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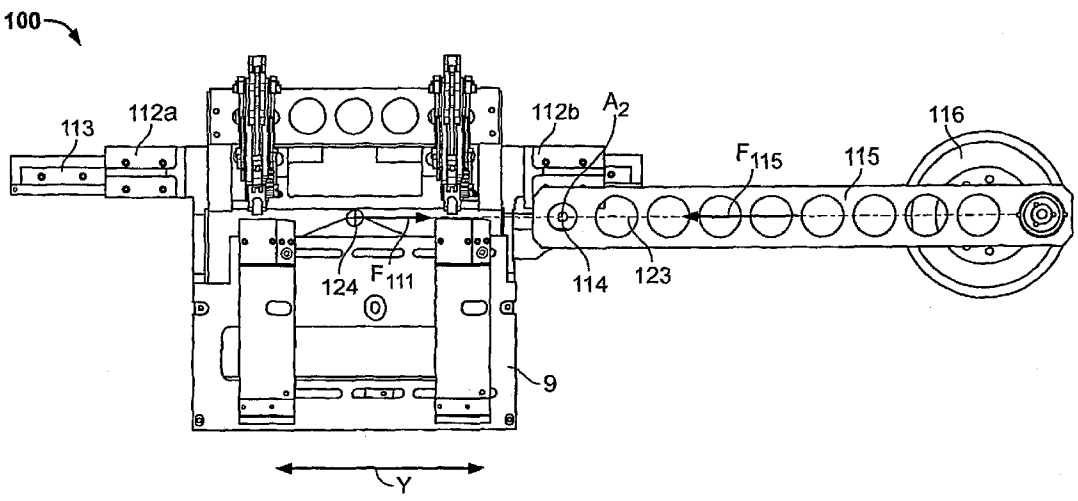
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(57) Abstract: A stitcher (100) is provided including a carriage (111) having a center of gravity (124), the carriage (11 1) movable between an extended position and a retracted position; at least one bearing (112a, 112b) for supporting the carriage (111); and an operating link (115) for driving the carriage (111), a driving force (Fπ5)of the link (115) being applied through the center of gravity (124) or between the center of gravity (124) and the bearing (112a, 112b). Another stitcher (200) also is provided including a movable carriage (211) having a center of gravity (224), the carriage (224) movable between an extended position and a retracted position; and an operating link (215) for driving the carriage (211), a driving force (F215) of the link (215) being applied through the center of gravity (224) when the carriage (211) is in the extended or retracted position. A saddle stitcher is also provided. Methods for stitching are also provided.

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STITCHER DRIVE

[0001] This claims the benefit of U.S. Provisional Application No. 60/838,635 filed August 18, 2006, and hereby incorporated by reference herein.

BACKGROUND

[0002] Gathering machines such as saddle stitchers are known. In a saddle stitcher, a plurality of signatures delivered from sheet material feeders or hoppers are collected on a saddle-back conveyor. A stitcher stitches the collected signatures.

[0003] A saddle stitcher, for example, may collate signatures to assemble complete sets of signatures and bind them together using stitches. The signatures are opened to the center fold and collated by feeders onto a saddle chain to be conveyed past a stitching mechanism. These bound signatures, or books, are then removed from the saddle conveyor for further processing, such as trimming the unbound edges.

[0004] U.S. Patent No. 4,196,835 purportedly discloses a collating machine that includes a stitcher assembly which stitches a group of signatures while they are moving. The stitching assembly does not require the use of rails for guiding any reciprocating mechanisms.

[0005] U.S. Patent No. 6,866,257 purportedly discloses a gathering-stitching machine having a guide element in the stitching region, wherein a run of folded sheets or signatures in the stitching region is improved, and downtime resulting from disruptions in the inlet and outlet of the stitching region is shortened.

[0006] U.S. Publication No. 2005/0285319 discloses a stitcher and a conveyor for moving unbound printed products past the stitcher for stitching. The conveyor includes a timing belt having a plurality of pushing elements for engaging and moving the unbound printed products past the stitcher.

SUMMARY OF THE INVENTION

[0007] In accordance with an embodiment of the present invention, a stitcher includes a carriage having a center of gravity. The carriage is movable between an extended position and a retracted position. At least one bearing is provided for supporting the carriage. An operating link is provided for driving the carriage. A driving force of the link is applied through the center of gravity or between the center of gravity and the bearing.

[0008] In accordance with another embodiment of the present invention, a stitcher includes a movable carriage having a center of gravity. The carriage is movable between an extended position and a retracted position. An operating link is provided for driving the carriage. A driving force of the link is applied through the center of gravity when the carriage is in the extended or retracted position.

[0009] In accordance with a further embodiment of the present invention, a saddle stitcher includes a plurality of hoppers. A conveyor is provided collecting sheet material from the plurality of hoppers. A stitcher is provided. The stitcher includes a carriage having a center of gravity. The carriage is movable between an extended position and a retracted position. At least one bearing is provided for supporting the carriage. An operating link is provided for driving the carriage. A driving force of the link is applied through the center of gravity or between the center of gravity and the bearing.

