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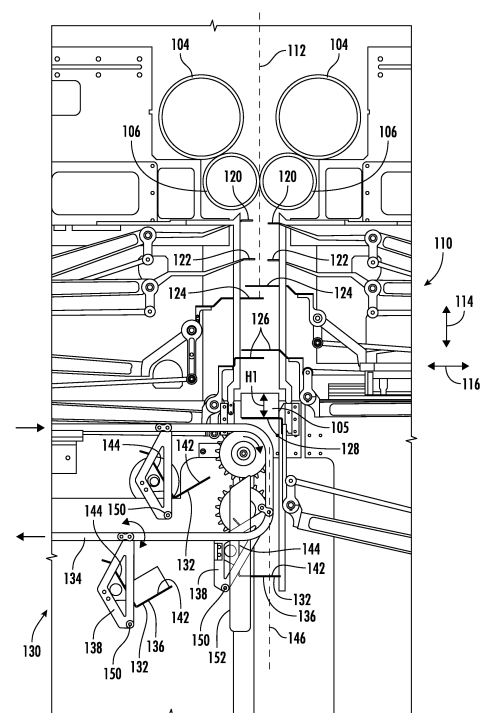
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(54) METHOD AND APPARATUS FOR ACCUMULATING LOGS OF FOLDED SHEETS

(57) An apparatus including a log accumulator (130) is provided. The log accumulator (130) can have logs (105) load therein while they travel along a path that is generally parallel to a path along which the logs (105) are separated from a building stream of sheets (107), such as when exiting a folder. The logs (105) may be loaded into buckets (132) of the accumulator (130) without requiring lateral accelerations out of a mechanism transferring the separated logs to the accumulator (130). Similarly, logs (105) may be initially removed from buckets (132) of the accumulator without requiring lateral accelerations. Further, an accumulator unloading apparatus may initially index the logs (105) perpendicular to a length to clear the path of the buckets (132) of the accumulator (130) and then accelerate the logs (105) parallel to a length of the logs (105) once removed from the path of the buckets (132).

**FIG. 2****EP 4 512 756 A1**

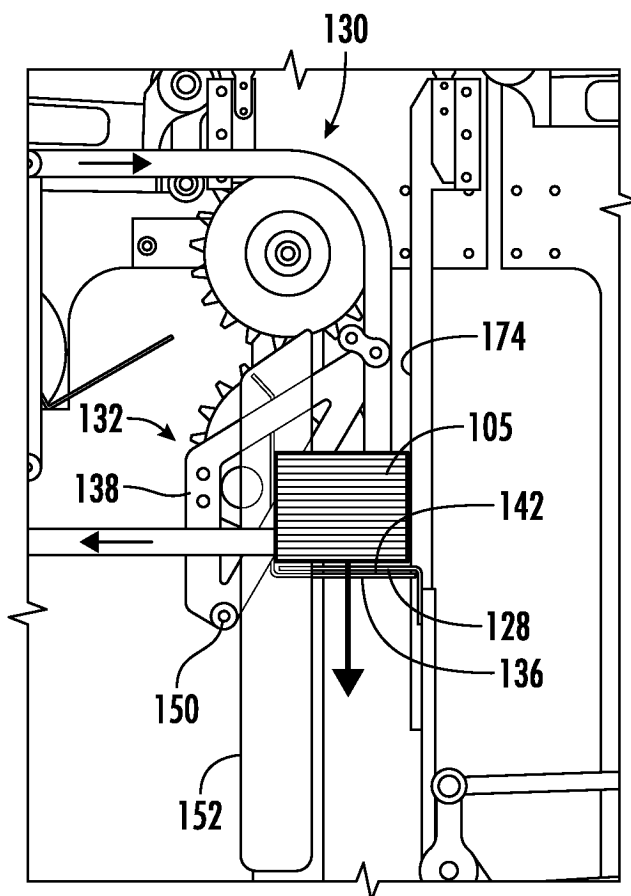


FIG. 8

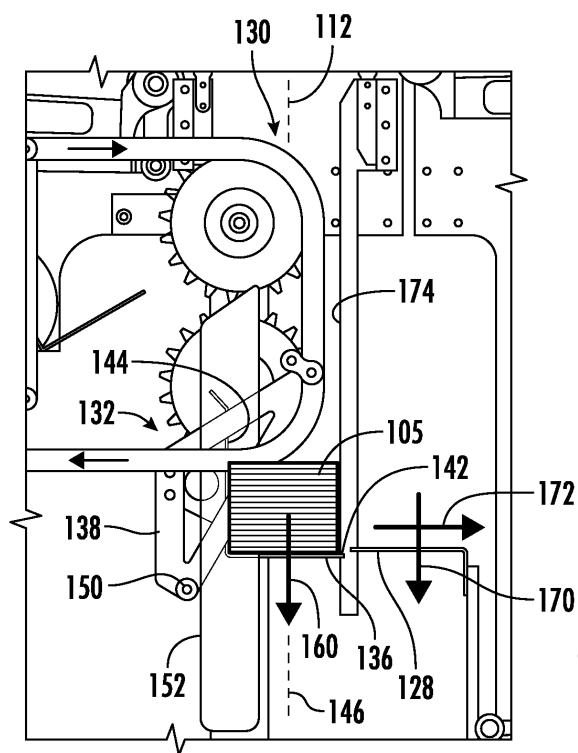


FIG. 9

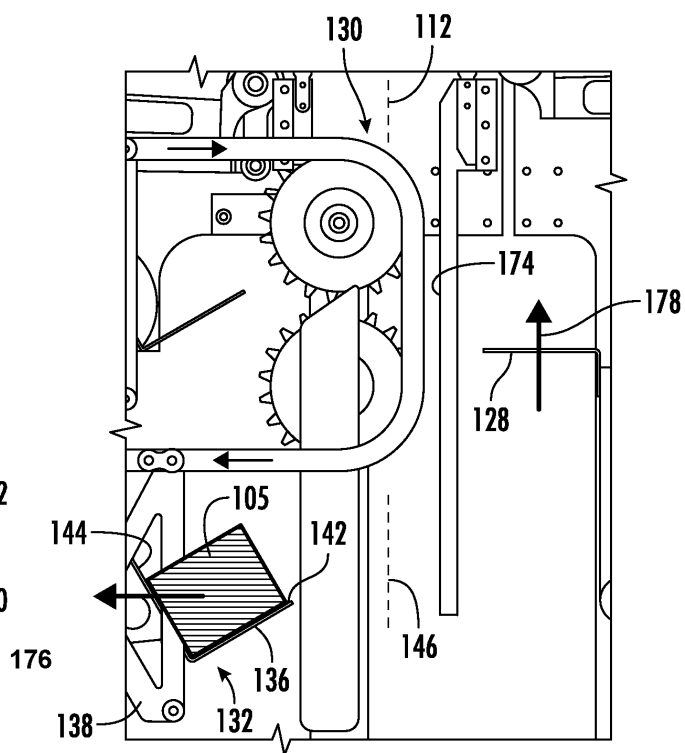


FIG. 10

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Description

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This Patent Application claims the benefit of U.S. Provisional Patent Application No. 63/598,335, filed November 13, 2023, and U.S. Provisional Patent Application No. 63/529,964, filed July 31, 2023, the entire teachings and disclosure of each which are incorporated herein by reference thereto.

FIELD OF THE INVENTION

[0002] This invention generally relates to an accumulator for temporarily storing and accumulating logs of elongated product, such as logs of paper products such as paper towels or facial tissues. More specifically, although not exclusively, the invention relates to an accumulator for storing and accumulating logs of elongated rolls or stacks of sheet products such as paper, paper towels, facial tissues and the like.

BACKGROUND OF THE INVENTION

[0003] Accumulators are used in manufacturing systems, and particularly paper processing systems, to store elongated logs of product that have been formed into elongated stacks prior to being reduced in length for commercial packaging. For example, during formation of folded or interfolded paper towels, the paper towels are initially formed into an elongated stack of paper towels that can be in excess of one hundred inches long. This log is then passed to downstream processing systems to be sawed into shorter lengths, such as four (4) to eighteen (18) inch lengths. These shorter lengths are then packaged for consumer use.

[0004] The accumulators store the logs as they are dispensed from the portion of the system that forms the logs (e.g. a folder or interfolder) in the event that there is a breakdown, scheduled maintenance, or other downtime experienced by the system. The accumulator allows other downstream systems that are not experiencing downtime to continue to operate. This can be very beneficial in the event that either system needs to run continuously to avoid long reset or startup time as well as portions of a system that can generate large amounts of waste until it is ramped up to standard operating speeds or conditions.

[0005] One problem particularly occurs with the use of rectangular logs of stacked paper. These logs do not roll. As such, they typically have to be slid laterally into buckets of the accumulator by a feed arrangement. The feed arrangement includes a pusher element that pushes the logs laterally into the buckets in a direction that is generally perpendicular to the direction of travel of the buckets. Thus, the bucket and the feed arrangement must be aligned during the process of loading a log into the

bucket.

[0006] Further, logs of stacked paper products are typically void of any central core, such as in wound products like rolls of paper towels or toilet paper. The lack of a central core can reduce the rigidity of the log such that the log should be supported substantially along its entire length and not merely at the ends thereof.

[0007] By requiring a pusher element to push the logs into the buckets, the buckets and the feed arrangement need to be maintained at a constant relative position during the loading operation to prevent damaging the logs or otherwise prevent interference between the components of the buckets and the feed arrangement.

[0008] To store the logs in a space efficient manner, the accumulator typically includes a transport system that includes an continuous carrier arrangement that defines a continuous path, e.g. a pair of parallel chains, that transports the buckets vertically up and down repeatedly. The buckets change vertical direction, typically, as the chains rotate about sprockets. Unfortunately, due to the change in direction, the buckets will tend to start to swing due to the acceleration/deceleration of buckets.

[0009] In the past, the entire system of buckets was stopped while an individual bucket was loaded. The system was then indexed to the next bucket for loading and then stopped again. However, the acceleration and deceleration of the system due to stopping and starting of the system amplifies the magnitude of the swinging of the buckets.

[0010] If the magnitude of the swinging is too severe, the swinging buckets can cause damage to the accumulator or cause the product to be spilled from the buckets.

[0011] As a result of above, the speed/throughput of prior accumulators has been limited. Modern upstream/downstream equipment could operate at higher speeds if accumulator speed could be similarly increased.

[0012] In prior approaches, however, running the accumulator at higher speed to increase throughput of logs through the accumulator by merely increasing speed of the chain through the accumulator will increase the acceleration/deceleration of the buckets as they traverse the changes in direction. This will thus result in increased swinging. This amplified swinging is then amplified again by the acceleration and deceleration of the system during the loading process. Further, as the chains must be accelerated to the now faster speeds, the magnitude of acceleration or period of acceleration from a dead stop to top speed must be increased further amplifying the swinging problem.

[0013] Further, attempts at improving the speed and operation of an accumulator are described in U.S. Pat. No. 8,490,772 assigned to the owner of the instant application. This system uses a loading unit that includes an oscillating guide unit that oscillates up and down to compensate for the continuously moving chain that carries the buckets. Due to the oscillating nature of the guide unit, a bucket could be effectively stopped adjacent a feed arrangement of the system while a log is laterally

pushed into the bucket. Thus, this prevented stopping the guide chain of the accumulator which could cause swinging of the other buckets in the system. While this system provided improved loading and unloading of the accumulator and allowed for increased manufacturing speeds, this system has significant complexity.

[0014] The present invention provides improvements over the art that permits faster throughput through an accumulator while preventing or reducing increases in swinging magnitude of the buckets.

BRIEF SUMMARY OF THE INVENTION

[0015] New and improved accumulators for storing logs of folded sheets is provided. Methods of use such as loading and unloading of the accumulator are also provided.

[0016] In an example, a method of loading an accumulator with logs of folded sheets formed by being separated from a continuously forming stream of sheets exiting a sheet folder is provided. The stream of folded sheet are formed along a stacking axis. The method includes moving a log holding bucket along a loading path. The log holding bucket has a log supporting surface. The method includes transporting a log of folded sheets separated from the stream of sheets away from the stream of sheets along the loading path. The method includes loading the log of folded sheets onto the log support surface while the log of folded sheets and the log holding bucket travel along the loading path.

[0017] In one example, the step of transporting the log of folded sheets away from the stream of sheets includes transporting the log with a finger of a carriage. The step of loading the log of folded sheets onto the log support surface includes abutting a side of the log of folded sheets against an abutment adjacent the loading path by retracting the finger from the loading path. The abutment prevents the log of folded sheets from being retracted from the loading path with the finger thereby removing the log of folded sheets from the finger and transferring to the log of folded sheets to the supporting surface.

[0018] In one example, the step of loading the log of folded sheets onto the log supporting surface includes:

- (a) transporting, at a first speed, the log of folded sheets along the loading path with the log of folded sheets supported by a finger of a carriage; and
- (b) moving the log holding bucket along the loading path at a second speed slower than the first speed such that the finger of the carriage passes the log supporting surface along the loading path and the log is transferred to the log supporting surface.

[0019] In one example, the method includes tipping the bucket after the step of loading the log of folded sheets onto the log support surface such that the log support surface is less orthogonal to the loading path than during the step of loading the log of folded sheets onto the log

support surface.

[0020] In one example, the loading path is coaxial with the stacking axis such that the sheets forming the log of folded sheets travel along a single axis while:

- (a) in the stream of sheets;
- (b) being separated from the stream of sheets to form the log;
- (c) being transported away from the stream of sheets while being part of the log; and
- (d) being loaded onto the log support surface.

[0021] In one example, the method includes (a) building the log of folded sheets on a build finger. The method includes separating the log of folded sheets from the stream of sheets with the log of folded sheets supported by the build finger. The step of transporting the log of folded sheets along the loading path includes transporting the log of folded sheets along the loading path using the build finger. The step of loading the log of folded sheets onto the log support surface includes directly transferring the log of folded sheets from the build finger to the log support surface while the bucket and build finger travel along the loading path.

[0022] In one example, the step of loading the log of folded sheets onto the log support surface includes retracting the build finger from the loading path. The step of loading includes abutting a side of the log of folded sheets against an abutment adjacent the loading path as the build finger is being retracted from the loading path such that the log of folded sheets is prevented from being retracted from the loading path with the build finger thereby removing the log of folded sheets from the build finger and transferring to the log of folded sheets to the supporting surface.

[0023] In one example, the method includes building the log of folded sheets on a build finger. The method includes separating the log folded sheets from the stream of sheets. The method includes, while the sheets forming the log of folded sheets are supported by the build finger, transferring the log of folded sheets to a transfer finger. The step of transporting the log of folded sheets along the loading path includes transporting the log of folded sheets along the loading path using the transfer finger. The step of loading the log of folded sheets onto the log support surface includes directly transferring the log of folded sheets from the transfer finger to the log support surface while the bucket and transfer finger travel along the loading path.

[0024] In one example, the step of loading the log of folded sheets onto the log support surface includes retracting the transfer finger from the loading path. The step of loading includes abutting a side of the log of folded sheets against an abutment adjacent the loading path as the transfer finger is being retracted from the loading path such that the log of folded sheets is prevented from being retracted from the loading path with the transfer finger thereby removing the log of folded sheets from the build

finger and transferring to the log of folded sheets to the supporting surface.

[0025] In one example, the step of loading the log of folded sheets onto the log support surface does not include transporting the log of folded sheets along an axis transverse to the loading path.

[0026] In one example, the method includes building the log of folded sheets along the stacking axis, the stacking axis being a vertical axis that is coaxial with the loading axis. The method includes separating the log of folded sheets from the stream of sheets. The buckets and log of folded sheets move vertically downward while traveling along the loading path.

[0027] In one example, the method includes tipping the bucket after the step of loading the log of folded sheets onto the log support surface such that the log support surface is less orthogonal to the loading path than during the step of loading the log of folded sheets onto the log support surface. After the bucket has been tipped, the log of folded sheets is vertically supported on at least two sides of the log of folded sheets.

[0028] In one example, the step of loading the log of folded sheets onto the log supporting surface includes transporting, in a first direction, the log of folded sheets along the loading path with the log of folded sheets supported by a finger of a carriage. The step of loading includes moving the log holding bucket along the loading path in a second direction such that the finger of the carriage passes the log supporting surface along the loading path and the log is transferred to the log supporting surface.

[0029] In one example, the loading path is non-parallel with the stacking axis.

[0030] In an example an apparatus including an accumulator, a log transport mechanism, and means for transferring the log of folded sheets from the transport mechanism to a bucket is provided. The accumulator is configured for holding a plurality of logs of folded sheets. The accumulator includes a plurality of buckets carried along a continuous path. A portion of the continuous path includes a loading path. Preferably, but not required, the buckets of the accumulator travel at a constant speed along the continuous path. The log transport mechanism is configured to carry a log of folded sheets along the loading path. The means for transferring the log of folded sheets transfers the log from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path.

[0031] In one example, the means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path includes a finger of the log transport mechanism that can be retracted from the loading path and an abutment adjacent the loading path that prevents the log from being removed from the loading path as the finger is retracted from the loading path.

[0032] In one example, the means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path includes a finger of the log transport mechanism that travels along the loading path at a speed greater than the bucket travels along the loading path such that the finger passes the bucket while traveling along the loading path and the log of folded sheets is transferred to the bucket.

[0033] In another example, the means is provided by a transport mechanism that transports the log along the loading path in a direction opposite the bucket travels.

[0034] In one example, the bucket includes a plurality of spaced apart bucket portions forming gaps therebetween and the finger includes a plurality of finger portions forming gaps therebetween. The finger portions pass through the gaps formed between adjacent bucket portions as the finger passes the bucket such that the bucket portions abut a side of the log of folded sheets that is being supported by the finger portions thereby transferring the log of folded sheets to the bucket portions.

[0035] In one example, the log of folded sheets is separated from a stream of sheets forming along a stacking axis, the stacking axis being coaxial with the loading path.

[0036] In one example, the stacking axis and loading path are coaxial such that the sheets forming the log of folded sheets travel along a single axis 1) while in the stream of sheets; 2) are carried by the log transport mechanism; and 3) are transferred from the log transport mechanism to the bucket.

[0037] In one example, the buckets travel along the loading path with a log support surface upon which the logs are supported when the logs are transferred to the buckets being substantially orthogonal to the loading path. The buckets tip after receiving a log of folded sheets such that the log support surface is less orthogonal to the loading path after receiving the log of folded sheets and the log of folded sheets is supported on at least two sides.

[0038] The tipping can occur using a cam follower and guide arrangement. Alternatively, tipping could be produced by an actuator such as a motor.

[0039] In one example, a log unloading arrangement including a plurality of laterally spaced indexing belts forming gaps therebetween is provided. A portion of the continuous path of the accumulator includes an unloading path. Each bucket travels along the unloading path and unloads the log of folded sheets carried thereby onto the indexing belts. The laterally spaced belts extend into the unloading path. Each bucket passes through the gaps formed between the laterally spaced indexing belts to transfer the log of folded sheets to the indexing belts.

[0040] In one example, the log of folded sheets carried by the bucket has a length, a width and a height that are perpendicular to one another. The length is the greatest dimension and is at least three times the width dimension. The height is aligned with the unloading path as the bucket travels along the unloading path. The indexing

belts are aligned with the width such that the indexing belts need index a log of folded sheets less than the length of the log of folded sheets to permit a subsequent bucket and subsequent log carried by the subsequent bucket to clear the log of folded sheets.

[0041] In one example, the means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path includes a transport mechanism that carries the log along the loading path at an opposite direction as the bucket travels along the loading path.

