(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 393 788 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.07.2024 Bulletin 2024/27

(21) Application number: **22216703.3**

(22) Date of filing: **27.12.2022**

(51) International Patent Classification (IPC):
B61G 7/08 *(2006.01)* ***B61G 5/04*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B61G 7/08; B61G 5/04

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Dellner Couplers AB**
791 95 Falun (SE)

(72) Inventor: **TUNELL, Fredrik**
79195 Falun (SE)

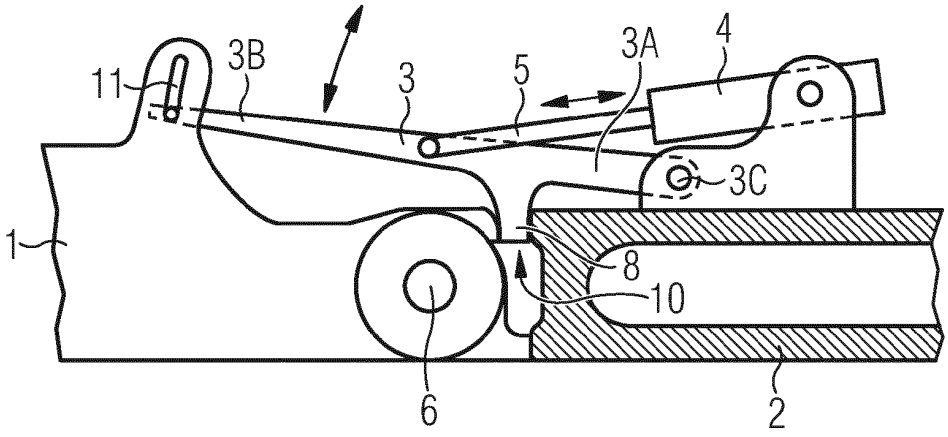
(74) Representative: **Klunker IP**
Patentanwälte PartG mbB
Destouchesstraße 68
80796 München (DE)

Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) COUPLING FOR RAIL VEHICLE

(57) A coupling for a rail vehicle comprises a coupler shank (2) for attaching the coupling to a rail vehicle, a coupler head (1) pivotably connected to a free end of the coupler shank so as to rotate about a primary axis (6) between an operational position and a non-operational position, a pivoting mechanism configured to rotate the coupler head (1) about the primary axis (6) from the coupler head's operational position toward the coupler head's non-operational position, and a locking member (8) configured to block rotation of the coupler head (1) about the primary axis (6) when the coupler head (1) is in the operational position. When the pivoting mechanism is actuated so as to rotate the coupler head (1) from the coupler head's operational position to the coupler head's non-operational position, the pivoting mechanism moves from an operational state to an interim state in a first period and from the interim state to a non-operational state in a second period, wherein the pivoting mechanism is configured to release the locking member (8) during the first period and to rotate the coupler head (1) into the non-operational position during the second period.

FIG 8



EP 4 393 788 A1

Description

FIELD OF THE INVENTION

[0001] This invention relates to a coupling for a rail vehicle, in particular in relation to automatic coupling systems (AC) in rail freight transportation (RFT), more specifically in relation to digital automatic coupling systems (DAC), and most specifically in relation to coupling systems which can be used alternatively as a screw coupling (SC) and as an automatic coupling (AC or DAC).

BACKGROUND OF THE INVENTION

[0002] An analysis of worldwide RFT activities, which was conducted by Berlin University of Technology for the German Federal Ministry of Transport and Digital Infrastructure (BMVI) and published on 29 June 2020 as "Development of a concept for the EU-wide migration to a digital automatic coupling system (DAC) for rail freight transportation" (generally referred to as Technical Report "DAC Technology"), showed that the couplings currently used in RFT (Janney and SA3) create only the mechanical connection between the wagons automatically. The BMVI proposes that the European rail freight sector upgrades from a screw coupling (SC) to a DAC Type 4. A DAC Type 4 permits automatic coupling of compressed air, electrical power, and data lines, in addition to the mechanical connection. One type of a DAC is the Scharfenberg-type coupling which is, however, not used in RFT so far but is the standard for high-speed rail transportation in Europe. For an interim period, i.e. until all freight transportation vehicles are equipped with a DAC coupling system, the newly developed coupling systems for freight vehicles should be suitable to be used as both an SC coupling and a DC or DAC coupling. This is the environment in which the present invention has been made, and thus, the present invention is particularly useful in coupling systems that can be used alternatively as a screw coupling (SC) and as an automatic coupling or digital automatic coupling (AC or DAC), but it is not limited thereto.

[0003] An SC coupling is a coupling which comprises a shackle which is suitable to be manually coupled to a draw hook, typically according to the standard EN 15566:2016. As compared to this, an AC coupling offers automatic coupling of the mechanical connection of two coupler heads (AC Type 1 to Type 3). Typically, the coupler head of an AC coupling has the characteristics as defined in section 4.1 of the standard SS-EN 16019:2014. A DAC coupling is an AC coupling which further offers automatic connection of power and data lines so that electric energy and digital information can be transmitted between two couplings that are coupled together (DAC Type 4 and Type 5).

[0004] EP 3590784 A1 discloses an automatic coupler head which is attached to a rail vehicle by means of a coupler shank, wherein the coupler head is pivotably connected to the free end of the coupler shank so that it can rotate about a horizontal axis between a horizontal, operational position and a vertical, non-operational position. The coupler head is held in the vertical, non-operational position by means of a wire which can be tightened and loosened by means of a drive. Upon loosening the wire, the coupler head may rotate into its operational position due to its weight. When the coupler head is rotated about the horizontal axis to its vertical, non-operational position, a shackle of a screw coupling automatically rotates about the same horizontal axis from a lower, non-operational position into an upper, horizontal, operational position. Axial forces acting on the automatic coupler head and the shackle of the screw coupling are transmitted into the coupler shank via a horizontal bolt about which both the automatic coupler head and the shackle of the screw coupling are pivotably mounted.

[0005] There is a need to improve the functionality of the coupling regarding the change of the coupler head between its operational and non-operational positions. For instance, one issue relates to securely holding the coupler head in its horizontal, operational position. Another issue relates to the transmission of the axial forces acting on the automatic coupler head to the coupler shank when the coupler head is in its operational position. An even further aspect relates to the movement of the coupler head between the two positions, in particular from its vertical position into the horizontal position, as the weight of the coupler head might not be enough to get the coupler head start moving downward, e.g. in icy weather conditions.

SUMMARY OF THE INVENTION

[0006] It is therefore an object of the present invention to provide a coupling for a rail vehicle with a coupler head which can be rotated from an operational position to a non-operational position and vice versa and which improves one or more or all of the above issues.

[0007] Accordingly, one aspect of the present disclosure relates to a coupling for a rail vehicle, preferably a freight locomotive, which comprises a coupler shank for attaching the coupling to a rail vehicle and a coupler head pivotably connected to a free end of the coupler shank so as to rotate about a primary axis, preferably a horizontal axis, between an operational position and a non-operational position. The coupling further comprises a locking member configured to assume a locking position in which it blocks rotation of the coupler head about the primary axis when the coupler head is in the operational position as well as a pivoting mechanism configured to rotate the coupler head about the primary axis, wherein the pivoting mechanism is configured to release the locking member.

[0008] Accordingly, on the one hand, the coupler head is securely held in its horizontal, operational position by means of the locking member. In addition, since the locking member is configured to block rotation of the coupler

head in the coupler head's operational position, it may transmit forces from the coupler head to the coupler shank which would otherwise cause a rotation of the coupler head out of its operational position. On the other hand, the pivoting mechanism, which is arranged to move the coupler head between its operational and non-operational positions, assumes the additional function of releasing the locking member, thereby allowing the coupler head's movement from the operational toward the non-operational position. This way, a train driver can simply actuate the pivoting mechanism from inside the locomotive's cabin in order to bring the coupler head out of the way.

[0009] According to one aspect of the present disclosure, the pivoting mechanism is configured to rotate the coupler head about the primary axis from the coupler head's non-operational position toward the coupler head's operational position, particularly downward. This way, by means of the pivoting mechanism, movement of the coupler head from its non-operational position toward the operational position is even possible where the coupler head may be stuck in its non-operational position, e.g. vertical position, such as in icy weather conditions.

[0010] Preferably, the pivoting mechanism is configured such that when it is actuated so as to rotate the coupler head from the coupler head's operational position to the coupler head's non-operational position, the pivoting mechanism moves from an operational state to an interim state in a first period and from the interim state to a non-operational state in a second period, thereby releasing the locking member during the first period and rotating the coupler head into the non-operational position during the second period.

[0011] These two steps, releasing the locking member and rotating the coupler head are preferably interconnected so as to achieve a continuous movement, i.e. such that the second period starts immediately when the first period ends. More preferably, these two steps are caused by movement of the pivoting mechanism in one direction, e.g. by moving a driving element of the pivoting mechanism in one direction.

