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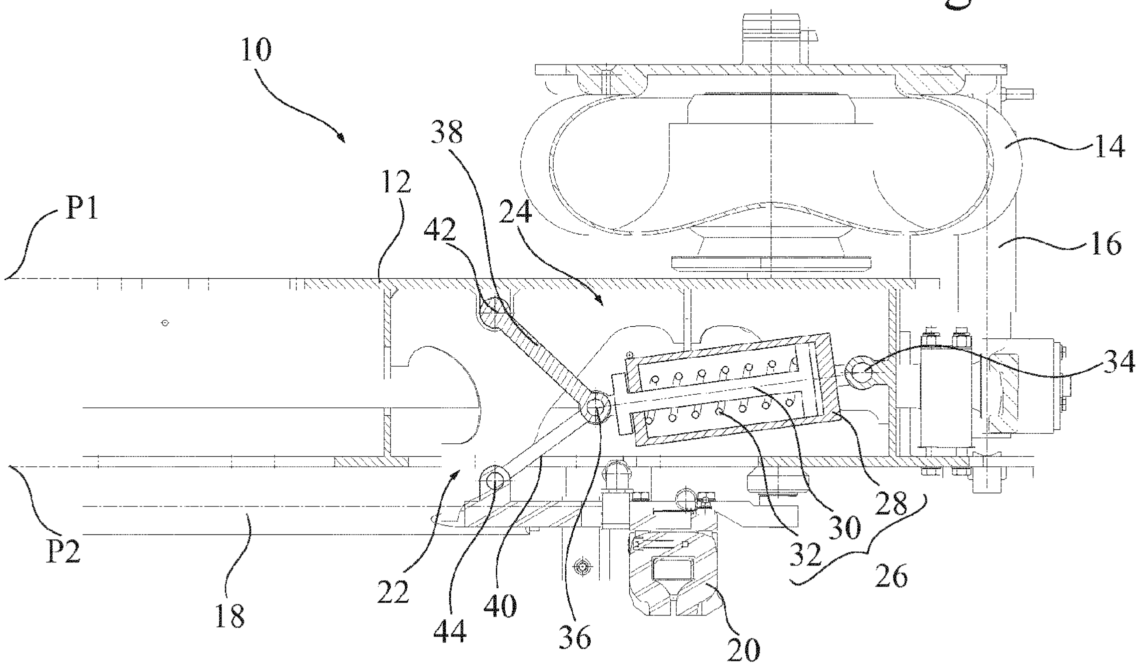
(54) Railway bogie provided with a movable electromagnetic driving or braking means

(57) A railway bogie, comprises a bogie frame (10), an electromagnetic linear motor and/or brake device (18) provided with at least one electromagnet (20), a linkage (22) for linking the electromagnetic device (18) to the bogie frame (10) between an upper standby position and a lower operational position, and at least one linear actuator (26) for actuating the linkage between the standby position and the operational position. In the standby position, the actuator (26) is housed within the bogie frame (10).

Fig.1



EP 2 754 599 A1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to a railway bogie provided with an electromagnetic driving and/or braking means, which cooperates with a rail on the track. It relates in particular to an arrangement for moving the electromagnetic driving and/or braking means between an upper standby position and a lower, operational position.

BACKGROUND ART

[0002] A railway bogie with a suspension system for an electromagnetic linear brake is disclosed in FR 2 314 852. The electromagnetic brake is connected to the chassis by a vertical linear sliding guide device, and movable in translation between an upper, standby position and a lower, operational position. The linear sliding guide device includes vertical pneumatic cylinders. This arrangement takes up a lot of space, particularly in the vertical direction.

[0003] An electromagnetic linear braking system for rail vehicles such as trains or trams is disclosed in GB 2 375 802. The arrangement comprises a housing in which is mounted an electro-magnet held in a parked position in line with and just above the rail by two bolts and springs. Above the electro-magnet are two horizontally and longitudinally mounted solenoids with push rods, arranged in such a way that when the solenoids are energised the electro-magnet is pushed down against the springs, the electro-magnet which is energised at the same time is pulled onto the rail by magnetism, and will remain clamped to it while the braking system is switched on. When the braking system is switched off the electro-magnet and the solenoids become inactive and the electro-magnet will be retracted by the springs to the standby position. The housing of the electromagnetic linear braking system is fixed beneath a bogie frame of the rail vehicle. Again, the arrangement takes up a lot of space in the vertical direction.

[0004] There is therefore a need for a more compact arrangement of the connection of a linear motor or linear electromagnetic braking system to a railway bogie.

