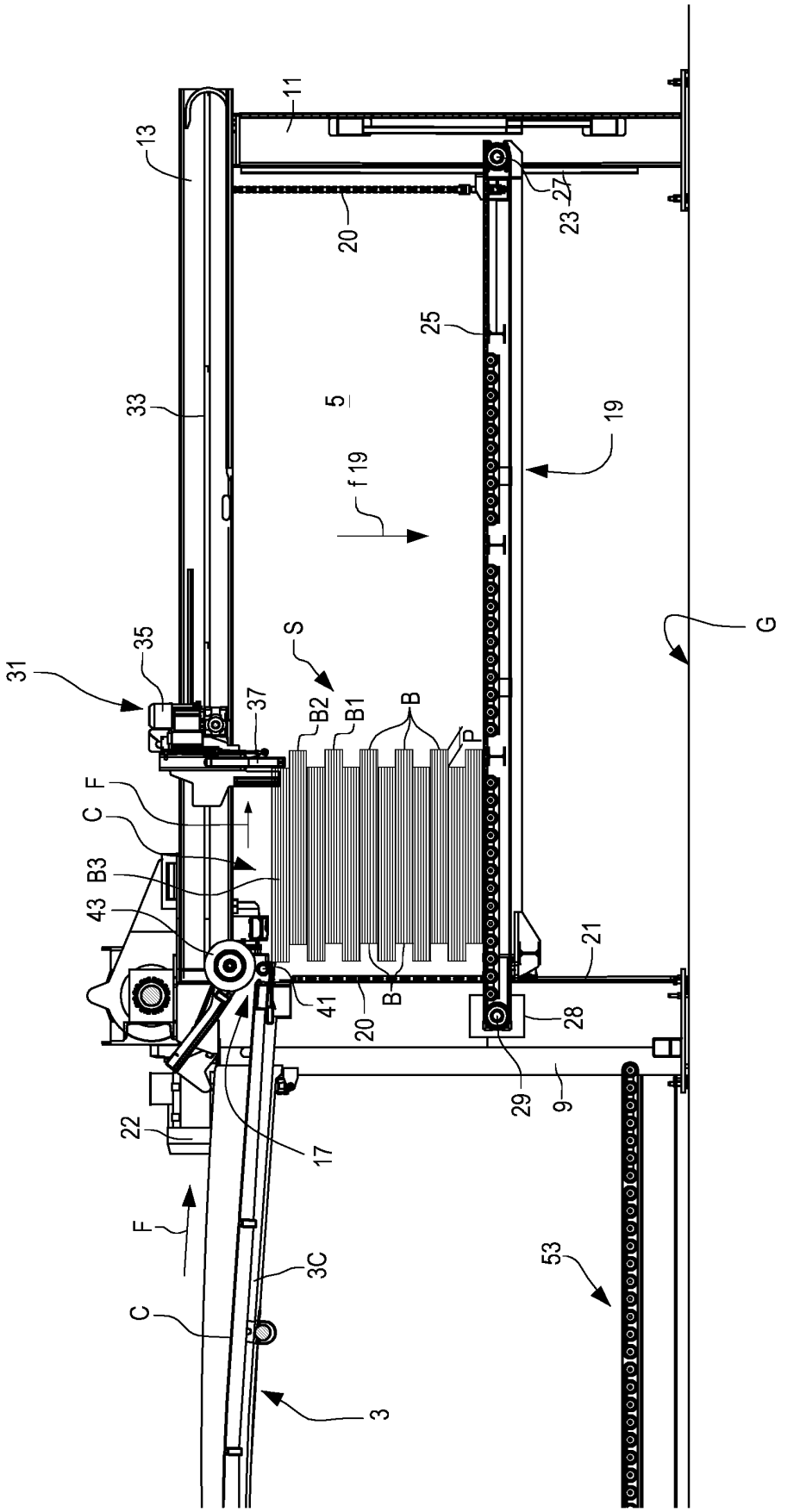
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Fig.4(G)

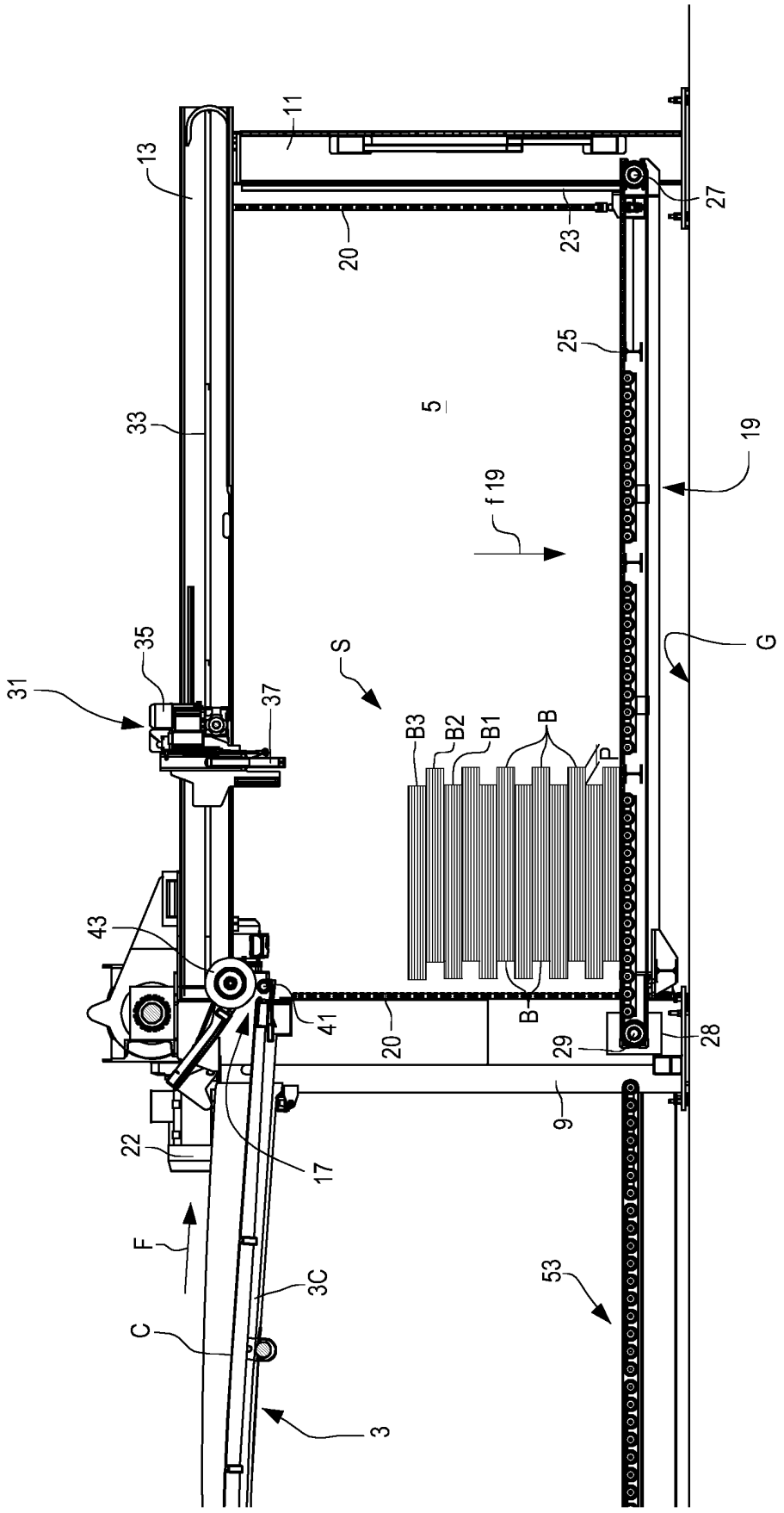
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Fig.4(H)

