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(54)

SUSPENSION ELEVATOR

- (57)

Suspension elevator with a car suspended in a pulley block on a usually multi-part, flexible suspension means, as well as a drive for moving the suspension means and several car pulleys rotatably held on a common axle between two car beams, which are preferably open-sided, for example in the form of C-profile beams, which form a car pulley unit over which the suspension means runs, wherein the common axle is mounted in at least one seat of the car beams in such a manner that it can be brought out of engagement with the seat or seat
- area by a pivoting or purely translatory displacement transversely to its central longitudinal axis, and that the at least one car beam is designed and adapted to the car pulley unit in such a way that the car pulley unit, after being disengaged from the at least one seat or seat area, can be pulled out of its installation space between the car beams by a movement extending at least substantially in the direction of its central longitudinal axis through one of the car beams.

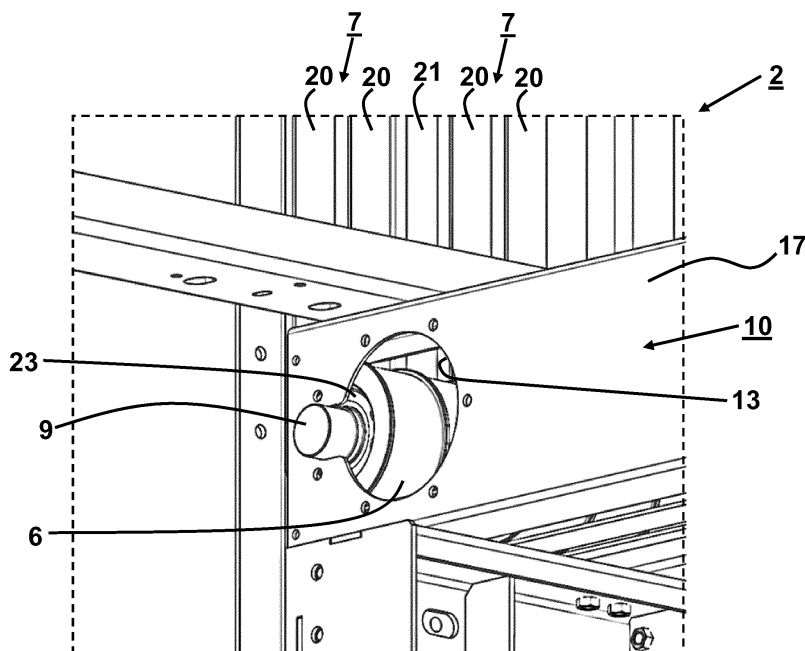


Fig. 8

Description

[0001] The invention relates to a suspension means elevator according to the generic concept of claim 1.

TECHNICAL BACKGROUND

[0002] Lifting and lowering of the elevator car along the elevator shaft is typically accomplished by means of driven suspension means such as ropes or belts - especially in the case of large height differences to be overcome. In order to reduce the drive torque required to operate a corresponding suspension elevator, the suspensions means is usually deflected several times with the aid of pulleys according to the principles of a pulley block.

[0003] This allows the use of small, high-speed drive motors, which are much easier to integrate into the elevator shaft.

[0004] The pulleys are mounted on the elevator car in such a way that the car is moved up and down in the elevator shaft together with the pulleys as a result of a corresponding tractive force exerted by the drive on the suspension means. Since the pulleys rotate during elevator operation and their bearings are exposed to high forces, they must be replaced from time to time due to wear.

STATE OF THE ART

[0005] However, the removal and installation of the car-mounted pulleys involve considerable assembly work.

[0006] Figures 1 and 2 show examples of the arrangement of the car pulleys in conventional suspension means elevators. On this basis, we will now describe the problems involved in removing and installing the car pulleys.

[0007] As can be seen from Fig. 1, the suspension means 7 are deflected on the car 2 with the aid of the car pulleys 6. In many cases, a total of four pulleys 6 are provided for this purpose on the underside of the car 2, of which, for example, two coaxially arranged pulleys 6 each form a pair of pulleys 5. The second pair of pulleys 5 is concealed by the car 2 in Figs. 1 and 2. In principle, it is also conceivable to mount the car pulleys 6 on the upper side of the car 2. However, particularly due to a lack of space in the upper area of the elevator shaft, the pulleys 6 are preferably mounted below the car 2.

[0008] Fig. 2 shows how a single car pulley 6 is attached to the car 2. The car pulley 6 and its bearings are supported by an axle 9 so that the car pulley 6 can rotate about the axle 9. The axle 9 is supported on the flanks of the beam 10 of the car 2, which is designed here as a U-section. Since the beam 10 is relatively thin-walled for weight reasons, it is reinforced on its underside with the cover 24 already shown here in the dismantled state to increase the rigidity of the beam 10.

[0009] To replace the car pulley 6 together with its bear-

ings, the cover 24 must first be removed from the beam 10 and then the axle 9 pulled out of the side of the beam 10. The car pulley 6 and its bearings can then be removed by pulling it downwards.

5 [0010] However, it is problematic that the downward space is generally blocked by other components not shown in Figs. 1 and 2 for reasons of clarity. For example, the elevator braking or safety gear is usually located below the car pulley 6. In order to be able to replace the car pulley 6, any components blocking access must first be dismantled, which is very time-consuming.

10 [0011] However, reducing the effort required to remove the car pulleys 6 by positioning either the assemblies, which block access to the pulleys 6 from below (not shown), or the pulleys 6 in different areas of the car 2 also has disadvantages. This is because both the assemblies blocking access to the car pulleys 6 and the car pulleys 6 should each be positioned at a short distance from the guide rail 21.

15 [0012] The assemblies blocking access to the car pulleys 6 are generally elements of the elevator braking device. This interacts with the guide rail 21 and therefore cannot be mounted on the car 2 at too great a distance from the latter.

20 [0013] However, the position of the pulleys 6 in the vicinity of the guide rail 21 is also predetermined to a certain extent. For example, as in the example shown in Fig. 1, a number of suspension means 7 are generally used to optimize the load introduction into the car 2. In this way, the suspension means 7 can be provided on both sides of the guide rail 21 and thus the generation of a torque acting around the guide rail 21 can be prevented. In addition, in order to prevent the suspension means 7 from being loaded to different extents and consequently stretched to different extents in the event of uneven weight distribution during operation of the elevator 1, the suspension means 7 are mounted symmetrically with respect to the guide rail 21 at the smallest possible distance therefrom. Since the position of the car pulleys 6 is determined by the position of the suspension means 7, the car pulleys 6 must therefore also be installed in the vicinity of the guide rail 21.

THE PROBLEM UNDERLYING THE INVENTION

45 [0014] In view of this, it is the object of the invention to specify a suspension means elevator with which the effort required for the assembly and disassembly of the pulleys is reduced.

THE SOLUTION ACCORDING TO THE INVENTION

50 [0015] According to the invention, this problem is solved with the features of the main claim directed to the suspension elevator.

55 [0016] Accordingly, the problem is solved by means of a suspension elevator with a car suspended in a pulley block from a usually multi-part, flexible suspension

means. The suspension elevator also comprises a drive for moving the suspension means and several car pulleys rotatably held on a common axle.

[0017] The car pulleys are located between two car beams which are preferably open-sided, for example in the form of C-section beams. The car pulleys form a car pulley unit over which the suspension means runs being deflected that way. The suspension elevator is characterized in that the common axle of the car pulleys is mounted in at least one seat of the car beams or held in a seat area of the car beams in such a manner that it can be brought out of engagement with the seat or seat area by a pivoting or purely translational displacement transversely and preferably perpendicularly to its central longitudinal axis. In addition, the at least one car beam is designed and adapted to the car pulley unit in such a way that the car pulley unit, after being disengaged from the at least one seat or seat area, can be pulled out of its installation space between the car beams through one of the car beams. The pulling out movement of the car pulley unit runs at least substantially in the direction of its central longitudinal axis.

[0018] To replace the car pulleys of a car pulley unit, the common axle of the respective car pulley unit is first brought out of its operating position by a translatory movement in a direction transverse to the axis of rotation of the car pulleys.

[0019] The car pulleys supported by the axle can then be pulled out of the car beam together with the axle. For this purpose, the axle can either be displaced in such a way that it is simultaneously released at both ends from its seat or seating area there, which is preferred. Alternatively, it can first be pivoted in such a way that it is first released completely from its seat or seating area at only one end and then pulled out slightly so that it is also released from its second seat or seating area.