[0042] In one example, a log unloading arrangement including a slide table having a plurality of laterally spaced bucket unloading portions forming gaps therebetween is provided. A portion of the continuous path of the accumulator includes an unloading path. Each bucket travels along the unloading path and unloads the log of folded sheets carried thereby onto the bucket unloading portions of the slide table. The laterally spaced bucket unloading portions extend into the unloading path. Each bucket passes through the gaps formed between the laterally spaced bucket unloading portions to transfer the log of folded sheets to the slide table.

[0043] In one example, the apparatus includes at least one pusher paddle configured to transport an unloaded log supported by the bucket unloading portions of the slide table along the slide table and out of the unloading path.

[0044] In one example, the unloaded log has a length, a width and a height that are perpendicular to one another. The length is the greatest dimension and is at least three times the width dimension. The height is aligned with the unloading path as the bucket travels along the unloading path. The at least one pusher paddle transports the unloaded log along an axis that is aligned with the width such that the unloaded log is transported entirely out of the unloading path.

[0045] In one example, the at least one pusher paddle has a paddle member and a support leg. The paddle member is located vertically above the slide table and abuts a vertical side of the unloaded log when the at least one pusher paddle transports the unloaded log out of the unloading path.

[0046] In one example, the support leg supports the paddle member and extends vertically through a slot formed in the slide table.

[0047] In one example, the slot through which the support leg extends is formed, at least in part, in the bucket unloading portion and is not provided by a gap through which the bucket passes as the log is transferred from the bucket to the bucket unloading portions of the slide table.

[0048] In one example, a longitudinal conveyor having first and second conveyor belts having adjustable spacing therebetween is provided. The longitudinal conveyor is configured to transport the unloaded log parallel to the length of the unloaded log. The at least one pusher

paddle transports the unloaded log from the slide table into the longitudinal conveyor and between the first and second conveyor belts.

[0049] In an example, an accumulator unloading apparatus for unloading a log of folded sheets from a bucket of an accumulator traveling along an unloading path is provided. The log has a length, a width and a height. The apparatus includes an indexing conveyor including laterally spaced apart indexing belts. The indexing conveyor has a log receiving region that intersects the unloading path. The indexing belts pass through the log receiving region. Within the log receiving region, the indexing conveyor has gaps formed between adjacent indexing belts configured to pass portions of the bucket therethrough as the bucket travels along the unloading path. The apparatus includes a longitudinal conveyor including a first conveyor belt and a second conveyor belt spaced apart from the first conveyor belt. The first and second conveyor belts are moveable relative to one another to adjust a spacing therebetween including a first spacing that is greater than the height of the log and a second spacing that is equal to or less than the height of the log. The first conveyor belt is guided along an undulating path. The undulating path has a plurality of peaks and a plurality of valleys. A first peak of the plurality of peaks is positioned laterally between a corresponding pair of indexing belts of the indexing conveyor and a first valley of the plurality of valleys is aligned with a first indexing belt of the plurality of indexing belts of the indexing conveyor. The first conveyor belt is positionable relative to the plurality of indexing belts between a first orientation in which the second conveyor belt is closer to the indexing belts than the first conveyor belt and a second orientation in which the second conveyor belt is closer to the first conveyor belt than the indexing belts.

[0050] In one example, when in the second orientation, the first indexing belt is received in the first valley of the undulating path to a greater extent than when in the first orientation.

[0051] In one example, at least a portion of the undulating path defining the first valley extends through a perimeter defined by a path traveled by the first indexing belt.

[0052] In one example, the first and second conveyor belts are spaced from the unloading path along indexing belts a distance of at least 2 times the width of the log.

[0053] In one example, the first conveyor belt is configured to move perpendicular to the indexing belts to lift the log relative to the indexing belts when the log is located in the space formed between the first and second belts.

[0054] In one example, the first conveyor belt is configured to move relative to the indexing belts parallel to the unloading path to lift the log relative to the indexing belts when the log is located in the space formed between the first and second belts.

[0055] In one example, the lifting of the log relative to the indexing belts entirely disengages the log from the

indexing belts.

[0056] In one example, the indexing belts transport the log in a direction that is perpendicular to a length of the log and the first and second conveyor belts transport the log in a direction that is parallel to the length of the log.

[0057] In one example, a guide table providing guide surfaces interposed between the indexing belts for supporting portions of the log that are offset from the indexing belts. The guide surfaces are offset from the log receiving region and the gaps.

[0058] In an example, a method of unloading an accumulator is provided. The method includes passing a bucket of an accumulator carrying a log of folded sheets along an unloading path of the accumulator through the log receiving region of the accumulator unloading apparatus of a prior unloading apparatus. The method includes transferring the log of folded sheets from the bucket to the indexing belts as the bucket passes through the log receiving region.

[0059] In one example, a portion of the bucket passes through one of the gaps in the log receiving region formed between adjacent indexing belts while traveling along the unloading path and as the log is transferred to the indexing belts.

[0060] In one example, the method includes transporting the log with the indexing belts parallel to the width of the log into the longitudinal conveyor and between the first and second conveyor belts. The method includes transporting the log with the first and second conveyor belts parallel to the length of the log with the first and second conveyor belts in the second spacing, with the first and second conveyor belts engaging the log, and with the first conveyor belt in the second orientation.

[0061] In an example, an accumulator unloading apparatus for unloading a log of folded sheets from a bucket of an accumulator traveling along an unloading path is provided. The log has a length, a width and a height with the length being greater than the width and the height. The apparatus includes a slide table, a longitudinal conveyor, and at least one pusher paddle. The slide table has a log support surface. The slide table includes laterally spaced apart bucket unloading portions forming a log receiving region that intersects the unloading path. The slide table has gaps formed between adjacent bucket unloading portions configured to permit portions of the bucket supporting the log to pass through the log receiving region as the bucket travels along the unloading path. The longitudinal conveyor includes a first conveyor belt and a second conveyor belt spaced apart from the first conveyor belt. The first and second conveyor belts are moveable relative to one another to adjust a spacing therebetween including a first spacing that is greater than the height of the log and a second spacing that is equal to or less than the height of the log. The longitudinal conveyor is configured to transport the log parallel to the length of the log. The at least one pusher paddle is actuatable parallel to a pusher paddle axis that is parallel to the width of the log to transport the log from the log

receiving region into the longitudinal conveyor between the first and second conveyor belts.

[0062] In one example, the at least one pusher paddle transports the log by pushing the log along the support surface of the slide table.

[0063] In one example, a carriage and an actuator are provided. The carriage is movable, by the actuator, generally parallel to the pusher paddle axis. The at least one pusher paddle includes a plurality of pusher paddles. Each pusher paddle is attached to the carriage for movement with the carriage parallel to the pusher paddle axis. Each pusher paddle includes:

- a) a pusher member that engages a vertical side of the log as the pusher paddle transports the log from the log receiving region and into the longitudinal conveyor, the pusher member being positioned vertically above the slide table; and
- b) a support leg that extends below the support surface of the slide, the support leg supporting the pusher member and being attached to the carriage.

[0064] In one example, the at least one pusher paddle extends vertically through a slot formed in the slide table such that a portion of the pusher paddle is vertically above the support surface of the slide table and a portion is vertically below the support surface of the slide table. The portion of the pusher paddle that is vertically above the support surface has a width being perpendicular to the pusher paddle axis and perpendicular to the unloading path that is greater than a width of the slot.

[0065] In one example, the slot formed in the slide table is formed in one of the bucket unloading portions and extends longitudinally parallel to the pusher paddle axis.

[0066] In one example, the at least one pusher paddle has a paddle member and a support arm. The support arm has a bent neck such that the paddle member may be located between the first and second conveyor belts while the support arm is positioned offset from the belts of the longitudinal conveyor when the pusher paddle transports the unloaded log into the longitudinal conveyor.

[0067] In an example, a method of unloading an accumulator is provided. The method includes passing a bucket of an accumulator carrying a log of folded sheets along an unloading path of the accumulator through the log receiving region of the accumulator unloading apparatus as outlined above. The method includes transferring the log from the bucket to the bucket unloading portions of the slide table as the bucket passes through the log receiving region.

[0068] In one example, the method includes passing a portion of the bucket through one of the gaps in the log receiving region formed between adjacent bucket unloading portions while the bucket travels along the unloading path and as the log is transferred to the slide table.

[0069] In one example, the method includes transport-

ing the log with the at least one pusher paddle parallel to the width of the log into the longitudinal conveyor and between the first and second conveyor belts. The method includes transporting the log with the first and second conveyor belts parallel to the length of the log with the first and second conveyor belts in the second spacing.

[0070] Other aspects, objectives and advantages of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0071] The accompanying drawings incorporated in and forming a part of the specification illustrate several aspects of the present invention and, together with the description, serve to explain the principles of the invention. In the drawings:

FIG. 1 is a schematic view of a system that includes folding arrangement, a log separator downstream of the folding arrangement, and an accumulator for storing logs formed from the folding arrangement;

FIG. 2 is an enlarge schematic view of the folding arrangement, log separator and a loading portion of the accumulator;

FIG. 2A is a perspective view of a bucket of the accumulator of the system of FIG. 1;

FIGS. 3-10 are simplified illustrations illustrating a process of separating a log from a continuously building stream of sheets and loading the separated log into the bucket of FIG. 2;

FIG. 11 is a perspective view of an accumulator unloading apparatus for removing a log from a bucket of the accumulator and then longitudinally transporting the log;

FIG. 12 is a partial top view of a bucket passing through the accumulator unloading apparatus;

FIG. 13 is a simplified plan view of a portion of the accumulator unloading apparatus of FIG. 12 illustrating the positioning of indexing belts thereof relative to a lower conveyor belt thereof;

FIG. 14 is side view illustration of a portion of the accumulator path where a bucket thereof is unloaded into the accumulator unloading apparatus prior to the log being unloaded;

FIG. 15 is a side view illustration of the log being unloaded from the accumulator and to the accumulator unloading apparatus illustrating a log being indexed out of the unloading path of the accumulator

perpendicular to a length of the log;

FIG. 16 is a side view illustration of the log being indexed into and compressed with a longitudinal conveyor of the accumulator unloading apparatus with the log traveling perpendicular to its length;

FIG. 17 is a side view illustration of the log being discharged from the longitudinal conveyor with the log traveling parallel to its length; and

FIG. 18 is an enlarged portion of FIG. 1 illustrating the accumulator unloading apparatus;

FIG. 19 is a perspective view of an accumulator unloading apparatus for removing a log from a bucket of the accumulator and then longitudinally transporting the log;

FIGS. 20 and 21 are side view illustrations of a portion of the accumulator path where a bucket thereof is unloaded into the accumulator unloading apparatus of FIG. 19 prior to the log being unloaded;

FIG. 22 is a top view illustration of the accumulator unloading apparatus of FIG. 19 shown without a log present;

FIGS. 23 and 24 are side view illustrations of the log being unloaded from the accumulator and to the accumulator unloading apparatus of FIG. 19 illustrating a log being indexed out of the unloading path of the accumulator perpendicular to a length of the log;

FIG. 25 is a side view illustration of the log being indexed into a longitudinal conveyor of the accumulator unloading apparatus with the log traveling perpendicular to its length;

FIG. 26 is a side view illustration of the log being compressed by the longitudinal conveyor and discharged from the longitudinal conveyor with the log traveling parallel to its length.

[0072] While the invention will be described in connection with certain preferred embodiments, there is no intent to limit it to those embodiments. On the contrary, the intent is to cover all alternatives, modifications and equivalents as included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

[0073] FIG. 1 is a simplified schematic illustration of a system 100 for forming logs of folded sheets of material such as paper towels or facial tissues. The system 100 includes a folding arrangement 102 that includes a pair of

folding rolls 106 downstream from one or more knife rolls 104. The knife rolls 104 sever sheets of material from a continuous web of material. The sheets are fed to the folding rolls 106 where the sheets are folded. The sheets may be interfolded or non-interfolded, but it is contemplated that the present application would have more applicability to interfolded sheets.

[0074] Typically, a continuously building stream of folded sheets will exit the folding rolls 106. Typically, this will be vertically below the folding rolls 106 however horizontally oriented systems are contemplated.

[0075] With additional reference to the schematic illustration of FIG. 2, the system 100 includes a separator 110 downstream of the folding rolls 106 for separating individual logs of folded sheets (e.g. a stack of an approximate predetermined number of sheets) from the stream of folded sheets. The separator 110 can include a plurality of different fingers and not all separators will have the same number or types of fingers. For example, build fingers can support a bottom of a log of folded sheets as the sheets are stacking on the build fingers until the predetermined number of sheets has been built onto the build fingers. Count fingers can be inserted into the stream to make a break between the top of the log and the bottom of the next log to be built. Transfer fingers can be used for transferring built logs from the stream to other components. In some examples, some fingers could perform multiple functions. For example, some fingers could be both a build finger and a transfer finger.

[0076] Typically, the fingers are carried by carriages for moving the fingers parallel to the axis 112 the stream of sheets is formed illustrated by arrow 114 as well as laterally relative to the axis 112 into and out of the stream of sheets illustrated by arrow 116.

[0077] In FIG. 1, the separator 110 includes opposed upper count fingers 120, opposed lower count fingers 122, opposed upper separator fingers 124, opposed lower separator fingers 126, and a transfer finger 128.

[0078] In this example, each finger is independently carried by a corresponding carriage for the required motion represented by arrows 114, 116.

[0079] In this example, the system 100 includes an accumulator 130 illustrated in part in FIG. 1 that has a plurality of log holding buckets 132 (referred to generally as buckets) that carry the formed logs away from the folding arrangement. The accumulator 130 can hold a predetermined number of logs.

[0080] The buckets 132 along a continuous path to be cyclically loaded with a log and then unloaded at a different location. The buckets 132 may be carried along the continuous path by belt 134 or driven along the path using other means such as actuators.

[0081] With additional reference to FIG. 2A, the buckets 132 generally include a log support 136 that is carried by bucket frame 138.

[0082] In this example, the log support 136 is L-shaped.

[0083] The log support 136 is formed from a plurality of

bucket portions 139 that are laterally spaced apart forming gaps 141 therebetween. The bucket portions 139 are attached to bucket frame 138 such that they travel together about the continuous path of the accumulator 130.

[0084] The L-shaped log support 136 has first and second log support surfaces defined by surfaces 142, 144 of the bucket portions 139.

[0085] A loading path, illustrated by axis 146, forms a portion of the continuous path along which the buckets 132 travel. When traveling along the loading path, the buckets 132 can be loaded with a corresponding log.

[0086] In this example, the loading path is generally vertically oriented and is aligned with sheet building axis 112. Here, the loading path is directly vertically below where the continuous stream of sheets is built and below the folding arrangement. As such, logs that are separated from the stream of sheets can be directly transferred into a corresponding bucket within the loading path while traveling along a single axis. In other words, axes 112, 146 are parallel and coaxial.

[0087] However, other situations are contemplated where the stacking axis 112 and loading axis 146 are not parallel. In some instances, the finger supporting log 105 could move in a non-parallel manner rather than having the log and bucket 132 moved parallel to one another and then using an actuator to push the log 105 laterally off of the associated finger.

[0088] In this example, the first log support surfaces 142 of the bucket portions 139 are substantially orthogonal to the axis 146 and the second log support surfaces 144 are substantially parallel when traveling along the loading path. After passing along the loading path, the buckets 132 may be tipped, as illustrated to an orientation where the first log support surfaces 142 are less orthogonal to axis 146 and second log support surfaces 144 are less parallel to axis 146 than when the buckets are traveling along the loading path.

[0089] In this example, the buckets include cam followers 150 that cooperate with guides 152 to maintain the buckets 132 with first log support surface 142 orthogonal to axis 146 and second log support surfaces 144 parallel to axis 146.

[0090] The accumulator 130 is configured to improve loading of the logs into the buckets and to reduce any need to stop and start the accumulator 130 (e.g. movement of the buckets 132 along the continuous path). It is also configured to prevent the need to laterally move the logs relative to their travel path, e.g. transverse to axis 112, while loading the logs into the buckets 132. This prevents rapid acceleration and deceleration of the logs which can result in skewing the shape of the logs, causing sheets to unfold due to air flow, or damage to the sheets within the logs.

[0091] Loading of the buckets 132 with logs in a first example will be described with reference to FIGS. 3-10.

[0092] In FIG. 3, a log 105 has been separated from the continuously building stream of sheets 107. Here, lower count fingers 122 and upper separator fingers 124 are

above log 105 but below continuously building stream of sheets 107. Lower separator fingers 126 are below the log 105 such that the log 105 is positioned between lower count fingers 122 and lower separator fingers 126. All identified fingers are generally inserted into the path way represented by axis 112. The fingers 122, 124, 126 and log 105 are moving along axis 112 as illustrated by arrow 160. Transfer finger 128 is spaced away from the lower separator fingers 126 but located within the path of the sheets.

[0093] In FIG. 4, the log 105 and lower separator fingers 126 have reached transfer finger 128. The lower separator fingers 126, log 105 and transfer finger 128 are traveling along axis 112 as illustrated by arrow 160 at substantially a same speed.

[0094] In FIG. 5, with the log 105 between guides 162 and lower separator fingers 126 moving at the same speed as transfer finger 128 parallel to axis 112, the lower separator fingers 126 are retracted as illustrated by arrows 164 such that the lower separator fingers 126 are no longer supporting the log 105. The guides 162 prevent the log 105 or sheets thereof from also traveling laterally with the corresponding lower separator fingers 126. With the lower separator fingers 126 retracted, the log 105 is transferred to transfer finger 128.

[0095] In FIG. 6, with the log 105 transferred to transfer finger 128, fingers 122, 124, 126 travel in an opposite direction illustrated by arrow 166 to separate another log from the continuously building stream of sheets. Here, the log 105 and transfer finger 128 are continuing along axis 112 as illustrated by arrow 160 towards accumulator 130.

[0096] In FIG. 7, the transfer finger 128 has carried the log 105 to the accumulator and to loading path thereof. The log 105 is separated from the stream of sheets and is being transported away from the stream of sheets along the loading path.

[0097] Here, the bucket 132 has been tipped such that the log support surface 142 is generally orthogonal to the loading path (e.g. axis 146). The bucket 132 and transfer finger 128 are both moving in the same direction along the loading path as illustrated by arrow 160. However, the transfer finger 128 and log 105 are not at a same location along the loading path and are axially spaced apart.

[0098] In FIG. 8, the transfer finger 128 has caught up to bucket 132 such that finger 128 and surface 142 of bucket 132 are at a same axial location along the loading path and are traveling in a same direction and at a same speed along the loading path as illustrated by arrow 160.

[0099] In FIG. 9, while continuing in the same direction as bucket 132 as illustrated by arrows 170, 160, transfer finger 128 is laterally retracted from the loading path as illustrated by arrow 172. The log 105 is transferred to the bucket 132. Guide 174 acts as an abutment that abuts a side of the log 105 and prevents the log 105 from being retracted from the loading path with transfer finger 128. In this instance, the log 105 is transferred to the bucket 132 while the bucket 132, log 105 and transfer finger are all

traveling in the same direction along the loading path.

[0100] In FIG. 10, the bucket 132 and associated log 105 exit the loading path as illustrated by arrow 176. Cam follower 150 no longer engages guide 152 and the bucket 132 tips such that first log support surface 142 is less orthogonal to axis 146 and second log support surface 144 is less parallel to axis 146. As the bucket 132 has tipped, a side of the log 105 is now also supported by second log support surface 144. As axes 112 and 146, in this example, are vertically oriented. Both the first and second log support surfaces 142, 144 vertically support log 105.

[0101] As no log 105 is supported by transfer finger 128, transfer finger 128 transitions back toward the separator to receive and then transfer another log. This motion is illustrated by arrow 178.

