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(54) MATERIAL HANDLING VEHICLE

(57) Material handling vehicle (1) comprising a mast (2), vehicle chassis (3), and a protruding load carrying section (4), wherein the mast (2) comprises at least two vertical and parallel beams (2a, 2b) that are separated in transversal direction of the material handling vehicle (1), further two support legs (7, 8) are comprised comprising each a wheel (13, 14), further comprised is a load carrier (22) movably attached to the mast (2), and movable by at least one comprised load hydraulic lift cylinder

(31, 32), wherein the support legs (7, 8) are fixedly attached to the mast (2) and the chassis (3) comprises a first section (3a) and a second section (3b) in longitudinal direction, wherein the second section (3b) extends through a plane (5) adjacent and parallel with the extension of the parallel vertical beams (2a, 2b) of the mast (2), wherein the plane is positioned on the side of the mast (2) that is opposite the load carrying section (4).

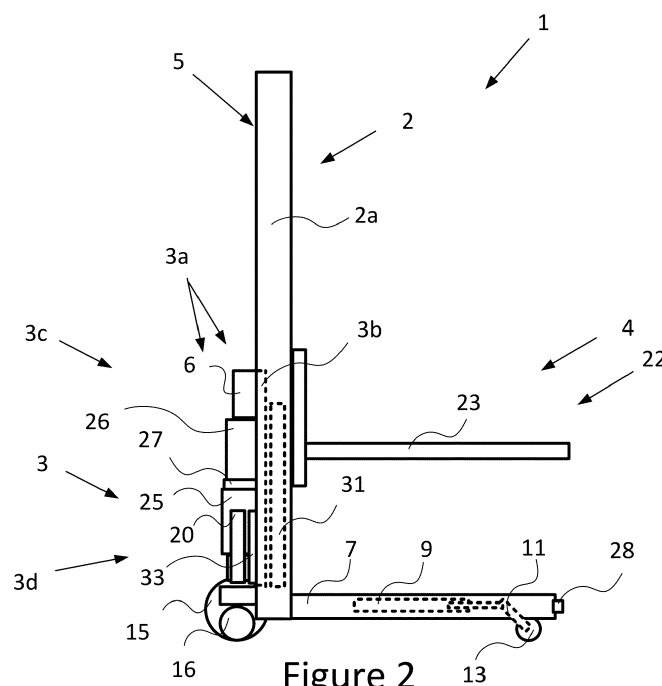


Figure 2

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Description

[0001] The present disclosure is related to a material handling vehicle according to the pre-characterizing part of claim 1.

BACKGROUND

[0002] Warehouses are confined spaces which is constantly refined and being optimized for quickest possible material handling of goods. In order to achieve an effective operation of a warehouse it is important to utilise all possible surface for racks and goods. Thus it is desired to have the smallest area possible for vehicles that operates in the warehouse. In order to achieve this it is important to have the smallest footprint possible of the vehicles operating in a warehouse.

SHORT DESCRIPTION OF THE INVENTION

[0003] A further problem is also to have such a low length as possible of the vehicle for manoeuvring reasons. A shorter vehicle can more easily turn and operate in an aisle of a warehouse.

[0004] The present disclosure is related to a material handling vehicle comprising a mast, vehicle chassis, and a protruding load carrying section. The mast comprises at least two vertical and parallel beams that are separated in transversal direction of the material handling vehicle. The material handling vehicle comprises two support legs each comprising a wheel. The material handling vehicle further comprises a load carrier movably attached to the mast, and movable by at least one comprised load hydraulic lift cylinder. The support legs are fixedly attached to the mast. The chassis comprises a first section and a second section in longitudinal direction. The second section extends through a plane adjacent and parallel with the extension of the parallel vertical beams of the mast. The plane is positioned on the side of the mast that is opposite the load carrying section.

[0005] The advantage of the subject matter is that the material handling vehicle is much shorter in the longitudinal direction. As the chassis can be made much shorter in longitudinal direction compared with a conventional stacker vehicle that has the mast docked to the chassis behind load carriers. An especially important measure is the so called L2 measure. This is a well-known and accepted definition in this technical field and defines the length from the back end of the load carrier to the back end of the vehicle. A shorter L2 generally provides for a shorter turning radius and allows for a better manoeuvrability in confined spaces. To be more explicit the L2-measure is the definition for the measure of the horizontal length between the end of the material handling vehicle opposite the load carrier and the beginning of the load carrier in a direction from the end of the material handling vehicle and the load carrying back.

