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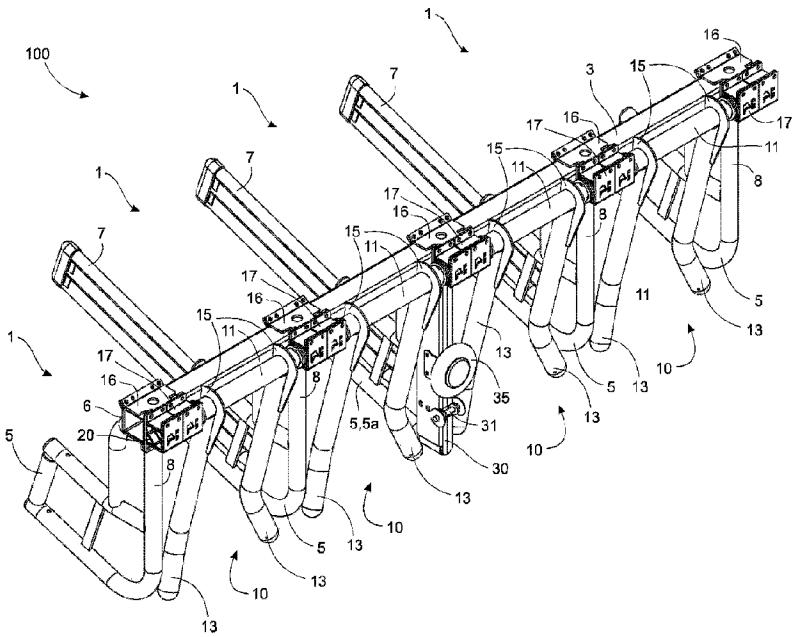
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(54) **Titre : STALLE DE TRAITE AVEC RAIL DE LEVAGE DE POSITIONNEMENT**
(54) **Title: MILKING STALL WITH INDEXING LIFT RAIL**



(57) **Abrégé/Abstract:**
A milking stall has a lift rail; an actuator for rotating the lift rail between neutral and maximum positions; a divider mounted on and extending rearward of the lift rail; and, an exit gate mounted on and depending downwardly from the lift rail. The exit gate has a head rail rotatably mounted on the lift rail and a shoulder bar connected to and depending downwardly from the head rail. The exit gate pivots with the lift rail, and the shoulder bar points more rearward in the maximum position than in the neutral position. The head rail is rotatably mounted on the lift rail through a torsion spring. The torsion spring biases rotation of the head rail relative to the lift rail and is pre-loaded on the lift rail to provide a rotational bias to the head rail so that the shoulder bar is urged rearward by the rotational bias.

ABSTRACT

A milking stall has a lift rail; an actuator for rotating the lift rail between neutral and maximum positions; a divider mounted on and extending rearward of the lift rail; and, an exit gate mounted on and depending downwardly from the lift rail. The exit gate has a head rail rotatably mounted on the lift rail and a shoulder bar connected to and depending downwardly from the head rail. The exit gate pivots with the lift rail, and the shoulder bar points more rearward in the maximum position than in the neutral position. The head rail is rotatably mounted on the lift rail through a torsion spring. The torsion spring biases rotation of the head rail relative to the lift rail and is pre-loaded on the lift rail to provide a rotational bias to the head rail so that the shoulder bar is urged rearward by the rotational bias.

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MILKING STALL WITH INDEXING LIFT RAIL

Field

This application relates to agriculture, in particular to animal husbandry, especially to milking parlors for animals, for example mammals such as cows.

Background

Milking parlors having a plurality of milking stalls are usually provided with a pit from which an operator attaches milking members to animals (e.g., cows) in the milking stalls. The animals in the milking stalls are preferably positioned so that the operator can easily reach the udders of the animals and attach the milking members. Because milking stalls are equally large and the animals in a herd have different sizes, there is a risk that small animals of the herd take a position in the milking stalls in which the udders of the animals are located at a relatively long distance from the pit. Therefore, it is desirable to have a mechanism by which animals are encouraged to remain at a rear of the milking stall so that the udders are within easy reach of the operator.

A variety of mechanisms have been proposed in the art, but these mechanisms generally suffer from one or more problems. Some of these mechanisms are insufficiently effective at encouraging the animals toward the rear of the milking stalls. Some mechanisms are overly robust or insufficiently flexible so when applied to a larger animal of the herd, the larger animal is harmed or at least discomfited, which makes the animal unruly and more difficult to handle. Some mechanisms are insufficiently autonomous or self-indexing requiring operator input to properly set the mechanism for each animal. Some mechanisms are overly expensive and/or overly complicated to install and/or operate.

There remains a need for a low-cost, effective, safer mechanism that permits self-indexing of animals to a rear of the milking stalls of a milking parlor without causing damage to or discomfiting the animals.

Summary

A milking stall comprises: a lift rail; an actuator for rotating the lift rail between a neutral position and a maximum position; at least one divider mounted on and extending transversely rearward of the lift rail; and, at least one exit gate mounted on and depending downwardly from the lift rail, the at least one exit gate comprising a head rail rotatably mounted on the lift rail and at least one shoulder bar connected to and

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depending downwardly from the head rail, the at least one exit gate pivoting with the lift rail between the neutral position and the maximum position, the at least one shoulder bar pointing more rearward in the maximum position than in the neutral position.

A milking parlor comprises the milking stall as defined above and a lift system connected to the lift rail and configured to raise and lower the milking stall.

In some embodiments, the head rail is rotatably mounted on the lift rail through at least one torsion spring mounted on the lift rail. The at least one torsion spring biases rotation of the head rail independent of and relative to the lift rail. In some embodiments, the torsion spring is pre-loaded on the lift rail to provide a rotational bias to the head rail so that the at least one shoulder bar is urged rearward by the rotational bias. In some embodiments, the torsion spring is pre-loaded on the lift rail so that the head rail is rotated at an angle of about 2.0° with respect to vertical when the lift rail is in the neutral position.

In some embodiments, the torsion spring is an elastomer powered torsion spring. In some embodiments, the elastomer powered torsion spring comprises: a tensioner housing; an insert; and a plurality of elastomeric plugs, wherein tensioner housing has the insert inserted therein, the tensioner housing and the insert have a same polygonal cross-section, the insert is rotated with respect to the tensioner housing to provide spaces between internal corners of the tensioner housing and outer faces of the insert, and the elastomeric plugs are friction fitted into the spaces. The polygonal cross-section may be triangular, square, rectangular pentagonal, etc. The polygonal cross-section is preferably square.

In some embodiments, the at least one exit gate further comprises at least one stop bracket connecting the at least one shoulder bar to the head rail. In some embodiments, the at least one stop bracket abuts the lift rail when the at least one exit gate is in a fully forward position thereby preventing the at least one exit gate from further forward rotation. In some embodiments, the at least one shoulder bar has a bottom flared portion for accommodating different animal widths in the at least one exit gate.

In some embodiments, the milking stall further comprises a support column attached to the lift rail. The support column may be configured to be pivotally connected to the lift system for raising and lowering the milking stalls.

Any suitable actuator may be used to rotate the lift rail. Some examples include a hydraulic cylinder, an electric linear actuator, a pneumatic actuator and a mechanical spring. Pneumatic actuators are preferred because provides some resiliency affording a

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measure of safety for the animals should pneumatic actuators provide some resiliency, which provides some measure of safety should the animal become unruly in the stall. A particularly preferred pneumatic actuator comprises an inflatable/deflatable air cushion. In some embodiments, the actuator is mounted on the support column and situated to abut the lift system when the milking stall is mounted on the lift system.

The various rails and bars may be solid or hollow or may have solid and hollow portions.

In some embodiments, the milking parlor comprises a plurality of the milking stalls. In some embodiments, the plurality of the milking stalls commonly shares the lift rail. In some embodiments, the plurality of milking stalls comprises a plurality of exit gates. In some embodiments, the plurality of milking stalls comprises a plurality of dividers. The milking stalls are preferably situated side-by-side longitudinally along the lift rail, the stalls separated by the dividers. The exits gate defines a front of the stall while the dividers define sides of the stall. A rear guardrail (butt pan) may be employed to close the stall at a rear of the stall to prevent the animal from backing into an operator pit. A single rear guardrail may be used for all of the stalls.

In a milking operation, with the stall in a lowered position, an animal is herded into the stall from the rear and prevented from exiting the stall by the exit gate. The actuator is actuated to rotate the lift rail, and therefore the exit gate, from the neutral position to the maximum position during which the at least one shoulder bar of the exit gate urges the animal to the rear of the stall where an operator can hook a milking machine to udders of the animal. The actuator is then actuated to rotate the lift rail, and therefore the exit gate, from the maximum position to the neutral position. The animal is then milked. At the end of the milking operation, the milking machine is disconnected from the animal's udders, and the lift system is activated to raise the stall thereby freeing the animal to move forward and out of the milking parlor.

During the process of encouraging the animals to the rear of the stall, the lift rail must be rotated sufficiently to encourage the smallest animal to the rear of the stall. The amount of rotation needed to accomplish this is more than for a larger animal, thus the amount of rotation required for the smallest animal risks discomfiting or harming the larger animal as the larger animal could be crushed in the stall by the at least one shoulder bar. To mitigate this problem, the exit gate is mounted on the at least one torsion spring so as the at least one shoulder bar encounters the larger animal, the exit gate can rotate against the bias of the at least one torsion spring to rotate the exit gate

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forwardly, the torsion spring providing resilience so that that animal is not harmed while encouraging the animal to the rear of the stall.