[0020] In its operating position, the axle is preferably mounted with one end in a seat on each car beam. When the axle is in its operating position, the car pulleys it supports are in a position from which they can cooperate with the suspension means. When the axle is in its operating position, additional means can also be provided on the axle and/or the car to prevent rotational movement and translational movement of the axle.

[0021] The car pulleys can thus be moved as close to the guide rail as is necessary for optimum weight distribution on the suspension means without colliding with the guide rail or any elements mounted on the car below or above the car guide rollers during dismantling. This ensures good load distribution with minimum assembly effort.

[0022] The fact that at least two car pulleys are mounted on a single axle and the axle is mounted in different car beams, ideally on different sides in relation to the guide rail, ensures that the force is applied uniformly to the car. In addition, the amount of work involved in assembling and disassembling the car pulleys is significantly reduced if each car pulley is not supported by its own

axle.

[0023] In this type of design, the car pulley units can be mounted either below or above the car as required. The number of such car pulley units per car can be varied depending on the suspension means.

[0024] The "operating position" means the position in which the axle is located when the pulleys it supports are engaged with the suspension means as intended.

[0025] "Car" means either a substantially non-self-supporting car housed in a load-bearing sling, i.e., a load-bearing frame, or a car with an integral car frame whose integration replaces the sling.

[0026] A "flexible" suspension means is to be understood as a suspension means whose geometry and material allow the suspension means to be bent flexibly around a pulley or traction sheave. More preferably, a "flexible" suspension means is to be understood as a suspension means whose geometry and material allow the suspension means to be bent by a radius that is less than five times the width of the suspension means. If the cross-section of a suspension means is such that not all sides of the cross-section are of equal length, the width of the suspensions means corresponds to the longest side of the cross-section.

[0027] A car pulley unit is understood to mean all car pulleys located on a common axle together with the axle.

[0028] The car pulley unit is completely "disengaged" when its axle is in a position from which displacement in the longitudinal direction of the axle is possible without the car pulleys supported by the axle colliding with the car beam.

[0029] A car is "suspended in a pulley block" if it is suspended by pulleys from a suspension means using the principles of a pulley block to reduce the force required to lift the car in the elevator shaft.

[0030] The seat of the axle of the car pulley unit is the holding section which correctly holds the axle it receives in its operational position. The seat can be provided solely by, or in individual cases together with, the car beam by means of a plate detachably attached to the car beam. The former in particular is always the case when the wall thickness of the car beam is too small to form a seat itself. This task is then performed by the plate, which has thicker walls than the car beam. It then absorbs the direct axle load and discharges it evenly into the side wall of the car beam.

[0031] If the car beam itself has sufficient wall thickness, it can also form the seat on its own. Otherwise, it only forms the seat area behind the actual seat.

PREFERENTIAL DESIGN OPTIONS

[0032] There are a number of ways in which the invention can be configured to further improve its effectiveness or usefulness.

[0033] It is therefore particularly preferred that at least one car beam has a removal opening for the car pulley unit in its front end regions. Ideally, even both car beams

between which the axle is accommodated have a removal opening. A slot for receiving the axle of the car pulley unit branches off from the removal opening. Exactly this slot may form what is called "the seat area" if it does not form the seat itself.

[0034] To "branch off" may mean, that the slot forms a channel in the flank of the car beam which is directly interconnected with the removal opening and which is able to completely accommodate the axle during regular operating conditions, so that the axle is no longer positioned within the removal opening.

[0035] During disassembly the axle can then first be moved along the slot in a direction orthogonal to the longitudinal direction of the axle until it is in the area of the removal opening. From there, it can be pulled out in the longitudinal direction of the axle. The end of the slot facing away from the removal opening could itself form the seat or a part of the seat of the axle or - without forming itself a part of the seat - receive the axle while it is in its seat without itself contributing to the seating effect. The latter is the rule. In this case the slot has a mere guide function and is a support means for bringing the axle in engagement with its seat formed by said plate.

[0036] The removal opening preferably has a clear cross-section area that is at least a factor of 7 larger than the slot for receiving the axle.

[0037] In addition, the clear cross-section area of the removal opening is larger than the outside diameter of the car pulleys.

[0038] The slot for seating the axle is matched to the axle diameter. Said slot is preferably larger than the diameter of the axle, preferably at least 1% larger than the axle diameter. In some cases it is even preferred that the slot is even larger in comparison to the axle diameter, if necessary at least 4%, better at least 7% larger than the axle diameter. In this way, very simple, cant-free installation and removal of the axle from the seating area is ensured.

[0039] Otherwise, if the slot is at least involved in seat formation, its clear diameter is in the range of the axle diameter plus a mere assembly tolerance as required for installation and removal.

[0040] The clear cross-section of the removal opening corresponds to the area outlined by the edges of the opening.

[0041] In another preferred embodiment, the slot at its end facing away from the removal opening is partially circular, ideally approximately semicircular. Thereby the slot may determine the end position of the fully into the slot inserted axle of the car pulley unit.

[0042] The partially circular section of the axle then forms the axle seat. The diameter of the part-circular section of the slot is ideally just enough larger than the diameter of the axle in the area with which the axle is pushed along the slot that the relationship between the two dimensions preferably corresponds to a clearance fit. As a result, a planar contact is established between the outer circumference of the axle and the car beam, at

least in sections, so that the force exerted by the axle on the car beam is at least partially transmitted planarly into the car beam. This reduces the risk of unacceptable plastic deformation on the axle and the car beam.

[0043] Ideally, the car beam is closed in the operational state by a plate which is preferably completely flat in itself. The plate is usually made of metal or steel and has an opening, also known as an "axle hole", which receives the axle. It is usually formed by an endless rim in the circumferential direction.

[0044] The opening of the plate usually has the same geometry as the cross-section of the axle, which is at the height of the plate when the axle is in its operational state. The diameter of the clear cross-section of the plate opening is ideally so much larger than the diameter of the axle in the area with which the axle is pushed along the slot that the relationship of the two dimensions corresponds to a transition fit or a clearance fit that can be pulled off without tools. In the assembled state, the plate thus prevents slippage of the axle in the direction parallel to the slot and orthogonal to the longitudinal direction of the axle.

[0045] In a further preferred embodiment, the material thickness of the plate exceeds that of the car beam supporting it by at least 20% and preferably even by at least 35%.

[0046] The car beam can then be designed to be very thin and save material as well as weight, because the plate supports the forces acting on the axle. That way the wall of the car beam needs not to constitute the seat but it forms the seat area only, that means the region being behind the seat itself.

[0047] In another preferred embodiment, the plate absorbs at least the predominant part of the axle load occurring in the region of the plate during operation and diverts it to the car beam.

[0048] The plate can transfer the absorbed axle load over a large area or via several joints into the car beam, so that the car beam can still be designed with relatively thin walls.

[0049] Preferably, the plate is frictionally clamped against the flank of the car beam by at least six screws in the operational state.

[0050] Such a connection can be made with relatively little effort, and at the same time ensures that the force is applied to the car beam over a large area, and that the axle load absorbed by the plate is distributed evenly over the car beam.

[0051] The panel reaches the "operational state" when the screws connecting it to the car beam are tightened.

[0052] Ideally, the suspension means consists of several belts which have at least one flat or flattened side. They interact with the car pulleys and/or the traction sheave via this side.

[0053] The advantage of using belts as suspension means is that belts are more flexible than steel cables. This means that relatively small pulleys can be used, which can be mounted in the car beam without any prob-

lems.

[0054] In this context, a belt is preferably understood to be a load-bearing means whose cross-section is rectangular. One of the long sides of the cross-section is the side facing the pulleys.

[0055] In another preferred embodiment, the pulley unit forms two pulleys or two groups of pulleys on a common axle. The two (groups of) pulleys are spaced apart from one another by a gap. A guide rail section projects into this gap when the pulley unit is installed as intended.

[0056] This ensures good load distribution and better comfort for the users of the elevator. By arranging the pulleys and correspondingly the suspension means in this way, the same number of suspension means is provided on both sides of the guide rail. This prevents the creation of a torque acting around the guide rail exerted by the suspension means on the car. In addition, this prevents the suspension means from being loaded to different extents and consequently stretched to different extents in the event of uneven weight distribution during operation of the elevator.

[0057] While elevators known from the prior art also have pulleys installed on both sides of the guide rail, the special feature here is that they are located on one axle and can be removed together with the axle at the same time. In addition, the pulleys according to the invention can be removed laterally, which reduces the assembly and disassembly effort.