[0006] According to a further development a material

handling vehicle is suggested in claim 2.

[0007] The effect of using a battery pack that is positioned in the top section of the chassis is that the chassis can be made even shorter in the longitudinal direction of the vehicle. This provides for a better manoeuvrability as the turning radius of the vehicle can be made even smaller.

[0008] According to a further development a material handling vehicle is suggested in claim 3.

[0009] The advantage to position the load hydraulic lift cylinders on the support legs is that the cylinders will follow the movements of the support legs and can be mounted independently from the chassis. According to a further development a material handling vehicle is suggested in claim 4.

[0010] The advantage of having support legs that can be lifted from the floor level is that the support legs can be used for carrying a second load as a first load is carried by the load carrier. The horizontal hydraulic cylinders provide for that the normal configuration of mechanical rods and links can be omitted and hence further shorten the length of the chassis since mechanical links inevitably are cumbersome and adds to the length of the chassis.

[0011] According to a further development a material handling vehicle is suggested in claim 5.

[0012] The backend support leg cylinders provides for a horizontal movement of the support legs thus improving the load capacity of the material handling vehicle, and also providing further for a horizontal position of the support legs when they are lifted.

[0013] According to a further development a material handling vehicle is suggested in claim 6.

[0014] By supporting the mast on the support legs the mast follows the support legs when the support legs are raised. Thus a load that has been loaded to the support legs will not risk to hitting the load carrier that is positioned above the load on the support legs. The reason for this being that the load carrier above will move with the mast upwards when the support legs are lifted.

[0015] According to a further development a material handling vehicle is suggested in claim 7.

[0016] By adding more wheels to the back of the vehicle that is a drive wheel and a stabilizing wheel the material handling vehicle will become more stable.

[0017] According to a further development a material handling vehicle is suggested in claim 8.

[0018] The advantage of having an adjustable stabilizing wheel is that the pressure of the drive wheel can be adjusted indirectly. And thus if there is not much load on the load carrier it is possible to decrease the pressure of the drive wheel to prevent unnecessary wear of the drive wheel. It is also possible to increase the pressure of the drive wheel to the ground if a heavy load is carried such braking with a higher load is provided for. It is also possible to completely retract the stabilizing wheel if there are irregularities in the floor for example.

[0019] According to a further development a material handling vehicle is suggested in claim 9.

[0020] With a second stabilizing wheel it is possible to for example better compensate for irregularities in the floor. It is also possible to lower both stabilizing wheels and there by lift the drive wheel from the floor and thus the vehicle can be easily moved if the drive motor has broken down.

[0021] According to a further development a material handling vehicle is suggested in claim 10.

[0022] The vertical drive motor provides for a compact installation of the drive motor.

[0023] According to a further development a material handling vehicle is suggested in claim 11.

[0024] Forks are very versatile for material handling purposes where standardized pallets are used.

[0025] According to a further development a material handling vehicle is suggested in claim 12.

[0026] The material handling vehicle is very robust and strong if there is hydraulics to power lifting functions of the vehicle.

[0027] According to a further development a material handling vehicle is suggested in claim 13.

[0028] By installing sensors the damages to the vehicle can be diminished as the vehicle can sense objects in a warehouse. Thus unnecessary contacts with loads and racks, walls etc. can be dispensed with. Navigation equipment will vastly improve the possibilities for an improved and efficient material handling operation.

[0029] According to a further development a material handling vehicle is suggested in claim 14.

[0030] An automated vehicle can operate longer without paus compared when an operator is directly involved in the material handling operation. Also fewer accidents will occur as the risk of human errors is eliminated. Also an automated vehicle is operated in a very strict manner; both at start of work pass and at end of work pass. No fatigue is built up.

[0031] According to a further development a material handling vehicle is suggested in claim 15.

[0032] A wireless interface for remotely controlling the vehicle can be useful if the vehicle needs to be moved by a remote operator, thus the operator need not operate in the vicinity of the vehicle but can reside in a control room elsewhere.