Further, at any time before the stall is raised out of the way, forward movement of the animal will cause the animal to encounter the at least one shoulder bar. Because the at least one shoulder bar is pre-loaded with a force acting rearward due to the pre-loading of the at least one torsion spring, when the animal encounters the at least one shoulder bar, the animal is encouraged to move rearward instead to relieve the pressure. If the animal is particularly unruly and continues to move forward, the exit gate will rotate on the at least one torsion spring, the torsion spring again providing resilience to prevent harm to the animal while encouraging the animal to the rear of the stall. Should the animal yet continue to move forward against the increasing force imparted by the at least one torsion spring on the exit gate, the at least one stop bracket will eventually abut the lift rail stopping rotation of the exit gate entirely to prevent the animal from exiting the stall.

The torsional spring applying force through the at least one shoulder bar of the exit gate serves to: encourage the animal to move to a rear of the stall when loading the animal in the stall for milking; provides a safety measure for larger animals during the loading process in a multi-stall milking parlor; and, provides a safety measure for the animal should the animal become unruly in the stall at any time during the milking operation.

The milking stall utilizes an inexpensive mechanism for effectively encouraging animals to a rear of the milking stall while at the same time discouraging animals from moving too far forward and providing a comfortable environment in the milking stall for the animal to increase animal safety and reduce the likelihood of the animal becoming unruly during a milking operation.

Further features will be described or will become apparent in the course of the following detailed description. It should be understood that each feature described herein may be utilized in any combination with any one or more of the other described features, and that each feature does not necessarily rely on the presence of another feature except where evident to one of skill in the art.

Brief Description of the Drawings

For clearer understanding, preferred embodiments will now be described in detail by way of example, with reference to the accompanying drawings, in which:

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Fig. 1 depicts a front perspective view of a series of four milking stalls for a four-stall milking parlor.

Fig. 2 depicts a rear perspective view of the milking stalls of Fig. 1.

Fig. 3 depicts a top view of the milking stalls of Fig. 1.

Fig. 4 depicts a front view of the milking stalls of Fig. 1.

Fig. 5 depicts a rear exploded view of a portion of the milking stalls of Fig. 1.

Fig. 6A depicts a side cross-sectional view of a milking parlor with the milking stalls of Fig. 1 mounted on a lift system in a lowered position to contain animals in the milking stalls and with a lift rail of the milking stalls in a neutral position.

Fig. 6B depicts the milking parlor of Fig. 6A with the lift rail in a maximum position.

Fig. 7A depicts the lift system of the milking parlor shown in Fig. 6A.

Fig. 7B depicts the lift system of Fig. 14A in a raised position to permit the animals to exit the milking parlor.

Fig. 8A depicts a side section view of one of the milking stalls shown in Fig. 1 with a lift rail of the milking stalls in a neutral position and an exit gate of the milking stall in a rearward position.

Fig. 8B depicts a magnified view of a torsion spring shown in Fig. 8A.

Fig. 8C depicts a cross-sectional view of the torsion spring shown in Fig. 8B.

Fig. 9A depicts the side section view of Fig. 8A with the exit gate in a forward position.

Fig. 9B depicts a magnified view of a torsion spring shown in Fig. 9A.

Fig. 10 depicts the side section view of Fig. 8A with the lift rail in a maximum position.

Fig. 11 depicts the side section view of Fig. 9A with the lift rail in a maximum position.

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Detailed Description

Fig. 1 to Fig. 5 depict a series of four milking stalls **1** for a four-stall milking parlor **100**. The four milking stalls **1** share a common lift rail **3** so that the stalls **1** can be operated in-tandem for milking four animals simultaneously. While a four-stall milking parlor is illustrated, the milking parlor can have any number of stalls, for example 1, 2, 3, 4, 5, 6, 7, 8 or more stalls. The stalls **1** are separated from each other by dividers **5** that are rigidly attached to and extend rearward and transversely from the lift rail **3**. The dividers **5** both separate the animals in the milking parlor **100** from each other and contain each animal in their respective stalls **1**. The dividers **5** in the middle comprise extension rails **7** so that the animals in adjacent stalls **1** do not interfere with each other. The dividers **5** are supported on the lift rail **3** through L-shaped mounting brackets **6**. The L-shaped mounting brackets **6** are preferably welded to the dividers **5**, but any suitable attachment may be used, for example bolts, rivets and the like. The dividers **5** comprise an upwardly extending mounting bar **8** that is rigidly attached to an underside of the L-shaped mounting brackets **6**. However, as seen in Fig. 2, a center divider **5a** lacks a mounting bar **8**, the mounting bar **8** being replaced by a centrally located support column **30** for a lift system **60** of the milking parlor **100**.

Exit gates **10** are rotatably mounted on and extend downwardly from the lift rail **3** at a position forward of the lift rail **3**. The exit gates **10** comprise head rails **11**, which are substantially parallel to and in front of the lift rail **3**. The exit gates **10** also comprise pairs of downwardly extending shoulder bars **13** that block the animals' exit from the stalls **1** when the lift rail **3** is in a lowered position. The shoulder bars **13** are rigidly connected to the head rails **11** by stop brackets **15**, for example by welding the stop brackets **15** to the head rails **11**. The stop brackets **15** are preferably welded to or monolithically molded with the shoulder bars **13**. To permit rotation of the head rails **11** independent of the lift rail **3**, and therefore the exit gates **10** independent of the lift rail **3**, ends of the head rails **11** are mounted to torsion springs **20**, which are housed in outer housings **17** attached to head-rail mounting brackets **16**. The ends of the head rails **11** are sized and shaped for mounting in the torsion springs **20**. The remaining portions of the head rails **11** can be any desired size and cross-sectional shape. Each of the head-rail mounting brackets **16** has an L-shaped portion that is supported on the lift rail **3**. The head rails **11** are separated from each other so the exit gates **10** are independent of each other. Thus, each exit gate **10** responds to the action of the animal in that stall **1** but not the actions of the animals in the other stalls **1**.

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As best seen in Fig. 5, each of the exit gates **10** is associated with one of the dividers **5** so that one exit gate **10** and the associated divider **5** can be installed together as a unit on the lift rail **3**. To mount the exit gates **10** and the dividers **5** on the lift rail **3**, the L-shaped portions of the head-rail mounting brackets **16** are bolted to the L-shaped mounting brackets **6** to clamp the lift rail **3** between the brackets **6**, **16**. One end of each head rail **11**, and therefore the torsion spring **20** to which the one end is mounted, is housed in one of the outer housings **17** attached to the head rail mounting bracket **16** of one of the units, while the other end of the head rail **11**, and therefore the torsion spring **20** to which the other end is mounted, is housed in one of the outer housings **17** attached to the head rail mounting bracket **16** of an adjacent unit.

The lift rail **3** is supported on at least one support column rigidly attached to and depending downwardly from the lift rail **3**. While more than one support column may be used, the illustrated embodiment utilizes the single centrally located support column **30**. The support column **30** is attached to a central the L-shaped mounting bracket **6a**, which is one of the L-shaped mounting brackets **6**. The support column **30** is preferably attached to the central the L-shaped mounting bracket **6a** by welding, although any suitable attachment may be used. The support column **30** comprises a lower mounting pin **31** and an upper aperture **32** that permit rotatably mounting the lift rail **3** on the lift system **60** of the milking parlor **100**. The support column **30** further comprises an inflatable/deflatable air cushion **35** connected to a front face of the support column **30**.

Fig. 7A and Fig. 7B depict the lift system **60** of the milking parlor **100**, while Fig. 6A and Fig. 6B depict the lift system **60** with the stalls **1** mounted thereon. The lift system **60** comprises an upwardly oriented pedestal **61** supported on the floor of a milking facility. The pedestal **61** comprises a support strut **62** and a slide **63** slidingly mounted on the strut **62**. A lower clevis fork **64** and an upper clevis fork **65** are rigidly connected to the slide **63**, the clevis forks **64**, **65** oriented transversely to the strut **62**. The lower clevis fork **64** comprises opposed slots **66** through which the lower mounting pin **31** of the support column **30** is inserted to mount the lift rail **3**, and therefore the stalls **1**, on the lift system **60**. The upper clevis fork **65** comprises opposed apertures **67** that can be aligned with the upper aperture **32** of the support column **30**, the aligned apertures **32**, **67** accepting a mounting pin therethrough to pivotally mount the lift rail **3**, and therefore the stalls **1**, on the lift system **60**. Pivoting of the lift rail **3** about the mounting pin through the aligned apertures **32**, **67** is permitted through a defined angle because the lower mounting pin **31** is able to translate in the slots **66**. The arcuate distance through which the lift rail **3** can pivot is limited by the length of the slots **66**. In order to pivot the lift rail **3**, the air cushion

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35 is situated on the support column **30** between the lower mounting pin **31** and the upper aperture **32**. When the stalls **1** are mounted on the lift system **60**, the air cushion **35** engages an abutment face **69** of the lower clevis fork **64**. Inflation and deflation of the air cushion **35**, which is sandwiched between the front face of the support column **30** and the abutment face **69** of the lower clevis fork **64**, causes the lift rail **3**, and therefore the stalls **1**, to pivot between a neutral position (Fig. 6A) and a maximum position (Fig. 6B).

The lift system **60** further comprises an actuator **70**, for example a hydraulic cylinder or a linear actuator. The actuator is configured to linearly translate the slide **63** on the strut **62**. One portion of the actuator **70** is connected to the slide **63** and another portion is connected to the strut **62**. Extension and retraction of the actuator **70** causes the slide **63** to translate on the strut **62** thereby lowering and raising the lift rail **3**, and therefore the stalls **1**, mounted on the slide **63**. The slide **63**, and therefore the lift rail **3** and the stalls **1**, can be lowered and raised between a lowered position (Fig. 7A) and a raised position (Fig. 7B). In the lowered position, the stalls **1** are in position to contain the animals for milking. When the stalls **1** are raised after milking is completed, the animals are free to leave by walking forward.