FIGURE LIST

[0058]

Fig. 1 shows a schematic diagram of a known prior art hoist.

Fig. 2 shows a car-mounted pulley known from the state of the art.

Fig. 3 shows a cross-section of a car according to the invention with a car pulley unit.

Fig. 4 shows a section of a car according to the invention with a car pulley unit in isometric view.

Fig. 5 shows a section of a car beam according to the invention.

Fig. 6 shows a car pulley unit according to the invention in the fully mounted state on the car.

Figs. 7-10 show step-by-step disassembly of a car pulley unit according to the invention.

Fig. 11 shows a cross-section of a single car pulley unit according to the invention.

PREFERRED EMBODIMENT

[0059] The operation of the invention is explained by way of example with reference to Figures 3-11.

[0060] Fig. 3 shows how the car pulleys 6 of the car pulley unit 11, which are in engagement with the belts 20 of the multi-part suspension means 7, are mounted on the car 2. The car pulley unit 11 as well as the car beam 10 and the plate 15 holding the car pulley unit 11 on the car beam 10, including the locking element 19, are thereby mirror-symmetrical with respect to the plane which runs orthogonally to the longitudinal axis of the axle 9 and centrally through the guide rail 21. The axle 9 of the car pulley unit 11, which is stationary as such during operation, projects through the two car beams 10 and bears the car pulleys 6 rotatably mounted on it with two pulley bearings 23 in each case.

[0061] In the fully assembled state shown in Fig. 3, the belts 20 are in contact with the car pulleys 6. Two belts 20 are in contact with each individual car pulley 6.

[0062] The car pulleys 6 are mounted on the axle 9 in such a way that there is a free space between them. The section 22 of the guide rail 21 projects partially into this free space, so that one car pulley 6 at a time would collide with the guide rail 21 if the car pulley unit 11 were to be moved directly from the position shown here in the direction transverse to the guide rail 21.

[0063] From Fig. 4, it can be seen that access to the car pulley unit 11 from below is blocked by other components belonging to the elevator 1.

[0064] The disassembly of the car pulley unit 11 is explained with reference to Figs. 6-10 and also Fig. 5.

[0065] In Fig. 6, the car pulley unit 11 is in the fully assembled state already shown in Figs. 3 and 4. The end of the axle 9 shown here projects through the car beam 10 and into or through the plate 15 bolted to the car beam 10. The same applies to the second end of axle 9, which is not visible in Fig. 6, due to the mirror symmetry of the car pulley unit 11. Overall, it is preferred that the plate 15 is thicker than the car beam 10 supporting it. Furthermore, as can be seen from Fig. 3, the plate 15 is at least 20% thicker, preferably at least 35% thicker, than the side wall of the car beam 10 against which it is bolted. Sometimes it is even preferred that the plate 15 is at least 50% thicker, preferably at least 70% thicker, than the side wall of the car beam 10.

[0066] It can also be seen clearly from Fig. 3 that the axle hole in the plate 15 is closed all around in the circumferential direction. In this embodiment, therefore, the reveal of the axle hole forms the seat 12 for the axle 9 of the car pulley unit 11 - at least without any substantial involvement of the car beam 10. The tolerancing is preferably designed in such a way that the axle 9 is received by the axle hole of the plate 15 with essentially no play, but there is still enough residual play to allow the plate 15 to be removed from the axle 9 without a removal tool by the axle 9 sliding out of the axle hole.

[0067] The axle 9 is secured against axial slippage as

well as against any rotational movement by means of the half-disc-shaped locking element 19, which engages in a groove 18 of the axle 9 visible in Fig. 11. The locking element 19 is in turn fixed with two of the screws 16 provided for fixing the plate 15 to the car beam 10, which is clever because it reduces the effort required.

[0068] To disassemble the car pulley unit 11, the locking element 19 must first be removed by loosening the two screws 16 fixing the locking element 19. This condition is shown in Fig. 7.

[0069] The plate 15 is then removed from the flank 17 of the car beam 10 by loosening the remaining screws 16. As can be seen in Fig. 8 in combination with Fig. 5, the axle 9 of the car pulley unit 11 rests against the semicircular axle stopper of the car beam 10 in its operating position, i.e. when the car pulleys 6 are engaged with the belts 20. To remove the car pulley unit 11 from the car 2, the axle 9 together with the car pulleys 6 carried by it is moved along the slot 14 (forming the seat area) in the direction of the removal opening 13 in the flank 17 of the car beam 10. As soon as the axle 9 is in a reasonably concentric position with respect to the removal opening 13 as shown in Fig. 9, the entire car pulley unit 11 can be pulled out in the direction of the longitudinal axis of the axle 9 from the area enclosed by the two car beams 10.

LIST OF REFERENCE NUMBERS

[0070]

- | | | |
|----|---------------------------|--|
| 1 | Suspension elevator | |
| 2 | Car | |
| 3 | Drive | |
| 4 | Not assigned | |
| 5 | Pair of pulleys | |
| 6 | Car pulley | |
| 7 | Suspension means | |
| 8 | Counterweight | |
| 9 | Axle of a car pulley unit | |
| 10 | Car beam | |
| 11 | Car pulley unit | |
| 12 | (Axle) Seat | |
| 13 | Removal opening | |
| 14 | Slot | |
| 15 | Plate | |
| 16 | Screws | |
| 17 | Flank of the car beam | |
| 18 | Groove | |
| 19 | Locking element | |
| 20 | Belt | |
| 21 | Guide rail | |
| 22 | Guide rail section | |
| 23 | Pulley bearing | |
| 24 | Cover | |

Claims

1. Suspension elevator (1) with a car (2) suspended in a pulley block on a usually multi-part, flexible suspension means (7), as well as a drive for moving the suspension means (7) and several car pulleys (6) rotatably held on a common axle (9) between two car beams (10), which are preferably open-sided, for example in the form of C-profile beams, which form a car pulley unit (11) over which the suspension means (7) runs, **characterized in that** the common axle (9) is mounted in at least one seat (12) of the car beams (10) in such a manner that it can be brought out of engagement with the seat (12) or seat area by a pivoting or purely translatory displacement transversely to its central longitudinal axis, and that the at least one car beam (10) is designed and adapted to the car pulley unit (11) in such a way that the car pulley unit (11), after being disengaged from the at least one seat (12) or seat area, can be pulled out of its installation space between the car beams (10) by a movement extending at least substantially in the direction of its central longitudinal axis through one of the car beams (10).
2. Suspension elevator (1) according to claim 1, **characterized in that** at least one car beam (10) has - preferably in its front end region - a removal opening (13) for the car pulley unit (11), from which a slot (14) for receiving the axle (9) of the car pulley unit (11) branches off.
3. Suspension elevator (1) according to claim 1 or 2, **characterized in that** the slot (14), at its end facing away from the removal opening (13), is of partly circular - ideally approximately semicircular - design and thereby determines the position of the fully into the slot inserted axle (9) of the car pulley unit (11) being an axle stopper.
4. Suspension elevator (1) according to claim 2 or 3, **characterized in that** the car beam (10) is closed in the operational state by a plate (15) having an opening which receives the axle (9) and preferably forms a seat (12) for it.
5. Suspension elevator (1) according to claim 4, **characterized in that** the material thickness of the plate (15) exceeds that of the car beam (10) supporting it by at least 20%, preferably by at least 35%.
6. Suspension elevator (1) according to one of the preceding claims, **characterized in that** the plate (15) absorbs at least the predominant part of the axle load occurring in the region of the plate (15) during operation and diverts it into the car beam (10).
7. Suspension elevator (1) according to one of the pre-

ceding claims, **characterized in that** the plate (15) is frictionally clamped against the flank (17) of the car beam (10) by at least six screws (16) in the operational state.

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8. Suspension elevator (1) according to one of the preceding claims, **characterized in that** the suspension means (7) consists of several belts (20) which have at least one flat or flattened side via which they interact with the car pulleys (6) and/or the traction sheave.

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9. Suspension elevator (1) according to one of the preceding claims, **characterized in that** the pulley unit (11) forms two or two groups of pulleys (6) on a common axle (9), which is spaced apart from one another by a gap into which a guide rail section (22) projects when the pulley unit (11) is installed as intended.