[0010] In accordance with an embodiment of the present invention, a method of stitching sheet material includes applying a driving force to a stitcher through the center of gravity or between the center of gravity and a bearing and stitching sheet material.

[0011] In accordance with another embodiment of the present invention, a method of stitching sheet material includes applying a driving force to a stitching carriage, moving the stitching carriage between a retracted position and an extended position and back to a retracted position to complete a stitching cycle and stitching sheet material during the stitching cycle. The driving force is applied through a center of gravity of the stitching carriage during at least one point in the stitching cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A preferred embodiment of the present invention will be elucidated with reference to the drawings, in which:

[0013] Figs. 1 and 2 show a prior art stitcher; and

[0014] Figs. 3A and 3B show a stitcher according to the present invention; and

[0015] Figs. 4, 5 and 6 show another preferred embodiment of a stitcher according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Figs. 1 and 2 show a prior art stitcher 10. A carriage 11 is supported by ball bushings 13A, 13B which slide on shaft 12. Carriage 11 oscillates back and forth via crank 16 and operating link 15. As crank 16 rotates, operating link 15 moves back and forth in a direction X. Operating link 15 is connected to carriage 11 by bearing block 14. Operating link 15 applies a force F_{15} at a point A_1 which is transferred to carriage 11.

[0017] Fig. 2 shows carriage 11 in a furthest upstream position. In this upstream position, carriage 11 has a zero velocity but is under maximum acceleration due to actions of crank 16 and operating link 15. The force F_{15} of operating link 15 on carriage 11 produces an inertial force F_I. Inertial force F_I is equal and opposite to link force F_{15}. A moment develops due to the displacement between the force F_{15} of operating link 15 applied at point A_1 and a center of gravity 24 of carriage 11. The resulting moment is supported by forces F_{13A}, F_{13B} in ball bushings 13A, 13B respectively. As shown in Figs. 1 and 2 the location of operating link 15 is such that force F_{15} is applied further from center of gravity 24 then ball bushings 13A, 13B. Inertial force F_I is very high, which results in very high forces F_{13A}, F_{13B} in ball bushings 13A, 13B.

[0018] Figs. 3A and 3B show a stitcher 100 in accordance with an embodiment of the present invention. A crank 116 drives an operating link 115 and rotates in a clockwise or counter-clockwise direction. In the position shown in Fig. 3A, link 115 is located in the three o'clock position with respect to crank 116. In this position, carriage 111 is closest to crank 116. When

link 115 is at the nine o'clock position with respect to crank 116, the carriage 111 is furthest from crank 116. Operating link 115 is connected to carriage 111 at a pivot 114 and oscillates carriage 111 in a direction Y. A bearing rail 113 and linear ball bearings 112A, 112B support carriage 111. Operating link 115 is horizontal and parallel to the direction of oscillation when operating link 115 is at the nine o'clock and three o'clock positions with respect to crank 116. Pivot 114 of link 115 is located on a centerline 123 which runs through a center of gravity 124 of carriage 111. When link 115 is horizontal, for example in the nine o'clock or three o'clock positions, the inertial force F_{111} of carriage 111 runs through operating link 115 and force F_{115} is applied at a point A_2 along centerline 123. Thus, there is no lateral displacement between force F_{115} applied at point A_2 and center of gravity 124. Consequently, none of the inertial force F_{111} is transmitted to bearings 112A, 112B.

[0019] When operating link 115 is not in a horizontal position, for example, as crank 116 rotates between the three o'clock and nine o'clock positions, bearings 112A, 112B provide support for inertial force F_{111} that develops due to the vertical displacement between F_{115} and inertial force F_{111} of carriage 111. The support in the bearings 112A, 112B is equal to the perpendicular distance from link 115 to center of gravity 124 and balances out the moment created.

[0020] Fig. 3B shows a top view of stitcher 100. The point A_2 of force F_{115} of operating link 115 and inertial force F_{111} of carriage 111 lie in the same vertical plane that goes through center of gravity 124. The positioning of inertial force F_{111} and force F_{115} in the same vertical plane reduces support loads in the linear bearings 112A, 112B. Thus, by moving the application point A_2 of the operating link force F_{115} closer to center of gravity 24, forces in bearings 112A, 112B are reduced.

[0021] Figs. 4 and 5 show another preferred embodiment according to the present invention. A stitcher 200 includes a carriage 211 mounted on linear ball bearings 212A, 212B. A crank 216 is connected to a link 217. A rocker arm 218 is movably mounted to a clevis 225 so rocker arm 218 can swing back and forth in a direction D. Rocker arm 218 is connected to an operating link 215 which is connected to carriage 211 at a pivot 222. When crank 16 is rotated, link 217 moves causing rocker arm 218 to move. Rocker arm 218 transmits the motion of link 217 to operating

link 215. Operating link 215 subsequently moves carriage 211 via pivot 222 causing carriage 211 to oscillate.

[0022] As further shown in Fig. 5, the force F_{215} of operating link 215 is applied at a point A_3 which lies in the same vertical plane as inertial force F_{211} of carriage 211. The positioning of inertial force F_{211} and force F_{215} in the same vertical plane reduces support loads in the linear bearings 212A, 212B.