With reference to Fig. 8A to Fig. 11, in addition to raising and lowering the stalls **1**, operation of the milking stalls **1** also comprises two independent pivoting motions, one in which the lift rail **3**, and therefore the entire stall **1**, is pivoted by inflation/deflation of the air cushion **35**, and one in which the head rail **11** is pivoted. The head rail **11** is pivoted by the torsion spring **20** so that the shoulder bars **13** point rearward; and, the head rail **11** pivoted against a rotational bias of the torsion spring **20** by the animal in the stall **1** engaging the shoulder bars **13** so that the shoulder bars **13** are moved more forward.

In operation, the animals enter the stalls **1** from a rear of the stalls **1** while the stalls **1** are lowered, the lift rail **3** is in a neutral position and the shoulder bars **13** are pivoted rearward. Fig. 8A depicts the stalls **1** when the animals first enter the stalls **1**. In the neutral position, the lift rail **3** has an angular position such that longitudinal axes **A-A** of the mounting bars **8** of the dividers **5** are about 1.9° from vertical. Once the animals are in the stalls **1**, the exit gate **10** prevents the animals from exiting the stalls **1**. The shoulder bars **13** point slightly rearward, the shoulder bars **13** having longitudinal axes **B-B** that are about 15.9° from vertical. With animals in the stalls **1**, the lift rail **3** can be rotated by inflation of the air cushion **35** up to a maximum position for the lift rail **3** (Fig. 10) such that the longitudinal axes **A-A** of the mounting bars **8** can be rotated up to about 14.3° from vertical. The shoulder bars **13** point further back into the stalls **1** when the lift rail **3** is rotated in this manner. Rotation of the lift rail **3** can bring the shoulder bars **13** into contact

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with the animals in the stalls **1**, encouraging the animals to move back in the stall **1** as far as possible so that the animals' udders are within easy reach of an operator in the pit. The amount of rotation of the lift rail **3** needed depends on the size of the smallest animal in the stalls **1**. While any actuator (e.g., a hydraulic cylinder, an electric linear actuator, a pneumatic actuator, a mechanical spring and the like, may be used to actuate rotation of the lift rail **3**, the use of an inflatable air cushion to actuate rotation of the lift rail **3** provides some resiliency affording a measure of safety for the animals should they become unruly in the stalls **1**.

Rotation of the lift rail **3** could potentially cause the animals, especially larger animals, to be crushed in the stalls **1** as the exit gates **10** move rearward. However, the head rails **11** of the exit gates **10** are mounted to the torsion springs **20**. The torsion springs **20** permit some rotation of the head rail **11** so that the shoulder bars **13** can be moved to point more forward. Rotation of the head rail **11** is independent of rotation of the lift rail **3** (see Fig. 9A and Fig. 11). The torsion springs **20** are pre-loaded to provide rotational biases rearward, which apply a certain pre-loaded force to the head rails **11** to assist in encouraging the animals to move to the rear of the stalls **1** while the lift rail **3** is rotated. However, once the larger animals are as far rearward as desired, further rotation of the lift rail **3** causes the shoulder bars **13**, which are attached to the pre-loaded head rails **11**, to press harder against the larger animals. When the shoulder bars **13** initially contact the animals, the resistance imparted by pre-loaded biases of the torsion springs **20** is non-zero but the resilience of the torsion springs **20** allows the exit gates **10** to rotate forward so that continued rearward motions of the shoulder bars **13** do not harm the larger animals. Once the lift rail **3** has been rotated sufficiently for moving the smaller animals to the rear of the stalls **1**, the lift rail **3** is returned to the neutral position. While the lift rail **3** is in the neutral position, if any of the animals is particularly unruly and wants to exit the stall **1**, the animal encounters the shoulder bars **13** and experiences enough resistance due to the rotational biases of the torsion springs **20** to urge the animal back into position. However, if the animals still attempt to move forward, once the longitudinal axes **B-B** of the shoulder bars **13** are parallel to the longitudinal axes **A-A** of the mounting bars **8**, the stop brackets **15** are abutting the lift rail **3** at a top portion **9** of the lift rail **3** (see Fig. 11) preventing the head rails **11**, and therefore the exit gates **10**, from further forward rotation. The stop brackets **15** comprise detents **19** at upper ends thereof that conform to the outer shape of the lift rail **3** to provide uniform abutment surfaces on the stop brackets **15** (see Fig. 8B). The exit gates **10** thereby prevent the animal from leaving the stalls **1**. Overall, the head rails **11** can rotate through an angle of about 14.0° between the fully rearward position of the shoulder bars **13** (Fig. 8A and Fig. 10) and the fully

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forward position of the shoulder bars **13** (Fig. 9A and Fig. 11). In the fully forward position, the longitudinal axes **B-B** of the shoulder bars **13** are parallel to the longitudinal axes **A-A** of the mounting bars **8**. Thus, the use of the torsion springs **20** as described above adds a safety factor in various ways, especially for larger animals.

While different torsion springs are useable together with the head rails **11, t**he torsion springs **20** are preferably elastomer powered torsional springs. As illustrated in Fig. 8C, an elastomer powered torsion spring comprises a tensioner housing **21** having a polygonal cross-section, preferably a square cross-section, that houses an insert **22** having the same or similar cross-section, preferably a square cross-section. The tensioner housing **21** and the insert **22** are tubes of different diameter, whereby the insert **22** is nested inside the tensioner housing **21**, the insert **22** having an outside diameter sufficiently smaller than an inside diameter of the tensioner housing **21** that the insert **22** is capable of rotating inside the tensioner housing **21**. The insert **22** is angularly rotated within the tensioner housing **21** with respect to the tensioner housing **21** to provide spaces **23** between internal corners of the tensioner housing **21** and outer faces of the insert **22**. When the tensioner housing **21** and the insert **22** have square cross-sections, the insert **22** is angularly rotated by 45° within the tensioner housing **21** with respect to the tensioner housing **21**. The spaces **23** are friction fitted with elastomeric plugs **24**, which are sufficiently compressible and resilient to permit some rotation of the insert **22** in the tensioner housing **21** while providing a counter-bias against the rotation, thereby acting as a torsion spring. The elastomeric plugs **24** act as 'lever arms' in the torsion springs **20**. The insert **22** has a hollow interior. Ends of the head rail **11** have a cross-sectional shape complementary to the cross-sectional shape of the hollow interior. The end of the head rail **11** is inserted into the hollow interior of the insert **22** so that the head rail **11** is engaged with inner walls of the insert **22**. Forces acting on the head rail **11** by movement of an animal against the shoulder bars **13** are thereby transmitted to the insert **22** and then to the elastomeric plugs **24**, the elastomeric plugs **24** providing the spring action for the torsion spring **20** to provide a counter-bias to the forces acting on the head rail **11**. The tensioner housing **21** is contained in one of the outer housings **17** attached to one of the head-rail mounting brackets **16** to mount the torsion spring **20** on the lift rail **3**.

The illustrated torsion spring **20** has an angular range of motion that permits rotation of the insert **22** through a maximum angle of about 16°. As previously indicated, the head rails **11** can rotate through an angle of about 14.0° between the fully rearward position of the shoulder bars **13**. As seen in Fig. 8C, in order to provide the pre-loaded bias (i.e., a pre-loaded tension) of the torsion spring **20**, the torsion spring **20** is pre-

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loaded at an angle **a-a** of about 2.0° with respect to vertical when the lift rail **3** is in the neutral position, the pre-load arising from the shoulder bars **13** pressing against the lift rail **3** at point **29** when the lift rail **3** is in the neutral position (see Fig. 8B). Elastomer powered torsional springs are particularly beneficial by providing a simple way of mounting the head rail while providing a rotational bias to the head rail through a limited angular range. Such torsion springs are available commercially, for example ROSTA™ Rubber Suspension Units.

The novel features will become apparent to those of skill in the art upon examination of the description. It should be understood, however, that the scope of the claims should not be limited by the embodiments but should be given the broadest interpretation consistent with the wording of the claims and the specification as a whole.

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Claims:

1. A milking stall comprising:

a lift rail;

an actuator for rotating the lift rail between a neutral position and a maximum position;

at least one divider mounted on and extending transversely rearward of the lift rail; and,

at least one exit gate mounted on and depending downwardly from the lift rail, the at least one exit gate comprising a head rail rotatably mounted on the lift rail and at least one shoulder bar connected to and depending downwardly from the head rail,

the at least one exit gate pivoting with the lift rail between the neutral position and the maximum position, the at least one shoulder bar pointing more rearward in the maximum position than in the neutral position,

the head rail rotatably mounted on the lift rail through at least one torsion spring mounted on the lift rail, the at least one torsion spring biasing rotation of the head rail independent of and relative to the lift rail, the torsion spring pre-loaded on the lift rail to provide a rotational bias to the head rail so that the at least one shoulder bar is urged rearward by the rotational bias.

2. The milking stall of claim 1, wherein the torsion spring is an elastomer powered torsion spring comprising: a tensioner housing; an insert; and a plurality of elastomeric plugs, wherein

the tensioner housing has the insert inserted therein,

the tensioner housing and the insert have a same polygonal cross-section,

the insert is rotated with respect to the tensioner housing to provide spaces between internal corners of the tensioner housing and outer faces of the insert, and

the elastomeric plugs are friction fitted into the spaces.

3. The milking stall of claim 2, wherein the cross-section is a square.

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4. The milking stall of any one of claims 1 to 3, wherein the torsion spring is pre-loaded on the lift rail so that the head rail is rotated at an angle of about 2.0° with respect to vertical when the lift rail is in the neutral position.

5. The milking stall of any one of claims 1 to 4, wherein the at least one exit gate further comprises at least one stop bracket connecting the at least one shoulder bar to the head rail, the at least one stop bracket abutting the lift rail when the at least one exit gate is in a fully forward position thereby preventing the at least one exit gate from further forward rotation.

6. The milking stall of any one of claims 1 to 5, wherein the actuator comprises an inflatable/deflatable air cushion.

7. The milking stall of any one of claims 1 to 5, further comprising a support column attached to the lift rail, the support column configured to be pivotally connected to a lift system for raising and lowering the milking stalls.