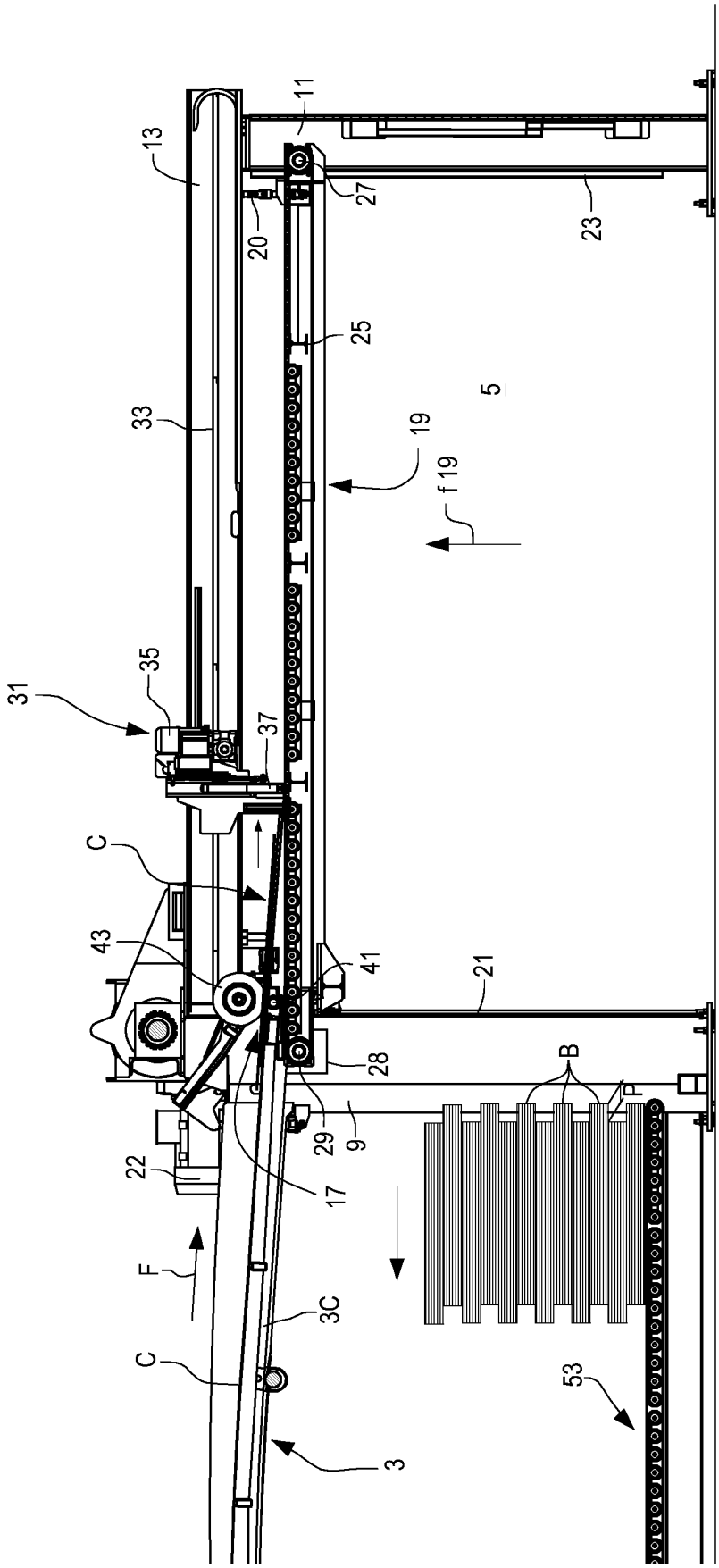
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Fig.4(l)