[0012] Accordingly, the arrangement is such that both functions of the coupling, the rotation and the blocking of the coupler head, are caused by one and the same pivoting mechanism, which facilitates the handling of the coupling substantially. This is particularly the case where the pivoting mechanism is automatically driven so that the train driver can trigger such actions remotely from the locomotive cabin.

[0013] The arrangement is preferably such that, when the coupling is attached to a rail vehicle with the primary axis inclined or horizontal, the pivoting mechanism lifts the coupler head upward when the pivoting mechanism rotates the coupler head from the coupler head's operational position toward the coupler head's non-operational position. This way, the weight of the coupler head helps lowering the coupler head when it is moved in the opposite direction, i.e. from the non-operational position to the operational position. Also, in particular when the primary axis is horizontal, the coupler head is substantially out of the way because the space above the coupler head is typically free and not of a particular use.

[0014] In one embodiment, the pivoting mechanism comprises a rod having a first end section connected to the coupler shank and a second end section connected to the coupler head, wherein at least one of the first and second end sections is pivotably mounted and wherein the rod pivots about the at least one pivotably mounted end section when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state. Due to the rod being connected to both the coupler shank and the coupler head and being pivotable, rotation of the rod about the pivot point causes a relative movement between the coupler shank and the coupler head, more specifically a rotation of the coupler head about the primary axis.

[0015] In one variant of this embodiment, the pivoting mechanism may comprise an oblong hole. The oblong hole which enables the second end section of the rod, when the pivoting mechanism moves from the operational state to the interim state during the first period, to move relative to the coupler head without causing rotation of the coupler head, and further, when the pivoting mechanism moves from the interim state to the non-operational state during the second period, to cause rotation of the coupler head. Furthermore, according to this variant, the rod is connected to the locking member in such a manner that the locking member is released when the pivoting mechanism moves from the operational state to the interim state in the first period. Thus, a single, preferably continuous, movement of the rod causes both release of the locking member and subsequent rotation of the coupler head.

[0016] Preferably, the pivoting mechanism comprises a cylinder and a plunger extending from the cylinder, wherein the arrangement is such that the cylinder and the plunger move relative to one another along a common longitudinal axis when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state. Thus, the cylinder and plunger may form the actual drive of the pivoting mechanism with the afore-mentioned rod being a drive member of the pivoting mechanism which is driven by the plunger and cylinder.

[0017] Preferably, the cylinder is a hydraulic cylinder so that hydraulic fluid can be used for driving the pivoting mechanism, a hydraulic system being commonly available on trains.

[0018] Even further preferably, the cylinder is a double-acting cylinder so as to enable the pivoting mechanism to urge the coupler head toward both the coupler head's non-operational position, e.g. toward its vertical position, when it is in the operational position, and the coupler head's operational position when it is in the (vertical) non-operational position.

[0019] Thus, the cylinder or the plunger may be attached to the rod so as to pivot the rod about its pivotably attached end section when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state. In a preferred embodiment, however, the cylinder and plunger form part of the rod itself such that the rod is extendable. Thus, since the rod is connected with its first end section to the coupler shank and with its second end section to the coupler head, extending and reducing the length of the rod by means of the cylinder and plunger causes movement of the pivoting mechanism from the operational state to the interim state and further from the interim state to the non-operational state and vice versa, thereby releasing the locking member and rotating the coupler head and vice versa.

[0020] A preferred design of this second variant is such that a first force which needs to be overcome by the pivoting mechanism in order to release the locking member and which acts on the first end section of the rod is lower than a second force which needs to be overcome by the pivoting mechanism in order to rotate the coupler head from its operational position toward its non-operational position and which acts on the second end section of the rod. In other words, when the cylinder-plunger-arrangement is activated to reduce or extend the length of the rod, it acts on both ends of the rod in the same way. Thus, by reducing the pressure in the cylinder or increasing the pressure in the cylinder, depending on the specific arrangement, the lower force acting on the first end section of the rod may be overcome first, thereby releasing the locking member, and the higher force acting on the second end section of the rod, which is attached to the coupler head, will be overcome only thereafter. This way, the coupler head is rotated from its operating position toward its non-operating position only after the locking member has already been released.

[0021] Preferably, both the first end section and the second end section of the rod are pivotably mounted, which means that these pivot mountings can transmit only axial forces and no torsional forces, whereas the first and second forces that need to be overcome by the cylinder-plunger-arrangement are axial forces which act on the rod in opposite directions along a longitudinal axis of the rod. The second (higher) force that needs to be overcome and acts on the second end section of the rod attached to the coupler head may partially or completely result from the weight of the coupler head. However, such force may also be provided solely or in addition by a spring, which is specifically needed in cases where the primary axis about which the coupler head is rotated is a vertical axis.

[0022] In a preferred way, the first end section of the rod is pivotably mounted to a swivel member. The swivel member is, on the one hand, pivotably mounted to the coupler shank either directly or indirectly and, on the other hand, connected to or integrally forming the locking member such that, when the pivoting mechanism moves from the non-operational state toward the interim state, the swivel member swivels and causes release of the locking member. A stop may be provided and arranged such that rotation of the coupler head from the coupler head's operational position toward the coupler head's non-operational position begins after the swivel member has reached the stop. Thus, in context with the aforementioned first lower force acting on the first end section of the rod and second higher force acting on the second end section of the rod, after the first force has been overcome and the rod has been moved a certain amount, thereby swiveling the swivel member against the stop, the interim position of the pivoting mechanism has been reached. From that point on, further extension or reduction of the length of the rod, as the case may be, is possible only by overcoming the higher, second force acting on the second end section of the rod, such as by the weight of the coupler head and/or the aforementioned spring force. Once that higher force has been overcome, the coupler head starts to rotate toward its non-operational position, such as into a vertical position.

[0023] The invention can preferably be used on a digital automatic coupling (DAC). DAC couplings are provided with an electric coupler for electrically connecting the coupling to an electric coupler of another coupling. By attaching the second end section of the rod to an attachment point at a rear part of the coupler head and arranging the electric coupler on the coupler head in front of said attachment point, a DAC-coupling can be easily obtained. That is, the attachment of the rod at a rear part of the coupler head leaves enough space for arranging the electric coupler on the coupler head in front of such attachment point.

[0024] Preferably, when the coupler head is in its operational position, the locking member is arranged in a gap between the coupler head and the coupler shank so as to transmit axial forces between the coupler head and the coupler shank. With respect to the locking member, this is preferably provided in the form of a wedge having opposing sides which engage with opposing walls of the gap into which the wedge is inserted when the coupler head is in its operational position. Forces acting on the coupler head are thus transferred through the locking member to the coupler shank.

[0025] Preferably, the wedge or the gap or both the wedge and the gap are tapered. This way, the wedge can be urged into the gap by means of the pivoting mechanism so as to avoid a space between the cooperating walls but rather obtain a tight fit between the wedge and the walls of the gap. This way, there is no slack in the system and forces are reliably transferred through the locking member. A totality of the tapers between the sides of the wedge and the walls of the gap may be between 1° and 5°. For instance, one side of the wedge may be tapered by +0.5° whereas the cooperating wall of the gap is not tapered and the other side of the wedge may be tapered by -0.5° whereas the cooperating wall of the gap is again not tapered, in which case the totality of tapers

is 1°. This allows movement of the wedge into the gap until the walls of the wedge are pressing against the associated walls of the gap.

[0026] Preferably, the movement of the locking member - or wedge - is perpendicular to a longitudinal axis of the coupler shank, more preferably substantially vertically.

[0027] Preferably, the coupler head is a DAC or AC coupler head and the coupling further comprises an SC coupler head which is operable when the DAC or AC coupler head is in its non-operational position.

[0028] A corresponding method is likewise disclosed, i.e. a method of bringing a coupler head of a coupling of a rail vehicle from an operational position into a non-operational position, in particular the coupling described above, comprising the steps of releasing the locking member during a first period and rotating the coupler head into the non-operational position during a second period. These steps are, as stated, interconnected such that the second period starts when the first period ends.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The foregoing summary as well as the following detailed description of preferred embodiments will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the present disclosure, reference is made to the drawings. The scope of the disclosure, however, is not limited to the specific embodiments disclosed in the drawings. In the drawings:

Fig. 1 is a perspective view of a coupling with a coupler head in a first, operational position,

Fig. 2 is a side view of the front part of the coupling shown in Fig. 1,

Fig. 3 shows the coupling of Fig. 2 with the coupling head positioned in a second, non-operational position,

Fig. 4 is a perspective view of the section of the coupling where the coupler head is pivotably connected to the free end of the coupling's coupler shank,

Fig. 5A is a side view of the coupling section shown in Fig. 4 in a first state in which the coupling head is in its operational position,

Fig. 5B shows the same side view as Fig. 5A, however, in a different cross-sectional plane,

Fig. 6 shows the same side view of the coupling section as shown in Fig. 5A, however, in an interim state in which a locking member is released and the coupler head is still in its operational position,

Fig. 7 shows again the same side view as in Figs. 5A and 6, however, with the coupler head rotated into its non-operational position,

Fig. 8 is a schematic side view of a coupling according to a second embodiment with the coupler head in its operational position, and

Fig. 9 shows the same schematic side view of the coupling shown in Fig. 8, however, with the coupler head rotated into its non-operational position.