8. The milking stall of claim 7, wherein the actuator comprises an inflatable/deflatable air cushion mounted on the support column and situated to abut the lift system when the milking stall is mounted on the lift system.

9. A milking parlor comprising the milking stall as defined in any one of claims 1 to 8 and a lift system connected to the lift rail and configured to raise and lower the milking stall.

10. The milking parlor of claim 9, comprising a plurality of the milking stalls commonly sharing the lift rail and having a plurality of exit gates and dividers, the milking stalls situated side-by-side longitudinally along the lift rail, the stalls separated by the dividers.

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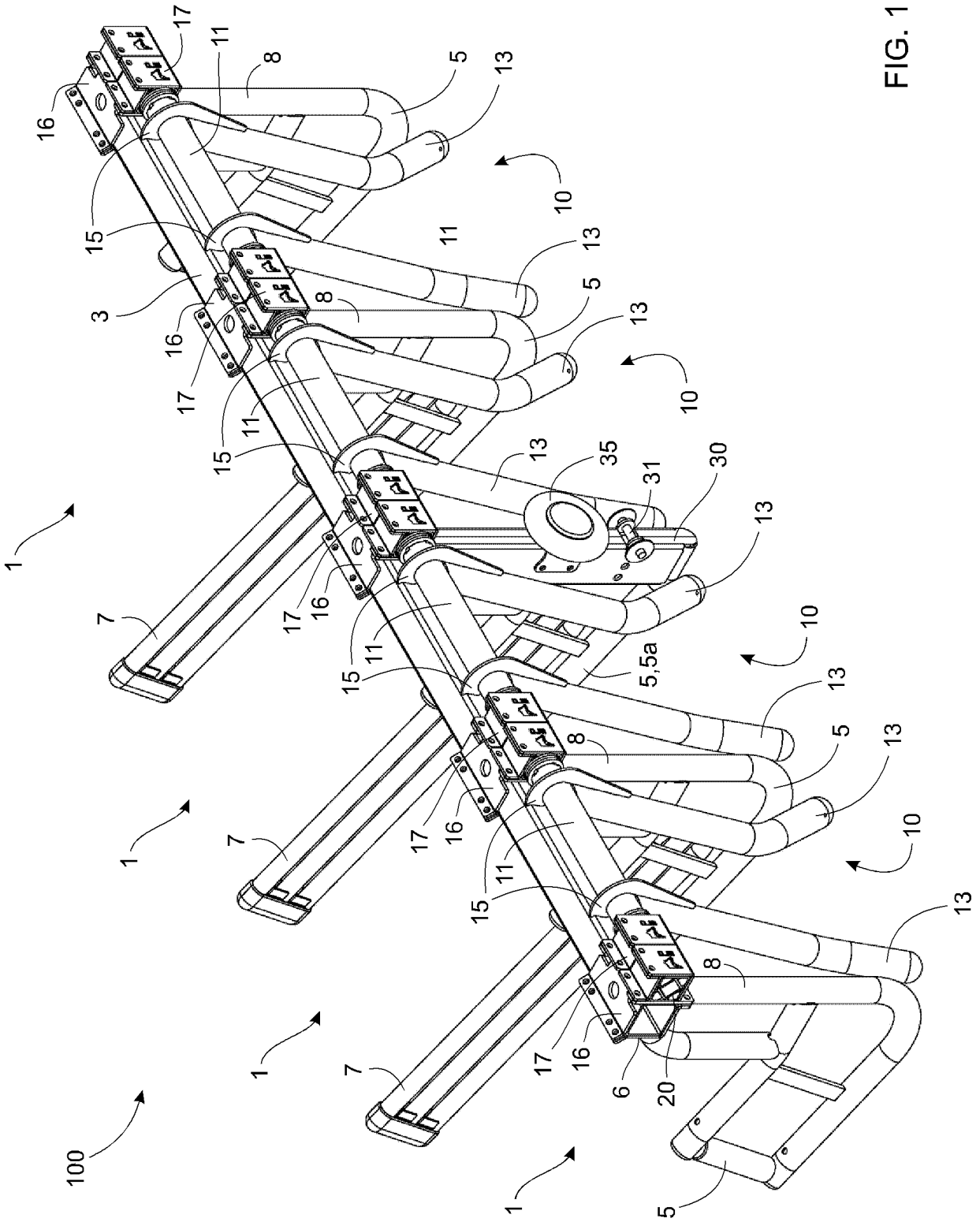


FIG. 1

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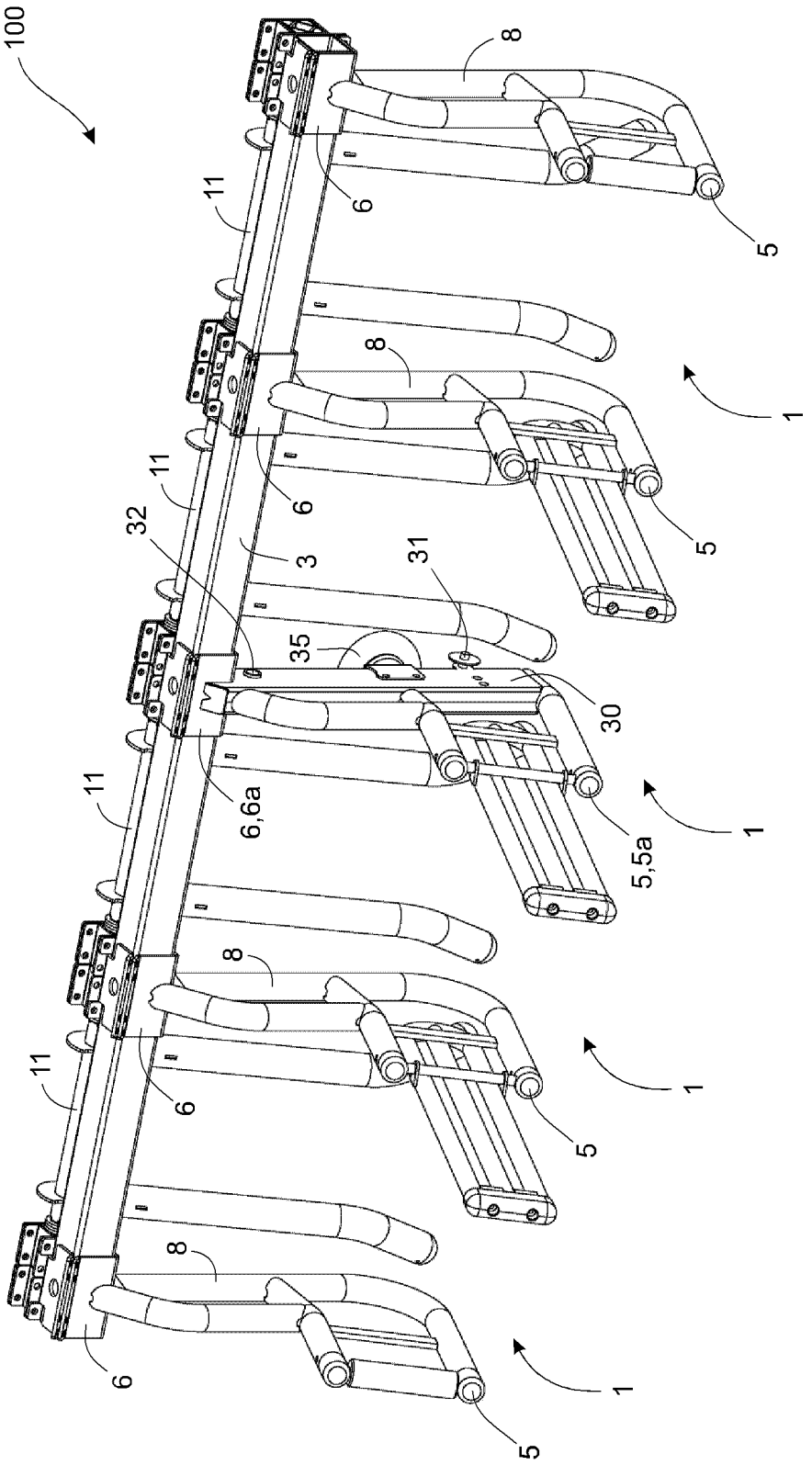