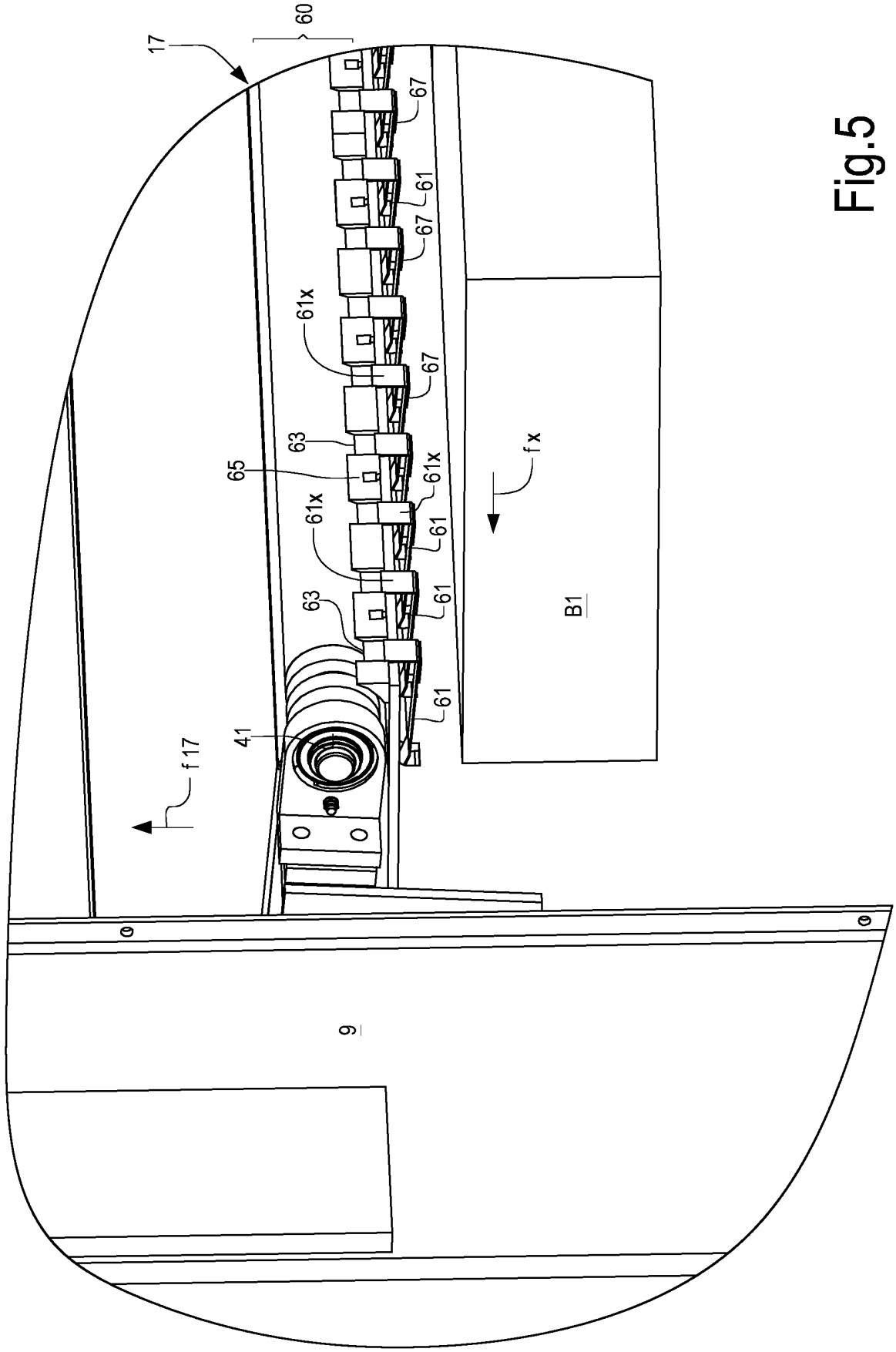

Fig.5

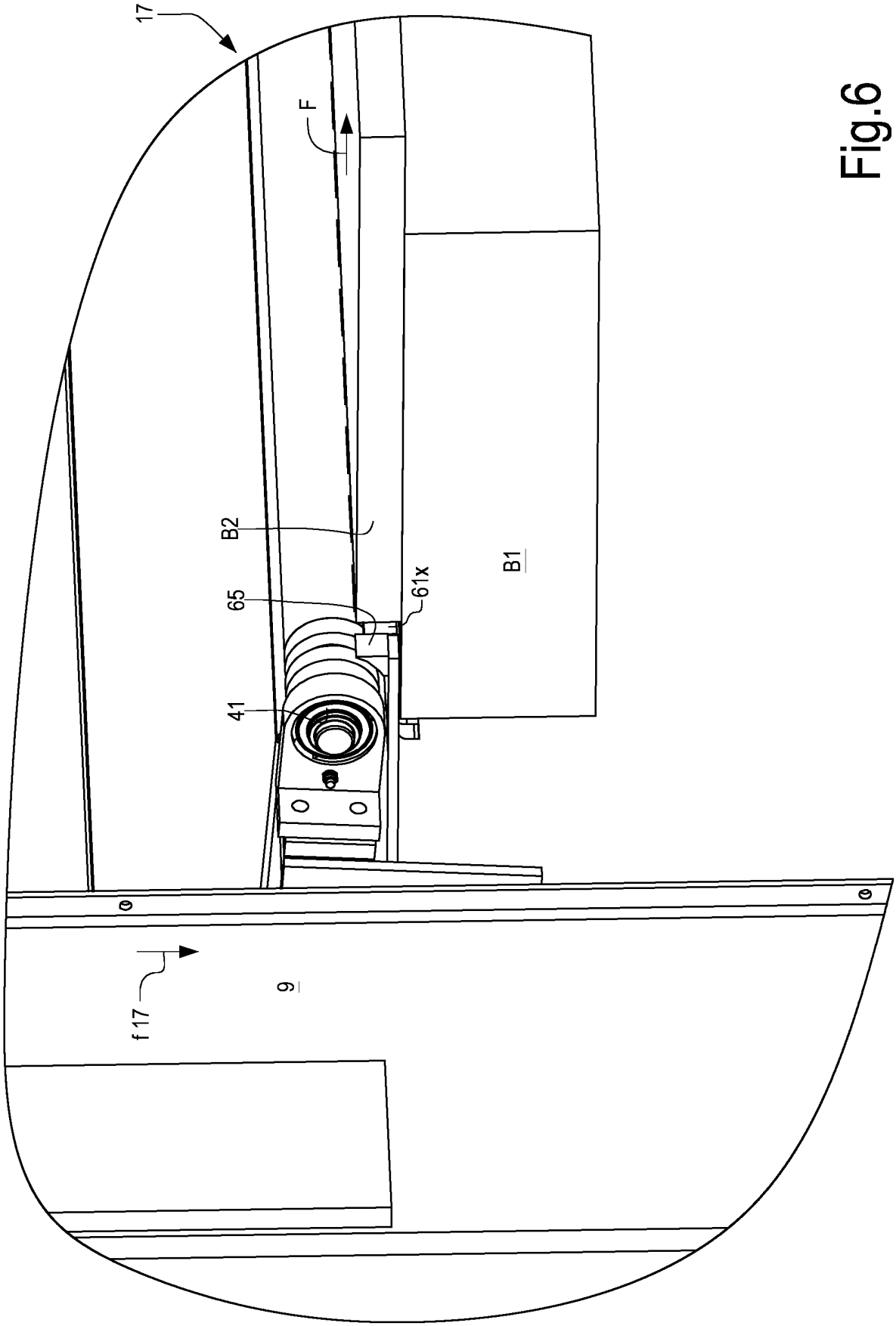

Fig.6

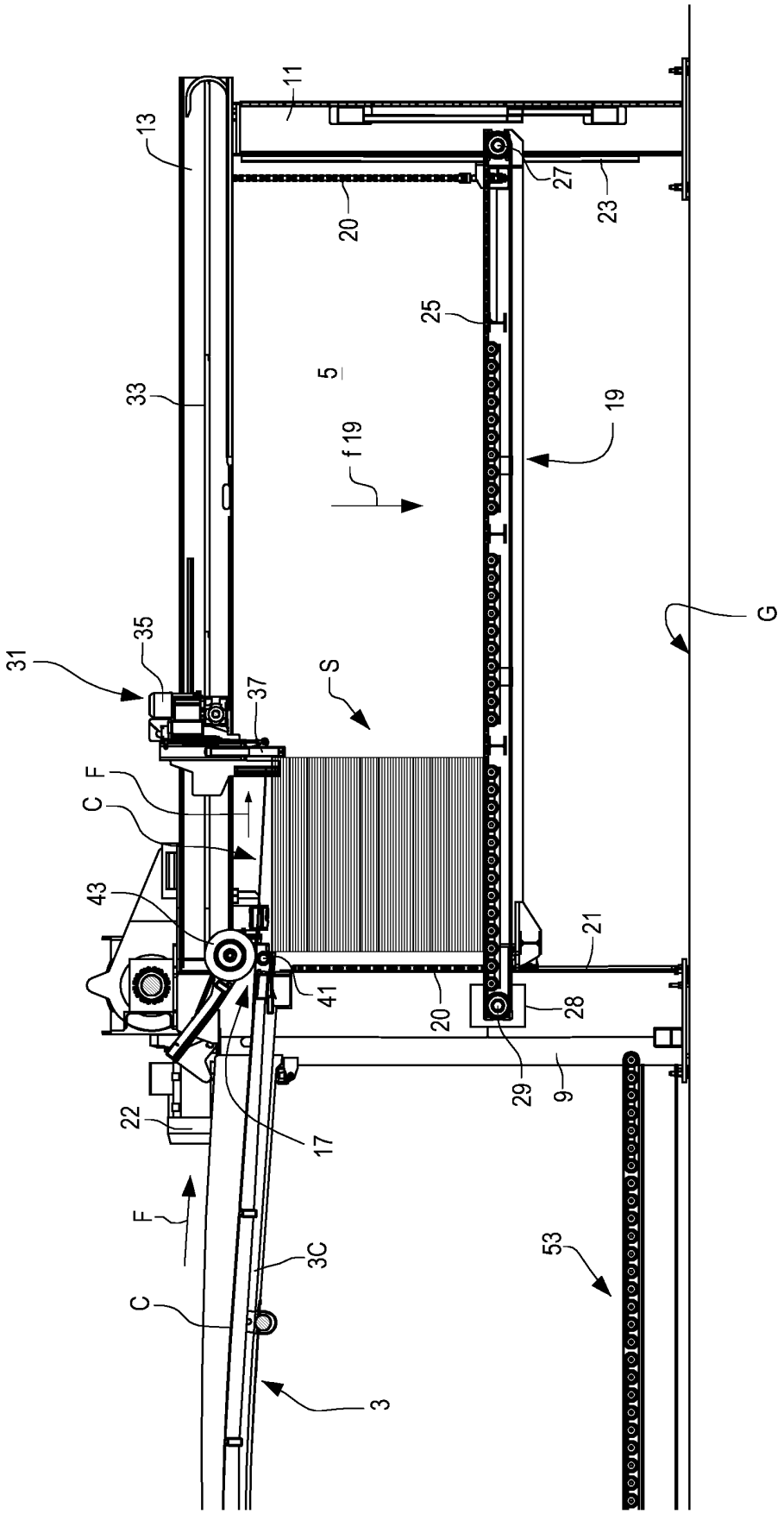
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Fig.7(A)