DETAILED DESCRIPTION

[0030] Fig. 1 is a perspective view of a coupling according to a first embodiment of the present disclosure. The coupling comprises a coupler head 1 of the Scharfenberg-type, more specifically a Scharfenberg-type 10 coupling. The coupler head 1 is connected to a coupler shank 2 by which the coupling can be attached to the body of a rail vehicle, preferably a freight locomotive (not shown). In the section encircled and labeled IV, there is a j oint by which the coupler head 1 is pivotably connected to the free end of the coupler shank 2.

[0031] Figs. 2 and 3 are side views of the front part of the coupling showing the coupler head 1 in its operational, preferably horizontal, position (shown in Fig. 2) and in its non-operational, preferably vertically lifted, position (shown in Fig. 3). As can be seen, a rod 3 comprising a cylinder 4 and plunger 5 extending from the cylinder 4 is attached with a first end area 3A thereof to the coupler shank 2 and with a second end area 3B thereof to the coupler head 1. More specifically, the second end 3B of the rod is attached to an attachment point at a rear part of the coupler head 1 which leaves room for an electric coupler 100 to be arranged on the coupler head 1 in front of such attachment point. The electric coupler 100 is designed for electrically connecting the coupling to an electric coupler of another coupling in order to transfer energy as well as data.

[0032] As can be seen by a comparison of Figs. 2 and 3, reducing the length of the rod 3 by means of the cylinder-plunger-arrangement 4, 5, which preferably is actuated hydraulically but may likewise be actuated pneumatically, the coupler head 1 rotates about a pivot axis 6 which is the primary axis of the connection. This will now be described in further detail in relation to Figs. 4 to 7 which merely show the joint section where the coupler head 1 is pivotably connected to the coupler shank.

[0033] In the embodiment shown in Figs. 4 to 7, the second end region 3B of the rod 3 is pivotably connected to the coupler head 1 and the second end region 3A of the rod 3 is pivotably connected to a swivel member 7 so that it can pivot about a pivot axis 3C. The swivel member 7, in turn, is mounted on the coupler shank 2 so that it can swivel about a swivel axis 7A. The swivel axis 7A of the swivel member 7 and the pivot axis 3C of the rod 3 are in parallel to each other. The pivot axis 3C of the rod 3 is not easily recognizable from Fig. 4 or Fig. 5A

and can be better derived from Fig. 5B, which shows the same side view as Fig. 5A, however, at a different cross-sectional plane which cuts through the rod 3 and the pivotable attachment of the rod 3 to the swivel member 7.

[0034] Now, as can be seen from Figs. 5A, 6 and 7, the swivel element 7 comprises a locking member 8 which is rotatably mounted to the swivel member 7 but which may alternatively form an integral part thereof. The functioning of the overall pivoting mechanism, by which the coupler head 1 is rotated about the primary axis 6, is as follows. Fig. 5A shows the coupler head 1 in its operational, preferably horizontal position. Then the length of the rod 3 is reduced using hydraulic or pneumatic pressure inside the cylinder-plunger-arrangement in order to lift the coupler head 1 upward. However, due to the substantial weight of the coupler head 1 and/or due to a strong force of a spring (not shown), the swivel member 7 will first swivel about the swivel axis 7A until it abuts against a stop 9 (shown in the cross-sectional view of Fig. 5B). Only thereafter will the coupler head 1 start to be raised. This is due to the fact that the forces acting on the first end 3A of the rod 3 are substantially only frictional forces which are substantially lower than the forces acting on the rod's other end section 3B caused by the weight of the coupler head 1 and/or spring force.

[0035] Accordingly, the pivoting mechanism reaches an interim state which is shown in Fig. 6 and in which state the swivel member 7 abuts against the stop 9. During this first period, i.e. the period in which the pivoting mechanism moves from the operational state (5A/5B) to the interim state (Fig. 6), the locking member 8 connected to the swivel member 7 is lifted and, thereby, released. As can be seen, the movement of the locking member 8 is perpendicular to a longitudinal axis of the coupler shank, namely substantially vertically. More specifically, in the operational state of the pivoting mechanism, the locking member 8 is inserted in a gap 10 and blocks the rotation of the coupler head 1 about the primary axis 6. Once it has been lifted from the gap 10, as shown in Fig. 6, the blocking is released so as to allow the coupler head 1 to rotate about the primary axis 6.

[0036] Such rotation of the coupler head 1 from its operational, but released position as shown in Fig. 6 to its non-operational position as shown in Fig. 7, occurs during a second period which starts after the first period has ended. In other words, as soon as the swivel member 7 abuts against the stop 9, further reduction of the length of the rod 3 by means of the cylinder-plunger-arrangement causes the rotation of the coupler head 1, in particular lifting thereof if the primary axis 6 is non-vertical.

[0037] Preferably, the cylinder is a double-acting cylinder, meaning that it is not only able to rotate the coupler head 1 about the primary axis 6 in one direction but also in the opposite direction. This is advantageous in order to lower the coupler head 1 from its vertical position in particular in situations where rotation about the primary axis is blocked, e.g. caused by icy weather conditions. Furthermore, the double-acting cylinder is relevant in this particular embodiment in order to urge the locking member 8 back into the gap 10 once the coupler head 1 has reached its operational, but unlocked position, i.e. the position shown in Fig. 6. Then, opposing sides of the locking member 8 engage with opposition walls of the gap 10, and by further extending the length of the rod 3, such interaction forms a strong blocking between the coupler shank 2 and the coupler head 1, as shown in Figs. 5A and 5B. As becomes particularly apparent from Fig. 5A, a lower rear end 1A of the coupler head 1 abuts against a lower front end 2A of the coupler shank 2. This is substantially caused by the weight of the coupler head 1 (and/or by a spring force, in particular when the primary axis 6 is not horizontal but vertical). Due to this abutment, axial forces are securely transferred from the coupler head 1 into the coupler shank 2. However, as long as the locking member is not securely inserted in the gap 10, any forces which do not strictly act axially on the coupler head 1 may cause rotation of the coupler head 1 about the primary axis 6. The locking member 8 in the gap 10 prevents such rotation and, furthermore, transfers part of the forces from the coupler head 1 to the coupler shank 2, thereby providing a more equal distribution of transmitted forces from the coupler head 1 to the coupler shank 2.

[0038] Preferably, the locking member 8 of this embodiment is wedge-shaped and tapered and/or the gap 10 is tapered so that at a certain point of insertion of the locking member 8 in the gap 10 the opposing sides of the locking member will come into contact with opposing walls of the gap. This ensures that there is no slack in the connection between the coupler head 1 and the coupler shank 2. The totality of tapers of the sides of the wedge and the walls of the gap is between 1° and 5°, i.e. in a symmetrical arrangement of the locking member 8 inside the gap 10 there may be a residual angular gap on each side of the locking member 8 of between 0.5° and 2.5°. The front end of the locking member 8 may be chamfered in order to facilitate the initial moment of insertion of the locking member 8 into the gap 10.

[0039] Unlike Figs. 1 to 3, Figs. 5A to 7 show the coupling with a screw coupler (SC) hanging down from the primary axis 6. A shackle is pivotably connected to the front end of the screw coupling SC. The shackle 20 is hooked into a transportation hook 21 mounted underneath the coupler head 1 so as to hold the screw coupling SC when the automatic coupler head 1 is operational. Before or after the coupler head 1 has been brought into its non-operational position as shown in Fig. 7, the shackle 20 can be unhooked from the transportation hook 21 and later hooked onto a draw hook of a corresponding screw coupling of another rail vehicle.

[0040] Figs. 8 to 9 show a second embodiment according to the present disclosure in which the cylinder-plunger-arrangement does not form part of the rod 3 but is pivotably attached with one end to the rod 3 and with an opposing end to the coupler shank 2. The locking member 8 forms part of the rod 3 but may equally be connected

to the rod 3 in a pivotable manner, similar to the arrangement discussed above in relation to the first embodiment. Again, in the non-operational position of the coupler head 1 as shown in Fig. 8, the locking member 8 is inserted in the gap 10 between the coupler head 1 and coupler shank 2, thereby blocking rotation of the coupler head 1 about the primary axis 6. Also, forces are transmitted from the coupler head 1 to the coupler shank 2 via the lower and upper rear ends of the coupler head 1 in this position of the coupler head, in the same way as described above in relation to the first embodiment.