FIG. 2

Date Reçue/Date Received 2023-06-28

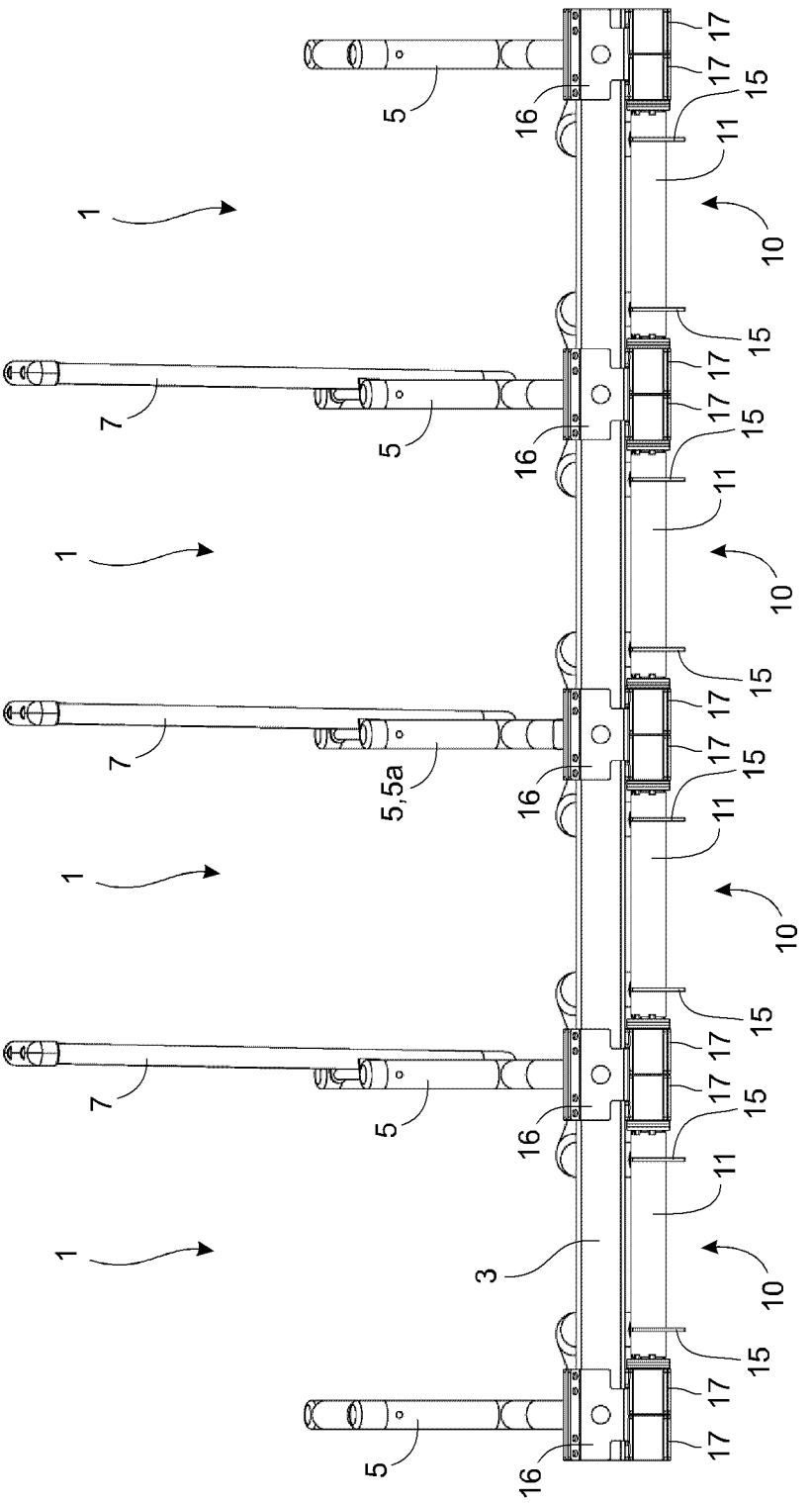

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FIG. 3

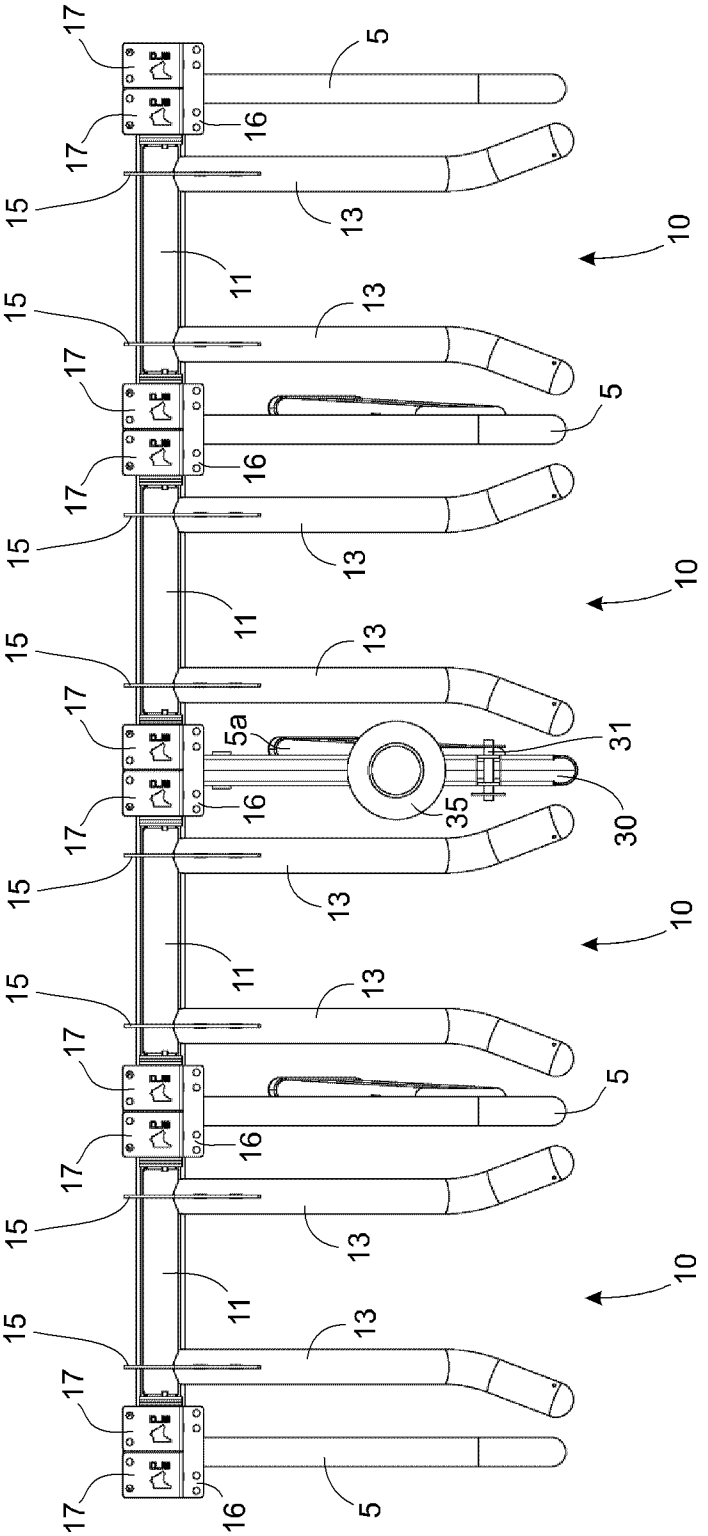


FIG. 4

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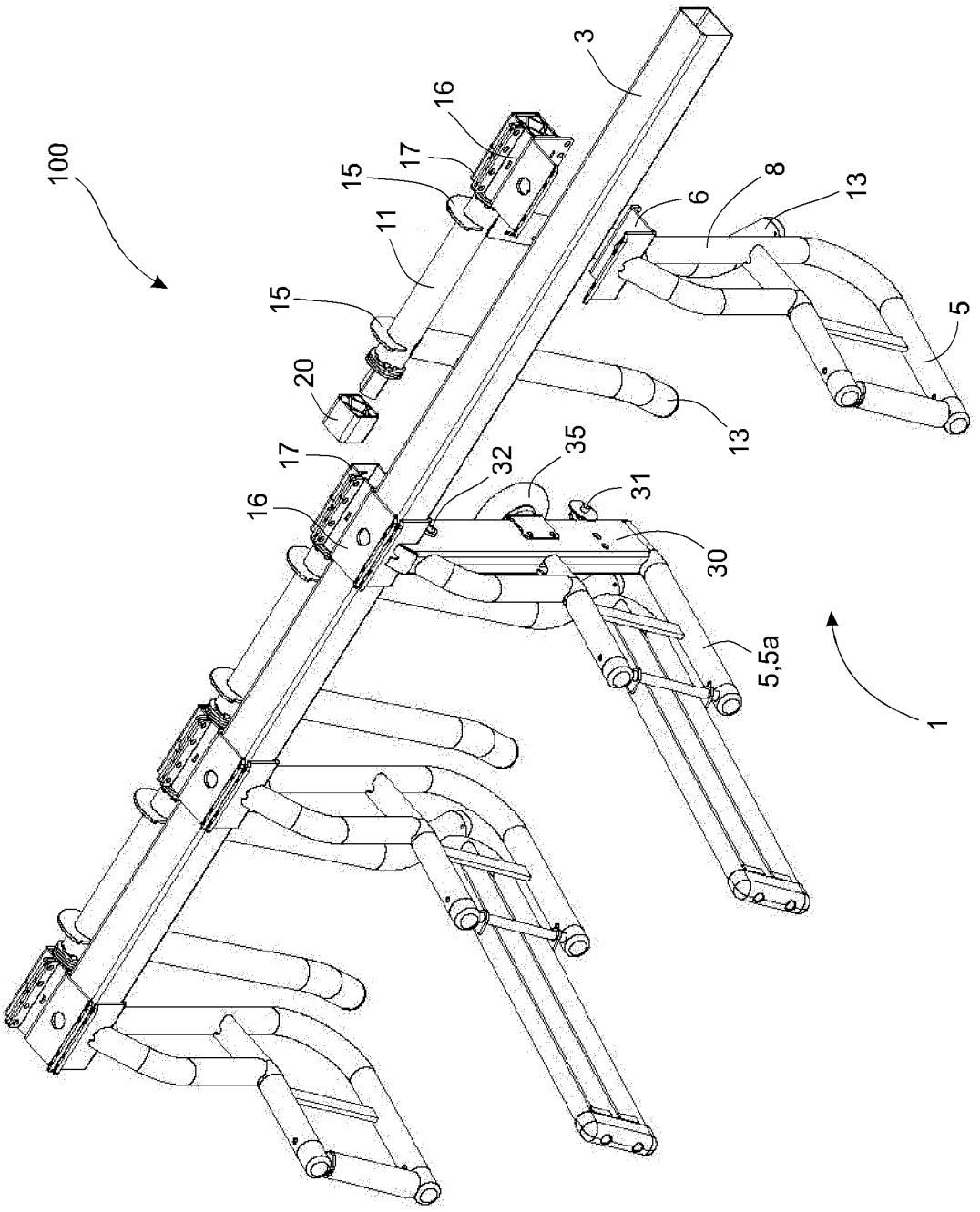