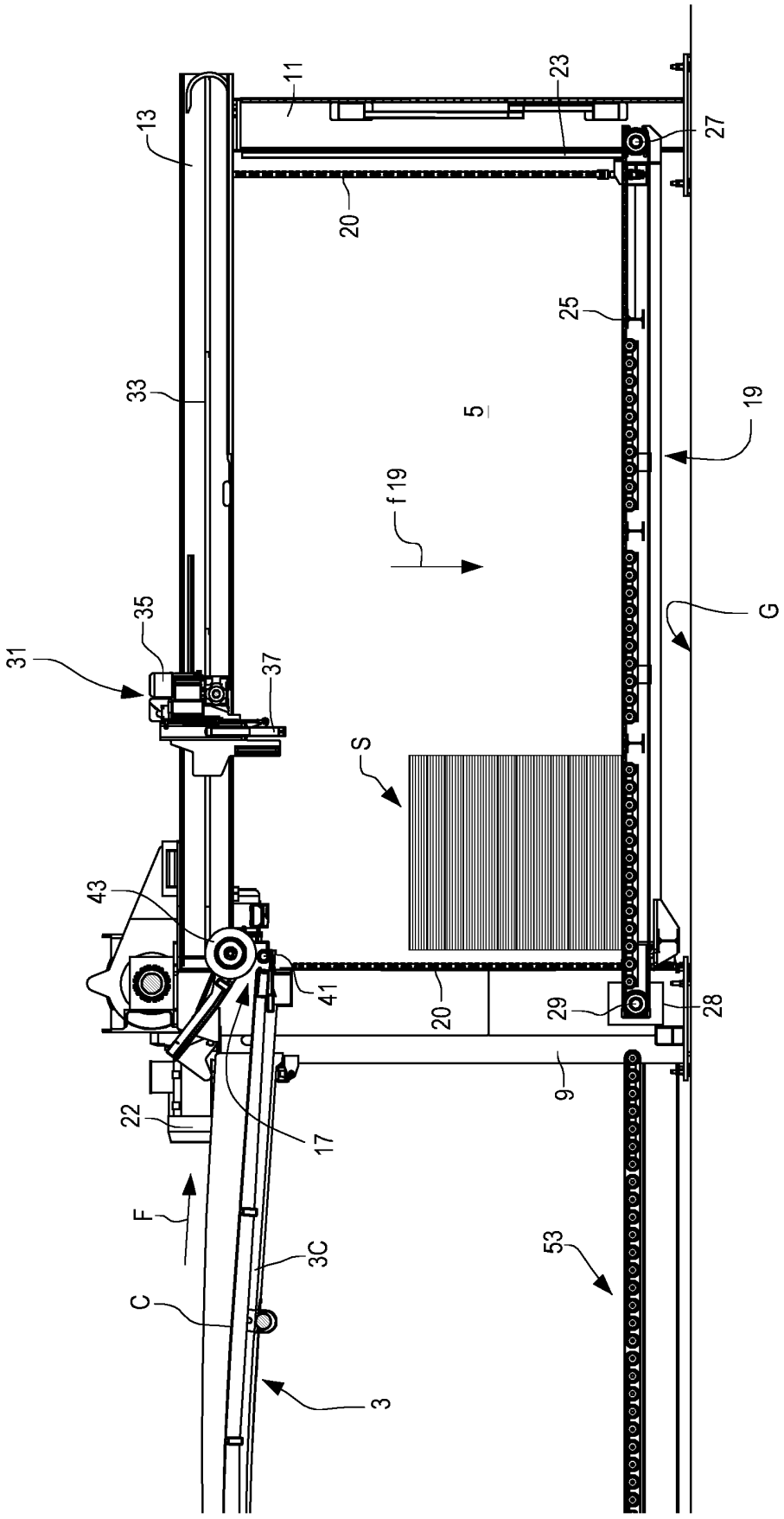
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Fig.7(B)