[0023] Fig. 6A shows rocker arm 218 in extended position 218a and the path for retracted position 218b. When rocker arm 218 is in extended position 218a or retracted position 218b, F_{215} is applied at point A and moves through center of gravity 224. The perpendicular distance from point A_3 to center of gravity 224 is zero. Thus, inertial force F_{211} is not transmitted to linear bearings 212A, 212B. When rocker arm 218 is any position between extended position 218a and retracted position 218b as shown in Fig. 6B, the force F_{215} is applied close to center of gravity 224. The perpendicular distance from F_{215} to center of gravity 224 is reduced resulting in reduced loads F_{212A}, F_{212B} in linear bearings 212A, 212B. Thus, by applying an operating force F_{215} between center of gravity 224 and bearings 212A, 212B, the support load in bearings 212A, 212B may be reduced.

[0024] In the preceding specification, the invention has been described with reference to specific exemplary embodiments and examples thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of invention as set forth in the claims that follow. The specification and drawings are accordingly to be regarded in an illustrative manner rather than a restrictive sense.

What is claimed is:

1. A stitcher comprising:

a carriage having a center of gravity, the carriage movable between an extended position and a retracted position;

at least one bearing for supporting the carriage; and

an operating link for driving the carriage, a driving force of the link being applied through the center of gravity or between the center of gravity and the bearing.

2. The stitcher as recited in claim 1 wherein the at least one bearing includes two bearings.

3. The stitcher as recited in claim 2 wherein the bearings are connected to a bearing rail.

4. The stitcher as recited in claim 1 further comprising a drive coupled to the operating link.

5. The stitcher as recited in claim 6 wherein the drive includes a crank.

6. The stitcher as recited in claim 7 wherein the crank is connected to a drive motor.

7. The stitcher as recited in claim 1 further comprising a second link connected to a drive.

8. The stitcher as recited in claim 9 wherein the drive includes a crank.

9. The stitcher as recited in claim 10 wherein the crank is connected to a drive motor.

10. The stitcher as recited in claim 9 further comprising a rocker arm connecting the operating link to the second link.

11. The stitcher as recited in claim 12 wherein the rocker arm is rotatably connected to a clevis.

12. The stitcher as recited in claim 13 wherein the driving force is transferred from the second link to the operating link via the rocker arm and clevis.

13. The stitcher as recited in claim 1 wherein the driving force of the link is applied through the center of gravity when the carriage is in an extended or retracted position.

14. A stitcher comprising:

a movable carriage having a center of gravity, the carriage movable between an extended position and a retracted position; and

an operating link for driving the carriage, a driving force of the link being applied through the center of gravity when the carriage is in the extended or retracted position.

15. A saddle stitcher comprising:

a plurality of hoppers;

a conveyor collecting sheet material from the plurality of hoppers; and

a stitcher, the stitcher including:

a carriage having a center of gravity, the carriage movable between an extended position and a retracted position;

at least one bearing for supporting the carriage; and

an operating link for driving the carriage, a driving force of the link being applied through the center of gravity or between the center of gravity and the bearing.

16. A method of stitching sheet material comprising the steps of:

applying a driving force to a stitcher through the center of gravity or between the center of gravity and a bearing; and

stitching sheet material.

17. A method of stitching sheet material comprising the steps of:

applying a driving force to a stitching carriage;

moving the stitching carriage between a retracted position and an extended position and back to a retracted position to complete a stitching cycle; and

stitching sheet material during the stitching cycle;

the driving force being applied through a center of gravity of the stitching carriage during at least one point in the stitching cycle.

18. The method of stitching sheet material as recited in claim 17 wherein the driving force is applied through the center of gravity when the stitching carriage is in the extended position.

19. The method of stitching sheet material as recited in claim 17 wherein the driving force is applied through the center of gravity when the stitching carriage is in the retracted position.

20. The method of stitching sheet material as recited in claim 17 wherein the step of applying a driving force to a stitching carriage includes using a link.

21. The method of stitching sheet material as recited in claim 20 wherein the step of applying a driving force to a stitching carriage includes using a crank connected to the link.

22. The method of stitching sheet material as recited in claim 21 wherein the step of applying a driving force to a stitching carriage includes using a second link.

23. The method of stitching sheet material as recited in claim 22 wherein the step of applying a driving force to a stitching carriage includes using a crank connected to the second link.

24. The method of stitching sheet material as recited in claim 23 wherein the second link is connected to the link by a rocker arm.

25. The method of stitching sheet material as recited in claim 24 wherein the rocker arm is rotatably mounted to a clevis.