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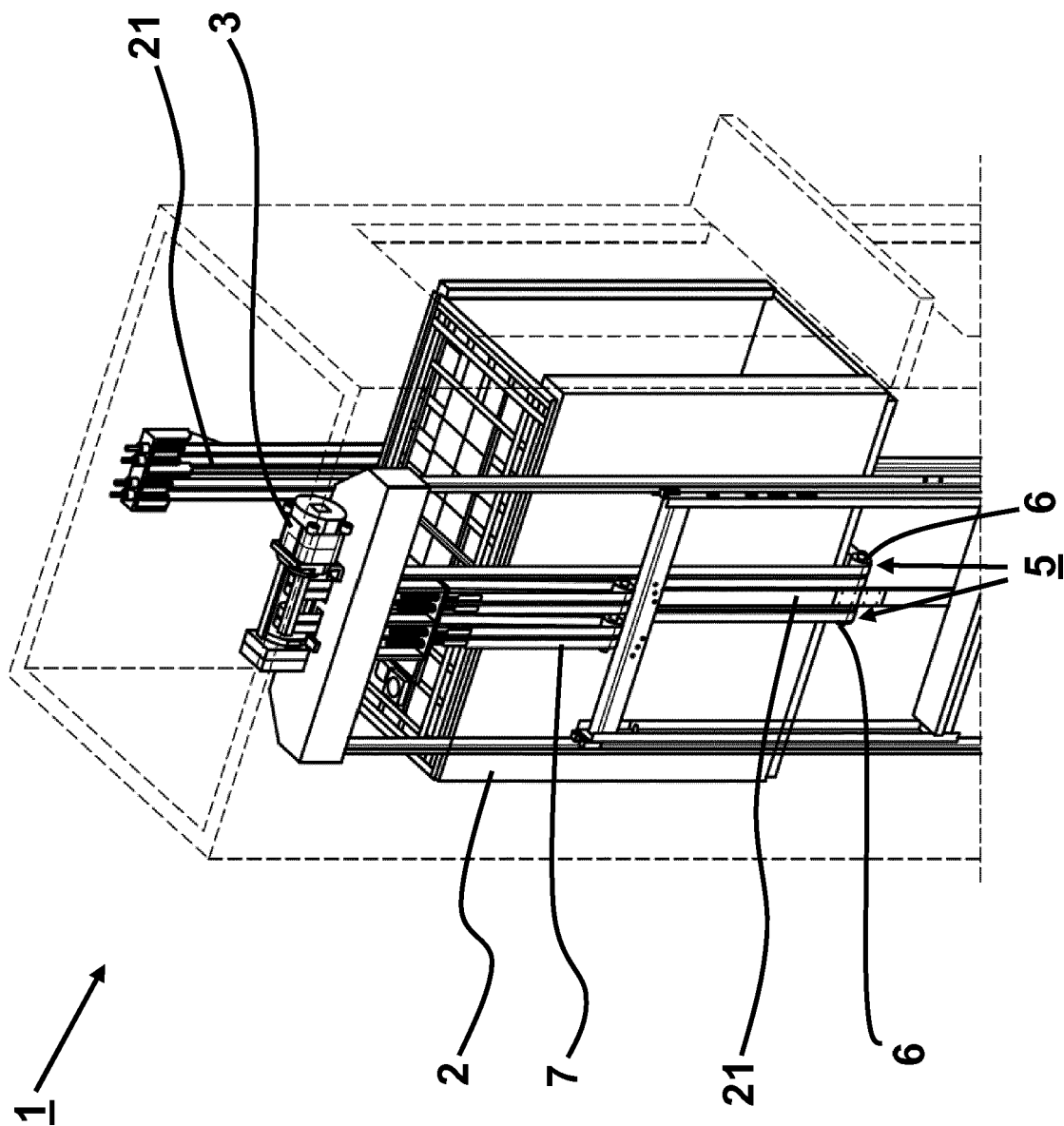