[0041] By means of the cylinder-plunger-arrangement, the rod 3 rotates about a pivot axis 3C at its rear end section 3A from an operational state as shown in Fig. 8, through an interim state (not shown) in a first period, and from the interim state to the non-operational state as shown in Fig. 9 in a second period. During such movement of the pivoting mechanism from the operational state through the interim state to the non-operational state, and vice versa, the rod 3 is respectively moved in a single direction, which is a rotational direction about the pivot axis 3C. Preferably, such movement is continuous.

[0042] During the first period of rotation of the rod 3, the second end section 3B at the front of the rod 3 is guided in an oblong hole 11 of the coupler head 1 so that the locking member 8 is released from the gap 10 without the coupler head 1 being rotated about the primary axis 6. The interim state of the pivoting mechanism is reached when the second end section 3B of the rod 3 reaches the opposite end of the oblong hole 11. At this point of time, the second period starts in which the coupler head 1 is rotated, preferably lifted, from its operational position shown in Fig. 8 to its non-operational position shown in Fig. 9.

[0043] Again, the cylinder-plunger-arrangement preferably comprises a double-acting cylinder 4 by which the locking member 8 can be urged into the gap 10 when the coupler head 1 is rotated from its non-operational position back into its operational position.

[0044] Preferred aspects of the present disclosure are specified in the following paragraphs, whereas the scope of protection of the present invention is defined by the appended claims:

1. A coupling for a rail vehicle, preferably a freight locomotive, comprising

- a coupler shank (2) for attaching the coupling to a rail vehicle,
- a coupler head (1) pivotably connected to a free end of the coupler shank so as to rotate about a primary axis (6) between an operational position and a non-operational position,
- a locking member (8) which is configured to assume a locking position in which it blocks rotation of the coupler head (1) about the primary axis (6) when the coupler head (1) is in the operational position and
- a pivoting mechanism configured to rotate the coupler head (1) about the primary axis (6), wherein the pivoting mechanism is configured to release the locking member.

2. The coupling of paragraph 1, wherein the pivoting mechanism is configured to rotate the coupler head (1) about the primary axis (6) from the coupler head's non-operational position toward the coupler head's operational position.

3. The coupling of paragraph 1 or 2, wherein, when the pivoting mechanism is actuated so as to rotate the coupler head (1) from the coupler head's operational position to the coupler head's non-operational position, the pivoting mechanism moves from an operational state to an interim state in a first period and from the interim state to a non-operational state in a second period, wherein the pivoting mechanism is configured to release the locking member (8) during the first period and to rotate the coupler head (1) into the non-operational position during the second period.

4. The coupling of paragraph 3, wherein the coupling is configured such that the movement of the pivoting mechanism from the operational state through the interim state to the non-operational state is a movement in one direction.

5. The coupling according to paragraph 3 or 4, wherein the coupling is configured such that the movement of the pivoting mechanism from the operational state through the interim state to the non-operational state is a continuous movement.

6. The coupling according to any one of paragraphs 3 to 5, wherein the pivoting mechanism comprises a rod (3) having a first end section (3A) connected to the coupler shank (2) and a second end section (3B) connected to the coupler head (1), wherein at least one of the first and second end sections (3A, 3B) is pivotably mounted and wherein the rod (3) pivots about the at least one pivotably mounted end section (3A, 3B) when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state.

7. The coupling of paragraph 6, wherein the pivoting mechanism comprises an oblong hole (11) which enables the second end section (3B) of the rod

- to move relative to the coupler head (1) without causing rotation of the coupler head (1) when the pivoting mechanism moves from the operational state to the interim state during the first

period and

- to cause rotation of the coupler head (1) when the pivoting mechanism moves from the interim state to the non-operational state during the second period,

wherein furthermore the rod (3) is connected to the locking member (8) in such a manner that the locking member (8) is released when the pivoting mechanism moves from the operational state to the interim state in the first period.

8. The coupling according to any one of paragraphs 3 to 7, wherein the pivoting mechanism comprises a cylinder (4) and a plunger (5) extending from the cylinder (4), wherein the arrangement is such that the cylinder (4) and plunger (5) move relative to one another along a common longitudinal axis when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state.

9. The coupling of paragraph 8, wherein the cylinder (4) is a double-acting cylinder so as to enable the pivoting mechanism to urge the coupler head (1) toward both the coupler head's non-operational position and the coupler head's operational position.

10. The coupling of paragraph 8 or 9, wherein the cylinder (4) is a hydraulic cylinder.

11. The coupling of any one of paragraphs 8 to 10, including claim 6, wherein the cylinder (4) or the plunger (5) is attached to the rod (3) so as to pivot the rod (3) about the at least one pivotably attached end section (3A, 3B) when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state.

12. The coupling of any one of paragraphs 8 to 10, including claim 6, wherein the cylinder (4) and plunger (5) form part of the rod (3) such that the rod (3) is extendable.

13. The coupling of paragraph 12, wherein a first force that needs to be overcome by the pivoting mechanism in order to release the locking member (8) and that acts on the first end section (3A) of the rod (3) is lower than a second force that needs to be overcome by the pivoting mechanism in order to rotate the coupler head (1) from its operating position toward its non-operating position and which acts on the second end section (3B) of the rod (3).

14. The coupling of paragraph 13, wherein the first force and the second force are forces which act on the rod (3) in opposite directions along a longitudinal axis of the rod (3).

15. The coupling of paragraph 13 or 14, wherein the second force is caused at least partly by a spring.

16. The coupling of any one of paragraphs 13 to 15, wherein the second force is caused at least partly by a weight of the coupler head (1).

17. The coupling of any one of paragraphs 13 to 16, wherein the first end section (3A) of the rod (3) is pivotably mounted to a swivel member (7) which is, on the one hand, pivotably mounted to the coupler shank (2) and, on the other hand, connected to or integrally forming the locking member (8) such that, when the pivoting mechanism moves from the non-operational state toward the interim state, the swivel member (7) swivels and causes release of the locking member (8).

18. The coupling of paragraph 17, wherein the configuration is such that rotation of the coupler head (1) from the coupler head's operational position toward the coupler head's non-operational position begins after the swivel member (7) has reached a stop (9).

19. The coupling of any one of paragraphs 1 to 18, including claim 6, wherein the coupling is a DAC coupling, wherein the second end section (3B) of the rod (3) is attached to an attachment point at a rear part of the coupler head (1) and wherein an electric coupler (100) for electrically connecting the coupling to an electric coupler of another coupling is arranged on the coupler head (1) in front of said attachment point.

20. The coupling of any one of paragraphs 1 to 19, wherein, when the coupler head (1) is in its operational position, the locking member (8) is arranged in a gap (11), which is a gap between the coupler head (1) and the coupler shank (2), so as to transmit axial forces between the coupler head (1) and the coupler shank (2).

21. The coupling of paragraph 20, wherein the locking member (8) comprises a wedge having opposing sides which engage with opposing walls of the gap (10) when the coupler head (1) is in its operational position.

22. The coupling of paragraph 21, wherein the locking member (8) or the gap (11) or both the locking member (8) and the gap (11) are tapered.

23. The coupling of paragraph 21 or 22, wherein a totality of tapers of the sides of the locking member

(8) and the walls of the gap (11) is between 1° and 5°.

24. The coupling of any one of paragraphs 1 to 23, wherein the coupler head (1) is a DAC or AC coupler head and wherein the coupling further comprises an SC coupler head (SC) which is operable when the DAC or AC coupler head (1) is in its non-operational position.

25. The coupling of any one of the preceding paragraphs, wherein, when the coupling is attached to a rail vehicle with the primary axis (6) inclined or horizontal, the pivoting mechanism lifts the coupler head (1) upward when the pivoting mechanism rotates the coupler head (1) from the coupler head's operational position toward the coupler head's non-operational position.

26. A method of bringing a coupler head (1) of a coupling of a rail vehicle from an operational position into a non-operational position, wherein the coupling comprises:

- a coupler shank (2) by which the coupling is attached to a rail vehicle,
- the coupler head (1) which is pivotably connected to a free end of the coupler shank (2) so as to be rotatable about a primary axis (6) between an operational position and a non-operational position and
- a locking member (8) which blocks rotation of the coupler head (1) about the primary axis when the coupler head (1) is in the operational position,

the method comprising the steps of:

(a) releasing the locking member (8) during a first period and
(b) rotating the coupler head (1) into the non-operational position during a second period,

wherein the steps (a) and (b) are interconnected such that the second period starts immediately when the first period ends.

27. The method according to paragraph 25, wherein rotating the coupler head (1) into the non-operational position causes the coupler head (1) to be lifted upward.

28. The method according to paragraph 25 or 26, wherein the steps (a) and (b) are caused by moving a driving element of the pivoting mechanism in one direction.

29. The method according to any one of paragraphs 25 to 27, wherein the coupling is a coupling according to any one of paragraphs 1 to 24.