FIGURES

[0033]

Figure 1 discloses the vehicle of the present disclosure from behind.

Figure 2 discloses the vehicle of the present disclosure from a first side.

Figure 3 discloses the vehicle of the present disclosure from above.

Figure 4 discloses a preferred design of the support legs.

DETAILED DESCRIPTION

[0034] The present disclosure is related to material handling vehicle. In general the material handling vehicle has a load carrier. The load carrier is in generally a pair of forks that is optimal for lifting a load that is positioned on a pallet. The material handling vehicle in general comprises an energy source that can power a drive motor. The energy source may be a battery, and the drive motor an electric motor. Other energy sources are thinkable but not so common in a warehouse environment, such energy sources could be gas or fuel cells. The material handling vehicle is in general not a counter balance vehicle. Further the material handling vehicle has support legs that will bear weight of a load such that the centre of gravity of the load itself is mainly positioned in the inner area of the wheels that bears the material handling vehicle. The material handling vehicle of the disclosure is a stacker vehicle that can stack a load on top of another load. The material handling vehicle of this disclosure in general has no drive or operation controls. Thus it does not have a steering wheel, tiller arm or buttons or levers for lifting or lowering a load.

[0035] Figure 1 discloses a material handling vehicle 1 according to the present disclosure. The vehicle in particular has two longitudinal sides 18, 19, as also seen in figure 2. Thus the transversal direction of the vehicle 1 is in the direction from one longitudinal side 18 to the other longitudinal side 19. The material handling vehicle 1 has a vertical direction. This is the same direction that the mast 2 is extending from the floor and up. There is also a front or forward direction which is in the direction of a load carrier 22. There is consequently a back direction that is in the direction of a chassis 3.

[0036] Figure 1-3 thus discloses the mast 2 with two vertical beams 2a, 2b. The beams 2a, 2b have respective inner sides 2aa, 2bb that is facing each other. The beams 2a, 2b are parallel and transversally distanced. The back side, i.e. the side of the beams 2a, 2b that faces the back of the vehicle 1, is considered to define a plane 5. The 5 plane is thus positioned adjacent against the back side of the beams 2a, 2b.

[0037] The material handling vehicle 1 also comprises two support legs 7, 8. As seen in figure 2 the support legs extend in the forward direction. The support legs differentiates the material handling vehicle 1 from a counter balance truck as the centre of gravity of a load is always positioned in vertical direction within the area defined by the support legs 7, 8 and the mast 2. Thus the material handling vehicle 1 in general cannot tip forward. The support legs 7, 8 may have an L shape as disclosed in figure 4. The L-shape is used when fixedly attaching the mast 2 to the support legs. The mast 2 is preferred to be positioned on the respective support leg 7, 8 and a bolt can then be screwed into the respective vertical beam 2a, 2b through the L shaped vertical section 7a, 8a of the respective support leg 7, 8. Figure 3 discloses the configuration of the support legs 7, 8 one of the load carriers

22 forks 24 has been graphically removed in order to disclose the support leg 8 below the fork 24. The support legs 7, 8 also comprise a respective wheel 13 and 14. The wheels 13, 14 are disclosed in figure 1-3 as being a single wheel, but this can be a boogie of wheels and also rolls. Further as seen in figure 2 the support legs comprises preferably a respective horizontal support leg hydraulic cylinder 9 and 10. The cylinders 9, 10 act on a respective lever 11 and 12 that is connected with the respective wheel 13 and 14. By pressing on the levers 11, 12 the support legs 7, 8 forward ends can be raised.

[0038] The vehicle chassis 3 has been altered in design compared with a general stacker material handling vehicle, such as a floor conveyor or a fork-lift truck or the like. The chassis 3 as can be seen in figure 2 slim in its profile. The chassis 3 has a first section 3a and a second section 3b. The second section of the chassis is extending through the defined plane 5. For this reason the mast 2 has been broadened, i.e. the beams 2a, 2b are positioned longer from each other in transversal direction than what is normally the case. This is preferred to be made without broadening the chassis 3 or increasing the width of the vehicle, thus not increasing the foot print of the vehicle. This makes it possible as seen in figure 2 to alter position for the mast 2 towards the back end of the vehicle 1. Thus the vehicle has a shorter size in longitudinal direction than a prior art stacker vehicle. In a prior art stacker vehicle the mast is merely docked adjacent the chassis and the mast cannot be moved further in direction of the back end as the beams and the chassis do not allow for this.