Fig. 1

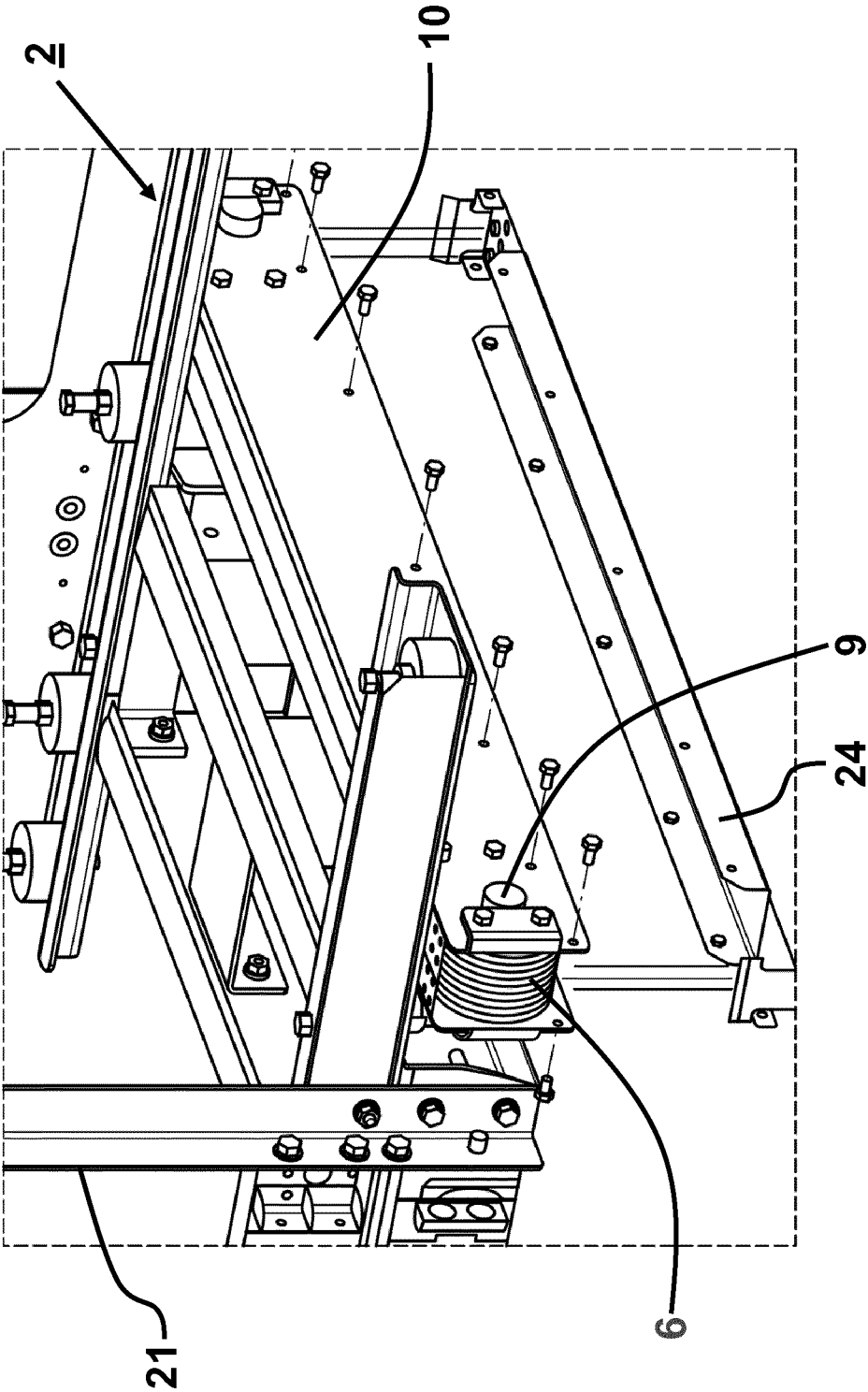


Fig. 2

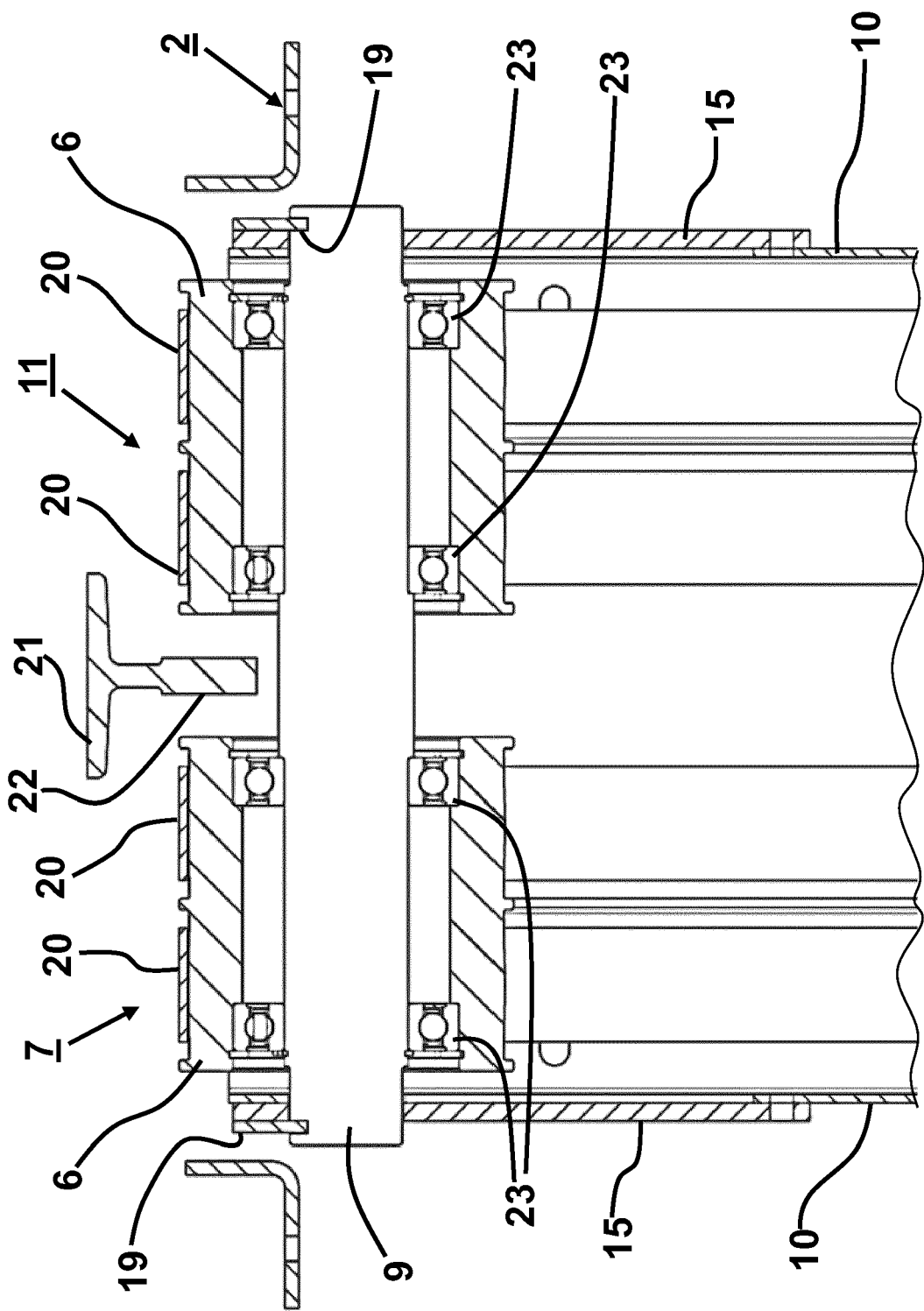
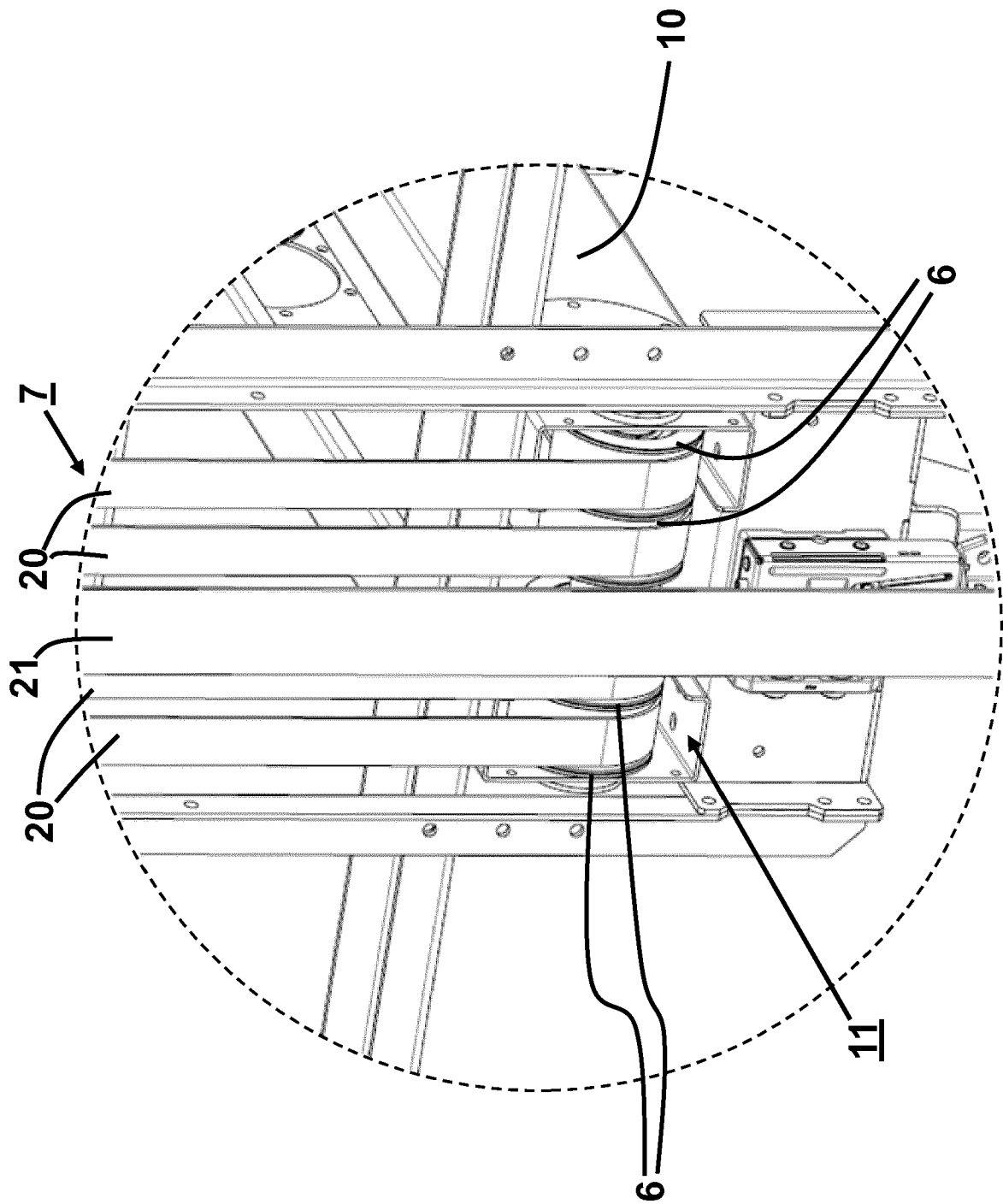