Claims

1. A coupling for a rail vehicle, comprising

- a coupler shank (2) for attaching the coupling to a rail vehicle,
- a coupler head (1) pivotably connected to a free end of the coupler shank so as to rotate about a primary axis (6) between an operational position and a non-operational position,
- a locking member (8) which is configured to assume a locking position in which it blocks rotation of the coupler head (1) about the primary axis (6) when the coupler head (1) is in the operational position and
- a pivoting mechanism configured to rotate the coupler head (1) about the primary axis (6), wherein the pivoting mechanism is configured to release the locking member.

2. The coupling of claim 1, wherein the pivoting mechanism is configured to rotate the coupler head (1) about the primary axis (6) from the coupler head's non-operational position toward the coupler head's operational position.

3. The coupling of claim 1 or 2, wherein, when the pivoting mechanism is actuated so as to rotate the coupler head (1) from the coupler head's operational position to the coupler head's non-operational position, the pivoting mechanism moves from an operational state to an interim state in a first period and from the interim state to a non-operational state in a second period, wherein the pivoting mechanism is configured to release the locking member (8) during the first period and to rotate the coupler head (1) into the non-operational position during the second period.

4. The coupling of claim 3, wherein the coupling is configured such that the movement of the pivoting mechanism from the operational state through the interim state to the non-operational state is one of: a movement in one direction, a continuous movement, and a continuous movement in one direction.

5. The coupling according to claim 3 or 4, wherein the pivoting mechanism comprises a rod (3) having a first end section (3A) connected to the coupler shank (2) and a second end section (3B) connected to the coupler head (1), wherein at least one of the first and second end sections (3A, 3B) is pivotably mounted and wherein the rod (3) pivots about the at least one pivotably mounted end section (3A, 3B) when the pivoting mechanism moves from the operational

state to the interim state and further from the interim state to the non-operational state.

6. The coupling of claim 5, wherein the pivoting mechanism comprises an oblong hole (11) which enables the second end section (3B) of the rod

- to move relative to the coupler head (1) without causing rotation of the coupler head (1) when the pivoting mechanism moves from the operational state to the interim state during the first period and
- to cause rotation of the coupler head (1) when the pivoting mechanism moves from the interim state to the non-operational state during the second period,

wherein furthermore the rod (3) is connected to the locking member (8) in such a manner that the locking member (8) is released when the pivoting mechanism moves from the operational state to the interim state in the first period.

7. The coupling according to any one of claims 3 to 6, wherein the pivoting mechanism comprises a cylinder (4) and a plunger (5) extending from the cylinder (4), wherein the arrangement is such that the cylinder (4) and plunger (5) move relative to one another along a common longitudinal axis when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state, wherein **preferably** the cylinder (4) is one or both of:

- a double-acting cylinder so as to enable the pivoting mechanism to urge the coupler head (1) toward both the coupler head's non-operational position and the coupler head's operational position, and
- a hydraulic cylinder.

8. The coupling of claim 7, including claim 5, wherein the cylinder (4) or the plunger (5) is attached to the rod (3) so as to pivot the rod (3) about the at least one pivotably attached end section (3A, 3B) when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state.

9. The coupling of claim 7, including claim 5, wherein the cylinder (4) and plunger (5) form part of the rod (3) such that the rod (3) is extendable.

10. The coupling of claim 9, wherein a first force that needs to be overcome by the pivoting mechanism in order to release the locking member (8) and that acts on the first end section (3A) of the rod (3) is lower than a second force that needs to be overcome by the pivoting mechanism in order to rotate the coupler head (1) from its operating position toward its non-operating position and that acts on the second end section (3B) of the rod (3), wherein **preferably** the second force is caused at least partly by a spring or by a weight of the coupler head (1) or by both a spring and a weight of the coupler head (1).

11. The coupling of claim 10, wherein the first end section (3A) of the rod (3) is pivotably mounted to a swivel member (7) which is, on the one hand, pivotably mounted to the coupler shank (2) and, on the other hand, connected to or integrally forming the locking member (8) such that, when the pivoting mechanism moves from the non-operational state toward the interim state, the swivel member (7) swivels and causes release of the locking member (8), wherein **preferably** the configuration is such that rotation of the coupler head (1) from the coupler head's operational position toward the coupler head's non-operational position begins after the swivel member (7) has reached a stop (9).

12. The coupling of any one of claims 1 to 11, including claim 5, wherein the coupling is a DAC coupling, wherein the second end section (3B) of the rod (3) is attached to an attachment point at a rear part of the coupler head (1) and wherein an electric coupler (100) for electrically connecting the coupling to an electric coupler of another coupling is arranged on the coupler head (1) in front of said attachment point.

13. The coupling of any one of claims 1 to 12, wherein, when the coupler head (1) is in its operational position, the locking member (8) is arranged in a gap (11), which is a gap between the coupler head (1) and the coupler shank (2), so as to transmit axial forces between the coupler head (1) and the coupler shank (2), wherein **preferably** the locking member (8) comprises a wedge having opposing sides which engage with opposing walls of the gap (10) when the coupler head (1) is in its operational position, wherein **more preferably** the locking member (8) or the gap (11) or both the locking member (8) and the gap (11) are tapered, wherein **even more preferably** a totality of tapers of the sides of the locking member (8) and the walls of the gap (11) is between 1° and 5°.

14. The coupling of any one of claims 1 to 13, wherein the coupler head (1) is a DAC or AC coupler head and wherein the coupling further comprises an SC coupler head (SC) which is operable when the DAC or AC coupler head (1) is in its non-operational position.

15. A method of bringing a coupler head (1) of a coupling of a rail vehicle from an operational position into a non-operational position, wherein the coupling com-

prises:

- a coupler shank (2) by which the coupling is attached to a rail vehicle,
- the coupler head (1) which is pivotably connected to a free end of the coupler shank (2) so as to be rotatable about a primary axis (6) between an operational position and a non-operational position and
- a locking member (8) which blocks rotation of the coupler head (1) about the primary axis when the coupler head (1) is in the operational position,

the method comprising the steps of:

(a) releasing the locking member (8) during a first period and
(b) rotating the coupler head (1) into the non-operational position during a second period,

wherein the steps (a) and (b) are interconnected such that the second period starts immediately when the first period ends,
wherein **preferably** the coupling is a coupling according to any one of claims 1 to 14.

Amended claims in accordance with Rule 137(2) EPC.

1. A coupling for a rail vehicle, preferably a freight locomotive, comprising

- a coupler shank (2) for attaching the coupling to a rail vehicle,
- a coupler head (1) pivotably connected to a free end of the coupler shank so as to rotate about a primary axis (6) between an operational position and a non-operational position,
- a locking member (8) which is configured to assume a locking position in which it blocks rotation of the coupler head (1) about the primary axis (6) when the coupler head (1) is in the operational position and
- a pivoting mechanism configured to rotate the coupler head (1) about the primary axis (6), wherein the pivoting mechanism is configured to release the locking member, wherein, when the pivoting mechanism is actuated so as to rotate the coupler head (1) from the coupler head's operational position to the coupler head's non-operational position, the pivoting mechanism moves from an operational state to an interim state in a first period and from the interim state to a non-operational state in a second period, wherein the pivoting mechanism is configured to release the locking member (8) during the first period and to rotate the coupler head (1) into the non-operational position during the second period,
wherein the pivoting mechanism comprises a rod (3) having a first end section (3A) connected to the coupler shank (2) and a second end section (3B) connected to the coupler head (1), wherein at least one of the first and second end sections (3A, 3B) is pivotably mounted and wherein the rod (3) pivots about the at least one pivotably mounted end section (3A, 3B) when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state,
wherein the pivoting mechanism comprises a cylinder (4) and a plunger (5) extending from the cylinder (4), wherein the arrangement is such that the cylinder (4) and plunger (5) move relative to one another along a common longitudinal axis when the pivoting mechanism moves from the operational state to the interim state and further from the interim state to the non-operational state, wherein the cylinder (4) and plunger (5) form part of the rod (3) such that the rod (3) is extendable,
characterized in that a first force that needs to be overcome by the pivoting mechanism in order to release the locking member (8) and that acts on the first end section (3A) of the rod (3) is lower than a second force that needs to be overcome by the pivoting mechanism in order to rotate the coupler head (1) from its operating position toward its non-operating position and which acts on the second end section (3B) of the rod (3), wherein the first force and the second force are forces which act on the rod (3) in opposite directions along a longitudinal axis of the rod (3).

2. The coupling of claim 1, wherein the pivoting mechanism is configured to rotate the coupler head (1) about the primary axis (6) from the coupler head's non-operational position toward the coupler head's operational position.

3. The coupling of claim 1 or 2, wherein the coupling is configured such that the movement of the pivoting mechanism from the operational state through the interim state to the non-operational state is a movement in one direction, wherein preferably the coupling is configured such that the movement of the pivoting mechanism from the operational state through the interim state to the non-operational state is a continuous movement.

4. The coupling of any one of claims 1 to 3, wherein the cylinder (4) is a doubleacting cylinder so as to enable the pivoting mechanism to urge the coupler head (1) toward both the coupler head's non-oper-

ational position and the coupler head's operational position, wherein preferably the cylinder (4) is a hydraulic cylinder.