[0102] While FIGS. 8 and 9 illustrate transferring the log 105 from finger 128 to bucket 132 using guide 174. In other embodiments, finger 128 may be configured to travel a different faster speed than bucket 132 along the loading path such that the log 105 is transferred to the bucket 132 as finger 128 axially passes bucket 132 and particularly first log support surface 142. Further yet, in some examples, the transfer finger 128 and bucket 132 could move in opposite directions. For example, if bucket 132 were moving in a direction opposite arrow 160, e.g. vertically upward, a transfer could occur. Notably, opposite directions could be used in the situation where the build finger is used to directly transfer the log to the buckets 132.

[0103] However, by using the guide 174 and lateral motion of finger 128, finger 128 need not be configured to support log 105 as well as to pass through log support 136 (e.g. the portions that define surfaces 142). Instead, the finger 128 need only be moved substantially adjacent (e.g. slightly vertically above) log support surface 142 immediately prior to retraction (arrow 172) and transfer of log 105 to bucket 132.

[0104] In both situations, the object (e.g. finger 128) supporting the log as it is transferred from the stream of sheets to the bucket is not positioned laterally next to the bucket 132 such that the log 105 need be accelerated laterally, e.g. perpendicular to axis 146 to transfer from the supporting object to the bucket 132.

[0105] It can be recognized that in the illustrated example, axis 146 of the loading path is coaxial with the stacking axis 112 along which the folded sheets form the continuous stream of sheets. Thus, the sheets forming the log 105 that are loaded into bucket 132 travel along a single axis while the sheets are 1) in the stream of sheets, 2) being separated from the stream of sheets to form log 105, 3) being transported away from the stream of sheets while being part of the log 105, and 4) being loaded onto the log support surface 142.

[0106] This provides for a compact arrangement while the transportation and movement of the log from the folding arrangement 102 to the accumulator 130 does not negatively impact the condition of log 105.

[0107] While being vertically oriented in the illustrated example, other examples contemplate an arrangement where the stacking axis 112 is horizontal.

[0108] While the example of FIGS. 1-10 illustrate the use of a transfer finger 128 to transfer the log 105 from the separator 110 to the accumulator 130, other examples contemplate directly transporting the log 105 to the accumulator 130 and to the bucket 132 thereof using the fingers of the separator 110 upon which the log is built. Such an arrangement could use either the guide 174 and retraction mode or differential speed mode to transfer the log 105 to the bucket 132 from the corresponding finger.

[0109] Typically, when loaded in bucket 132, the length L2 of the log 105 is aligned with the width W1 of the bucket 132. The width W2 of the log 105 is aligned with the depth D1 of the bucket 132. The height H1 of the log 105 is aligned with a height H2 of the bucket 132 (these dimensions are generally illustrated in FIG. 5 and FIG. 2).

[0110] Typically, the length L2 of the log 105 corresponds to the width W1 of the bucket and is at least 3 times greater than either the width W2 or height H1 of the log 105. Length is often 6-25 times greater than the width W2 or height H1.

[0111] With reference to FIG. 11, a log unloading arrangement 200 for unloading log 105 from bucket 132 is illustrated. Log unloading arrangement 200 is also illustrated in FIG. 1. FIG. 18 is an enlarged portion of the accumulator 130 and the log unloading arrangement 200. Typically, after being unloaded from the accumulator 130, the log 105 will be transported to log saw where the log is chopped into shorter lengths.

[0112] A portion of the continuous path of the accumulator 130 along which bucket 132 travels is an unloading path. In FIG. 11, the bucket 132 travels along the unloading path as illustrated by arrow 202. In this region of the path, the log 105 is removed from bucket 132.

[0113] Similar to loading of the bucket 132, as illustrated in FIG. 14, the bucket 132 pivots to present the log support surface 142 generally orthogonal to the axis defined by the unloading path and arrow 202. This can be done in a similar fashion using cam follower 150 and guide 211.

[0114] The log unloading arrangement 200 includes a plurality of indexing belts 210 that are laterally spaced apart. A portion 212 of each of the indexing belts 210 intersects with the unloading path of the accumulator 130. Adjacent pairs of indexing belts 210 have gaps 214 located there between. The gaps 214 are located proximate the portions 212 that intersect the unloading path of the accumulator 130.

[0115] As illustrated in FIG. 12, the gaps 214 are sized and configured to allow the bucket portions 139 to pass therethrough when traveling along the unloading path as illustrated by arrow 202. This configuration allows the log 105 to be transferred to the indexing belts 210. More particularly, the exposed bottom side of log 105 will abut engagement surfaces of the indexing belts 210 proximate the unloading portions 212 of the indexing belts

210.

[0116] As the bucket portions 139 pass by the belts 210, the log 105 will be lifted off of the log support surfaces 142 and onto belts 210. This also illustrated in FIG. 15.

[0117] With reference to FIGS. 12, 15 and 16, once loaded onto indexing belts 210, the log 105 will be controlled by the indexing belts 210 and indexed away from the unloading portions 212 and unloading path of the accumulator 130 towards a longitudinal conveyor 220, as illustrated by arrow 218. The log 105 will move with indexing belts 210 perpendicular to the length L2 of the log 105 and typically parallel to the width W2 of the log 105. By traveling along the width W2 as opposed to along length L2, the log has to travel less distance to clear the unloading portions 212 to allow for a subsequent bucket 132 to unload its log onto indexing belts 210. This reduces the acceleration that is needed to be applied to the log 105 to have the log clear the unloading portions 212.

[0118] The indexing belts 210 travel across a guide table 219 (see FIGS. 11 and 12) that has support surfaces 221 located laterally offset from the indexing belts 210. The guide table 219 and support surfaces 221 thereof support the portions of the log 105 that are not directly supported by indexing belts 210 as the log 105 is transferred to the longitudinal conveyor 220.

[0119] However, the log 105 will typically pass through a log saw, not shown, when traveling parallel to length L2. Thus, the indexing belts 210 carry the log 105 into the longitudinal conveyor 220 which will convey the log 105 parallel to length L2.

[0120] With reference to FIGS. 11, 16 and 17, the longitudinal conveyor 220 includes a lower conveyor belt 222 and an upper conveyor belt 224. The lower and upper conveyor belts 222, 224 are spaced apart from one another an adjustable spacing S. The lower and upper conveyor belts 222, 224 are moveable relative to one another such that spacing S can be adjusted between a first spacing that is greater than the height H1 of log 105 (e.g. in an uncompressed state) that allows the log 105 to be indexed into the longitudinal conveyor 220 and a second spacing that is equal to or less than height H1 so that opposed sides (e.g. top and bottom sides) of the log 105 can be engaged by the lower and upper conveyor belts 222, 224 to transport the log 105 in the lengthwise direction (e.g. toward and/or through a log saw).

[0121] Preferably and as illustrated in FIG. 16, the spacing S is reduced to less than height H1 such that the log 105 is compressed between lower and upper conveyor belts 222, 224.

[0122] Because the log 105 is controlled both on the top side and bottom side, the log 105 can be exposed to significantly larger accelerations without deforming the shape or sheets of log 105. These larger accelerations allow for the log to travel a greater distance in the necessary amount of time required for the log 105 to clear the longitudinal conveyor 220 in time for the longitudinal conveyor to receive a subsequent log therein. This allows for acceleration parallel to the length L2 of the log with out

the problems of unfolding of the sheets or deformation in the shape of the log.

[0123] With reference to FIG. 13, the lower conveyor belt 222 travels along an undulating path that defines a plurality of peaks 230 and valleys 232 between adjacent peaks 230. The portions of the travel path of the lower conveyor belt 222 that form the valleys 232 pass through the periphery defined by aligned indexing belts 210. In particular, an indexing belt 210 is aligned with each valley 232 of the undulating path of lower conveyor belt 222. Peaks 230 of the undulating path are positioned laterally offset from the indexing belts 210.

[0124] The lower conveyor belt 222 is moveable relative to the indexing belts 210 such that the peaks 230 of the undulating path can be positioned on either side of the of the log engaging surface 240 of the indexing belts 210.

[0125] When the lower conveyor belt 222 is in a first position, the upper conveyor belt 224 is closer to the log engaging surface 240 of the indexing belts 210 than to the log engaging surface 242 of the lower conveyor belt 222. Further, the log engaging surface 242 of the lower conveyor belt 222 is offset below the log engaging surface 240. This allows the indexing belts 210 to index the log 105 between the lower and upper conveyor belts 222, 224. This configuration is illustrated in FIG. 13. In particular, the portion of the log engaging surface 242 of the lower conveyor belt 222 passing through peaks 230 is positioned above the log engaging surface 240 of the indexing belts 210.

[0126] When the lower conveyor belt 222 is in a second position, the upper conveyor belt 224 is closer to the log engaging surface 242 of the lower conveyor belt 222 than to the log engaging surface 240 of the indexing belts 210. Further, the log engaging surface 242 of the lower conveyor belt 222 is offset above the log engaging surface 242. This allows the lower conveyor belt 222 to engage the log 105 on a side opposite that which is engaged by upper conveyor belt 224 such that the longitudinal conveyor 220 can longitudinally transport the log 105.

[0127] When the lower conveyor belt 222 is in the second position, the indexing belts 210 are received in their adjacent valley 232 defined by the undulating path of lower conveyor belt 222 to a greater extent than when the lower conveyor belt 222 is in the first position. In the first position, the indexing belts 210 may be entirely removed from the valleys 232.

[0128] With reference to FIG. 16, typically, lower conveyor belt 222 will be actuated upwards, illustrated by arrow 250 when transitioning from the first position to the second position. During this motion, the log 105 will be lifted off of or have less weight thereof supported by the indexing belts 210. In a preferred embodiment, the upper conveyor belt 224 will be lowered towards the lower conveyor belt 222 as illustrated by arrow 252.

[0129] Once the log 105 has been dispensed from between the lower and upper conveyor belts 222, 224, the lower conveyor belt 222 will be lowered, illustrated by arrow 261 in FIG. 16 to permit a subsequent log to be

indexed into the longitudinal conveyor 220 between the lower and upper conveyor belts 222, 224.

[0130] The embodiments described herein allow for the accumulator 130 to operate such that the buckets 132 remain moving at a constant speed provided by the continuous path of the accumulator even through the unloading and loading paths during the unloading and loading processes. However, these embodiments reduce the complexity of the accumulator 130.

[0131] With reference to FIG. 19, an alternative example of a log unloading arrangement 300 for unloading log 105 from bucket 132 is illustrated. Log unloading arrangement 300 could be put in place of log unloading arrangement 200 in FIGS. 1 and 18 and operates for the same purpose of unloading logs 105 from the buckets 132 of the accumulator 130.

[0132] A portion of the continuous path of the accumulator 130 along which bucket 132 travels is an unloading path. In FIGS. 20 and 21, the bucket 132 travels along the unloading path as illustrated by arrow 302. In this region of the path, the log 105 is removed from bucket 132.

[0133] As illustrated in FIG. 20, the bucket 132 pivots (illustrated by arrow 303) to present the log support surface 142 generally orthogonal to the axis defined by the unloading path and arrow 302. This can be done in a similar fashion using cam follower 150 and guide 311.

[0134] The log unloading arrangement 300 includes a slide table 310 that includes bucket unloading portions 312 that are laterally spaced a part. Bucket unloading portions 312 of slide table 310 intersect with the unloading path of the accumulator 130. Adjacent pairs of bucket unloading portions 312 have gaps 314 located therebetween.

[0135] The bucket unloading portions 312 form a bucket unloading region of the slide table 310.

[0136] As illustrated in FIG. 22, the gaps 314 are sized and configured to allow the bucket portions 139 to pass therethrough when traveling along the unloading path as illustrated by arrow 302. This configuration allows the log 105 to be transferred to the slide table 310. More particularly, the exposed bottom side of log 105 will abut engagement surfaces of the slide table 310 provided by the bucket unloading portions 312.

[0137] As the bucket portions 139 pass by the slide table 310, the log 105 will be lifted off of the log support surfaces 142 and onto the bucket unloading portions 312. This is illustrated in FIGS. 23 and 24.

[0138] Once supported by the slide table 312 and particularly bucket unloading portions 312, the log 105, pusher paddles 313 will index the log 105 away from the bucket unloading portions 312 and unloading path of the accumulator 130 towards a longitudinal conveyor 320, as illustrated by arrow 318.

[0139] The pusher paddles 313 will engage the log 105 by pushing on a side of the log 105. In this example, the pusher paddles 313 will engage a vertical side of the log 105 while a bottom side of the log 105 is supported by the support surface of the slide table 310.

[0140] The log 105 will move with pusher paddles 313 by sliding on the support surface of slide table 310 perpendicular to the length L2 of the log 105 and typically parallel to the width W2 of the log 105 along a pusher paddle axis generally parallel to arrow 318. By traveling along the width W2 as opposed to along length L2, the log is required to travel a shorter distance to clear the bucket unloading portions 312 to allow for a subsequent bucket 132 to pass through gaps 314 and unload its log onto slide table 310. This reduces the acceleration that is needed to be applied to the log 105 to have the log 105 clear the bucket unloading portions 312 and the travel path of the subsequent bucket 132.

[0141] In this example, each bucket unloading portion 312 includes a pusher slot 315.

[0142] A support arm 317 of a corresponding pusher paddle 313 extends through the pusher slot 315 with a paddle member 319 of the pusher paddle 313 located vertically above the slide table 310. The pusher paddle 315 will travel through pusher slot 315 to index the log 105 towards the conveyor 320.

[0143] The support arm 317 and paddle member 319 may be a single one piece component or separate components attached to one another.

[0144] In this example, the paddle member 319 has a width that is greater than the width of the pusher slots 315. The width, however, is preferably narrower than the space between adjacent bucket portions 139 of bucket 132. This allows the paddle member 319 to pass between adjacent bucket portions 139 in the direction illustrated by arrow 318.

[0145] With the paddle member 319 having a width greater than the width of the slots 315, the support arm 317 consequently has a width that is narrower than the width of the paddle members 319. However, other configurations are contemplated.

[0146] However, other configurations are contemplated. For example, if the pusher paddle 313 is not actuated until the support surface 142 of the bucket portion 139 clears the slide table, paddle members 319 could be wider than the space between the portions of the bucket portions 139 that provides support surface 142. For example, the paddle members 319 may have a width that is less than a space between the portion of buckets 132 that provide support surfaces 144 (e.g. the vertically upright portion of the bucket portion 139). Thus, if support surface 144 has a different, smaller width than support surface 142 such that the gap between adjacent support surfaces 144 is greater than the gap between support surfaces 142, this could allow the paddle member 319 to have a larger width than the space between support surfaces 142 while still allowing the paddle member to clear the bucket 132 while indexing a log 105 away from the bucket unloading portions 312 of slide table 310.

[0147] In this example, four pusher paddles 313 are provided. However, more or less pusher paddles 313 could be provided.

[0148] In other examples, slots 315 are not required if

the support arm 317 has a horizontal component parallel to arrow 318 that is substantially equal to or greater than the length of slots 315. Such an implementation could occur when the slide table 310 needs more surface area for supporting the log 105.

[0149] Further yet, in some implementations, the support arm 317 may simply pass through gaps 314 formed between portions 312. Thus gaps 314 could function as slots 315.

[0150] In this example and as illustrated in FIGS. 23 and 24, the pusher paddles 313 are operably attached to a same carriage 325. The carriage 325 is mounted to linear slides 327 for linear motion illustrated by arrow 329. Notably, motion illustrated by arrow 329 corresponds to motion illustrated by arrow 318.

[0151] An actuator 331 is attached to carriage 325 by linkage 333 to drive the carriage 325 along linear slides 327. To reduce time, the actuator 331 oscillates back and forth rather than rotates in a continuous circle.

[0152] As actuator 331 drives the pusher paddles 313 to push log 105 into conveyor 320, the paddle members 319 are located vertically above the slide table 310.

[0153] Conveyor 320 is substantially similar to conveyor 220 and includes lower conveyor belt 322 and upper conveyor belt 324. However, the lower conveyor belt 322 need not have the undulating configuration as described above for conveyor 220. This configuration provides for a simpler implementation of conveyor 320.

[0154] FIG. 25 illustrates the pusher paddles 313 having pushed log 105 into conveyor 320.

[0155] Here, the support arm 317 has a bent neck region 337 that allows the paddle member 319 to be pushed into the space formed between the lower and upper conveyor belts 322, 324.

[0156] A log stop 335 limits pushing the log 105 to far into or through the conveyor 105 in the direction 318.

[0157] Once inserted into the conveyor and sufficiently between lower and upper conveyor belts 322, 324, the actuator 331 will return pusher paddles 313 back to its starting point, such as illustrated in FIG. 21 as illustrated by arrow 339. Thus, the pusher paddles 313 will be in position for pushing the next log 105.

[0158] This also removes the paddle member 319 from between the lower and upper conveyor belts 322, 324 to avoid interference between the conveyor 320 and the pusher paddles 313.

[0159] Similar to conveyor 220, the lower and upper conveyor belts 322, 324 are spaced apart from one another an adjustable spacing S (see FIG. 26). The lower and upper conveyor belts 322, 324 are moveable relative to one another as illustrated by arrows 343 such that spacing S can be adjusted between a first spacing that is greater than the height H1 of log 105 (e.g. in an uncompressed state) that allows the log 105 to be indexed into the longitudinal conveyor 320 and a second spacing that is equal to or less than height H1 so that opposed sides (e.g. top and bottom sides) of the log 105 can be engaged by the lower and upper conveyor belts 322, 324 to trans-

port the log 105 in the lengthwise direction (e.g. toward and/or through a log saw as illustrated by arrow 345).

[0160] Preferably and as illustrated in FIG. 26, the spacing S is reduced to less than height H1 of the uncompressed log such that the log 105 is compressed between lower and upper conveyor belts 322, 324 so that conveyor 320 has good control over log 105 for the benefits described above for conveyor 220.

[0161] In one example, the pusher paddles 313 extend vertically above the support surface of the slide table 310 no more than and typically less than the height H1 of the uncompressed log.

[0162] When loading the log 105 into the conveyor 320, the upper surface of the lower conveyor belt 322 may be at or slightly below the support surface of the slide table 310 to prevent the log 105 caught on the lower conveyor belt 322 as it transitions from being supported by slide table 310 to being supported by lower conveyor belt 322.

[0163] In this example, the paddle members 319 remain above a plane defined by the support surface of the slide table 310 when pushing the log 105 from the bucket unloading portions 312 into the conveyor 320 and when returning the pusher paddle 313 to the start position illustrated in FIG. 21.

[0164] In other examples, the paddle members 319 could travel along a path that drops below the support surface of the slide table when returning to the start position illustrated in FIG. 21. This would assist in avoiding the paddle members 319 from running into and interfering with the next log 105 that is being deposited onto the slide table 310. In such an arrangement, the paddle members 319 would be required to have both a horizontal travel component (e.g. illustrated by arrow 318) and a vertical component (e.g. perpendicular to arrow 318).

[0165] Further, while arrows 343 indicate that both the upper and lower conveyor belts 322, 324 are operably moved vertically, e.g. relative to slide table 310, to compress log 105, in some examples, only one of the upper and lower conveyor belts 322, 324 are moved relative to slide table 310, but this would still have the two conveyor belts 322, 324 moving relative to one another to adjust spacing S.

[0166] The embodiments described herein allow for the accumulator 130 to operate such that the buckets 132 remain moving at a constant speed provided by the continuous path of the accumulator even through the unloading and loading paths during the unloading and loading processes. However, these embodiments reduce the complexity of the accumulator 130.