[0039] The load carrying section 4 is seen also in figure 2. The load carrying section has a load carrier 22. The load carrier 22 in general comprises two forks 23 and 24. However it is thinkable to use other load carriers such as a clamping device or other adapted load carriers. The load carrier 22 is movable up and down the mast 2. To the load carrying section 4 is added also the support legs 7, 8. The support legs 7, 8 can also carry a load in parallel with the load carrier 22.

[0040] The chassis further comprises back end support leg hydraulic cylinders 33, 34. These cylinders 33, 34 are positioned on the vehicle chassis 3 and can act upon the support legs 7, 8 back end close to the L-shape. This will thus raise the back end of the respective support leg 7, 8.

[0041] The material handling vehicle 1 is preferred to be configured such that the backend support leg hydraulic cylinders 33, 34 cooperates with the horizontal support leg hydraulic cylinders 9, 10. Thus the cylinders 33, 34, 9, 10 provide the same amount of lifting distance at the back end as at the front end of the support legs 7, 8. As the mast 2 is fixedly attached to the support legs 7, 8 the operation of lifting the support legs 7, 8 will also lift the mast 2 with the load carrier 22.

[0042] The material handling vehicle 1 also comprises at least one load hydraulic lift cylinder 31, figure 2. But it preferably comprises two load hydraulic lift cylinders 31,

32. These two hydraulic lift cylinders 31, 32 are positioned on the support legs 7, 8 as the mast 2. Thus when the support legs 7, 8 are lifted also the hydraulic lift cylinders are lifted.

[0043] As can be seen in figure 1 a battery pack 6 is provided in the top section 3c of the chassis. This is not the general and normal position of a battery pack for a stacker material handling vehicle. This position of the battery pack 6 provides for the shorter chassis in longitudinal direction as the battery is stacked in height instead of in longitudinal direction. The battery pack is preferred to be a lithium ion battery pack that can be quickly charged. The battery pack 6 is also conveniently positioned if it is needed to change any of the battery pack cells. And also, it is convenient to add more battery power if needed just by building on the height which will not add anything to the length of the chassis.

[0044] The material handling vehicle has a drive wheel 15. The drive wheel 15 is fixedly attached in the chassis by means of a gear. That is the drive wheel 15 is operable to steer but it cannot regulate its pressure to the floor. A vertical drive motor 25 is attached to the gear and drives the drive wheel 15. The motor 25 is electric.

[0045] On both sides of the drive wheel 15 there is one stabilizing wheel 16 and 17. The stabilizing wheels 16, 17 are swivel wheels. The swivel wheels 16, 17 are adjustable in height by means of electric adjustment devices 20 and 21. The electric adjustment devices can adjust the height of the stabilizing wheels in relation to the chassis 3 and consequently in relation to the drive wheel 15. Thus, in this way the pressure of the drive wheel 15 to the floor can indirectly be adjusted.

[0046] The material handling vehicle 1 also comprises a hydraulic system with a hydraulic pump motor 26 and a hydraulic pump 27. The hydraulic system powers the hydraulic functions of the material handling vehicle 1.

[0047] The material handling vehicle 1 may be a fully automated vehicle 1. This means that it can operate independently in a warehouse environment. In order to perform the vehicle 1 is fitted with sensors 28, 29 that can detect objects in that environment. The figures 1-3 disclose sensors that are positioned on the forward end of the support legs 7, 8. However this is by no means a mandatory position for the sensors 28, 29. They can be positioned in any suitable position. In particular there may be more than two sensors that cooperate in detecting objects on all sides of the vehicle 1. The sensors 28, 29 are of any suitable type such as laser, radar, ultra sound, or the like type.

[0048] Cooperating with the sensors is navigation equipment 30. The navigation equipment is preferred to be such equipment that is suitable to be used inside a warehouse. Thus GPS equipment is not preferred.

[0049] The material handling vehicle 1 is also provided with a control unit, in particular for controlling both hydraulic and electrical functions. The control unit is also able to store and perform given tasks from a central material handling system. The control unit also cooperates

with the navigation equipment and the sensors 28, 29 for manoeuvring in a warehouse and by this performing material handling tasks in the warehouse.