5. The coupling of any one of claims 1 to 4, wherein the second force is caused at least partly by a spring.

6. The coupling of any one of claims 1 to 5, wherein the second force is caused at least partly by a weight of the coupler head (1).

7. The coupling of any one of claims 1 to 6, wherein the first end section (3A) of the rod (3) is pivotably mounted to a swivel member (7) which is, on the one hand, pivotably mounted to the coupler shank (2) and, on the other hand, connected to or integrally forming the locking member (8) such that, when the pivoting mechanism moves from the non-operational state toward the interim state, the swivel member (7) swivels and, thereby, releases the locking member (8), wherein preferably the configuration is such that rotation of the coupler head (1) from the coupler head's operational position toward the coupler head's non-operational position begins after the swivel member (7) has reached a stop (9).

8. The coupling of any one of claims 1 to 7, wherein the coupling is a digital automatic coupling, wherein the second end section (3B) of the rod (3) is attached to an attachment point at a rear part of the coupler head (1) and wherein an electric coupler (100) for electrically connecting the coupling to an electric coupler of another coupling is arranged on the coupler head (1) in front of said attachment point.

9. The coupling of any one of claims 1 to 8, wherein, when the coupler head (1) is in its operational position, the locking member (8) is arranged in a gap (11), which is a gap between the coupler head (1) and the coupler shank (2), so as to transmit axial forces between the coupler head (1) and the coupler shank (2), wherein preferably the locking member (8) comprises a wedge having opposing sides which engage with opposing walls of the gap (10) when the coupler head (1) is in its operational position, wherein more preferably the locking member (8) or the gap (11) or both the locking member (8) and the gap (11) are tapered.

10. The coupling of claim 9, wherein a totality of tapers of the sides of the locking member (8) and the walls of the gap (11) is between 1° and 5°.

11. The coupling of any one of claims 1 to 10, wherein the coupler head (1) is a coupler head of an automatic or digital automatic coupling and wherein the coupling further comprises a coupler head of a screw coupling which is operable when the coupler head (1) of the automatic or digital automatic coupling is in its non-operational position.

12. The coupling of any one of the preceding claims, wherein, when the coupling is attached to a rail vehicle with the primary axis (6) inclined or horizontal, the pivoting mechanism lifts the coupler head (1) upward when the pivoting mechanism rotates the coupler head (1) from the coupler head's operational position toward the coupler head's non-operational position.

13. A method of bringing a coupler head (1) of a coupling of a rail vehicle from an operational position into a non-operational position, wherein the coupling is a coupling according to any one of paragraphs 1 to 12,

the method comprising the steps of:

(a) releasing the locking member (8) during a first period and
(b) rotating the coupler head (1) into the non-operational position during a second period,

wherein the steps (a) and (b) are interconnected such that the second period starts immediately when the first period ends.

14. The method according to claim 13, wherein rotating the coupler head (1) into the non-operational position causes the coupler head (1) to be lifted upward.

15. The method according to claim 13 or 14, wherein the steps (a) and (b) are caused by moving a driving element of the pivoting mechanism in one direction.