SUMMARY OF THE INVENTION

[0005] According to one aspect of the invention, there is provided a railway bogie, comprising:

- a bogie frame,

- an electromagnetic linear motor and/or brake device provided with at least one electromagnet,

- at least one linear actuator for actuating the electromagnetic linear device between an upper, standby position and a lower, operational position, wherein in the standby position, the actuator is housed within the bogie frame.

[0006] The bogie frame is preferably an H-shaped frame or double H-shaped frame. The actuator in the standby position is preferably housed within a cavity of a hollow beam of the bogie frame, which can be a cross-beam or side beam. The arrangement takes advantage of the thickness of the side beams and cross beam(s) to house at least part of the mechanism for lowering the electromagnet. The overall height of the bogie can be optimised, as well as the distance of the bogie frame to the ground. Moreover, the actuator in the standby position is protected by the bogie frame.

[0007] According to one embodiment, the system further comprises a linkage for linking the electromagnetic device to the bogie frame between the upper standby position and the lower operational position. Alternatively, the linear actuator can be connected to the electromagnetic linear device via a cam mechanism.

[0008] According to a preferred embodiment, the linear actuator is provided with pivot connections with the linkage and with the bogie frame. According to a preferred embodiment, the pivot connexions have pivot axes that are parallel to a longitudinal horizontal axis of the bogie frame. In the standby position, the pivot axes are preferably spaced apart from one another in a transverse direction of the bogie frame. In other words, the actuator in the standby position extends essentially transversally. In the standby position, the pivot axes can be in the same horizontal plane (in which case the actuator is horizontal) or in two parallel horizontal planes that are close to one another (in which case the actuator is slightly inclined). In any case, the two parallel horizontal planes are close to one another in the sense that they are both within the bogie frame, i.e. between the upper and lower side of the side beams. This arrangement has proved particularly compact, and even more so when the actuator is received within a cavity of the transverse beam. It perfectly takes advantage of the large hollow cavity available in the transverse beam and results in a very compact layout. It also allows for the integration of other components such as an anti-roll bar assembly.

[0009] According to an alternative embodiment, the pivot axes are parallel to a transversal horizontal axis of the bogie frame. In the pivot axes are preferably spaced apart from one another in a longitudinal direction of the bogie frame.

[0010] According to one embodiment, the actuator is a pneumatic actuator, which comprises a cylinder and a piston. Alternatively, the actuator can be an electromechanical or electromagnetic actuator.

[0011] According to a preferred embodiment, the linkage comprises at least one set of connecting rods, comprising an upper connecting rod pivotally connected the bogie frame and a lower connecting rod pivotally connected to upper connecting rod and to the electromagnetic device. Preferably, all the one-axis pivot connections are parallel to one another to ensure that the actual motion of the linkage between the standby position and the operational position is a planar motion. The same holds for the pivot axes of the one-axis pivot connections of the actuator, which are preferably parallel with the pivot axes of the set of connecting rods.

[0012] The connecting rods form a toggle linkage. According to one embodiment, the toggle linkage, works only on one side of its centre position, i.e. it remains unclamped, between the upper standby position and the lower operational position. In this case, the standby position can advantageously correspond to the centre position. Alternatively, the lower operational position can be an over-centre, clamped position.

[0013] Preferably, the connecting rods have pivot axes that are parallel to a longitudinal axis of the bogie frame.

[0014] The actuator is preferably pivotally connected to a pivot connection between the upper and lower connecting rods.

[0015] According to a preferred embodiment, the linkage comprises four sets of connecting rods, each comprising an upper connecting rod pivotally connected the bogie frame and a lower connecting rod pivotally connected to the upper connecting rod and to the electromagnetic device. The pivot axes of the four sets of connecting rods are preferably all parallel to one direction, which can be a transverse direction or preferably the longitudinal direction of the bogie frame.

[0016] The linkage may further comprise at least one shaft that rigidly connects at least two of the four sets of connecting rods to ensure simultaneous joint motion and reduce the number of actuators.

[0017] The actuator further comprises a return spring to bias the electromagnetic device towards the standby position.

[0018] The bogie may further comprise an auxiliary frame for supporting the electromagnetic drive and/or brake device, the linkage being directly connected to the auxiliary frame.

[0019] Both aspects of the invention can be combined at will.

DESCRIPTION OF THE FIGURES

[0020] Other advantages and features of the invention will become more clearly apparent from the following description of specific embodiments of the invention given as non-restrictive example only and represented in the accompanying drawings, in which:

- Fig. 1 is a cross-section of a portion of a bogie according to a first embodiment of the invention in an upper, standby position;
- Fig. 2 is an isometric view of the bogie of Fig. 1 in the upper standby position.
- Fig. 3 is a cross section of a portion of the bogie of Fig. 1, in a lower operational position;
- Fig. 4 is a longitudinal section of the bogie of Fig.1 in the lower, operational position;
- Fig. 5 is a partial isometric view of a bogie according to another embodiment of the invention, in an upper, standby position;
- Fig. 6 is a longitudinal section of the bogie of Fig. 5, in a lower, operational position.
- Fig. 7 is a longitudinal section of a bogie according to a further embodiment of the invention.