[0167] While the embodiments described above have a single unloading arrangement for removing logs from the accumulator, other embodiments may include multiple unloading arrangements. In such an arrangement, the accumulator would have multiple portions that form an unloading path. In such an arrangement, each unloading arrangement would handle half of the logs that are removed from the accumulator.

[0168] In one example, the unloading arrangements

would be aligned in series. Every other bucket would be unloaded at the first unloading arrangement and the ones that are not unloaded at the first unloading arrangement would be unloaded at the second unloading arrangement.

[0169] It is contemplated that by separating the unloading to two separate unloading arrangements allows for more buckets to be unloaded per minute while reducing the speeds at which the unloading arrangement has to operate, e.g. how fast any unloading belts have to move or how fast any pusher paddles have to move.

[0170] Further, the conveyors of the unloading arrangements could be aligned in parallel such that a single downstream cutoff could be used to cut the both streams of logs. E.g. a rotary spinning cutoff would be located between the adjacent lanes of removed logs and cut one lane of logs in a first half of its rotational path and cut the other lane of logs in the second half of its rotational path.

[0171] In some examples, when multiple unloading arrangements, the buckets that skip a first unloading arrangement, numerous means for bypassing the first unloading arrangement are contemplated. For example, the buckets that skip could cooperate with a cam arrangement that tip the bucket out of the unloading path such that the log and bucket do not cooperate with the unloading arrangement and remove the log from the bucket.

[0172] In some examples, the skipping buckets could be removed from the chain or belt of the accumulator and attached to a different belt or chain or guided by other mechanisms as it passes around the components of the first unloading arrangement and then reattached to the chain or belt as it travels to and through the unloading path of the second unloading arrangement.

[0173] In some examples, portions of the unloading arrangement that intersect the unloading path could be actuated out of the unloading path along with or separate from the logs that it is unloading to permit the skipping logs to bypass the unloading arrangement. For example, unloading portions 312 could tip downward as soon as an associated log is discharged therefrom to permit a subsequent log to bypass the corresponding unloading arrangement.

[0174] All references, including publications, patent applications, and patents cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0175] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) is to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of

referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

[0176] Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

[0177] The following clauses, which are not claims, may relate to one or more aspects or embodiments of the present invention:

1. An accumulator unloading apparatus for unloading a log of folded sheets from a bucket of an accumulator traveling along an unloading path, the log having a length, a width and a height, the apparatus comprising:

an indexing conveyor including laterally spaced apart indexing belts, the indexing conveyor having a log receiving region that intersects the unloading path, the indexing belts passing through the log receiving region, within the log receiving region, the indexing conveyor having gaps formed between adjacent indexing belts configured to pass portions of the bucket there-through as the bucket travels along the unloading path;

a longitudinal conveyor including a first conveyor belt and a second conveyor belt spaced apart from the first conveyor belt, the first and second conveyor belts being moveable relative to one another to adjust a spacing therebetween including a first spacing that is greater than the height of the log and a second spacing that is equal to or less than the height of the log;

wherein:

the first conveyor belt is guided along an undulating path, the undulating path has a plurality of peaks and a plurality of valleys, a first peak of the plurality of peaks is positioned laterally between a corresponding pair of indexing belts of the indexing conveyor and a first valley of the plurality of valleys is aligned with a first indexing belt of the plurality of indexing belts of the indexing conveyor;

the first conveyor belt is positionable relative to the plurality of indexing belts between a first orientation in which the second conveyor belt is closer to the indexing belts than the first conveyor belt and a second orientation in which the second conveyor belt is closer to the first conveyor belt than the indexing belts.

2. The accumulator unloading apparatus of clause 1, wherein, when in the second orientation, the first indexing belt is received in the first valley of the undulating path to a greater extent than when in the first orientation.

3. The accumulator unloading apparatus of clause 1, wherein at least a portion of the undulating path defining the first valley extends through a perimeter defined by a path traveled by the first indexing belt.

4. The accumulator unloading apparatus of clause 1, wherein the first and second conveyor belts are spaced from the unloading path along indexing belts a distance of at least 2 times the width of the log.

5. The accumulator unloading apparatus of clause 1, wherein the first conveyor belt is configured to move perpendicular to the indexing belts to lift the log relative to the indexing belts when the log is located in the space formed between the first and second belts.

6. The accumulator unloading apparatus of clause 1, wherein the first conveyor belt is configured to move relative to the indexing belts parallel to the unloading path to lift the log relative to the indexing belts when the log is located in the space formed between the first and second belts.

7. The accumulator unloading apparatus of clause 6, wherein the lifting of the log relative to the indexing belts entirely disengages the log from the indexing belts.

8. The accumulator unloading apparatus of clause 1,

wherein the indexing belts transport the log in a direction that is perpendicular to a length of the log and the first and second conveyor belts transport the log in a direction that is parallel to the length of the log.

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9. The accumulator unloading apparatus of clause 1 further including a guide table providing guide surfaces interposed between the indexing belts for supporting portions of the log that are offset from the indexing belts, the guide surfaces offset from the log receiving region and the gaps.

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10. A method of unloading an accumulator comprising:

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passing a bucket of an accumulator carrying a log of folded sheets along an unloading path of the accumulator through the log receiving region of the accumulator unloading apparatus of clause 1;

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transferring the log of folded sheets from the bucket to the indexing belts as the bucket passes through the log receiving region.

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11. The method of clause 10, wherein:

a portion of the bucket passes through one of the gaps in the log receiving region formed between adjacent indexing belts while traveling along the unloading path and as the log is transferred to the indexing belts.

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12. The method of clause 10, further comprising:

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transporting the log with the indexing belts parallel to the width of the log into the longitudinal conveyor and between the first and second conveyor belts;

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transporting the log with the first and second conveyor belts parallel to the length of the log with the first and second conveyor belts in the second spacing, with the first and second conveyor belts engaging the log, and with the first conveyor belt in the second orientation.

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13. An accumulator unloading apparatus for unloading a log of folded sheets from a bucket of an accumulator traveling along an unloading path, the log having a length, a width and a height, the length being greater than the width and the height, the apparatus comprising:

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a slide table having a log support surface, the slide table including laterally spaced apart bucket unloading portions forming a log receiving

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region that intersects the unloading path, the slide table has gaps formed between adjacent bucket unloading portions configured to permit portions of the bucket supporting the log to pass through the log receiving region as the bucket travels along the unloading path;

a longitudinal conveyor including a first conveyor belt and a second conveyor belt spaced apart from the first conveyor belt, the first and second conveyor belts being moveable relative to one another to adjust a spacing therebetween including a first spacing that is greater than the height of the log and a second spacing that is equal to or less than the height of the log, the longitudinal conveyor configured to transport the log parallel to the length of the log; and

at least one pusher paddle actuatable parallel to a pusher paddle axis that is parallel to a width of the log to transport the log from the log receiving region into the longitudinal conveyor between the first and second conveyor belts.

14. The accumulator unloading apparatus of clause 13, wherein the at least one pusher paddle transports the log by pushing the log along the support surface of the slide table.

15. The accumulator unloading apparatus of clause 13, further comprising a carriage and an actuator, the carriage movable generally parallel to the pusher paddle axis; wherein the at least one pusher paddle includes a plurality of pusher paddles, each pusher paddle being attached to the carriage for movement with the carriage parallel to the pusher paddle axis, each pusher paddle includes:

a) a pusher member that engages a vertical side of the log as the pusher paddle transports the log from the log receiving region and into the longitudinal conveyor, the pusher member being positioned vertically above the slide table; and

b) a support leg that extends below the support surface of the slide, the support leg supporting the pusher member and being attached to the carriage.

16. The accumulator unloading apparatus of clause 13, wherein the at least one pusher paddle extends vertically through a slot formed in the slide table such that a portion of the pusher paddle is vertically above the support surface of the slide table and a portion is vertically below the support surface of the slide table, the portion of the pusher paddle being vertically above the support surface having a width being

perpendicular to the pusher paddle axis and perpendicular to the unloading path that is greater than a width of the slot.

17. The accumulator unloading apparatus of clause 16, wherein the slot formed in the slide table is formed in one of the bucket unloading portions and extends longitudinally parallel to the pusher paddle axis.

18. The accumulator unloading apparatus of clause 13, wherein the at least one pusher paddle has a paddle member and a support arm, the support arm having a bent neck such that the paddle member may be located between the first and second conveyor belts while the support arm is positioned offset from the conveyor when the pusher paddle transports the unloaded log into the longitudinal conveyor.

19. A method of unloading an accumulator comprising:

passing a bucket of an accumulator carrying a log of folded sheets along an unloading path of the accumulator through the log receiving region of the accumulator unloading apparatus of clause 13;

transferring the log from the bucket to the bucket unloading portions of the slide table as the bucket passes through the log receiving region.

20. The method of clause 19, including passing a portion of the bucket through one of the gaps in the log receiving region formed between adjacent bucket unloading portions while the bucket travels along the unloading path and as the log is transferred to the slide table.

21. The method of clause 13, further comprising:

transporting the log with the at least one pusher paddle parallel to the width of the log into the longitudinal conveyor and between the first and second conveyor belts;

transporting the log with the first and second conveyor belts parallel to the length of the log with the first and second conveyor belts in the second spacing.

Claims

1. A method of loading an accumulator with logs of folded sheets being formed by being separated from a continuously forming stream of sheets exiting a sheet folder, the stream of folded sheet being formed

along a stacking axis, the method comprising:

moving a log holding bucket along a loading path, the log holding bucket having a log supporting surface;
transporting a log of folded sheets separated from the stream of sheets away from the stream of sheets along the loading path; and
loading the log of folded sheets onto the log support surface while the log of folded sheets and the log holding bucket travel along the loading path.

2. The method of any preceding claim, wherein:

the step of transporting the log of folded sheets away from the stream of sheets includes transporting the log with a finger of a carriage;
the step of loading the log of folded sheets onto the log support surface includes abutting a side of the log of folded sheets against an abutment adjacent the loading path by retracting the finger from the loading path, the abutment preventing the log of folded sheets from being retracted from the loading path with the finger thereby removing the log of folded sheets from the finger and transferring to the log of folded sheets to the supporting surface, and/or

wherein:

the step of loading the log of folded sheets onto the log supporting surface includes:

transporting, at a first speed, the log of folded sheets along the loading path with the log of folded sheets supported by a finger of a carriage;
moving the log holding bucket along the loading path at a second speed slower than the first speed such that the finger of the carriage passes the log supporting surface along the loading path and the log is transferred to the log supporting surface.

3. The method of claim 1, further comprising tipping the bucket after the step of loading the log of folded sheets onto the log support surface such that the log support surface is less orthogonal to the loading path than during the step of loading the log of folded sheets onto the log support surface, and/or

wherein:

the loading path is coaxial with the stacking axis such that the sheets forming the log of folded sheets travel along a single axis while:

in the stream of sheets;
being separated from the stream of sheets to form the log;
being transported away from the stream of

sheets while being part of the log; and
being loaded onto the log support surface.

4. The method of any preceding claim, further including:

building the log of folded sheets on a build finger;
separating the log of folded sheets from the
stream of sheets with the log of folded sheets
supported by the build finger; and

wherein:

the step of transporting the log of folded
sheets along the loading path includes
transporting the log of folded sheets
along the loading path using the build
finger; and

the step of loading the log of folded
sheets onto the log support surface
includes directly transferring the log
of folded sheets from the build finger
to the log support surface while the
bucket and build finger travel along
the loading path, and optionally

wherein the step of loading the log of folded
sheets onto the log support surface in-
cludes:

retracting the build finger from the load-
ing path; and
abutting a side of the log of folded
sheets against an abutment adjacent
the loading path as the build finger is
being retracted from the loading path
such that the log of folded sheets is
prevented from being retracted from
the loading path with the build finger
thereby removing the log of folded
sheets from the build finger and trans-
ferring to the log of folded sheets to the
supporting surface.

5. The method of any preceding claim, further includ-
ing:

building the log of folded sheets on a build finger;
separating the log folded sheets from the stream
of sheets, while the sheets forming the log of
folded sheets are supported by the build finger;
transferring the log of folded sheets to a transfer
finger;

wherein:

the step of transporting the log of folded
sheets along the loading path includes

transporting the log of folded sheets
along the loading path using the trans-
fer finger; and

the step of loading the log of folded
sheets onto the log support surface
includes directly transferring the log
of folded sheets from the transfer finger
to the log support surface while the
bucket and transfer finger travel along
the loading path, and optionally

wherein the step of loading the log of folded
sheets onto the log support surface in-
cludes:

retracting the transfer finger from the
loading path; and
abutting a side of the log of folded
sheets against an abutment adjacent
the loading path as the transfer finger is
being retracted from the loading path
such that the log of folded sheets is
prevented from being retracted from
the loading path with the transfer finger
thereby removing the log of folded
sheets from the transfer finger and
transferring to the log of folded sheets
to the supporting surface.

6. The method of any preceding claim, wherein the step
of loading the log of folded sheets onto the log sup-
port surface does not include transporting the log of
folded sheets along an axis transverse to the loading
path.

7. The method of any preceding claim, further includ-
ing:

building the log of folded sheets along the stack-
ing axis, the stacking axis being a vertical axis
that is coaxial with the loading axis;
separating the log of folded sheets from the
stream of sheets; and

wherein the buckets and log of folded
sheets move vertically downward while tra-
veling along the loading path, and optionally
further comprising tipping the bucket after
the step of loading the log of folded sheets
onto the log support surface such that the
log support surface is less orthogonal to the
loading path than during the step of loading
the log of folded sheets onto the log support
surface, wherein after the bucket has been
tipped, the log of folded sheets is vertically
supported on at least two sides of the log of
folded sheets.

8. The method of any preceding claim, wherein:

the step of loading the log of folded sheets onto the log supporting surface includes:

transporting, in a first direction, the log of folded sheets along the loading path with the log of folded sheets supported by a finger of a carriage;
moving the log holding bucket along the loading path in a second direction such that the finger of the carriage passes the log supporting surface along the loading path and the log is transferred to the log supporting surface, and/or

wherein the loading path is non-parallel with the stacking axis.

9. An apparatus comprising:

an accumulator for holding a plurality of logs of folded sheets, the accumulator comprising a plurality of buckets carried along a continuous path, a portion of the continuous path including a loading path;
a log transport mechanism configured to carry a log of folded sheets along the loading path;
means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path.

10. The apparatus of claim 9, wherein the means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path includes:

a finger of the log transport mechanism that can be retracted from the loading path; and
an abutment adjacent the loading path that prevents the log from being removed from the loading path as the finger is retracted from the loading path

11. The apparatus of claim 9 or claim 10, wherein the means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path includes:

a finger of the log transport mechanism that travels along the loading path at a speed greater than the bucket travels along the loading path such that the finger passes the bucket while

traveling along the loading path and the log of folded sheets is transferred to the bucket, and optionally

wherein the bucket includes a plurality of spaced apart bucket portions forming gaps therebetween and the finger includes a plurality of finger portions forming gaps therebetween, the finger portions passing through the gaps formed between adjacent bucket portions as the finger passes the bucket such that the bucket portions abut a side of the log of folded sheets that is being supported by the finger portions thereby transferring the log of folded sheets to the bucket portions.

12. The apparatus of claim 9, wherein the log of folded sheets is separated from a stream of sheets forming along a stacking axis, the stacking axis being coaxial with the loading path, and optionally wherein the stacking axis and loading path are coaxial such that the sheets forming the log of folded sheets travel along a single axis while:

in the stream of sheets;
are carried by the log transport mechanism; and
are transferred from the log transport mechanism to the bucket.

13. The apparatus of claim 9, wherein:

the buckets travel along the loading path with a log support surface upon which the logs are supported when the logs are transferred to the buckets being substantially orthogonal to the loading path; and
the buckets tip after receiving a log of folded sheets such that the log support surface is less orthogonal to the loading path after receiving the log of folded sheets and the log of folded sheets is supported on at least two sides.

14. The apparatus of claim 9, further comprising a log unloading arrangement including a plurality of laterally spaced indexing belts forming gaps therebetween;
wherein:

a portion of the continuous path of the accumulator includes at least one unloading path, each bucket travels along the unloading path and unloads the log of folded sheets carried thereby onto the indexing belts;
the laterally spaced belts extend into the unloading path;
each bucket passes through the gaps formed between the laterally spaced indexing belts to transfer the log of folded sheets to the indexing belts, and optionally

wherein the log of folded sheets carried by the bucket has a length, a width and a height that are perpendicular to one another, the length being the greatest dimension and being at least three times the width dimension, the height being aligned with the unloading path as the bucket travels along the unloading path, the indexing belts being aligned with the width such that the indexing belts need index a log of folded sheets less than the length of the log of folded sheets to permit a subsequent bucket and subsequent log carried by the subsequent bucket to clear the log of folded sheets.

15. The apparatus of claim 9, wherein the means for transferring the log of folded sheets from the log transport mechanism to one of the buckets of the plurality of buckets while the log of folded sheets and the bucket travel along the loading path includes a transport mechanism that carries the log along the loading path at an opposite direction as the bucket travels along the loading path.
16. The apparatus of claim 14, wherein the at least one portion of the continuous path includes multiple unloading paths, and optionally wherein the unloaded log has a length, a width and a height that are perpendicular to one another, the length being the greatest dimension and being at least three times the width dimension, the height being aligned with the unloading path as the bucket travels along the unloading path, the at least one pusher paddle transporting the unloaded log along an axis that is aligned with the width such that the unloaded log is transported entirely out of the unloading path
17. The apparatus of claim 9, further comprising a log unloading arrangement including a slide table having plurality of laterally spaced bucket unloading portions forming gaps therebetween;

wherein:

a portion of the continuous path of the accumulator includes at least one unloading path, each bucket travels along the unloading path and unloads the log of folded sheets carried thereby onto the bucket unloading portions of the slide table; the laterally spaced bucket unloading portions extend into the unloading path; each bucket passes through the gaps formed between the laterally spaced bucket unloading portions to transfer the log of folded sheets to the slide table, and optionally

wherein the at least one portion of the continuous path includes multiple unloading paths.

18. The apparatus of claim 17, further including at least one pusher paddle configured to transport an unloaded log supported by the bucket unloading portions of the slide table along the slide table and out of the unloading path.
19. The apparatus of claim 18, wherein:
 - the at least one pusher paddle has a paddle member and a support leg;
 - the paddle member is located vertically above the slide table and abuts a vertical side of the unloaded log when the at least one pusher paddle transports the unloaded log out of the unloading path;
 - the support leg supports the paddle member and extends vertically through a slot formed in the slide table, and optionally wherein the slot through which the support leg extends is formed, at least in part, in the bucket unloading portion and is not provided by a gap through which the bucket passes as the log is transferred from the bucket to the bucket unloading portions of the slide table.
20. The apparatus of claim 18, further comprising a longitudinal conveyor having first and second conveyor belts having adjustable spacing therebetween, the longitudinal conveyor configured to transport the unloaded log parallel to the length of the unloaded log, the at least one pusher paddle transporting the unloaded log from the slide table into the longitudinal conveyor and between the first and second conveyor belts.