Fig. 3

Fig. 4



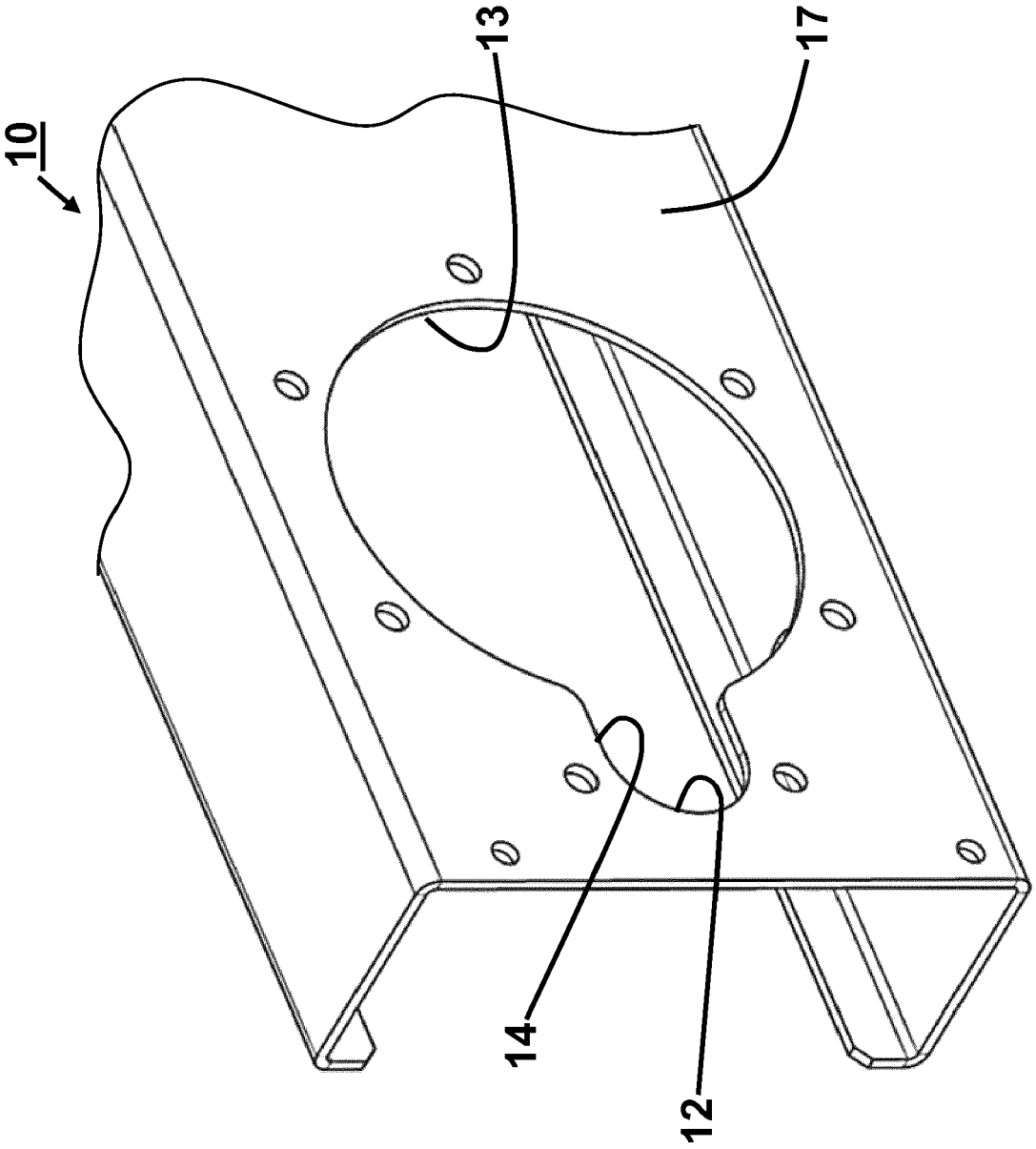


Fig. 5

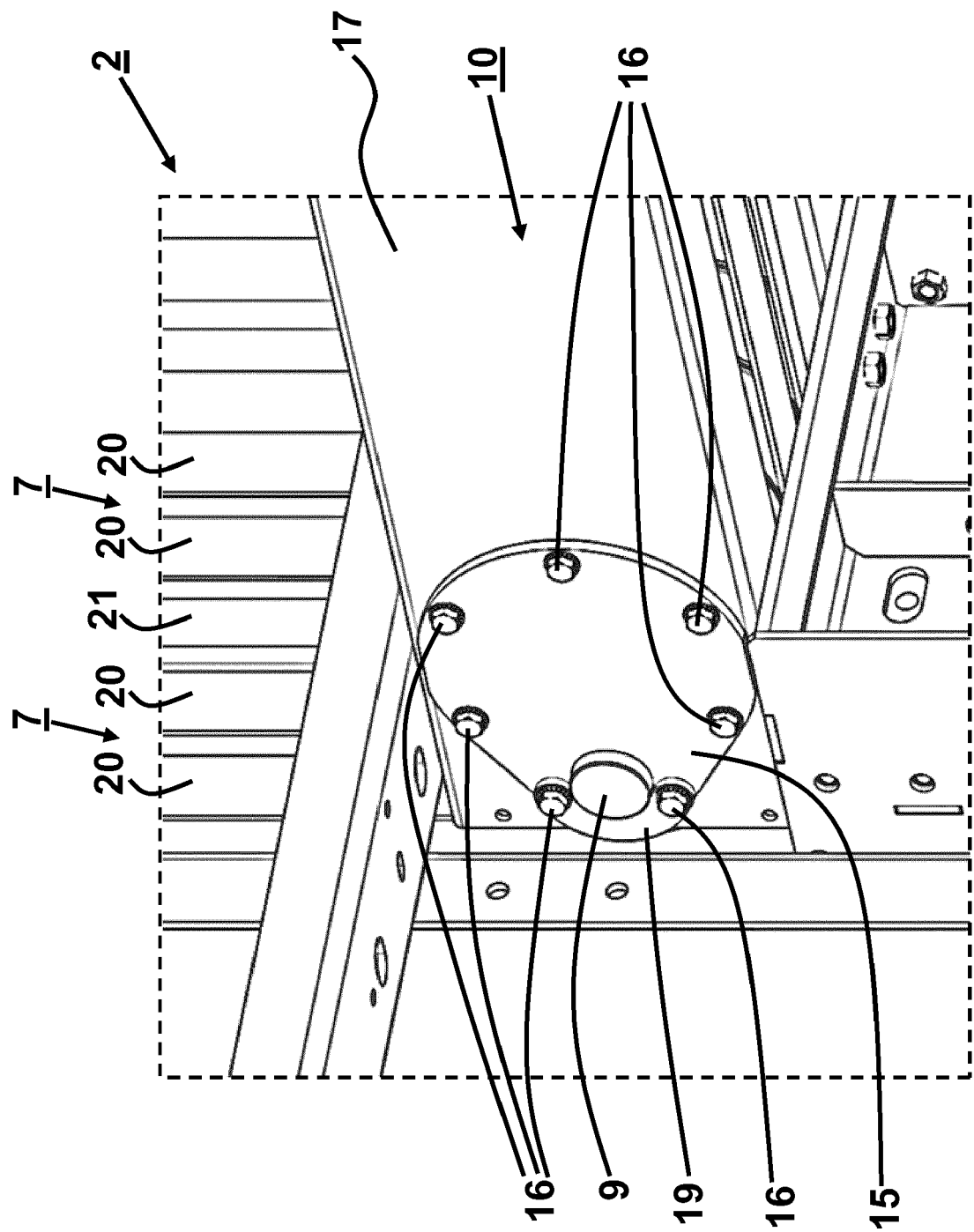


Fig. 6

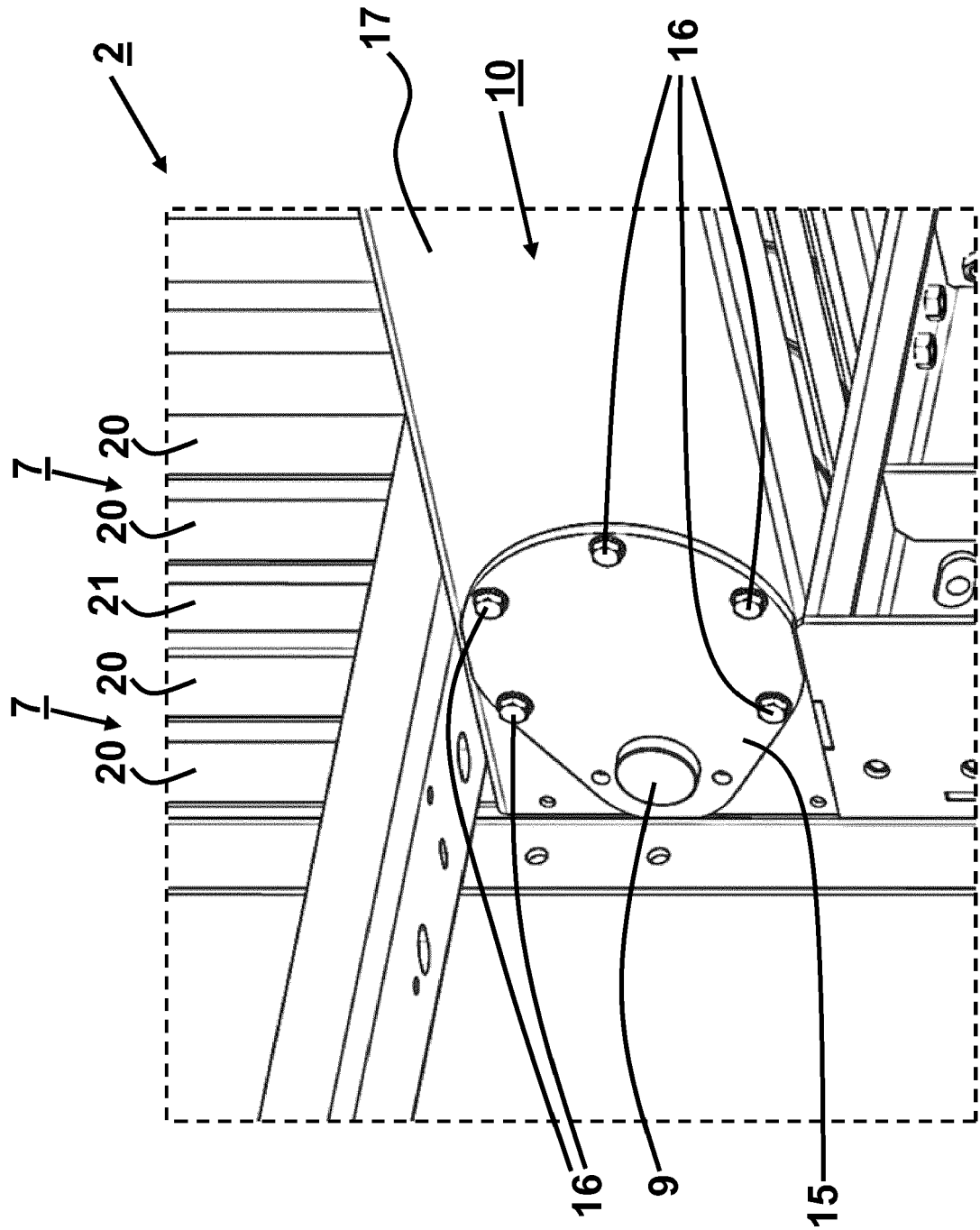