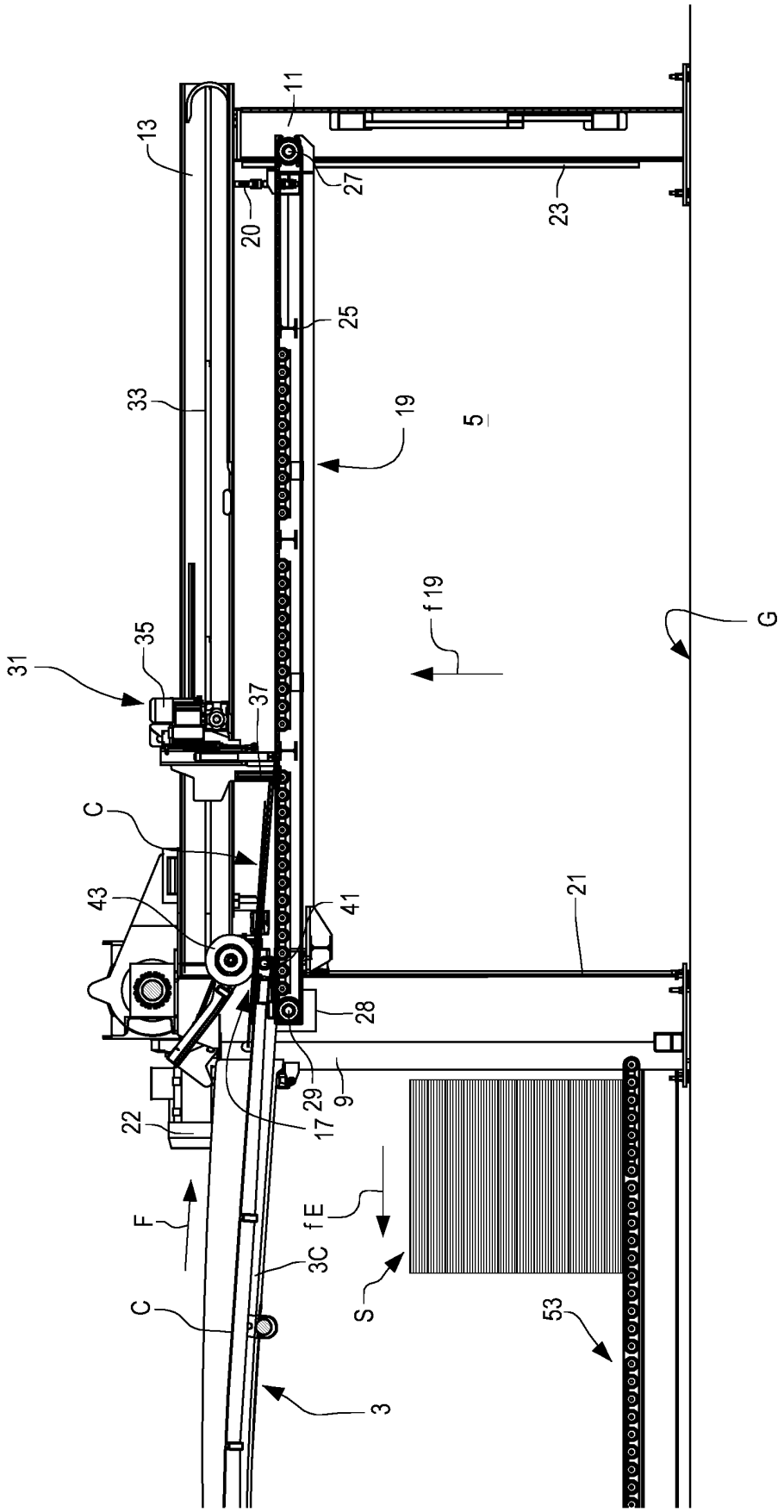
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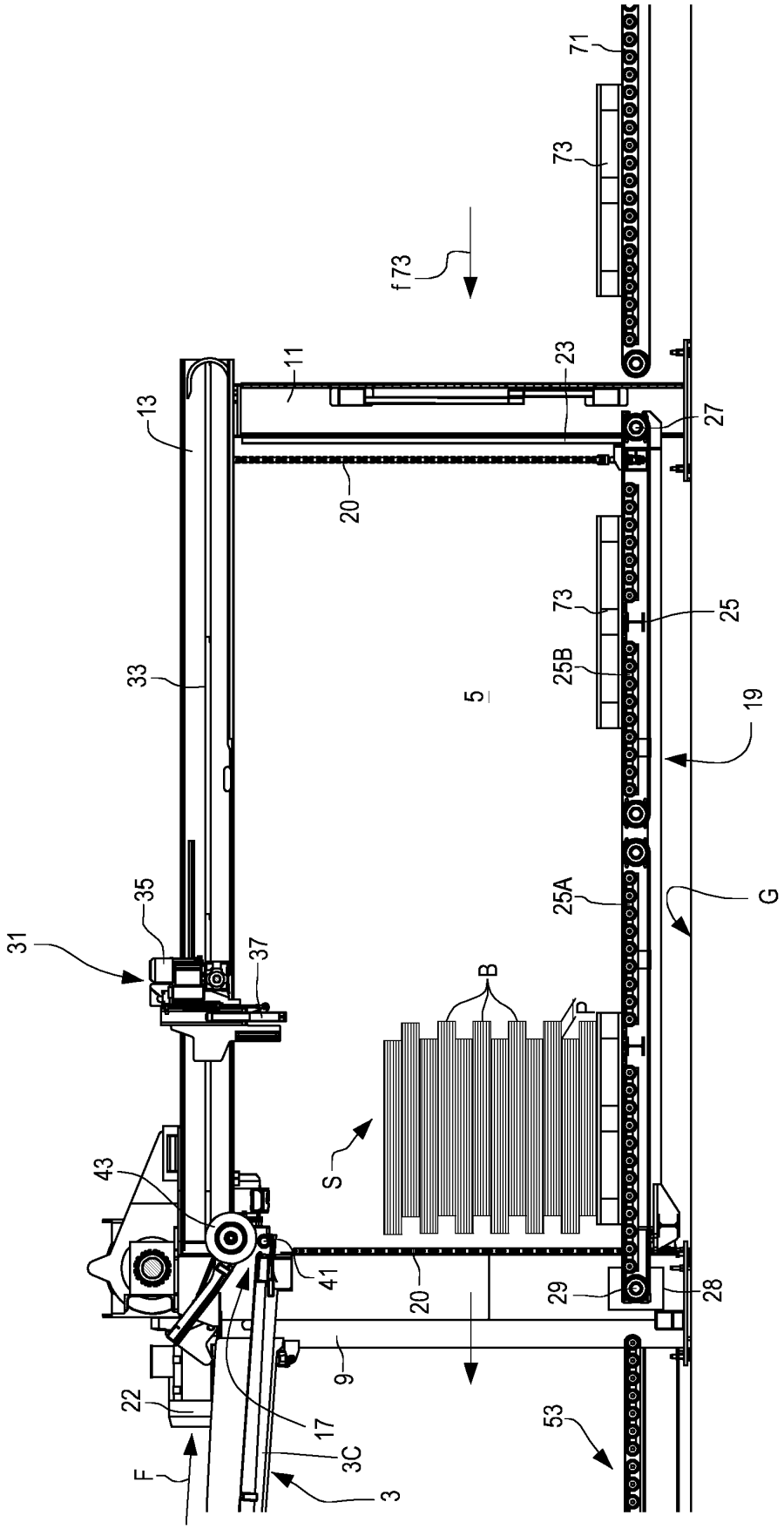
Fig.7(C)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73
f 73
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Fig.8