[0050] The material handling vehicle 1 may be provided with a wireless interface 35 that provides for that the material handling vehicle can receive order for material handling but also for the possibility of remotely controlling the vehicle manually. This means that an operator that is not on board the vehicle can control the vehicle remotely. For this purpose the material handling vehicle can also be provided with at least one camera capable of sending live video to the operator. As an example, if the vehicle has stopped for any reason, for an example due to an obstacle in its way, the remote operator can take over the control of the vehicle and manually do what is needed to start the vehicle again, for example, steer the vehicle around the obstacle.

Claims

1. Material handling vehicle (1) comprising a mast (2), vehicle chassis (3), and a protruding load carrying section (4),
wherein the mast (2) comprises at least two vertical and parallel beams (2a, 2b) that are separated in transversal direction of the material handling vehicle (1), further two support legs (7, 8) are comprised comprising each a wheel (13, 14),
further comprised is a load carrier (22) movably attached to the mast (2), and movable by at least one comprised load hydraulic lift cylinder (31, 32),
wherein the support legs (7, 8) are fixedly attached to the mast (2),
further the chassis (3) comprises a first section (3a) and a second section (3b) in longitudinal direction,
characterized in that
the second section (3b) extends through a plane (5) adjacent and parallel with the extension of the parallel vertical beams (2a, 2b) of the mast (2), wherein the plane (5) is positioned on the side of the mast (2) that is opposite the load carrying section (4).
2. The material handling vehicle (1) according to claim 1, wherein the vehicle (1) further comprises a battery pack (6), wherein the battery pack is positioned on the top section (3c) of the chassis (3).
3. The material handling vehicle (1) according to any of the claims above, wherein the at least one load hydraulic lift cylinder (31, 32) is positioned onto one of the support legs (7, 8), preferably said load hydraulic lift cylinder (31, 32) is thus not fixedly attached with the chassis (3).
4. The material handling vehicle (1) of any of the claims above, wherein the support legs (7, 8) may be raised from floor level by means of a respective horizontal

support leg hydraulic cylinder (9, 10) comprised in the support legs (7, 8) and acting on levers (11, 12) that is associated with the comprised wheels (13, 14) in the support legs (7, 8).

5. The material handling vehicle (1) of claim 4, wherein further comprised are back end support leg hydraulic cylinders (33, 34), wherein these hydraulic cylinders (33, 34) are supported by the chassis (3) such that they can lift the back end of the support legs (7, 8),
6. The material handling vehicle (1) of any of the claims above, wherein the mast (2) is supported on the support legs (7, 8), preferably the mast (2) is fixedly attached to the respective support leg (7, 8), even more preferred each support leg (7, 8) has an L-shape and the mast (2) is attached to a vertical section (7a, 8a) of the support leg (7, 8).
7. The material handling vehicle (1) according to any of the claims above, wherein the vehicle chassis (3) comprises at least one drive wheel (15) and at least one first stabilizing wheel (16), preferably the stabilizing wheel (16) is a swivelling wheel positioned near one longitudinal side (18, 19) of the material handling vehicle (1).
8. The material handling vehicle (1) according to claim 7, wherein the at least one stabilizing wheel (16) is adjustable preferably by being movable in vertical direction by means of an electrical adjustment device (20).
9. The material handling vehicle (1) according to the claim 7 or 8, wherein the vehicle chassis (3) comprises a second stabilizing wheel (17) positioned near the other longitudinal side (19) of the vehicle (1), preferably the second stabilizing wheel (17) is also adjustable by means of an electrical adjustment device (21).
10. The material handling vehicle (1) according to any of the claims 7-9, wherein the drive wheel (15) is connected to a vertical drive motor (25).
11. The material handling vehicle (1) according to any of the claims above, wherein the load carrier (22) comprises a pair of forks (23, 24) extending in the longitudinal direction of the vehicle (1).
12. The material handling vehicle (1) according to any of the claims above, wherein further comprise is a pump motor (26) and a hydraulic pump (27) for powering the hydraulic functions of the material handling vehicle (1).
13. Material handling vehicle (1) according to any of the claims above, wherein the material handling vehicle

(1) further comprises sensors (28, 29) for detecting objects in the surrounding area of the vehicle (1), preferably the vehicle (1) further is provided with navigation equipment (30) for navigating in a warehouse environment.