Fig. 7

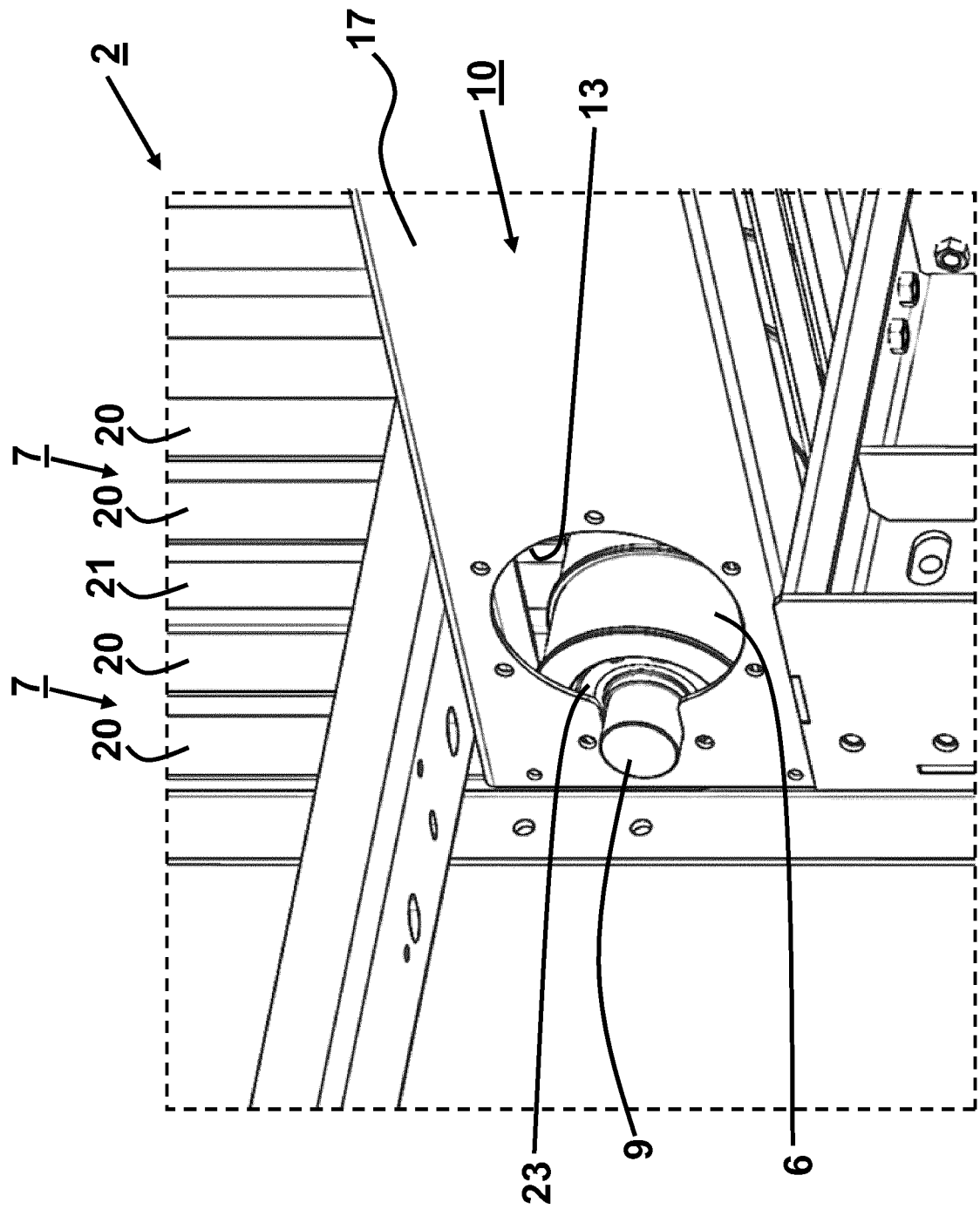


Fig. 8

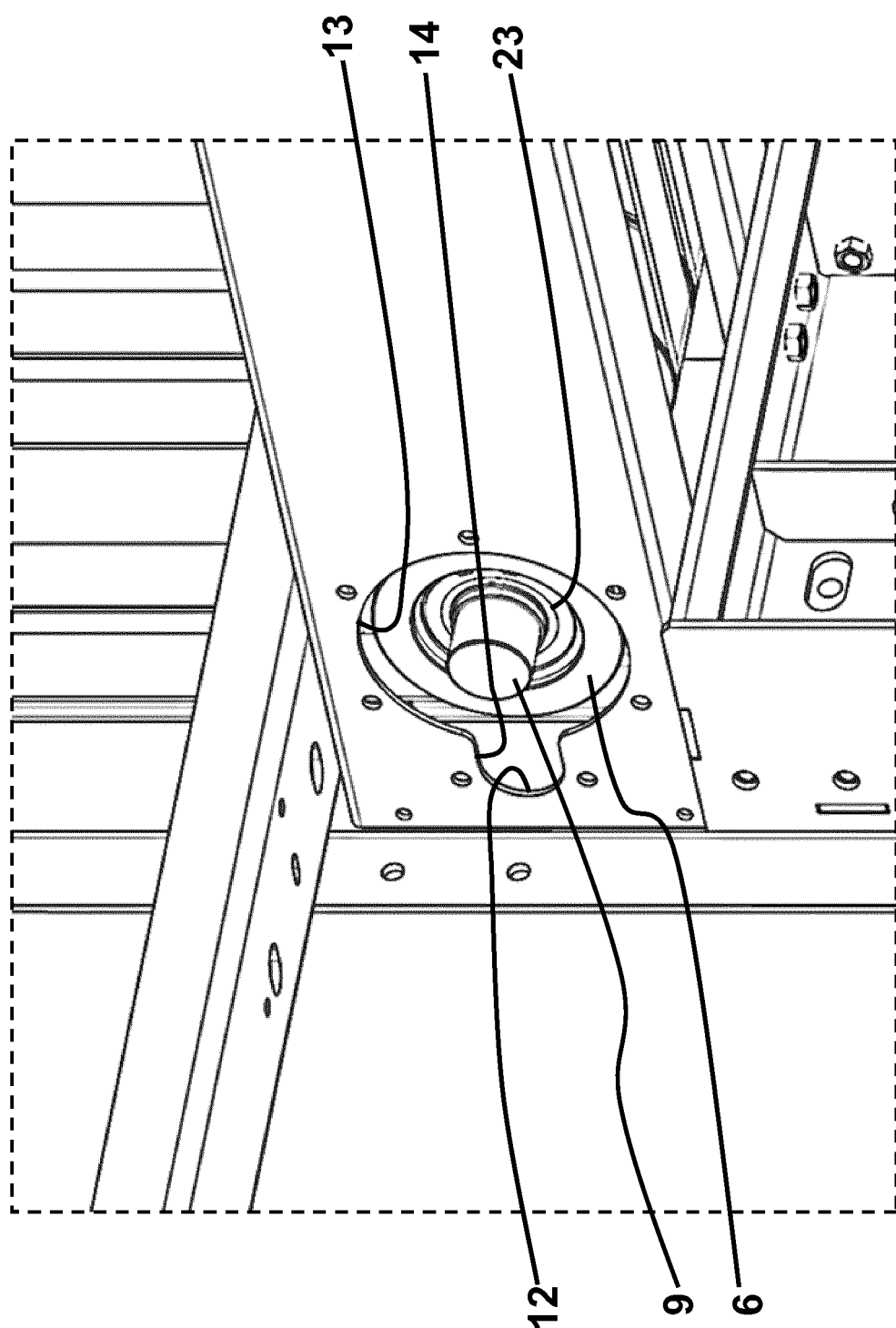


Fig. 9

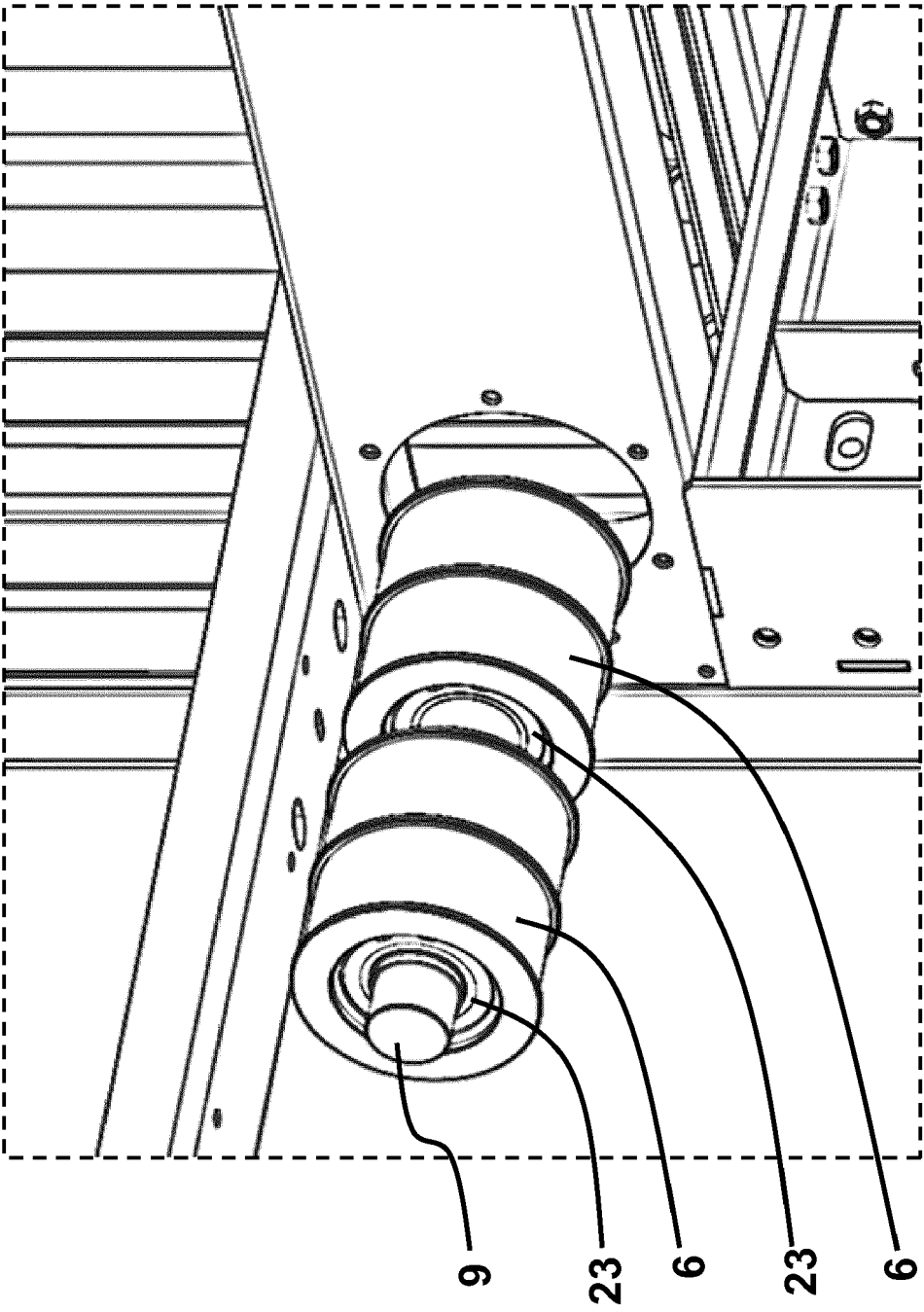


Fig. 10