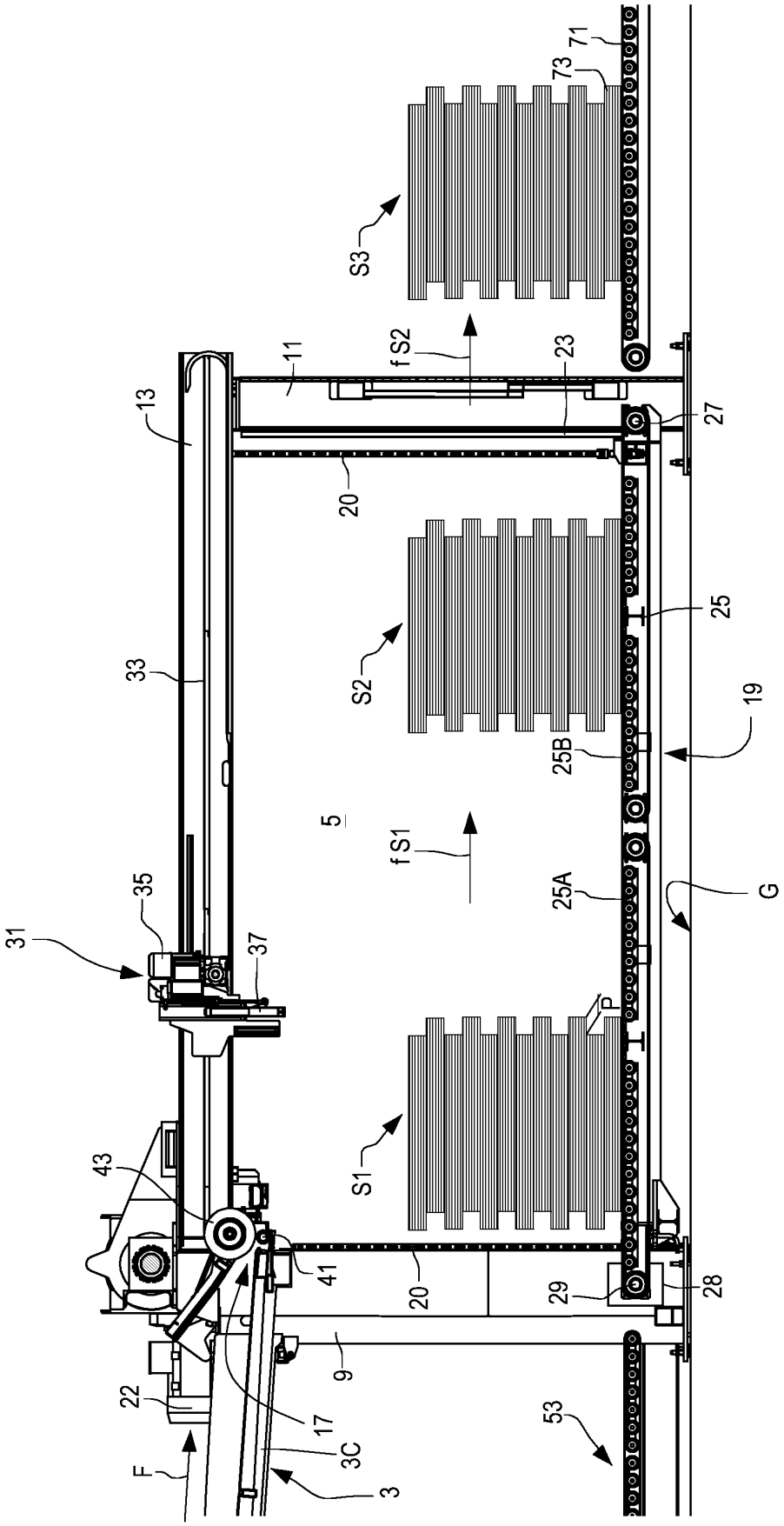
71
73
S3
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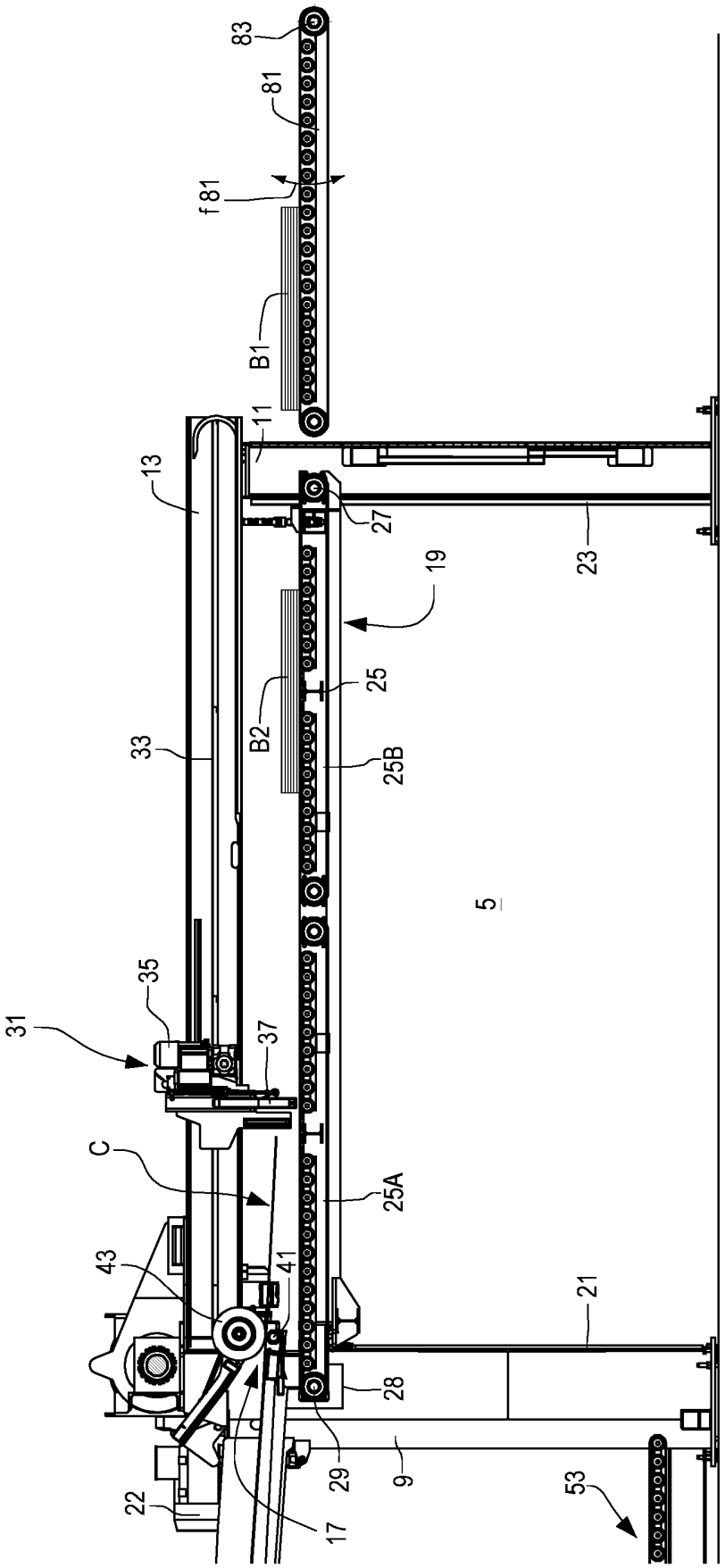
Fig.9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81
f 81
B1
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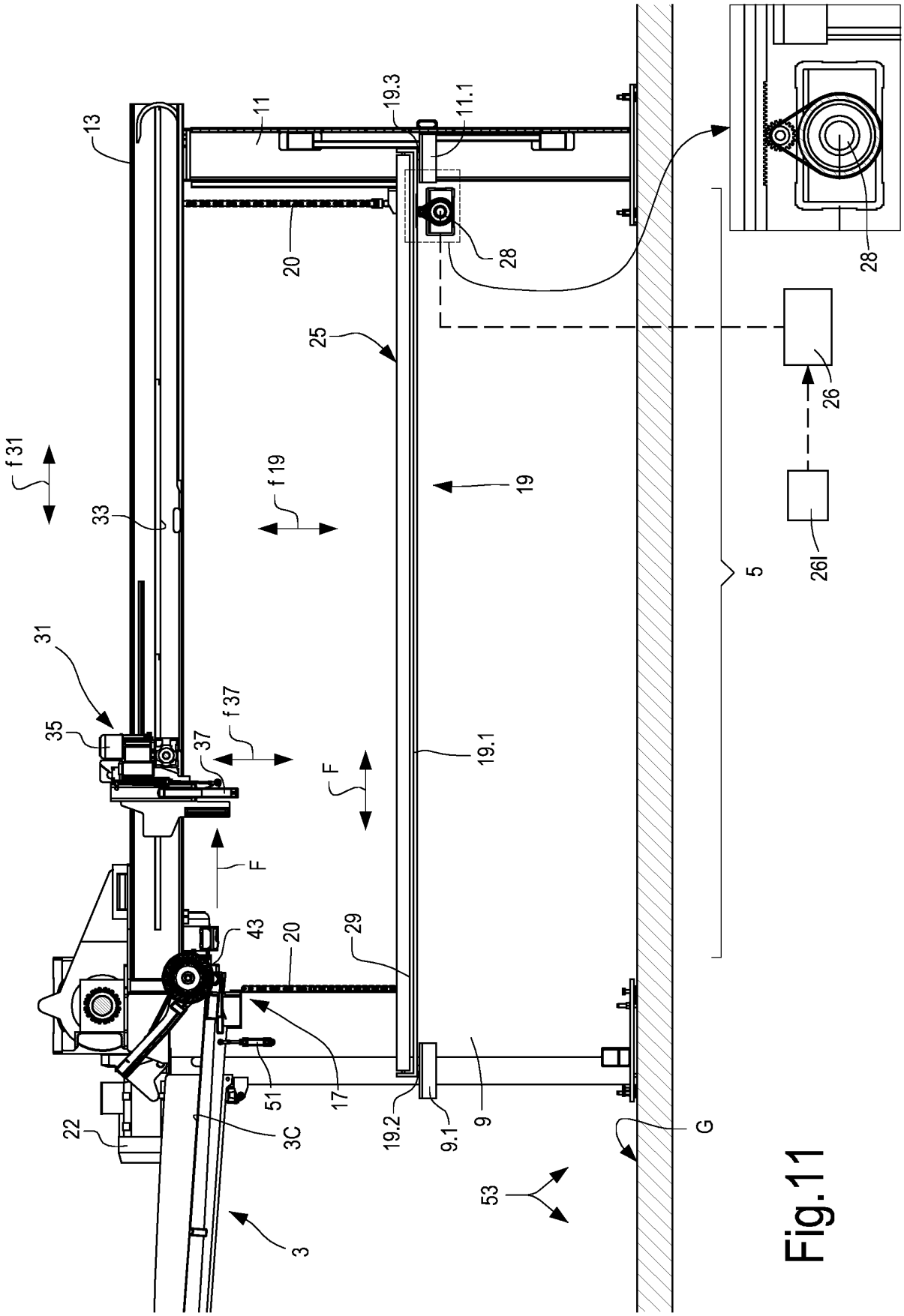