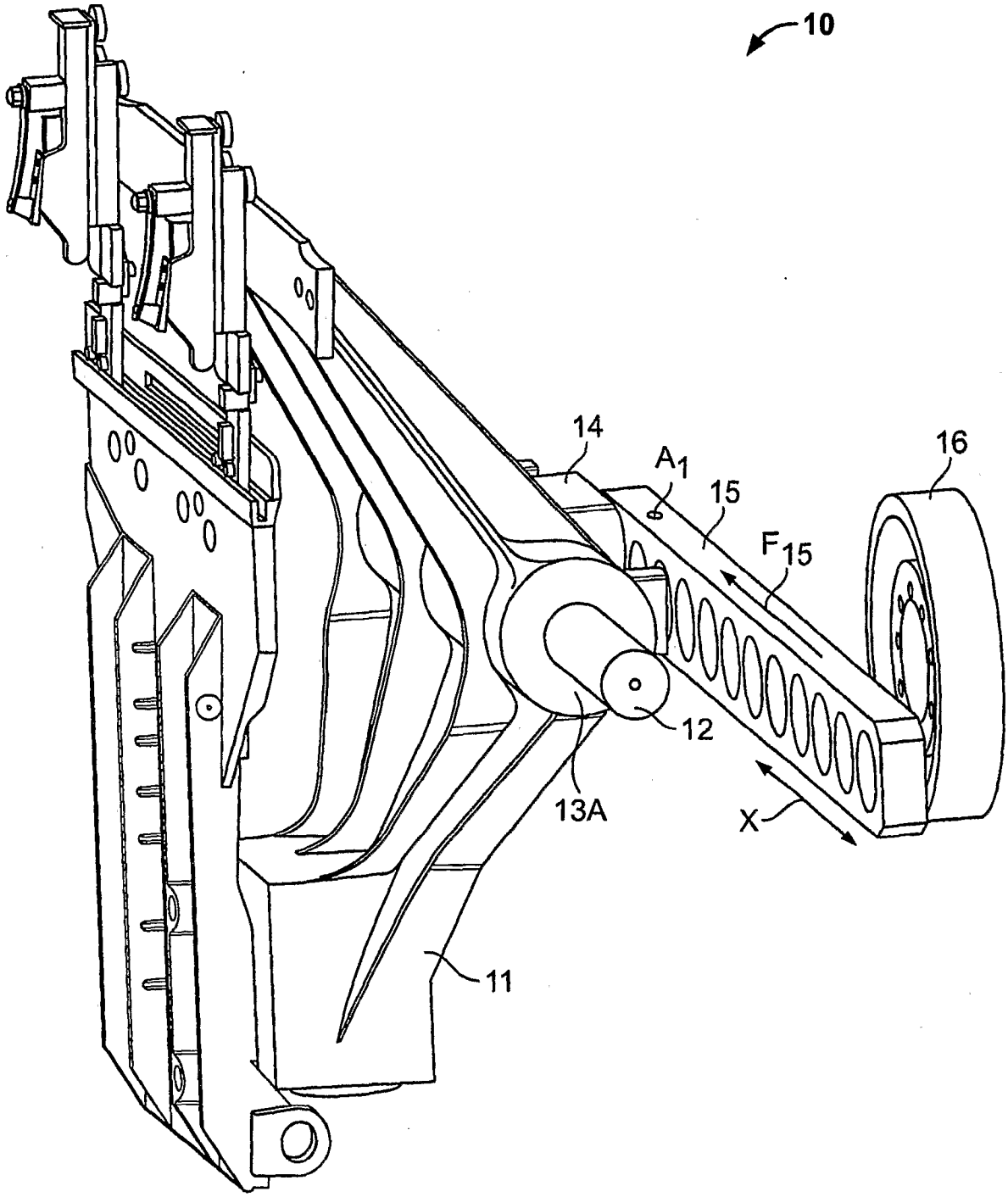


FIG. 1
(Prior Art)