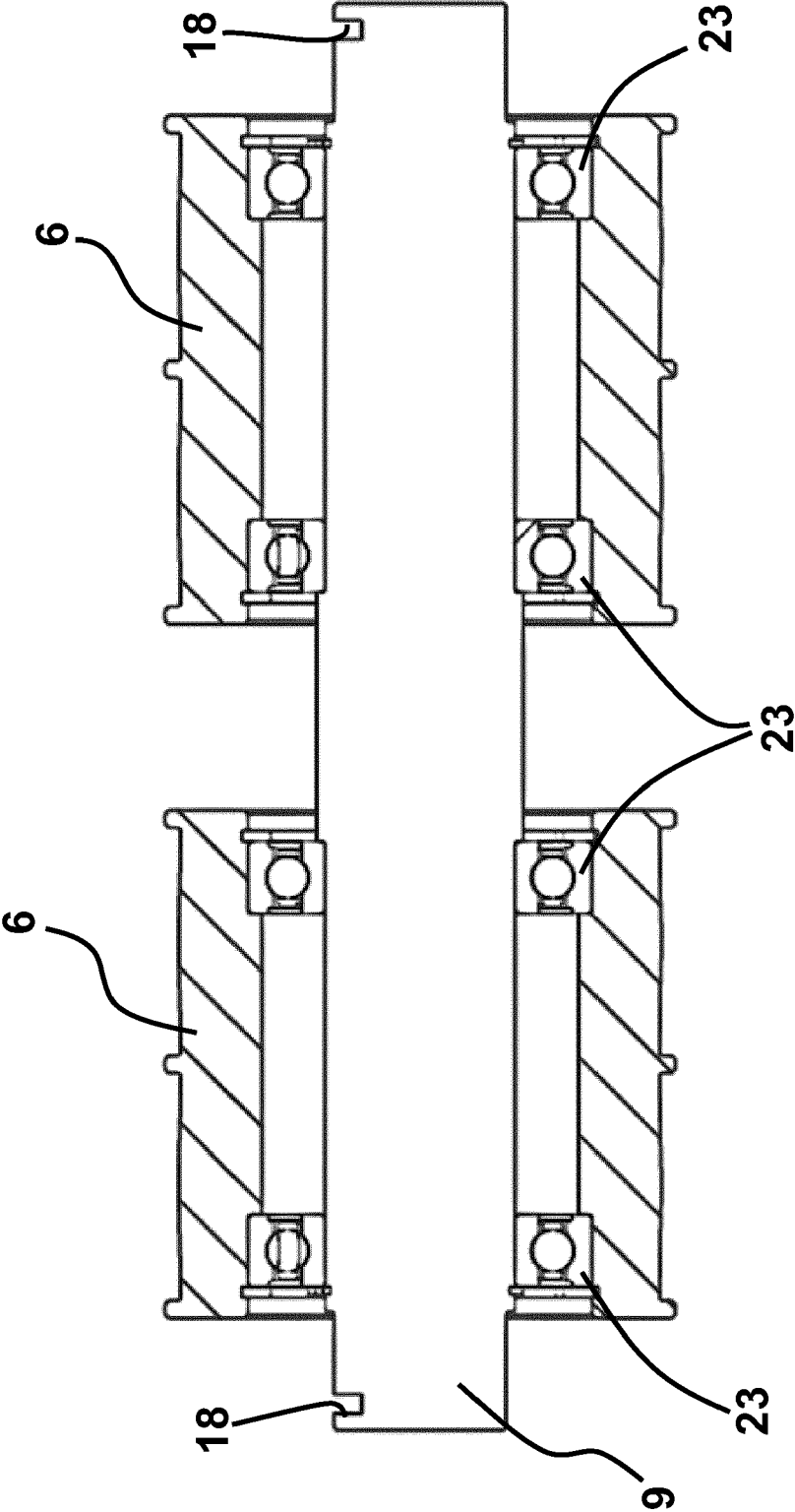


Fig. 11



EUROPEAN SEARCH REPORT

Application Number

EP 22 20 4420

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