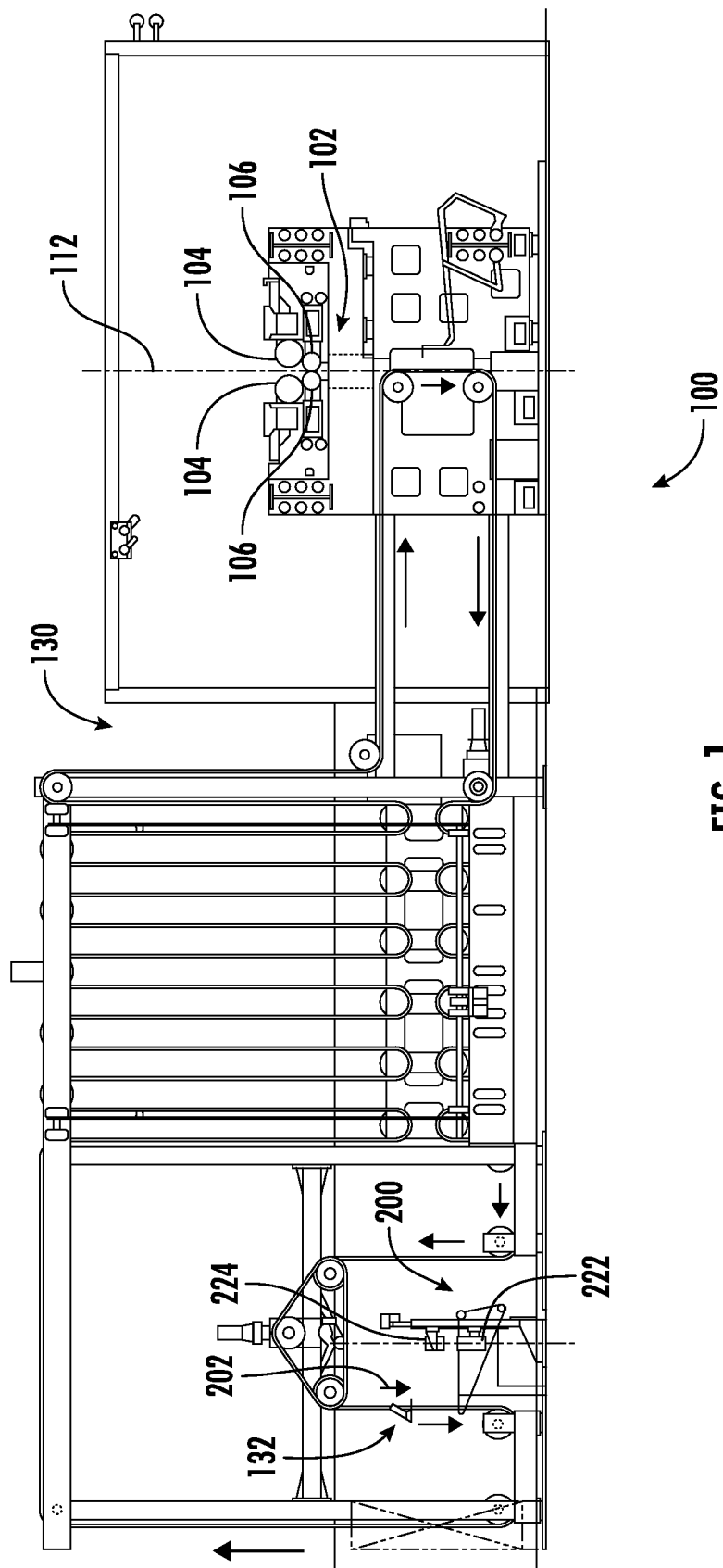


FIG. 1

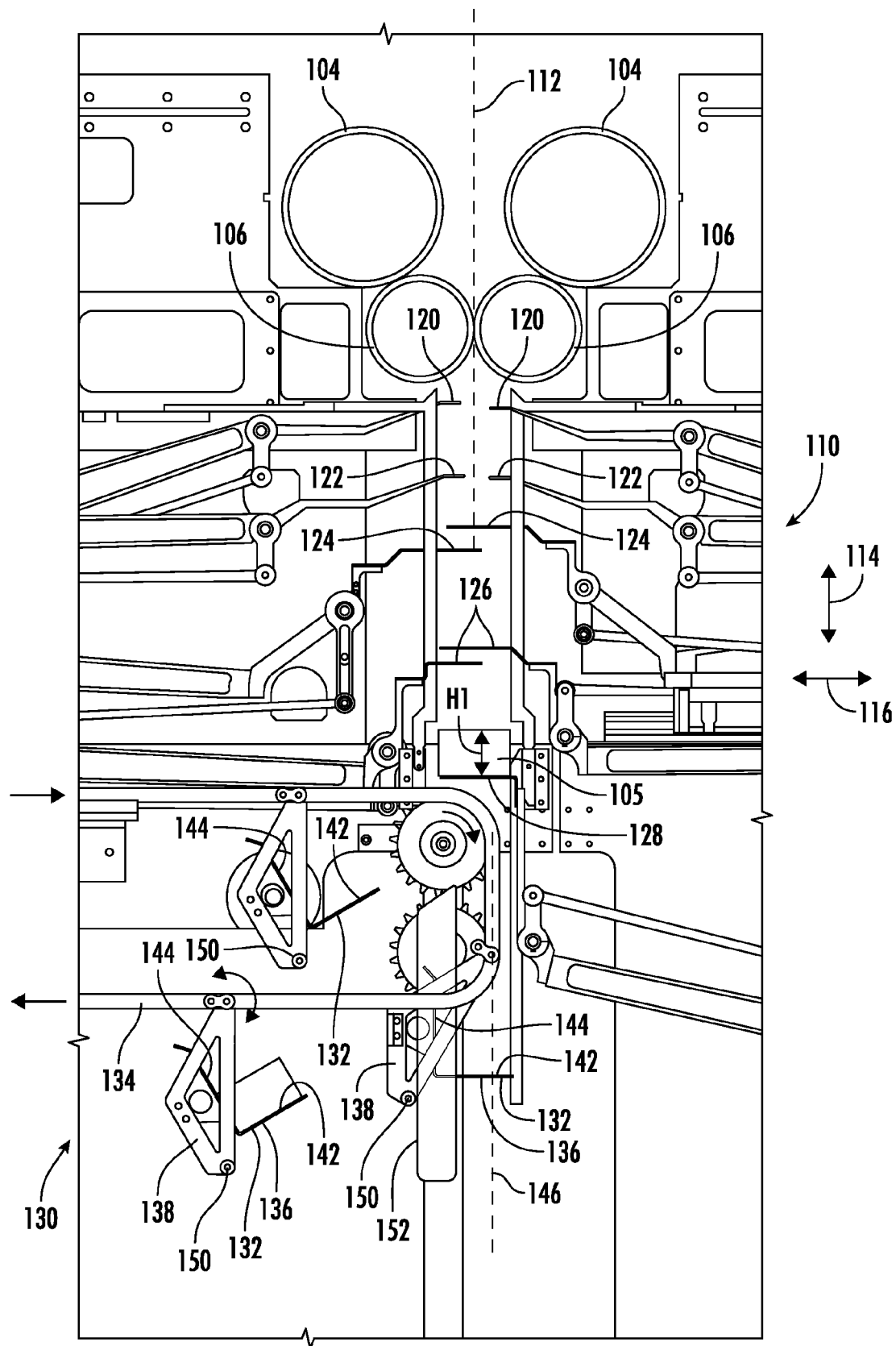
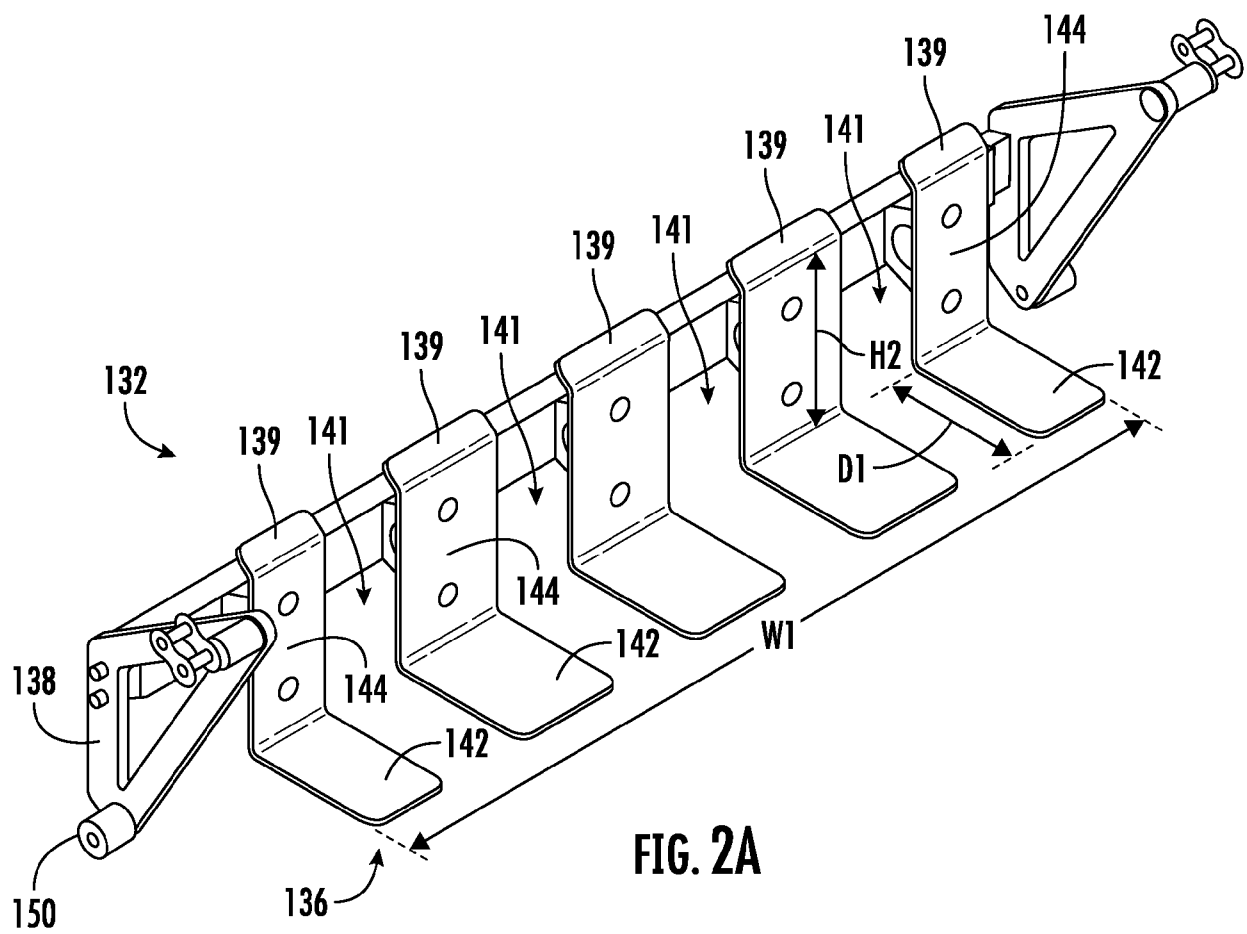