FIG. 5

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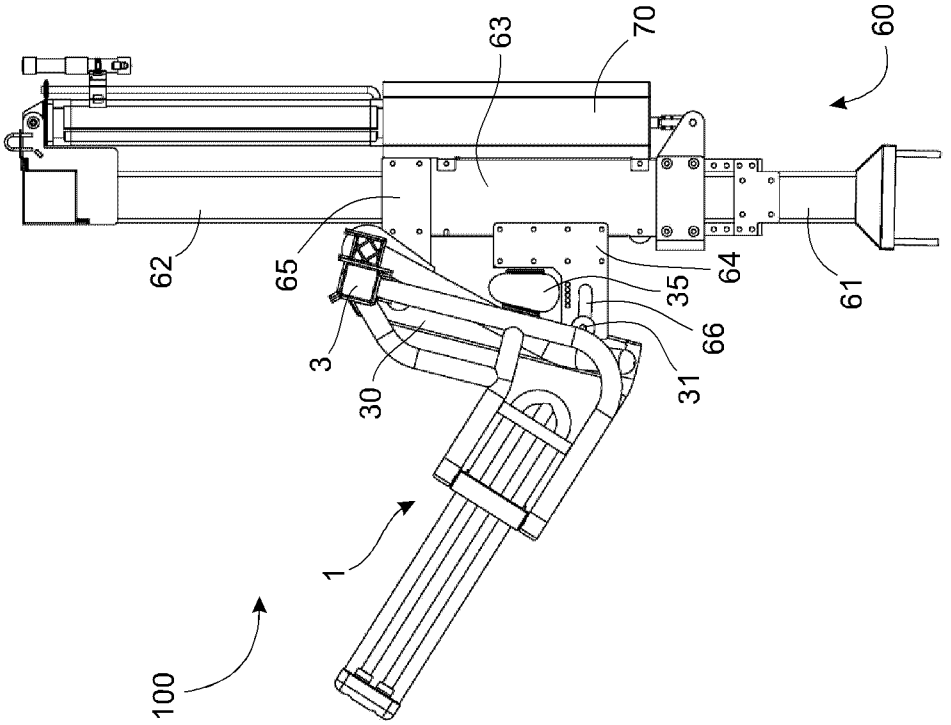

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FIG. 6B

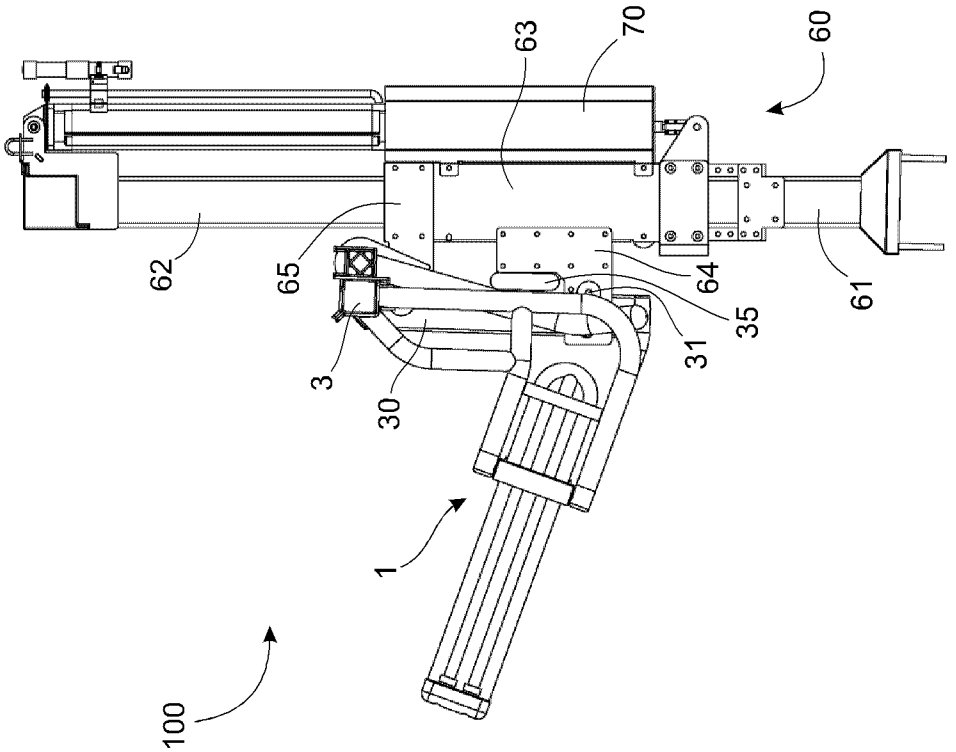

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FIG. 6A

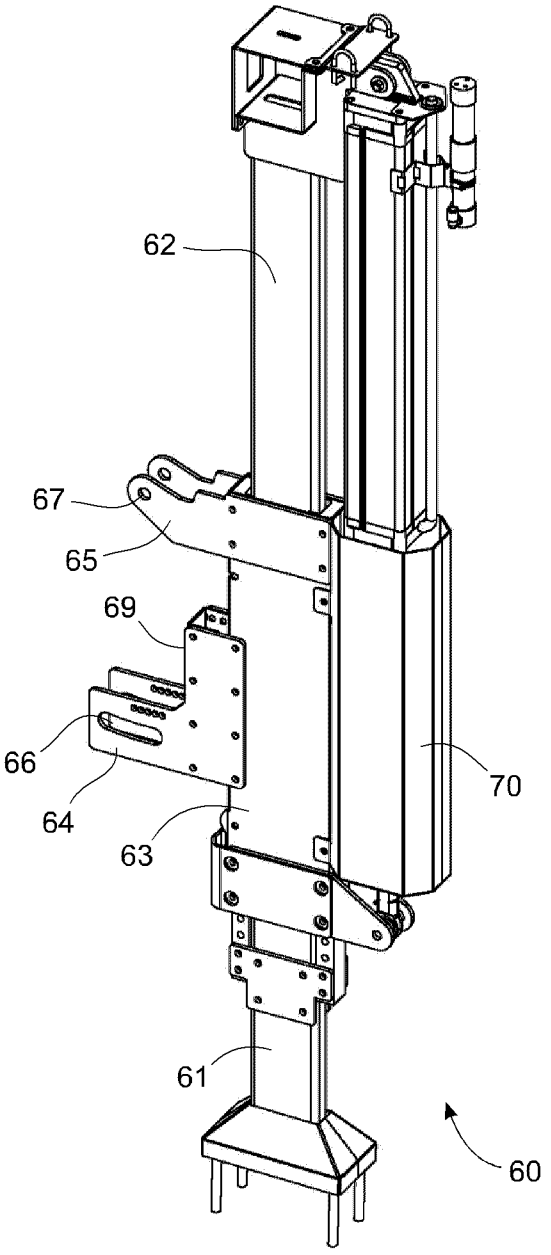


FIG. 7A

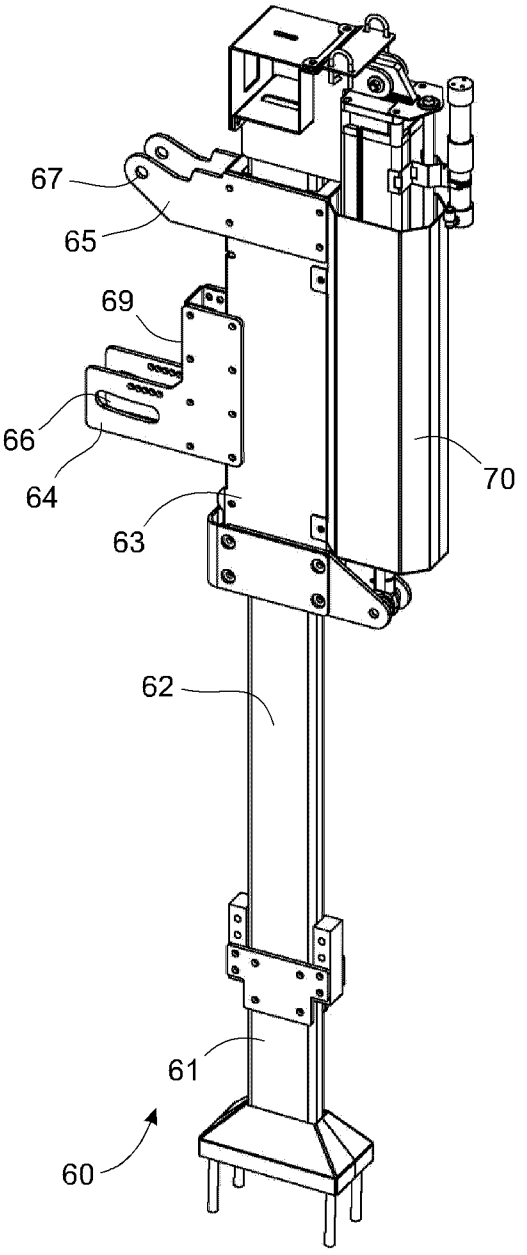


FIG. 7B

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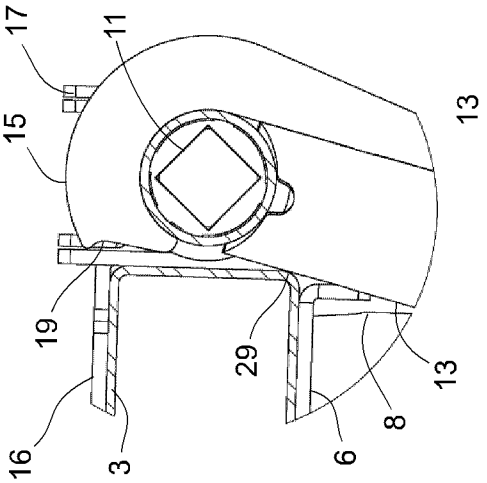