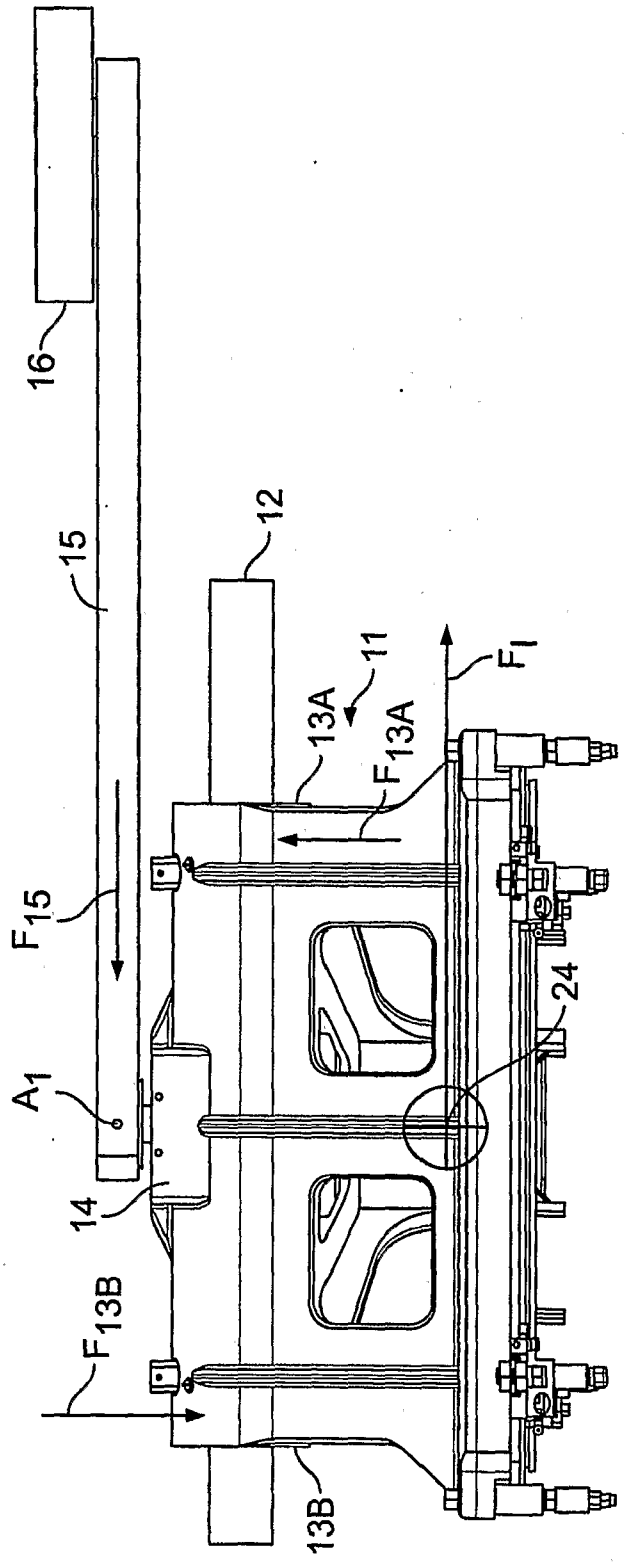


FIG. 2
(Prior Art)