FIG. 2



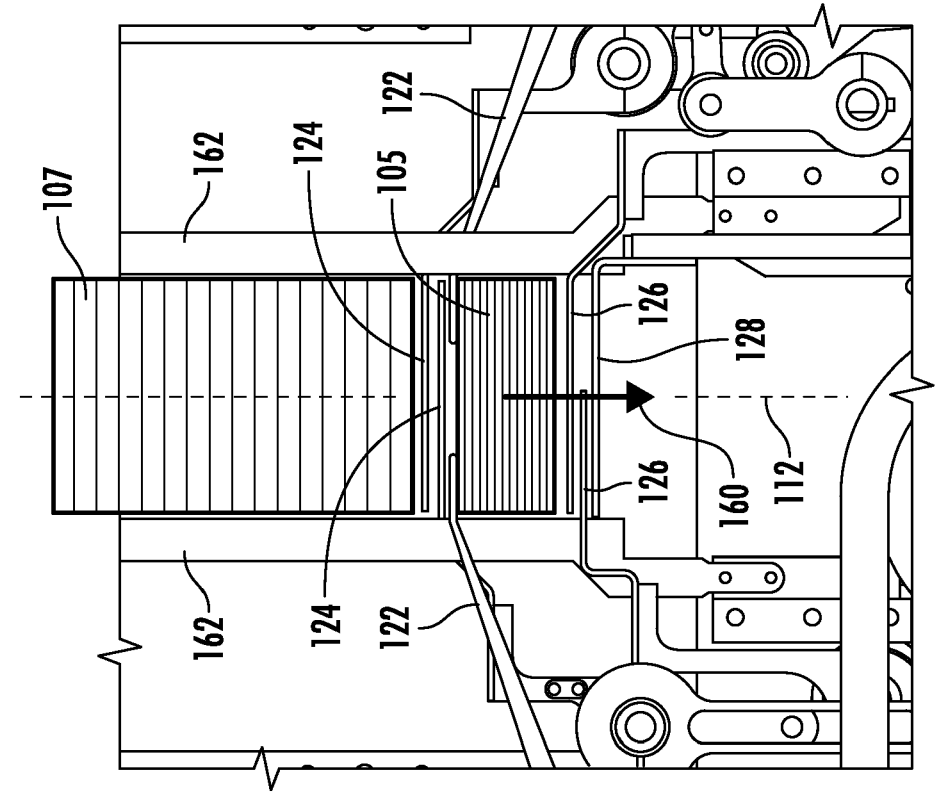


FIG. 3

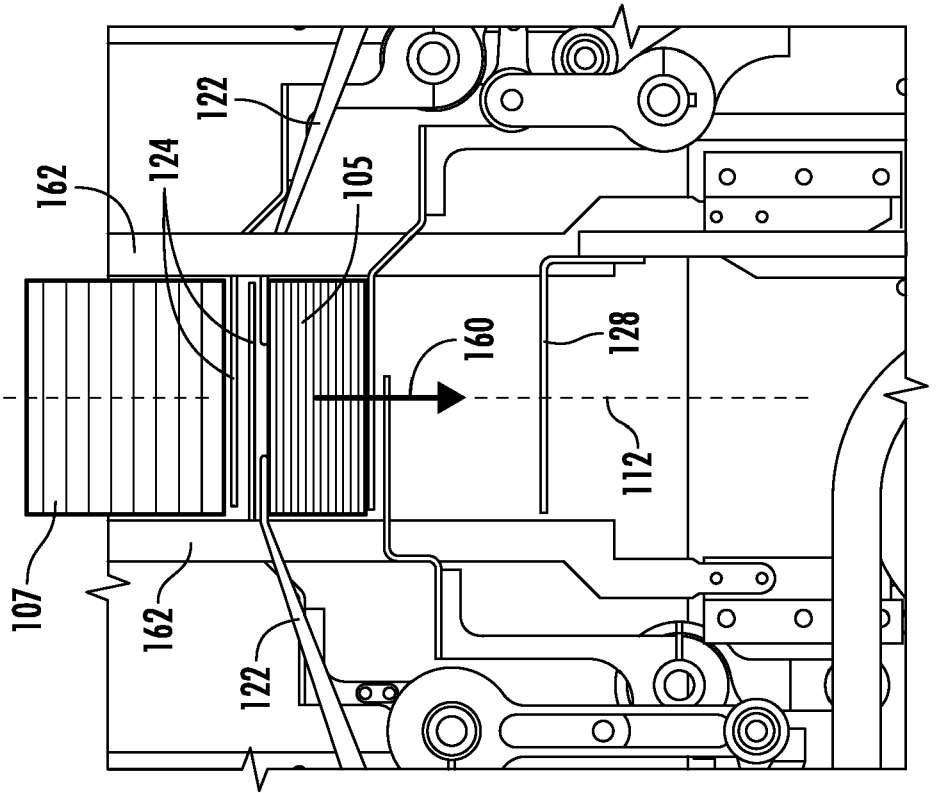


FIG. 4

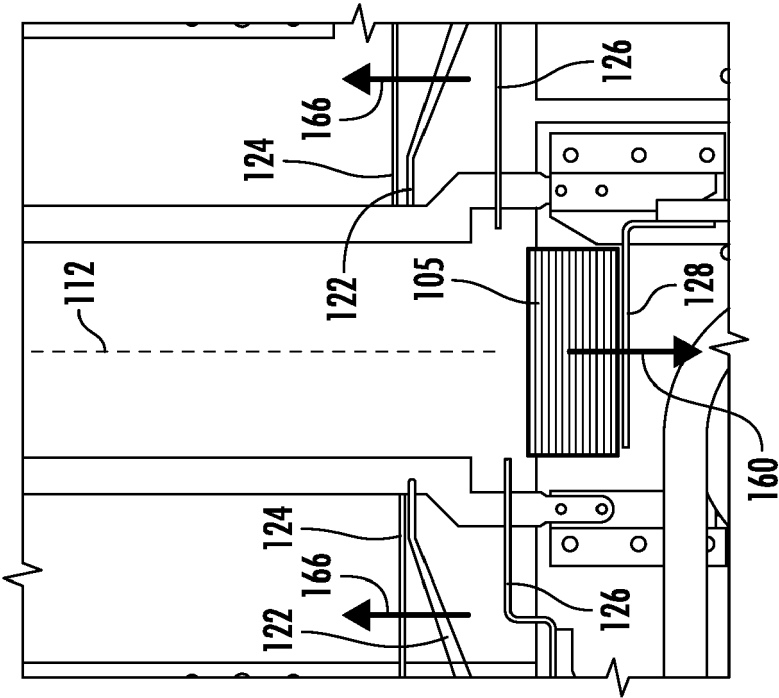


FIG. 5

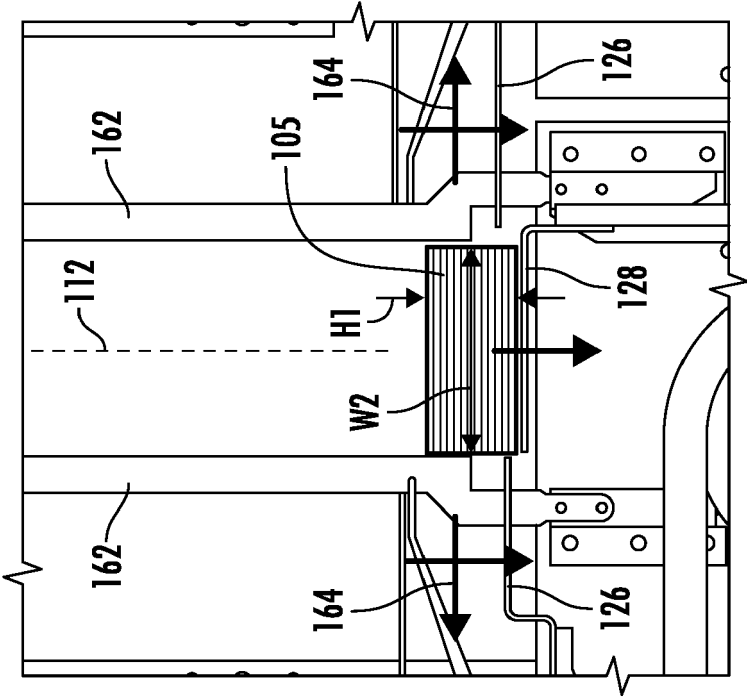


FIG. 6

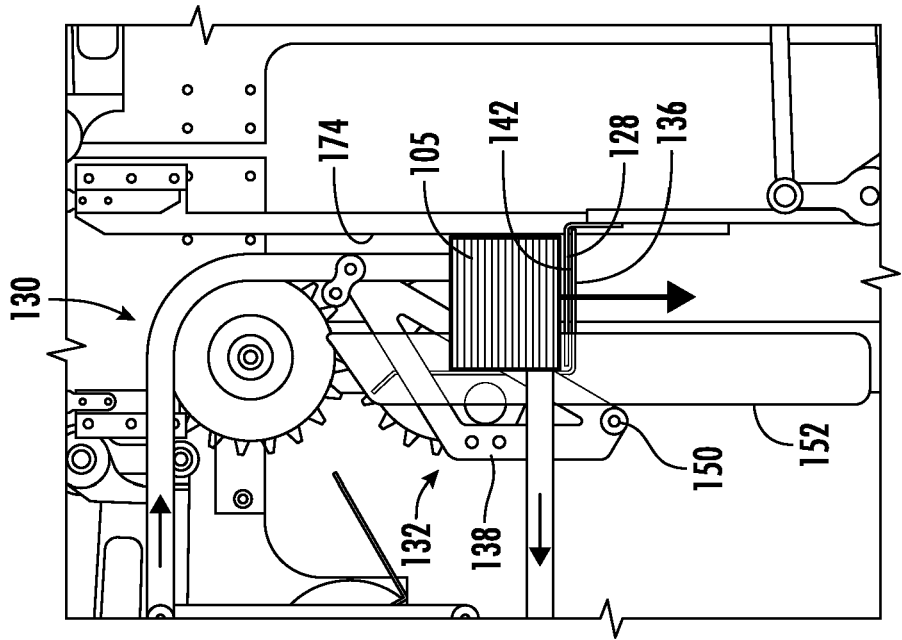


FIG. 7

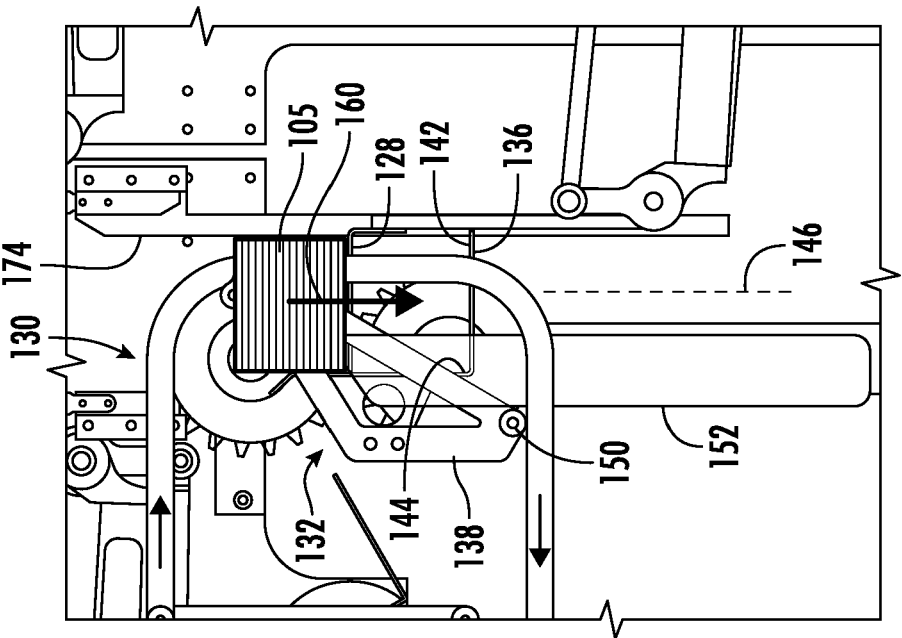


FIG. 8

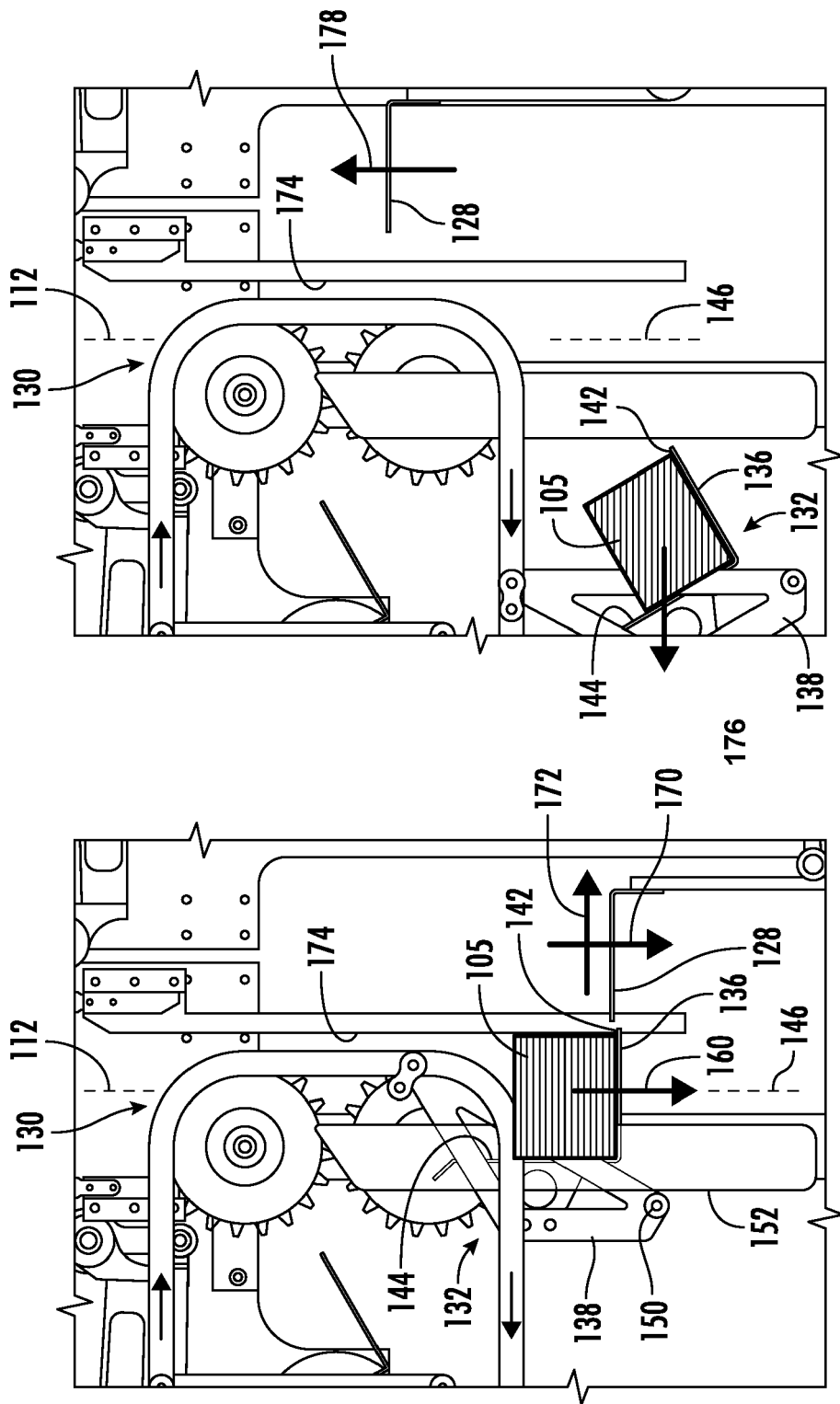


FIG. 10

FIG. 9

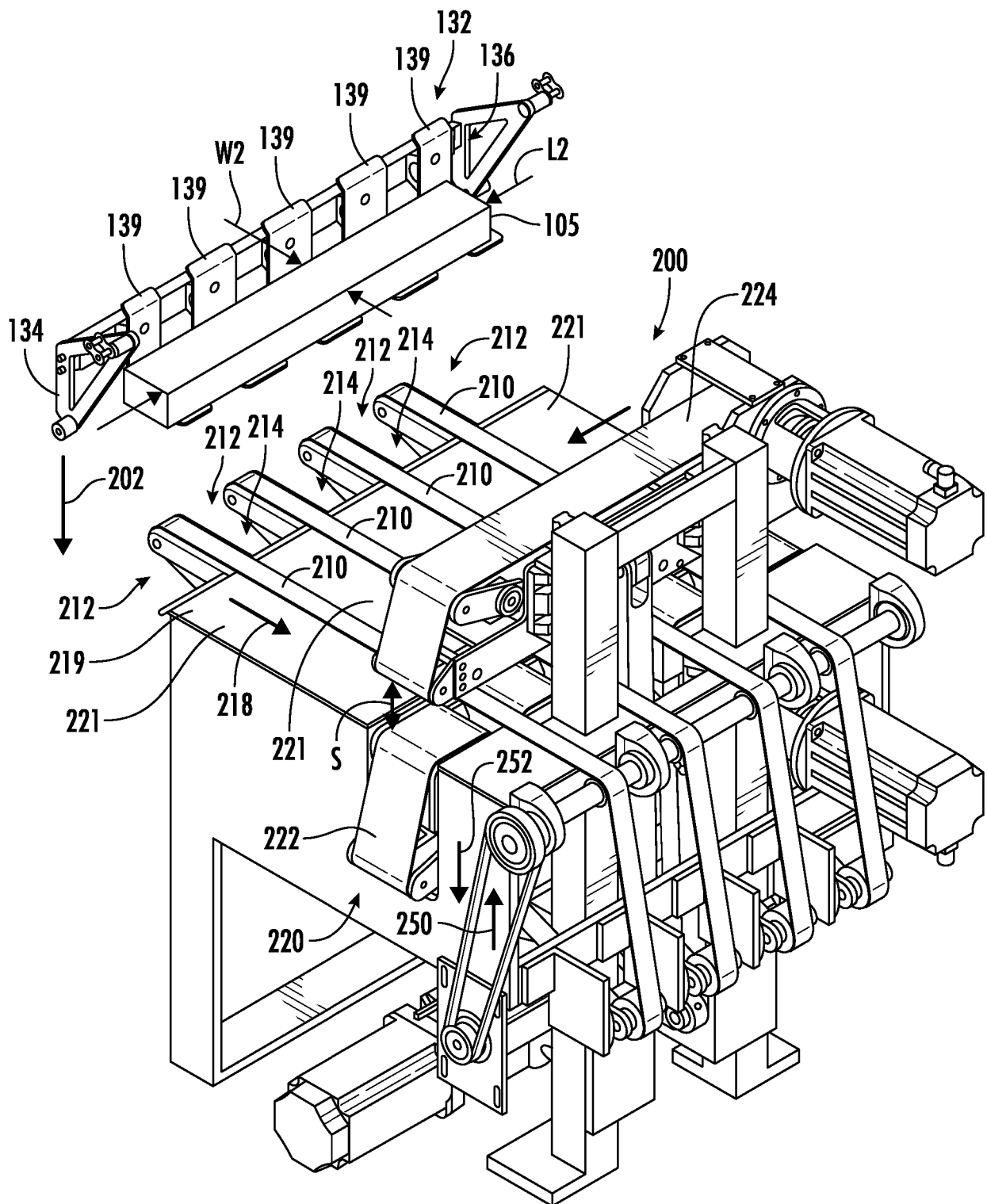


FIG. 11

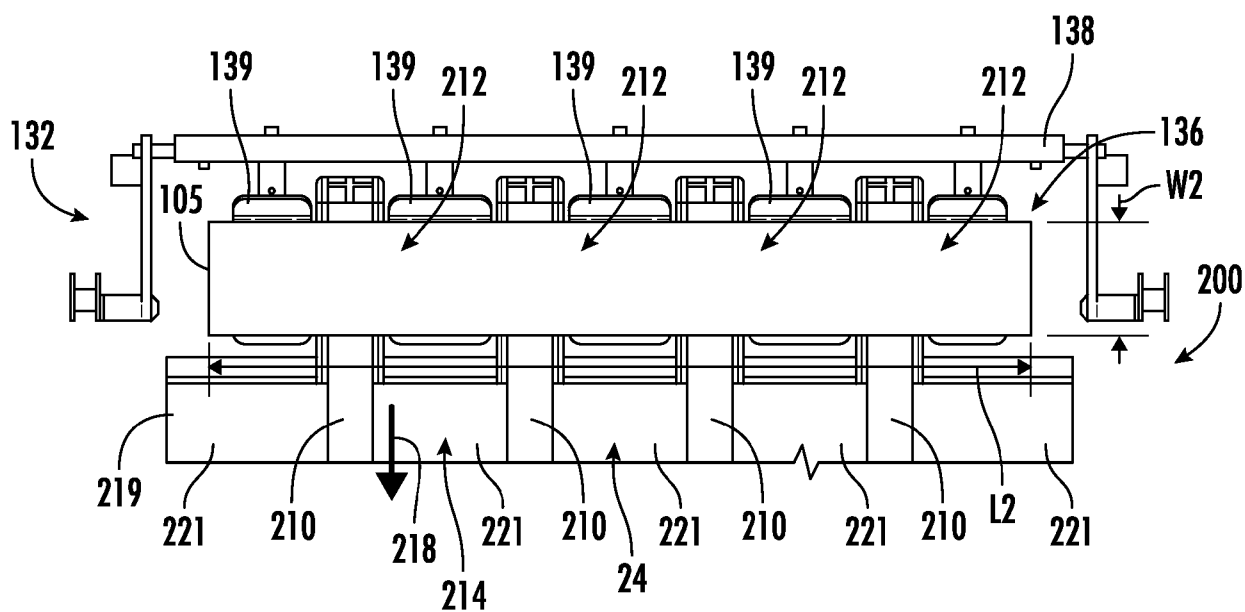


FIG. 12

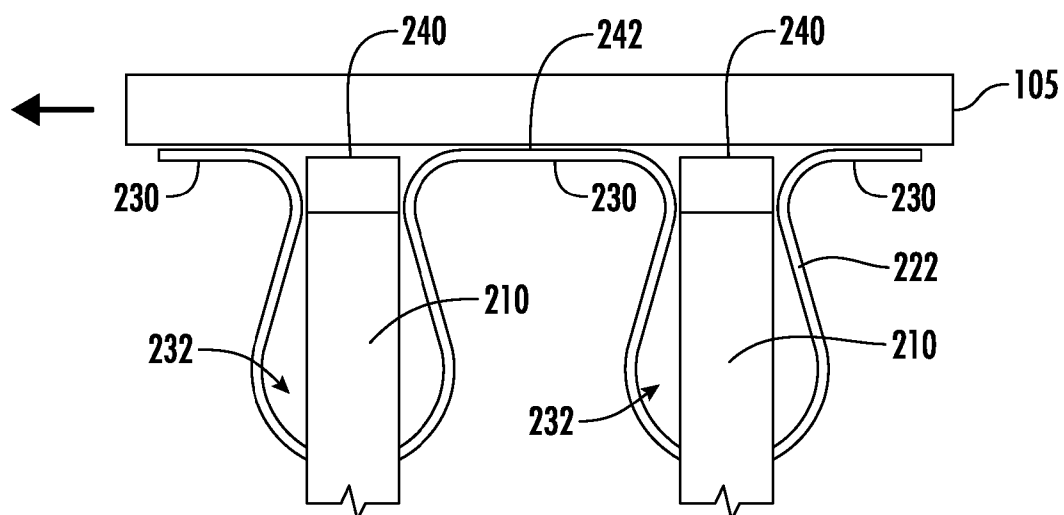
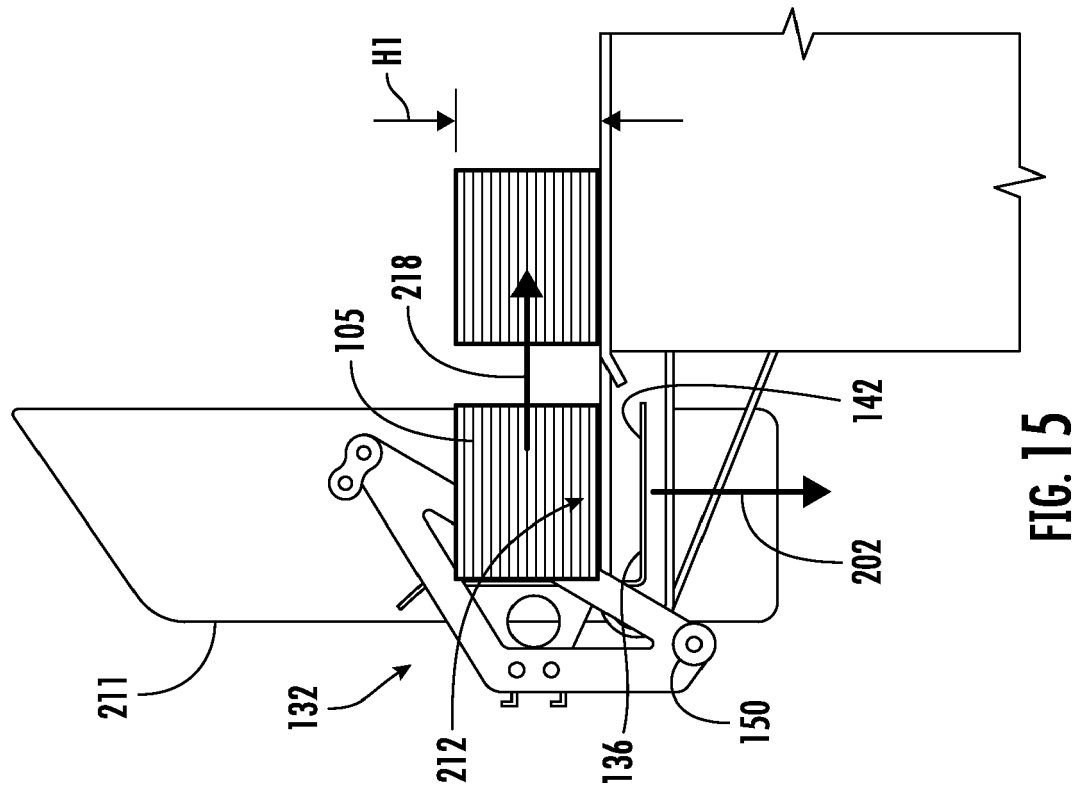
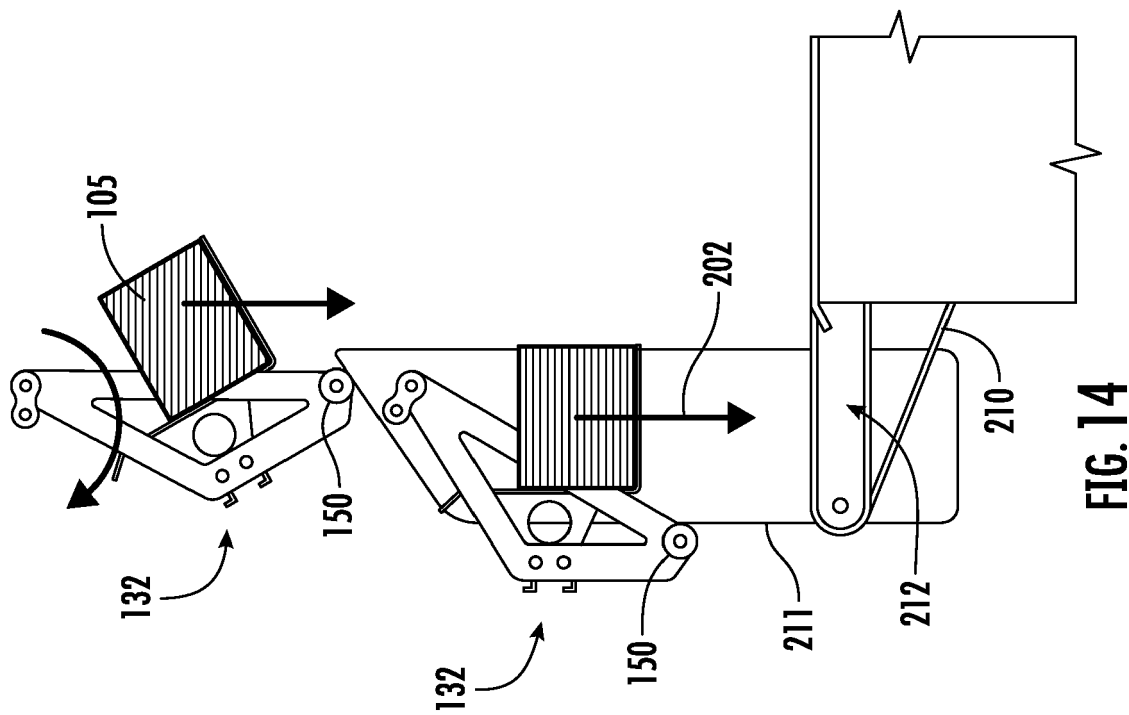