FIG. 8B

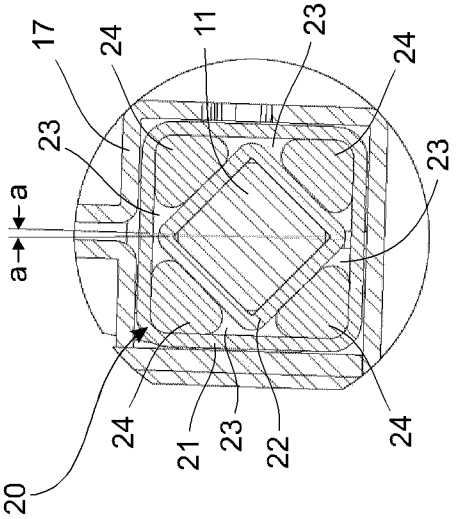


FIG. 8C

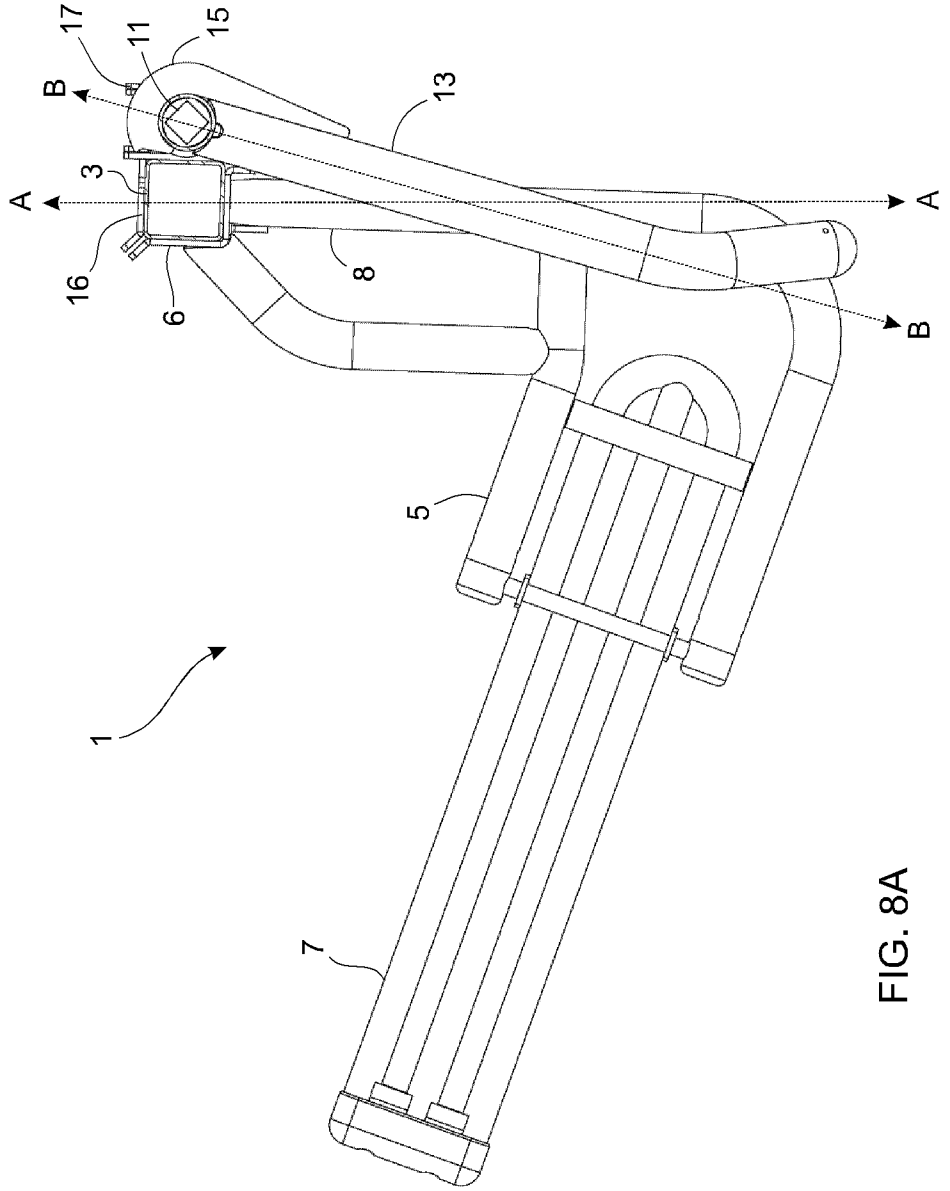


FIG. 8A

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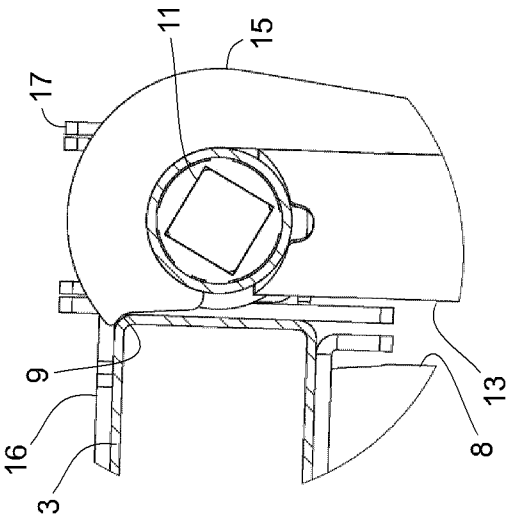