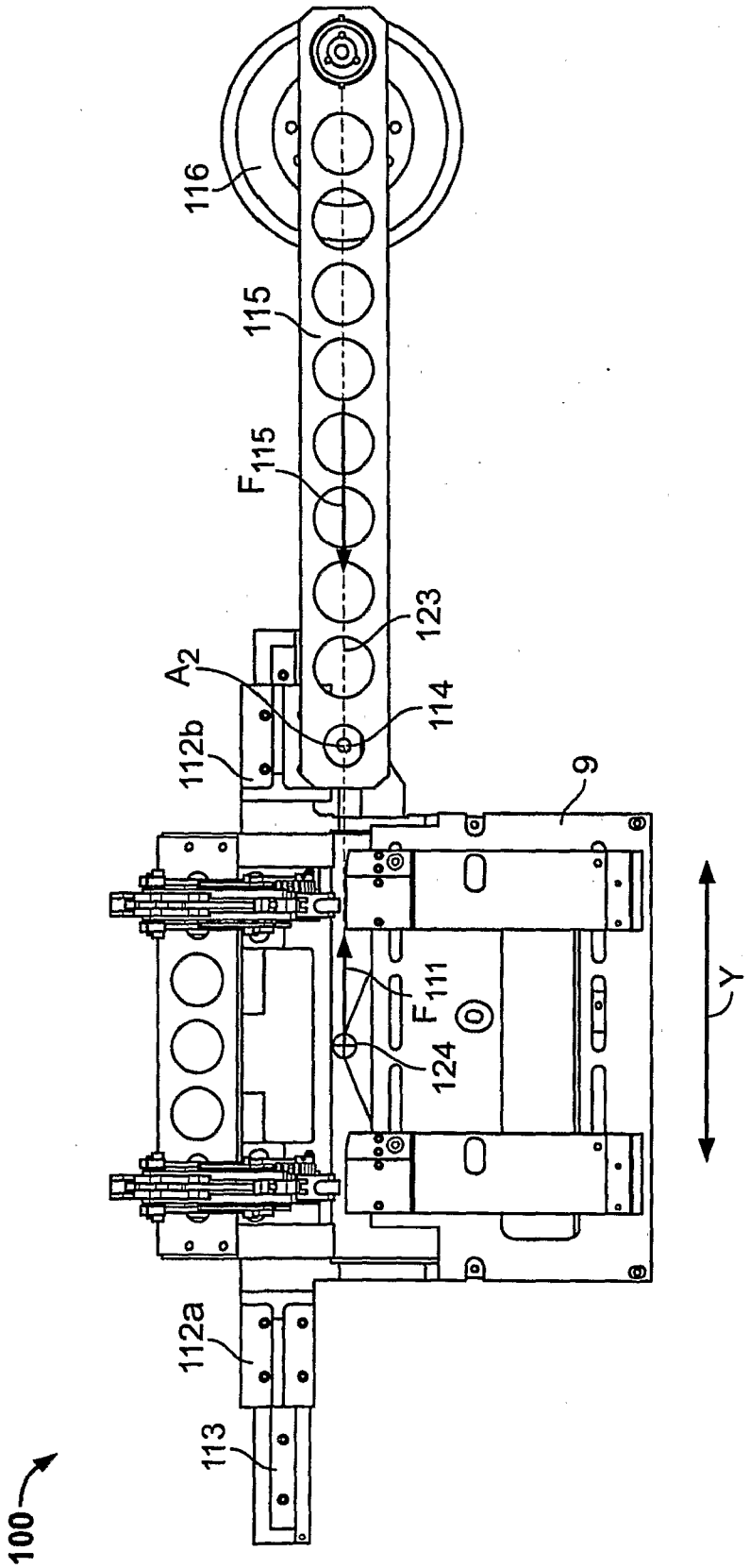


FIG. 3A

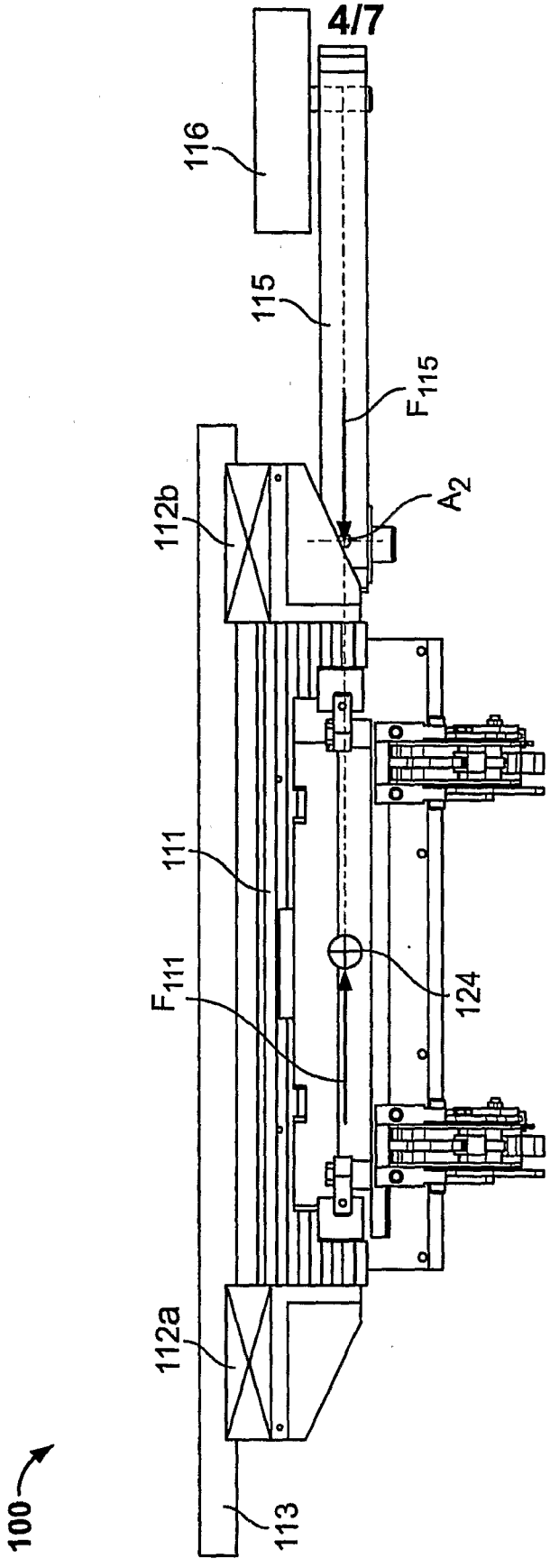


FIG. 3B

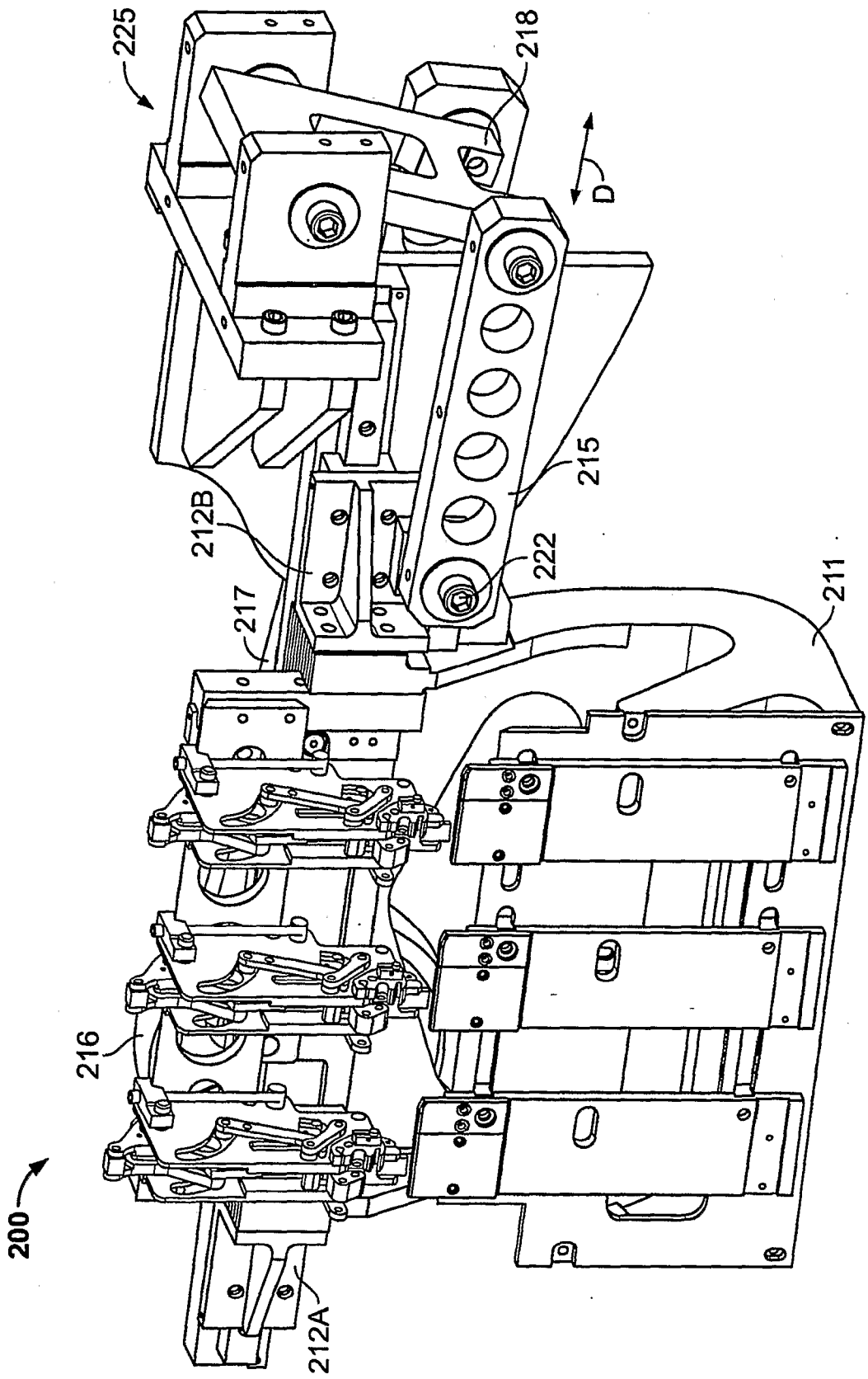