FIG. 13



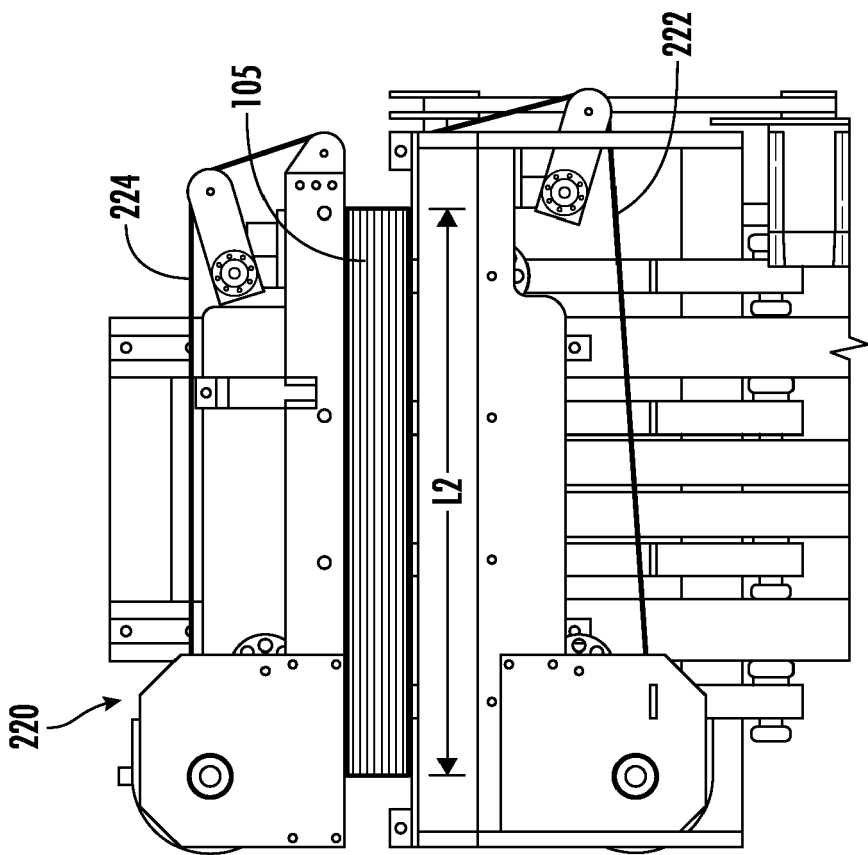


FIG. 17

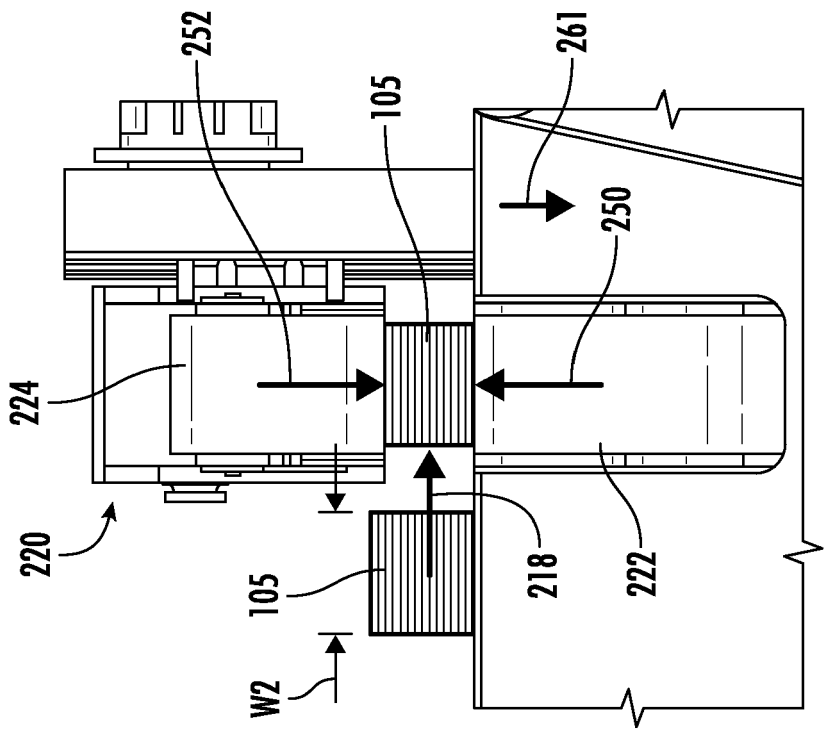


FIG. 16

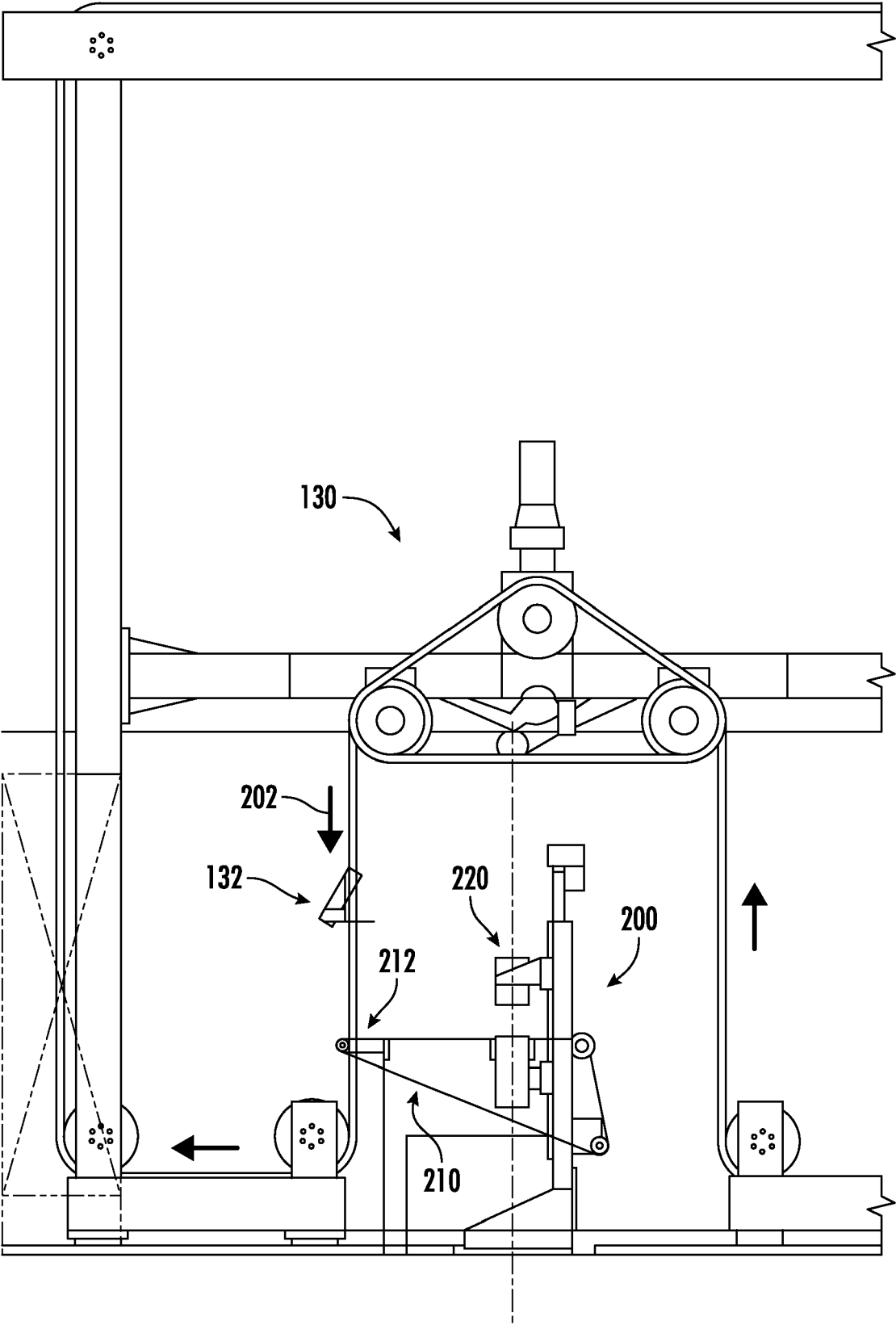
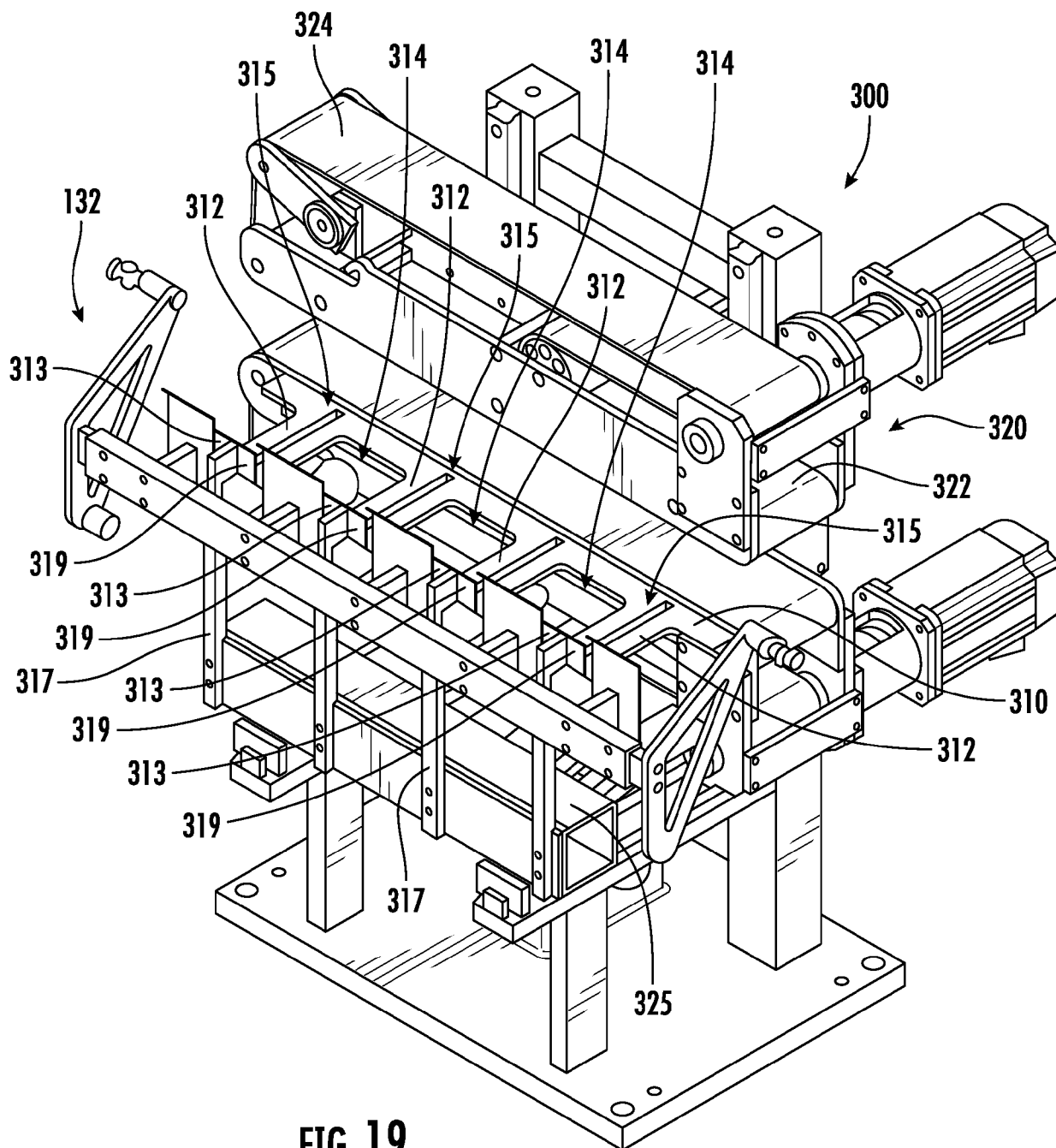
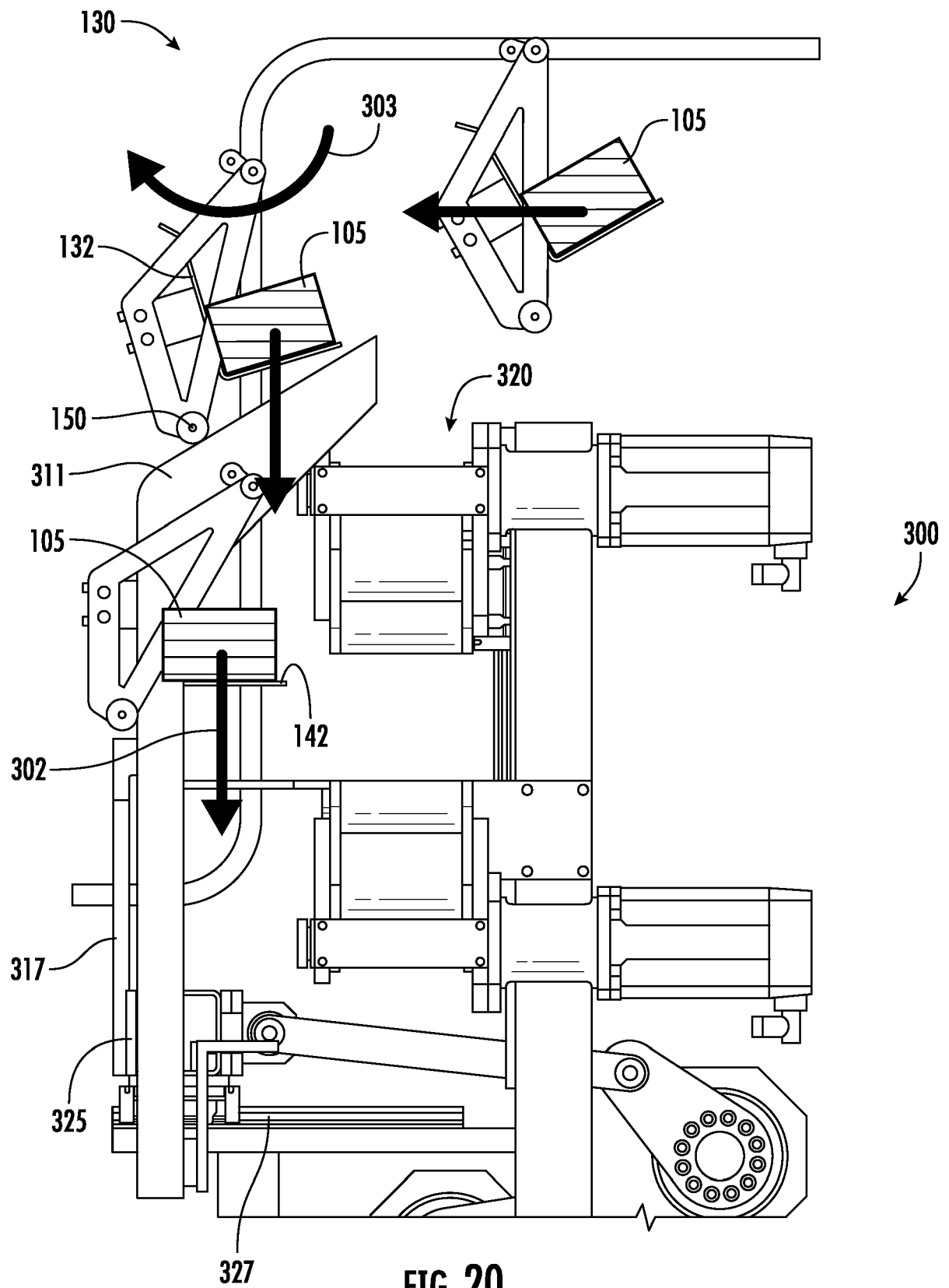