FIG. 9B

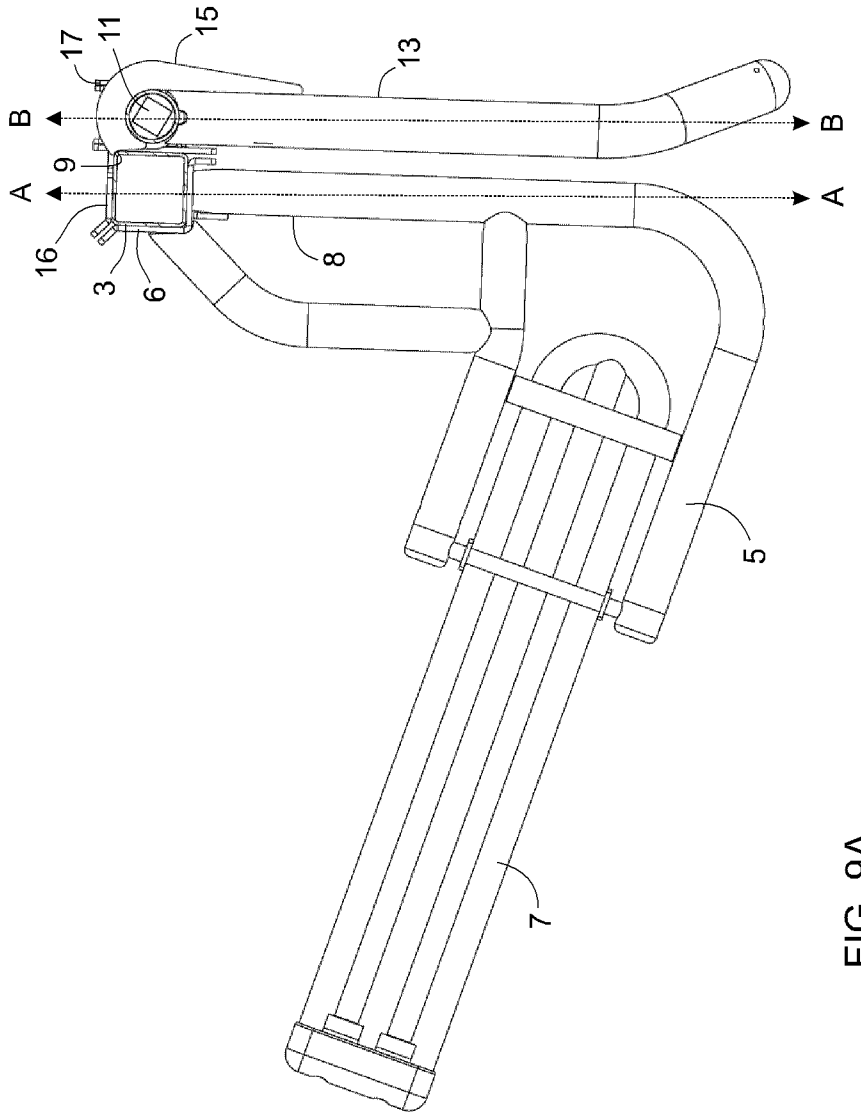


FIG. 9A

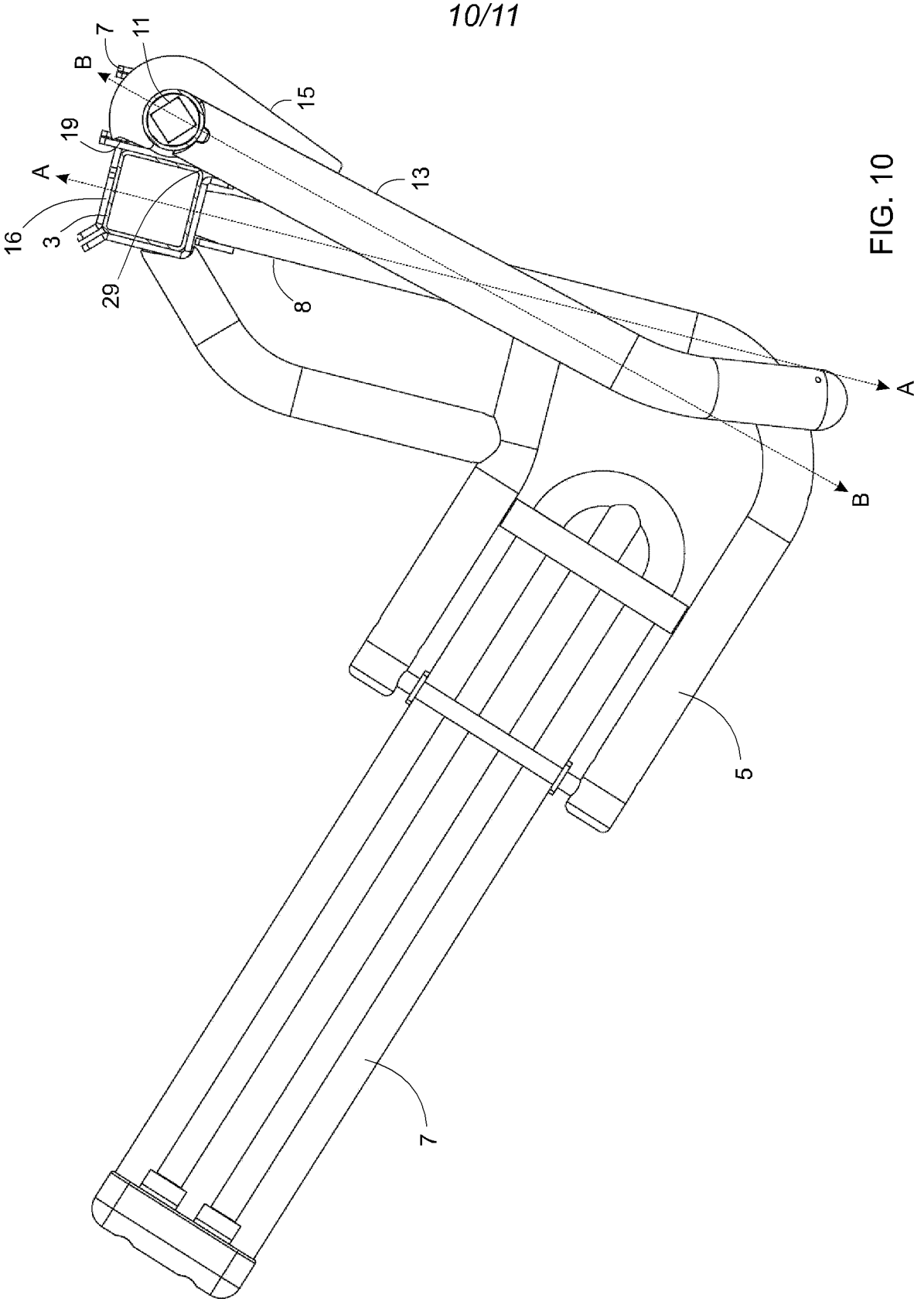


FIG. 10

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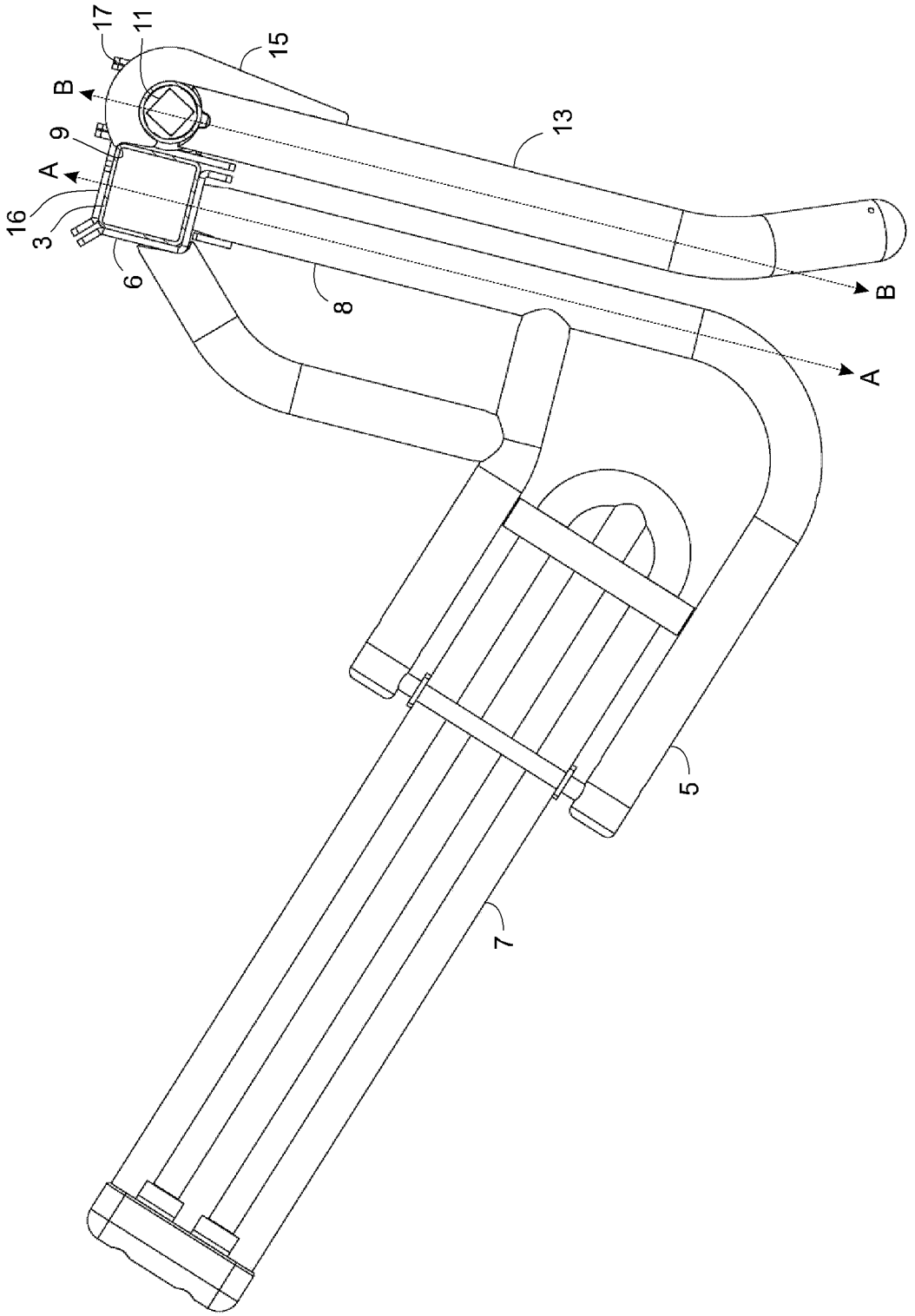
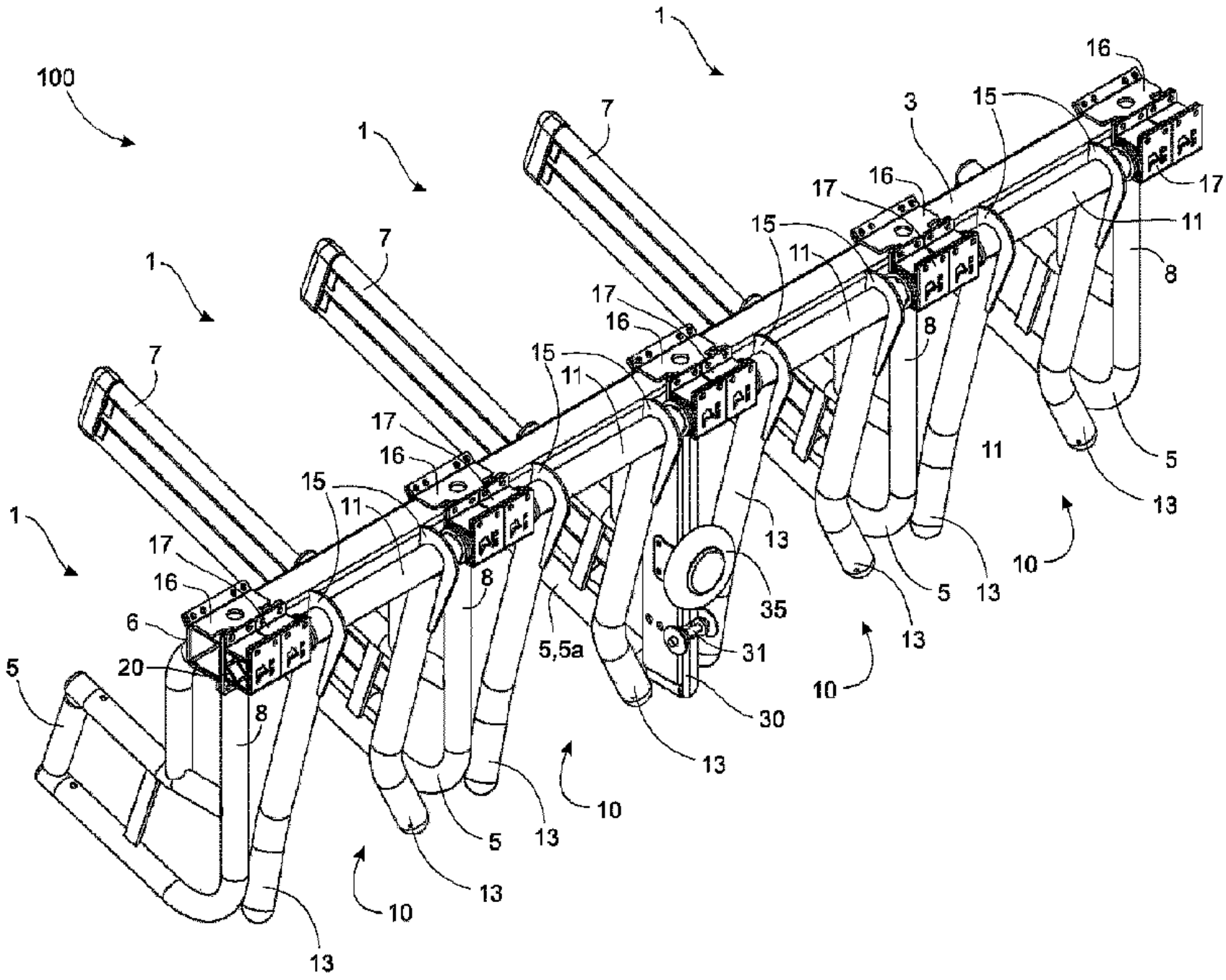


FIG. 11

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