FIG 1

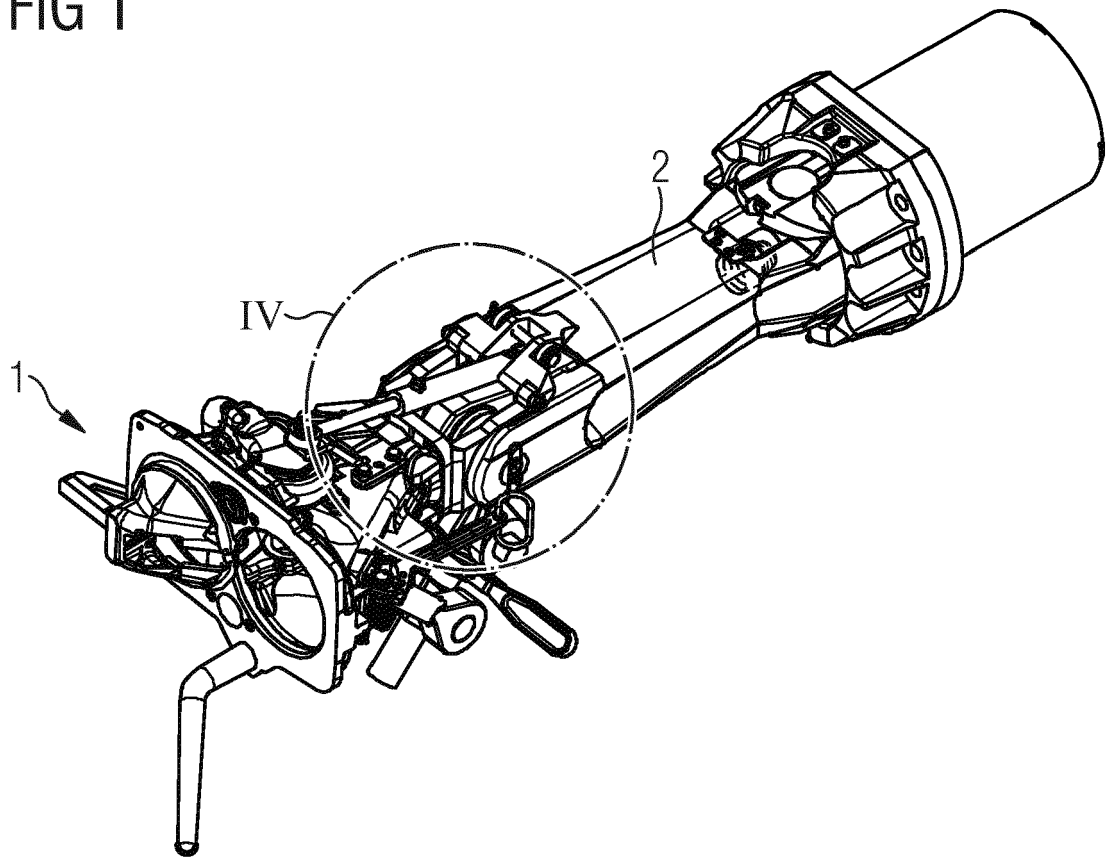


FIG 2

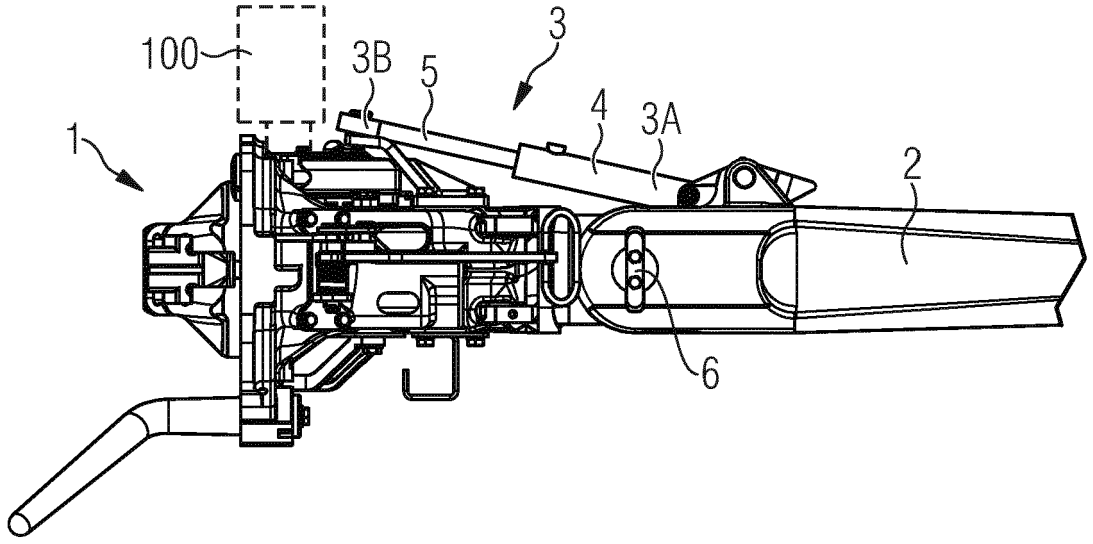


FIG 3

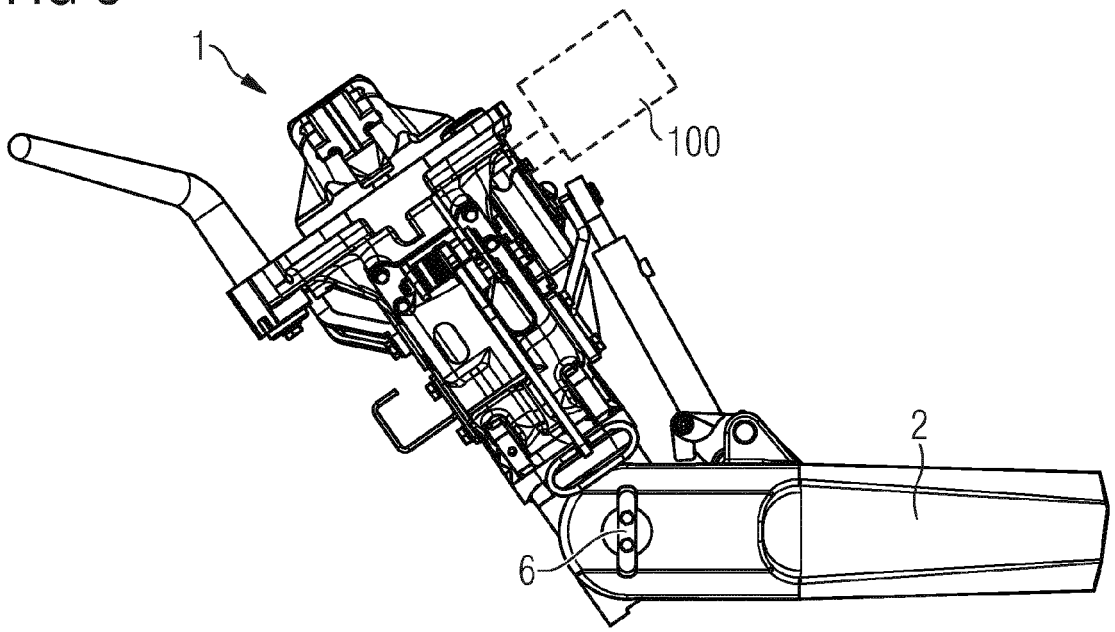


FIG 4

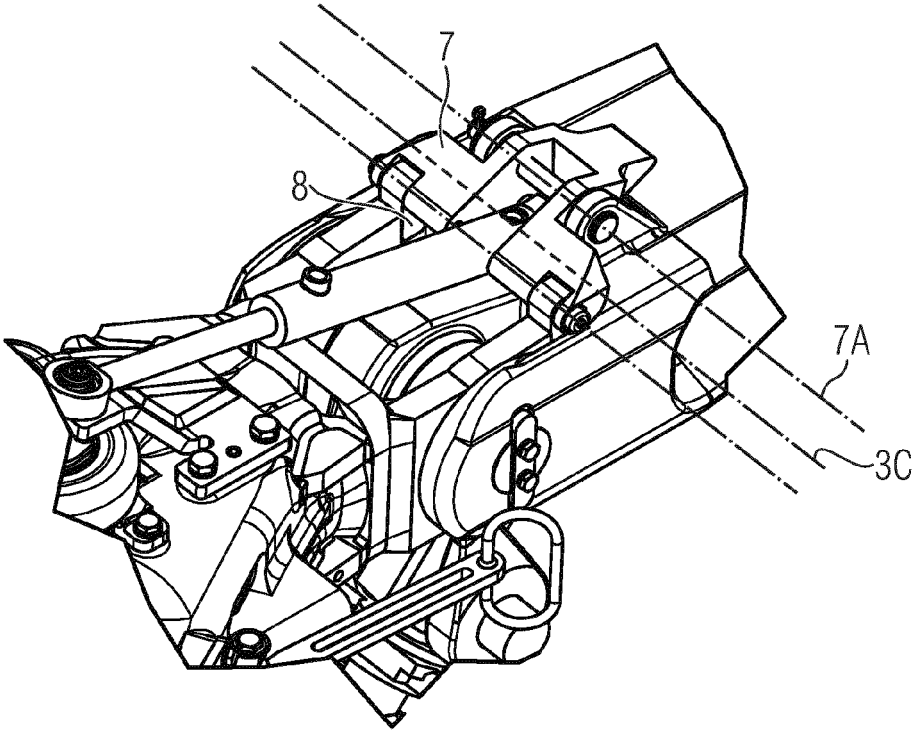


FIG 5A

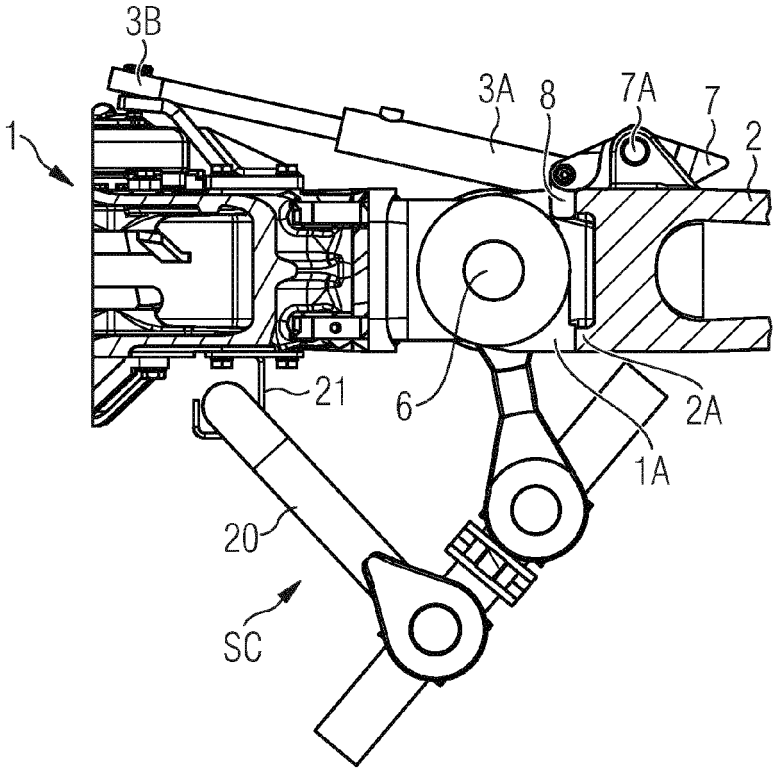


FIG 5B

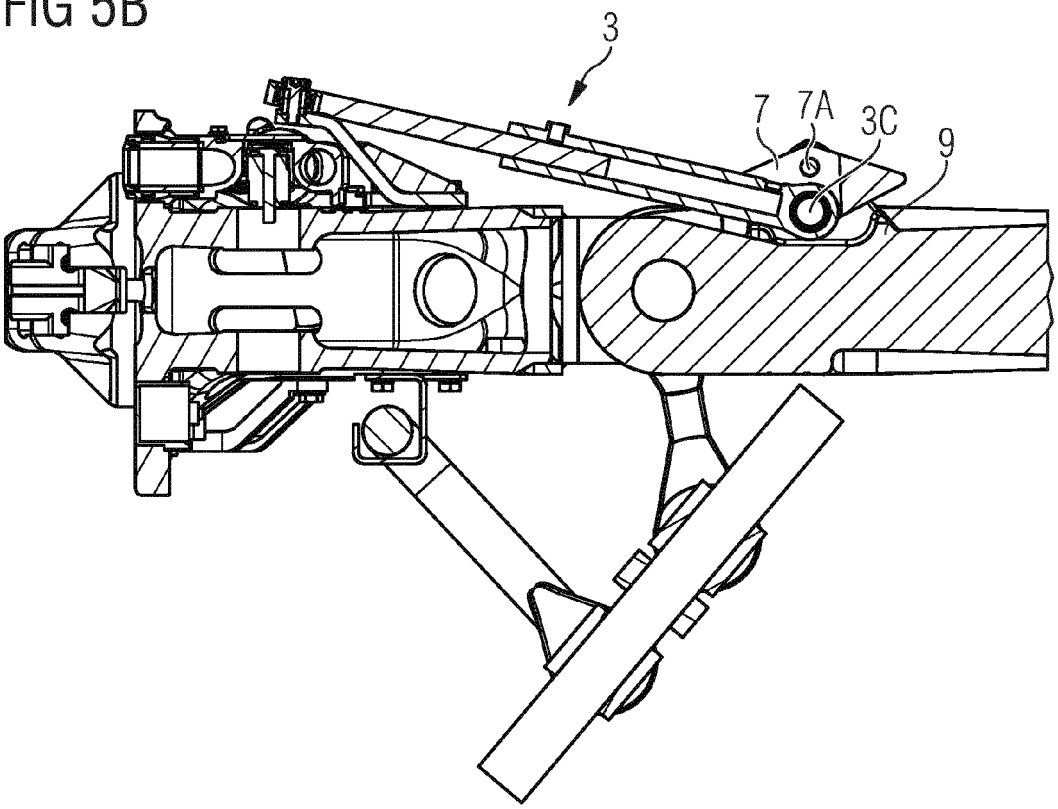


FIG 6

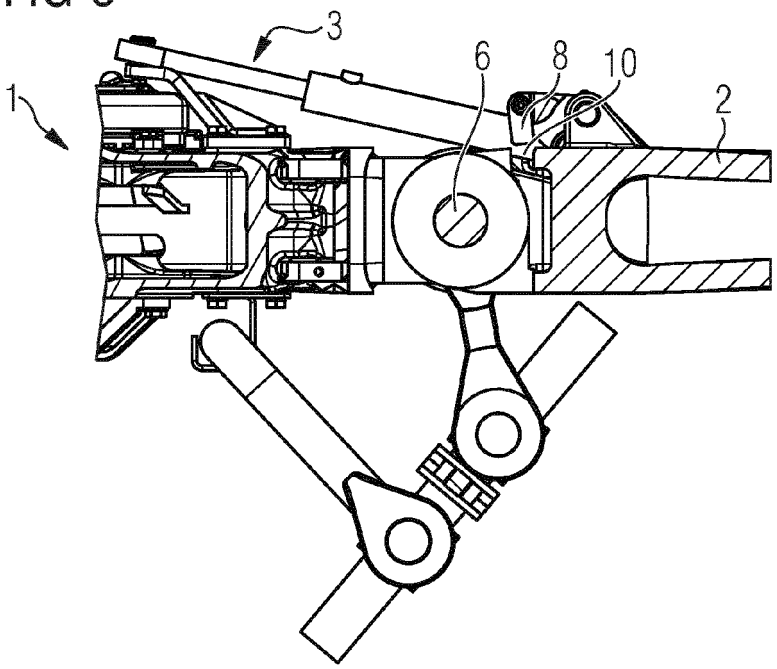


FIG 7

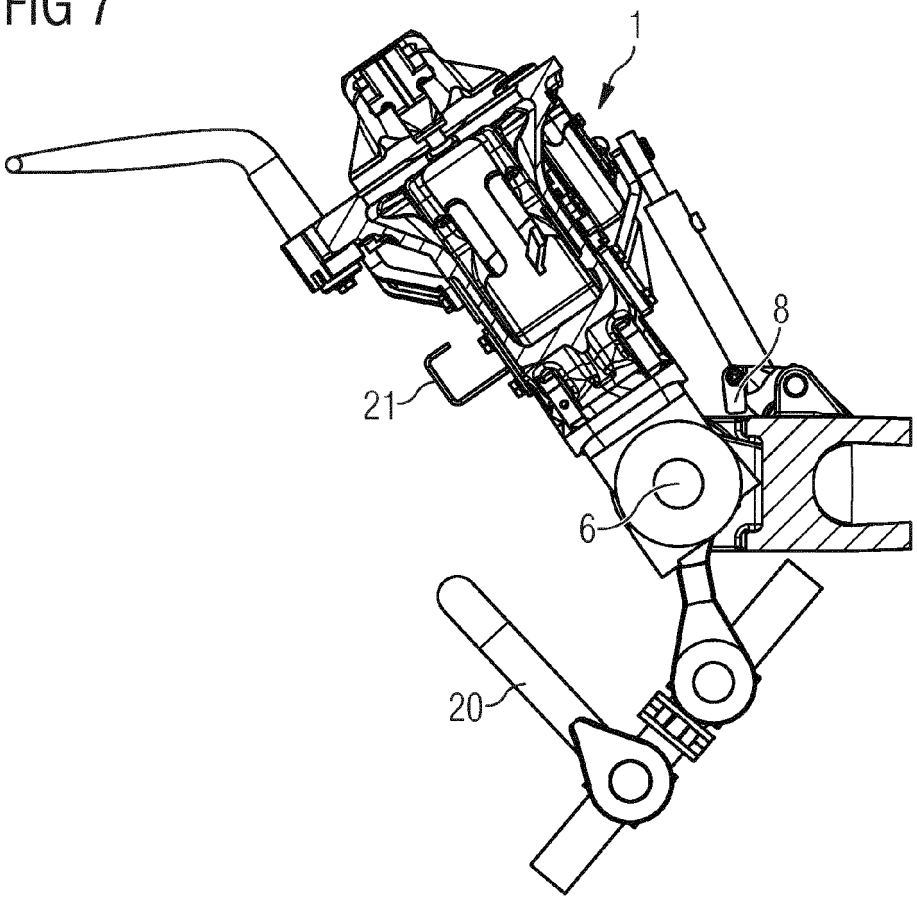


FIG 8

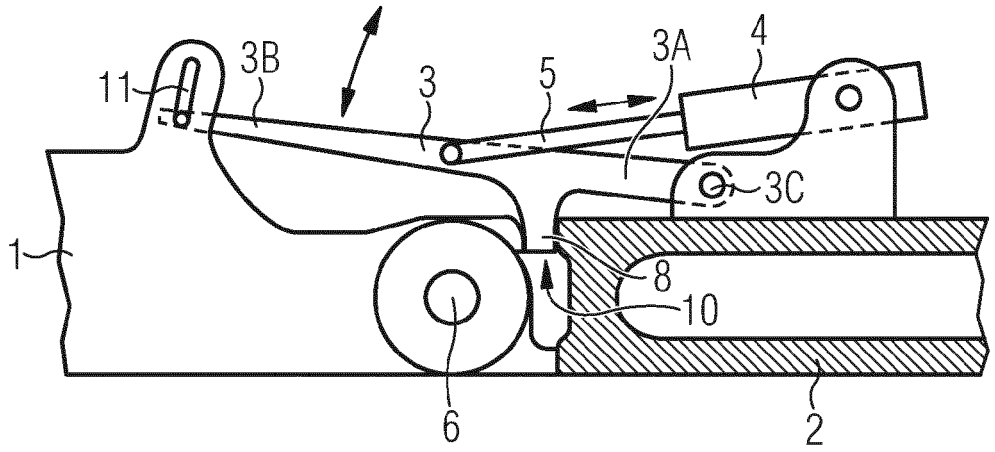
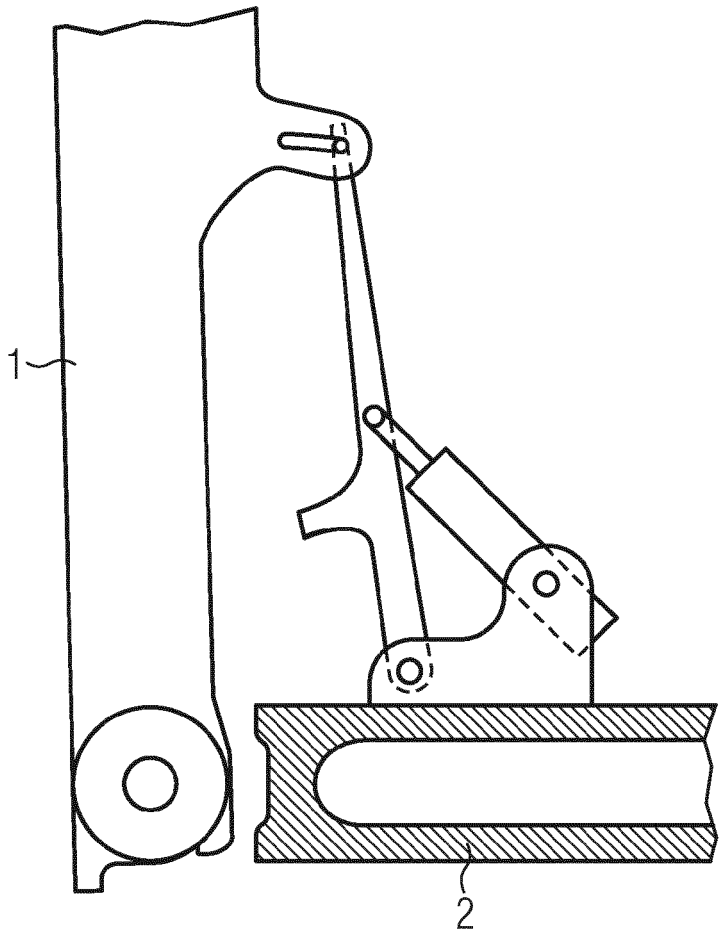


FIG 9



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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 6703

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 992 054 A1 (CRRC QINGDAO SIFANG ROLLING STOCK RES INST CO LTD [CN]) 4 May 2022 (2022-05-04)	1-7,9, 10,12, 13,15	INV. B61G7/08 B61G5/04
Y	* figures 1-14 *	14	
A	* page 8, column 13, paragraph 0060 - column 14, paragraph 0062 *	8,11	
X	WO 2008/132124 A1 (VOITH PATENT GMBH [DE]) 6 November 2008 (2008-11-06) * figures 1-4 *	1-4,15	
X	US 653 075 A (DUNN JAMES F [US]) 3 July 1900 (1900-07-03) * the whole document *	1-4,7,15	
Y	WO 2021/185497 A1 (VOITH PATENT GMBH [DE]) 23 September 2021 (2021-09-23)	14	
A	* figures 1-3 *	1,15	
A	US 630 575 A (TEAL STEBBINS A [US] ET AL) 8 August 1899 (1899-08-08) * figure 4 *	1,15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B61G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 May 2023	Crama, Yves

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 21 6703

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-05-2023

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REFERENCES CITED IN THE DESCRIPTION

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