FIG. 4

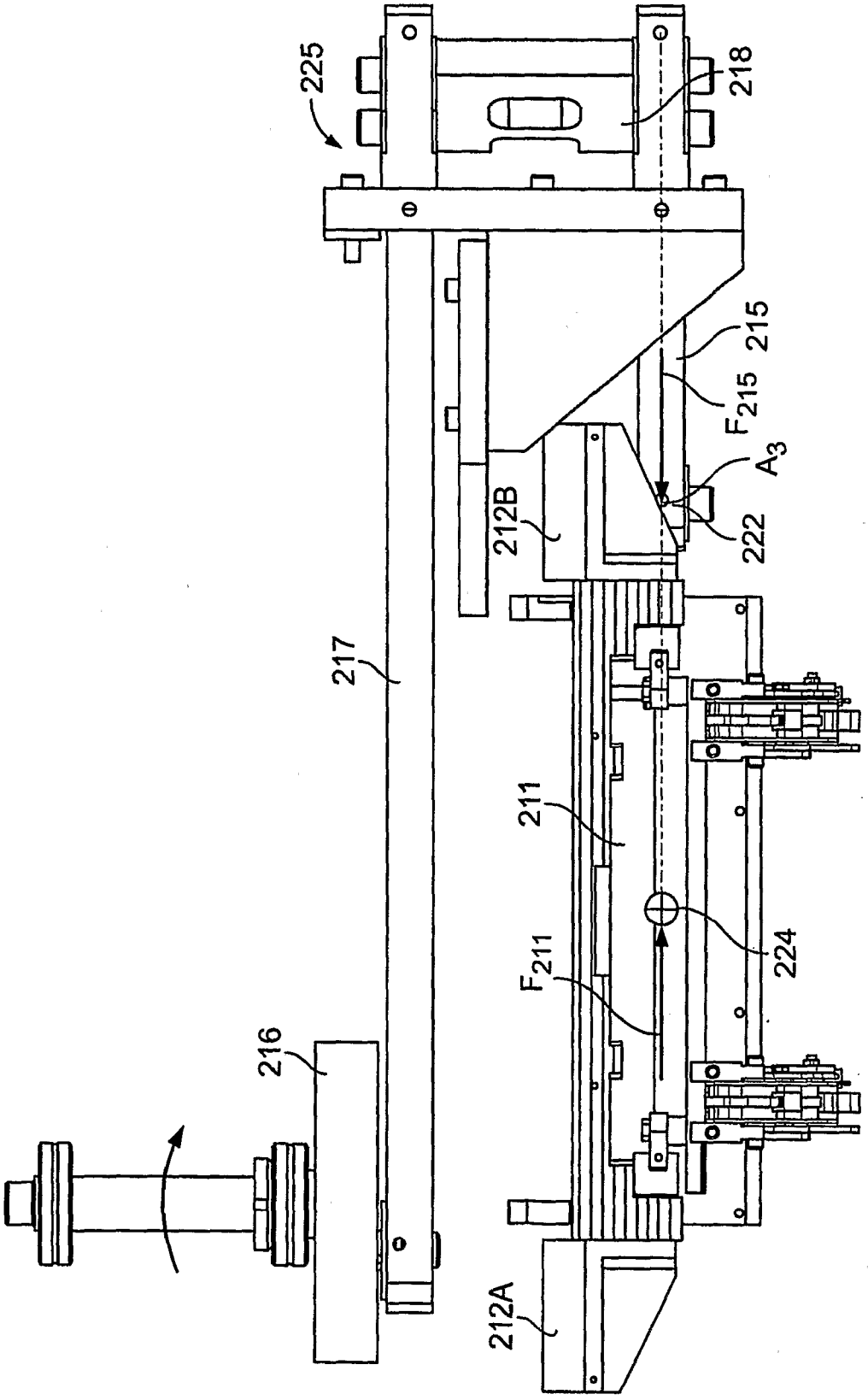


FIG. 5

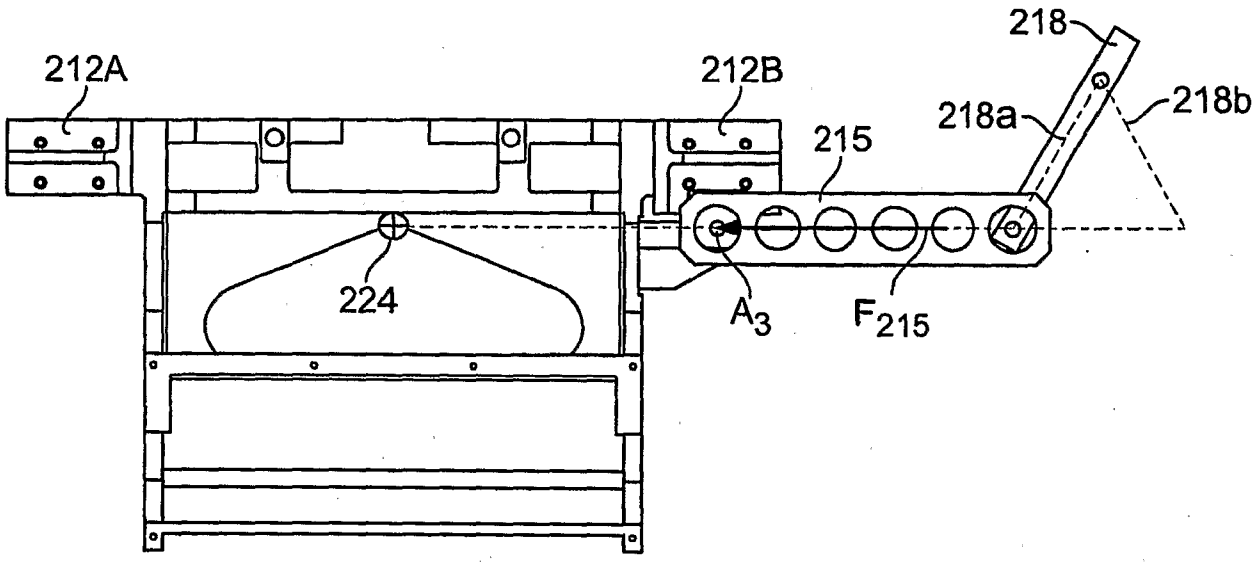

218
212A
212B