FIG. 18





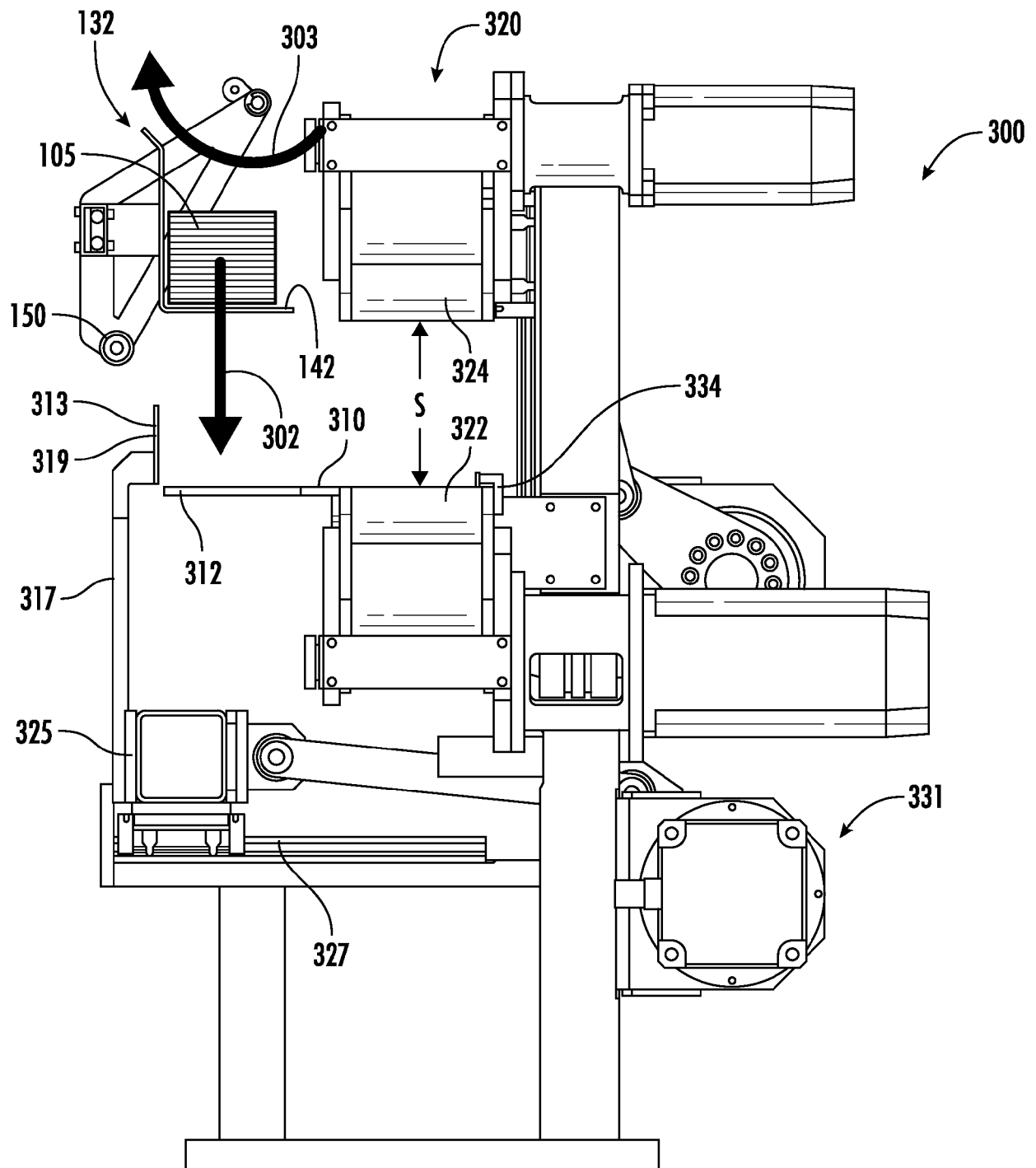


FIG. 21

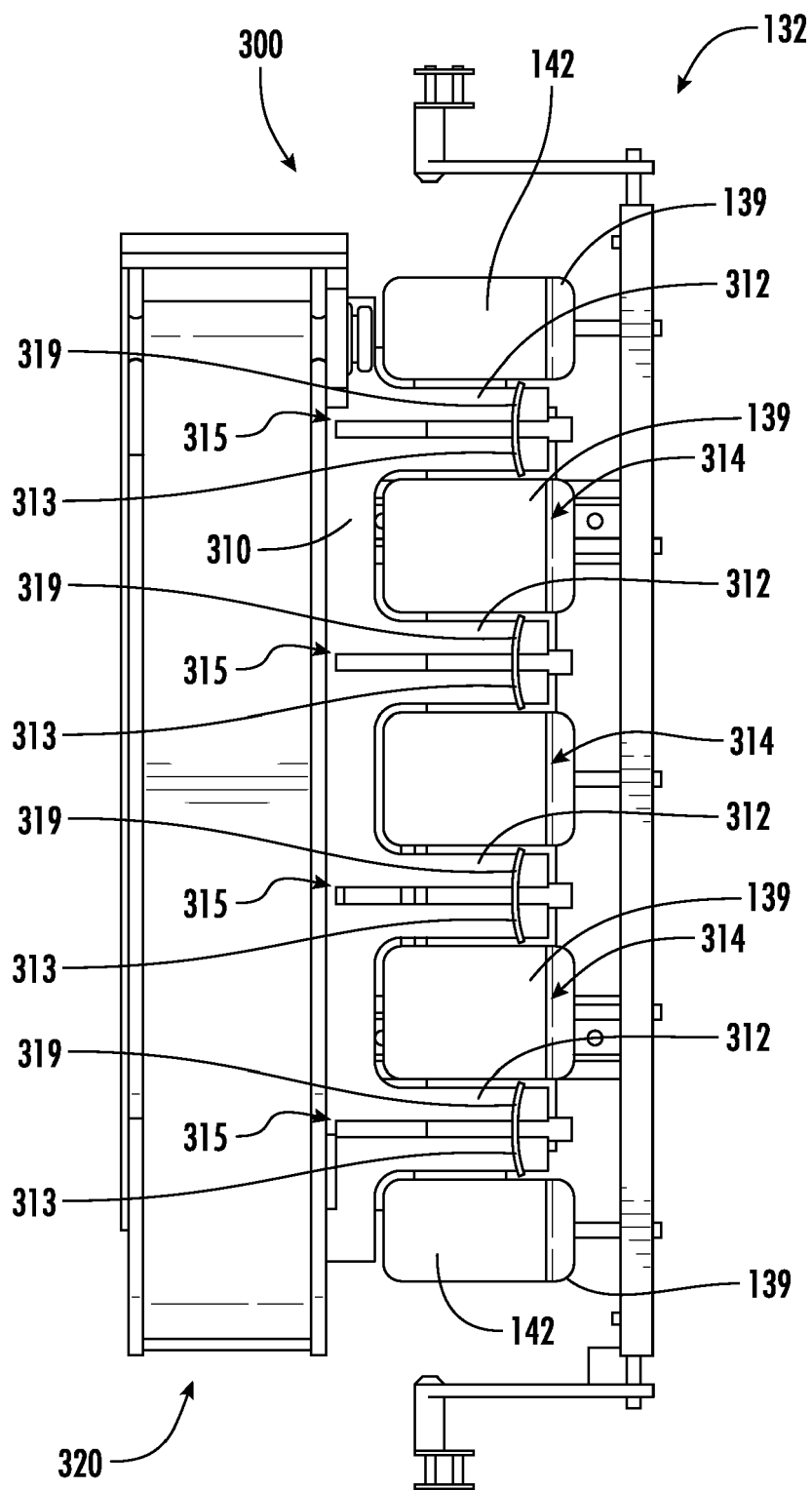


FIG. 22

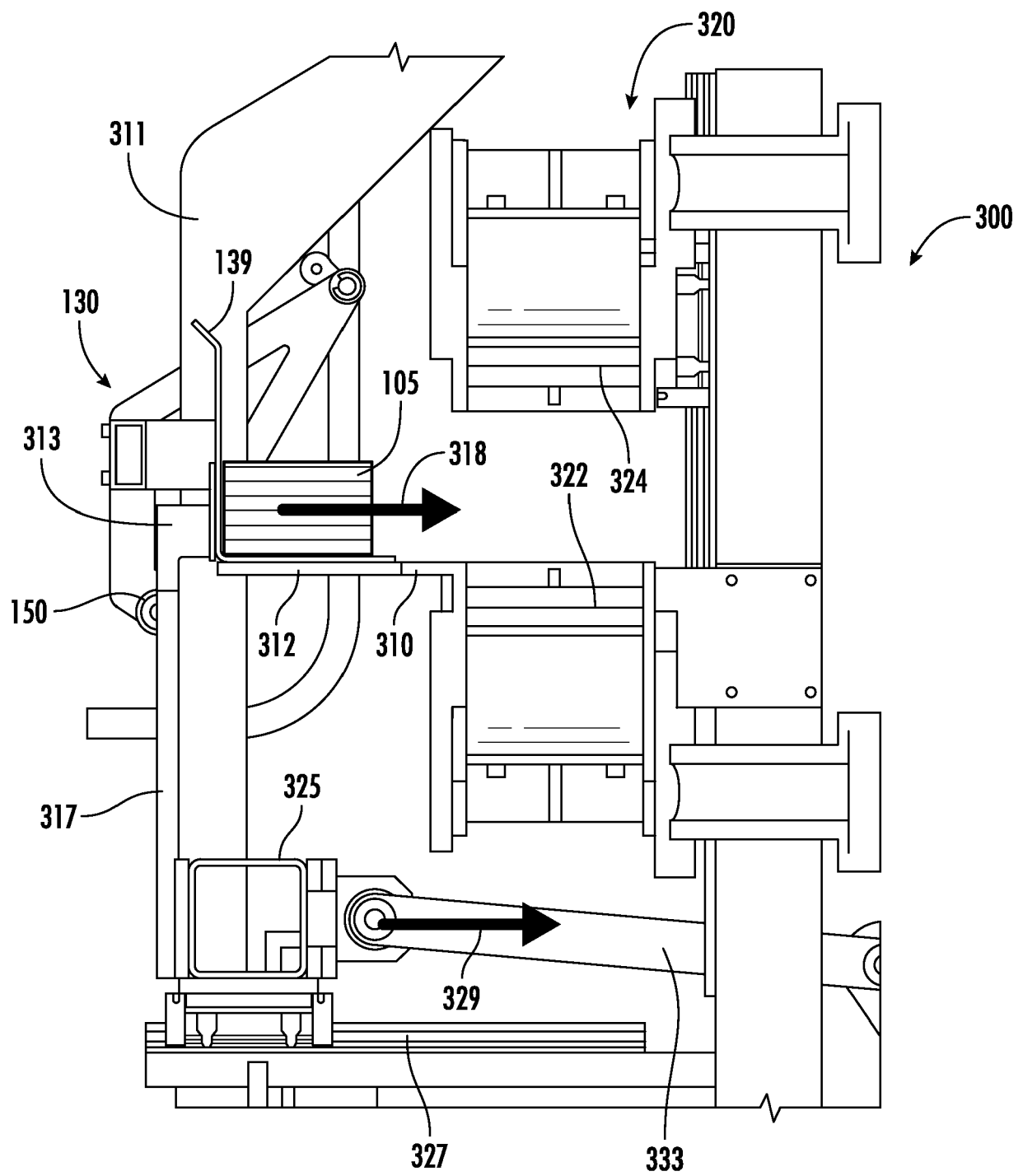


FIG. 23

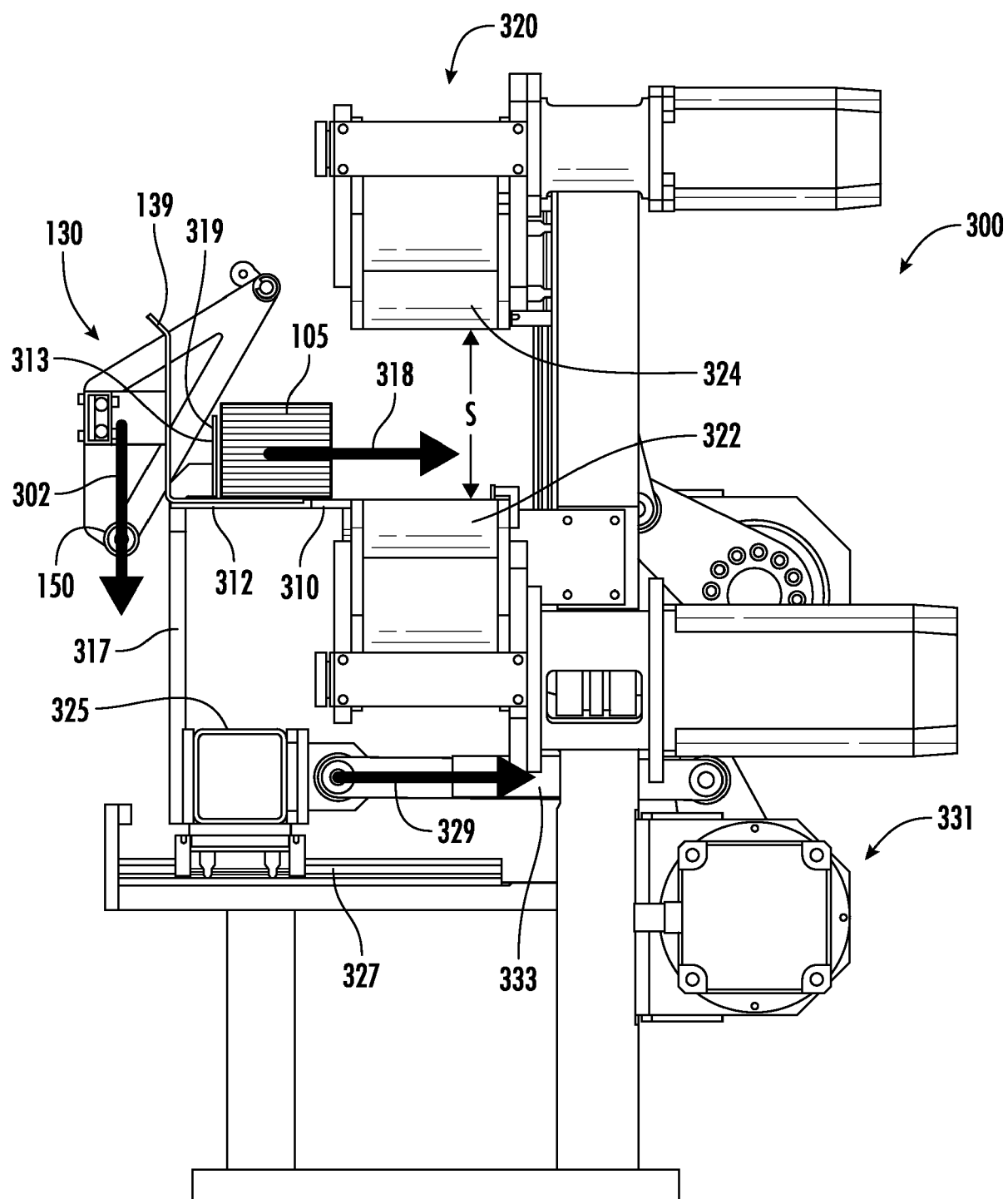


FIG. 24

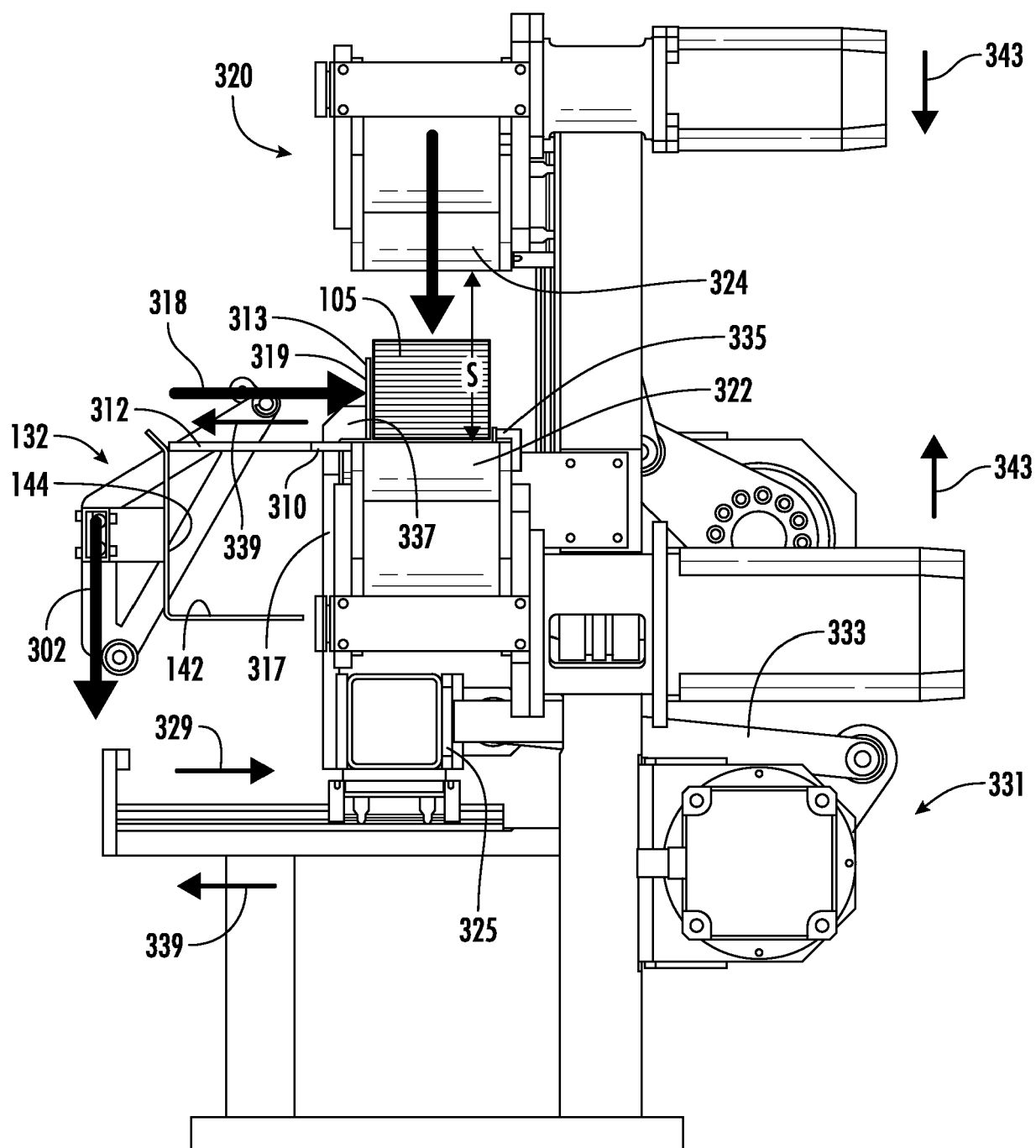


FIG. 25

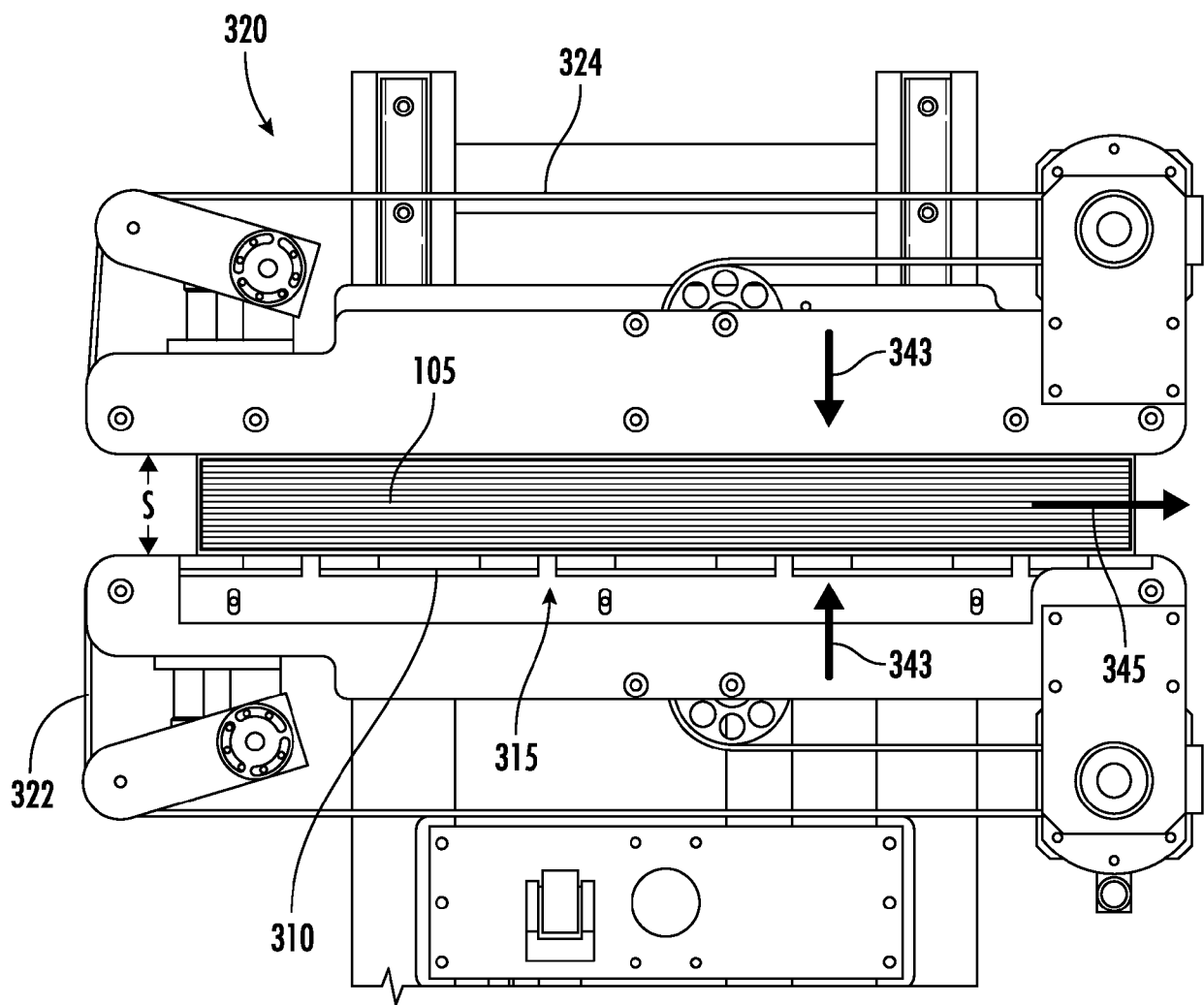


FIG. 26



EUROPEAN SEARCH REPORT

Application Number

EP 24 19 2096

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2 675 747 A (.) 20 April 1954 (1954-04-20) * the whole document *	2-8, 10-19	
A	US 2002/034435 A1 (SCHMIDT CHARLES LOUIS [US] ET AL) 21 March 2002 (2002-03-21) * the whole document *	20	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		15 January 2025	Ureta, Rolando
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 19 2096

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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