Fig.10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f 19
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19.1
F
F
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20
29
51
17
19.2
9.1
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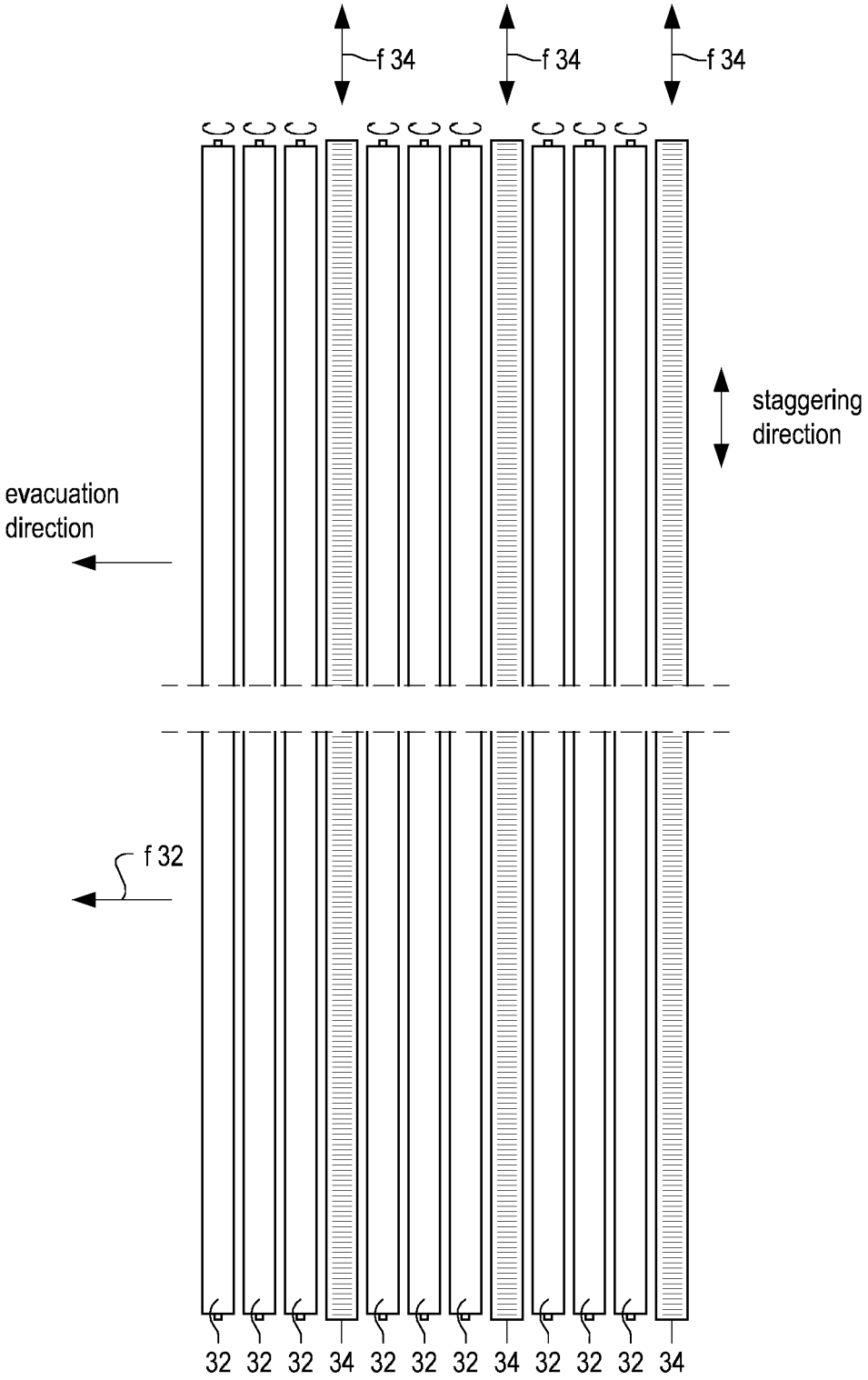
G
22
3C
53
3