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- 14.** Material handling vehicle (1) according to claim 14, wherein the vehicle (1) is an automated material handling vehicle that independently of direct input from an operator can handle goods in a warehouse environment.

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- 15.** The material handling vehicle (1) according to any of the claims above, wherein the vehicle (1) is provided with a wireless interface (35) for manually remotely controlling the vehicle (1).

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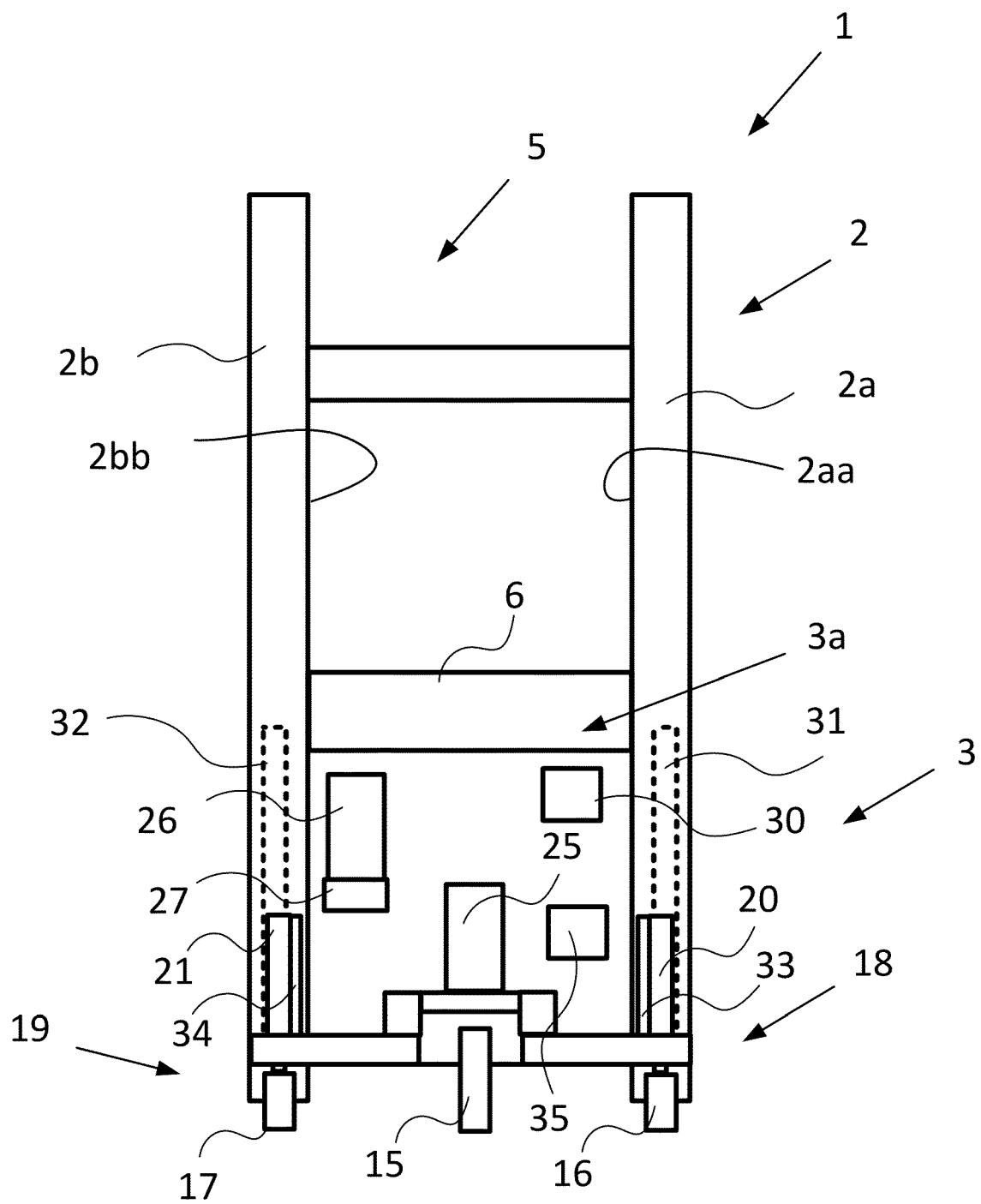
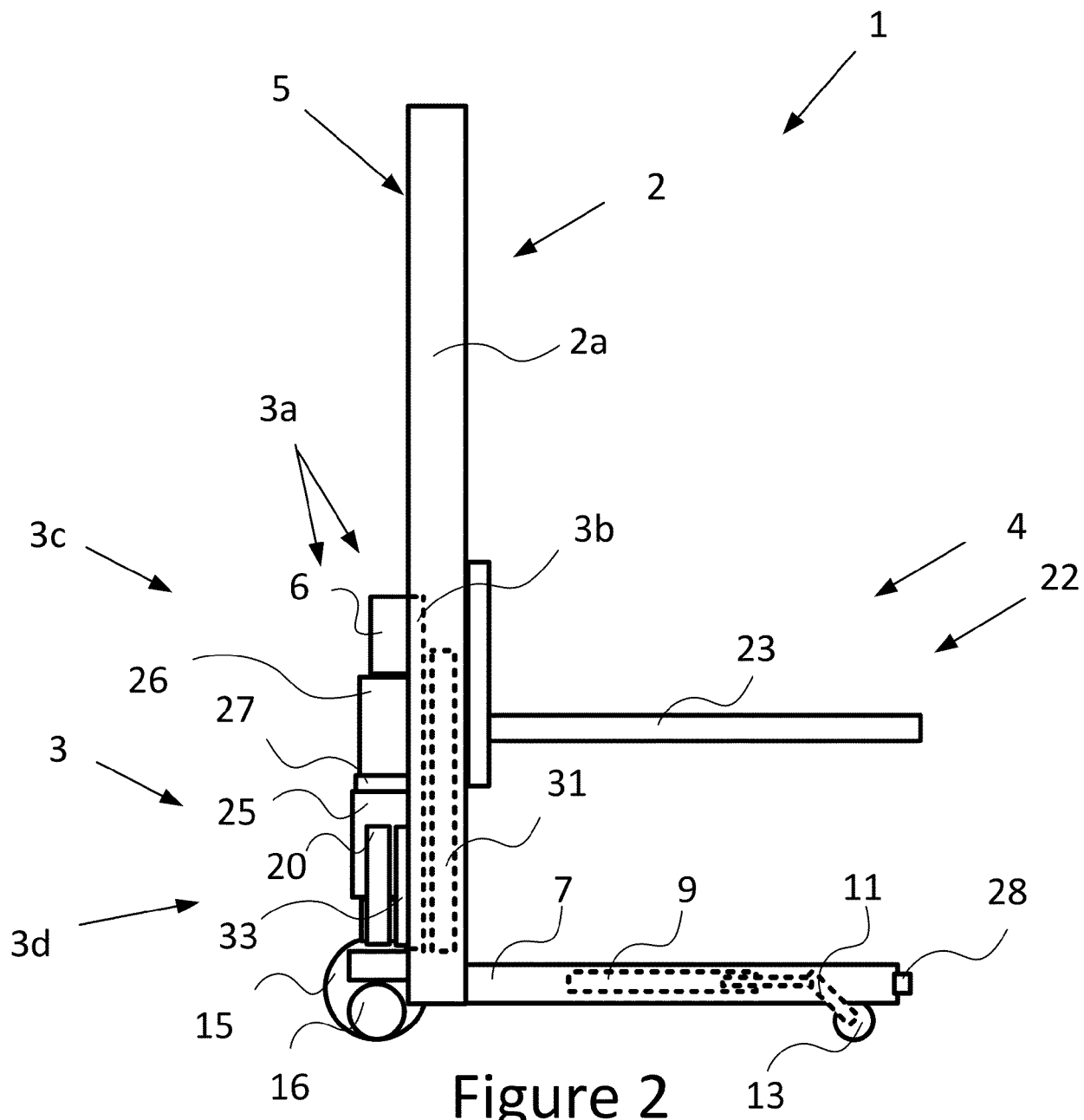
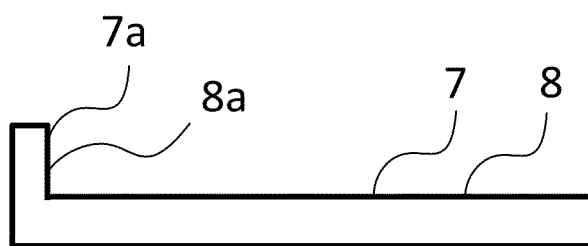
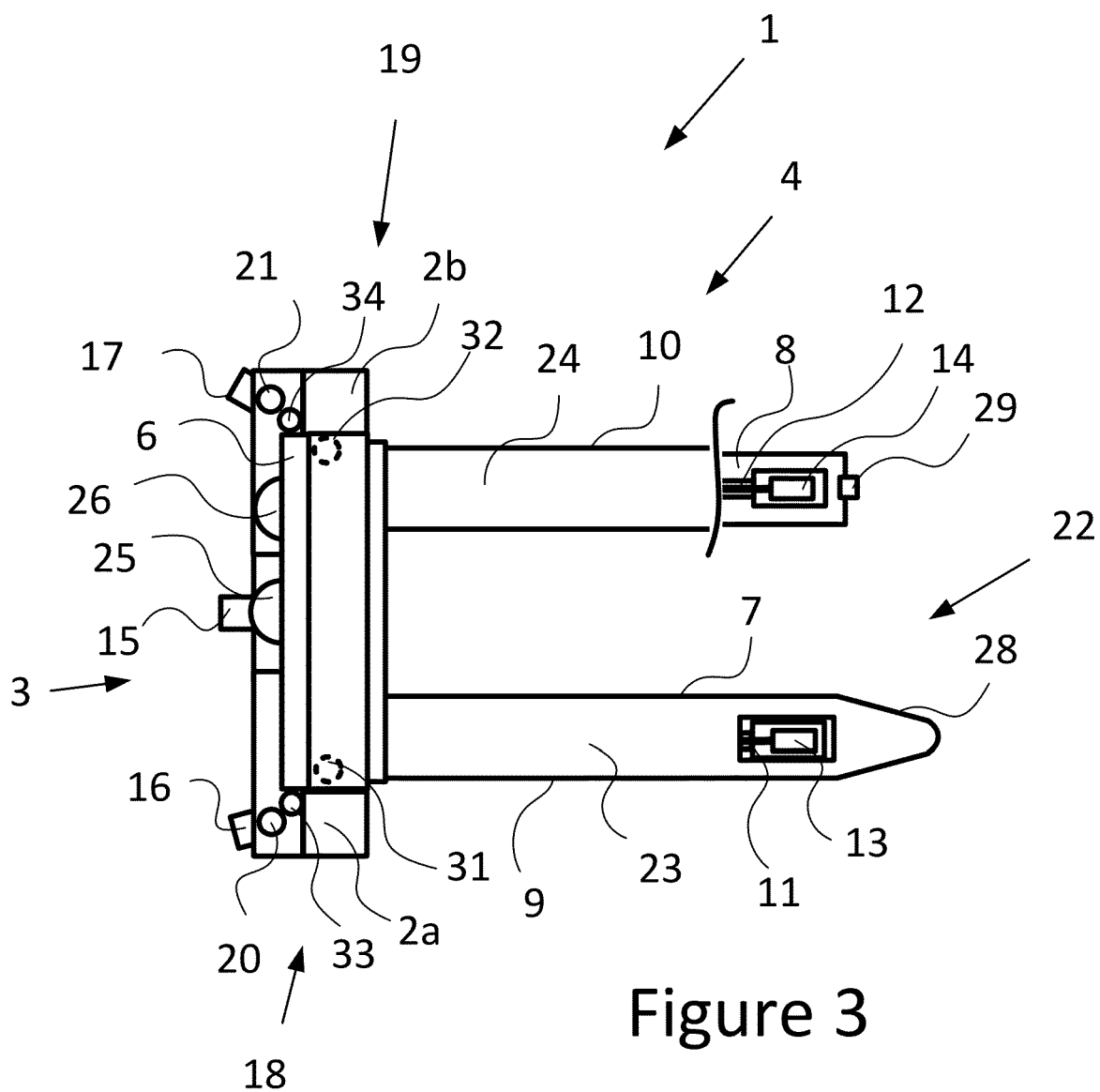


Figure 1







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