218a
218b
215
224
A_3
F_{215}

FIG. 6A

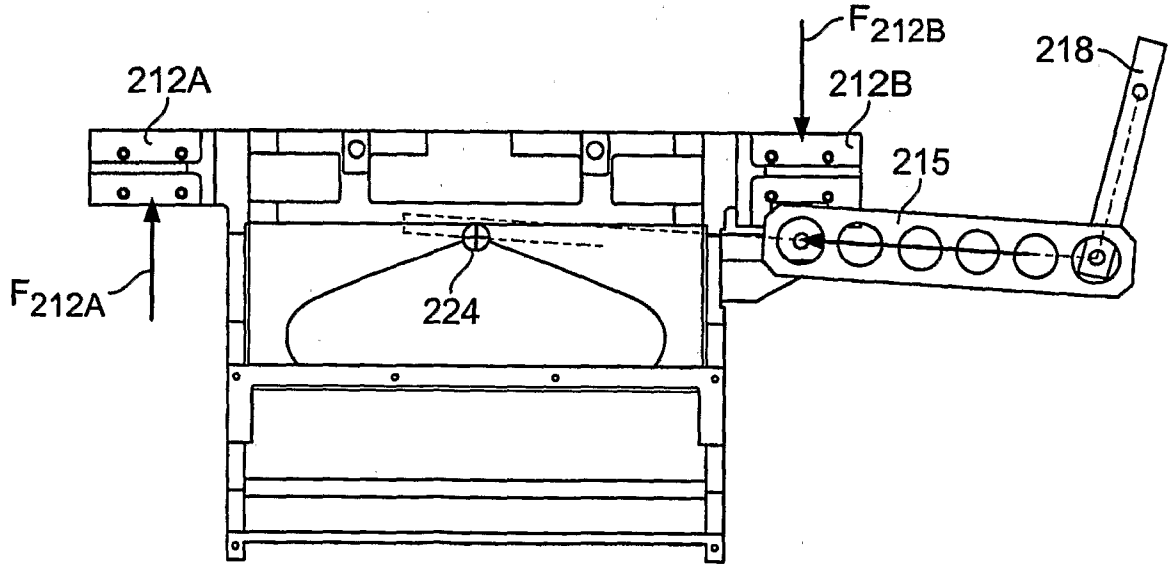

F_{212B}
218
212A
212B
215
F_{212A}
224

FIG. 6B