Fig.11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f 34
f 34
staggering direction
evacuation direction
f 32
32 32 32 34 32 32 32 34 32 32 32 34

Fig.12

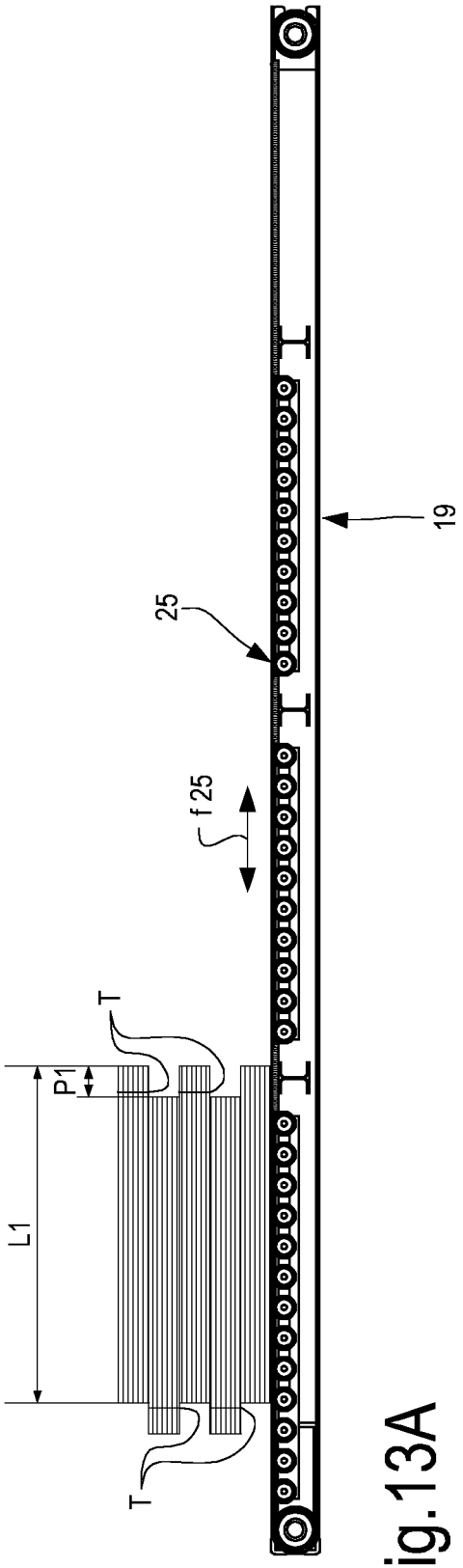

Fig.13A

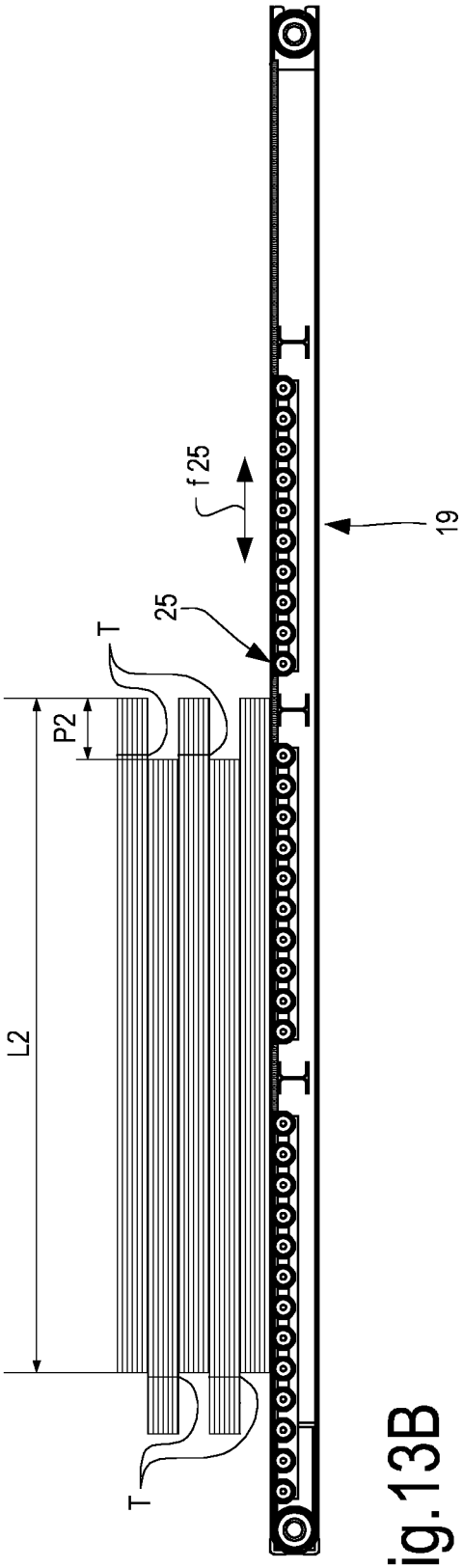

Fig.13B

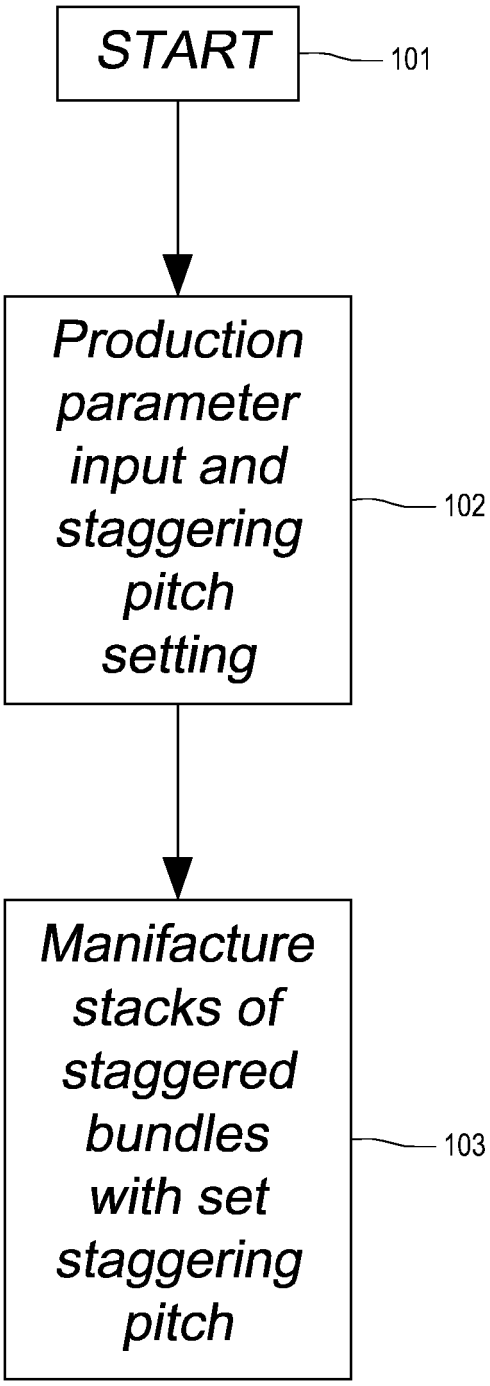
START
101
Production parameter input and staggering pitch setting
102
Manifacture stacks of staggered bundles with set staggering pitch
103

Fig.14

REFERENCES CITED IN THE DESCRIPTION

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