[0021] Corresponding reference numerals refer to the same or corresponding parts in each of the figures.

DETAILED DESCRIPTION OF PREFERED EMBODIMENTS

[0022] Referring to Figs. 1 to 4, a bogie for a rail vehicle comprises a H-shaped bogie frame **10** including one cross beam **12** and two side beams (not shown). The Figs. 1 to 4 illustrate only a portion of the bogie, which is located at one end of the cross beam **12.** It should be understood that the corresponding portion of the bogie at the opposite end of the cross beam is the mirror image of the portion illustrated in the drawings.

[0023] The side beams support a secondary suspension that directly or indirectly links the bogie frame to a car body of the rail vehicle. In the present case, the secondary suspension includes air springs **14** located at the intersection between the cross beam and side beams as well as one or more dampers **16.** As is well known in the art, the bogie frame is supported by two sets of wheels (not shown), which run on a railway track. The bogie frame is linked to the wheel sets by a primary suspension.

[0024] The bogie is further provided with a linear eddy current rail brake device **18** provided with at least one electromagnet **20.** The linear eddy current brake device **18** is articulated to the bogie frame **10** by means of a linkage **22** to move between an upper standby position illustrated in Fig. 1 and 2 and a lower operational position illustrated in Figs. 3 and 4. In the operational position, the electromagnet **20** faces a rail (not shown) with an air gap, which should be kept as small and as constant as possible.

[0025] The cross beam **12** is hollow and defines a cavity **24.** A linear pneumatic actuator **26** for moving the linkage **22** between the standby position and the operational position is housed in the cavity **24,** in particular in the standby position.

[0026] The linear actuator **26** comprises a cylinder **28** pivotally connected to the bogie frame **10** and a piston **30,** which is pivotally connected to the linkage **22** and slides linearly inside the cylinder **28.** A return spring **32** biases the piston **30** towards a retracted position that corresponds to the upper standby position of the linear eddy current brake device as depicted in Fig. 1. The pivot axes **34, 36** of the pivot connections between the cylinder **28** and the bogie frame **10** on the one hand and between the piston **30** and the linkage **22** on the other hand are parallel to a longitudinal horizontal axis of the bogie, i.e. perpendicular to the axis of the cross beam (and to the section plane of Fig. 1).

[0027] As illustrated in Fig. 1, the actuator **26** in the standby position is completely received in the cavity **24** defined by the hollow transverse beam **12** and extends transversally, i.e. the pivot axes **34, 36** are spaced apart in the transverse direction. More specifically, the actuator **26** is located between an upper horizontal plane **P1** that is flush with an upper side of the cross beam **12** and a lower horizontal plane **P2** that is flush with a lower side of the cross beam **12.**

[0028] The linkage **22** comprises two sets **22.1, 22.2** of two connecting rods. Each set of connecting rods comprises an upper connecting rod **38** pivotally connected to the bogie frame **10** and a lower connecting rod **40** pivotally connected to upper connecting rod **38** and to the linear eddy current brake device **18.** The pivot axes **42, 44, 36** of all the connecting rods are parallel to the longitudinal axis of the bogie frame **10.**

[0029] Each set of connecting rods constitutes a toggle linkage, which moves between a folded position corresponding to the standby position of the linear eddy current brake device and a centre or slightly over-centre position which corresponds to the lower, operational position of the linear eddy current brake device. In the folded position of Fig. 1, the upper connecting rod **38** is located within the cavity **24.** As is well known in the art, the centre position of a toggle linkage is the position in which the pivot axes of the connecting rods are coplanar and, more specifically in this particular case, are located in one and the same vertical longitudinal plane, as illustrated in Fig. 3. When the toggle reaches the centre position, vertical forces applied at the lower end of the lower connecting rod **40** are directly and integrally transmitted to the bogie frame **10** via the upper connecting rod **38,** without torque being generated.

[0030] As illustrated in Fig. 2, the two sets **22.1, 22.2** of connecting rods at one end of the transverse beam constitute a front and a rear set of connecting rods, which are rigidly connected to one another via a shaft **46** to ensure simultaneous joint motion of the two sets. The actuator **26** is pivotally connected to the pivot connection between the upper and lower connecting rods **38, 40** of the front set **22.1** of connecting rods. As has been explained above, a similar assembly is provided at the opposite end of the transverse beam **12,** such that the electromagnetic brake device **18** is supported on each side by two sets of connecting rods linked by a shaft and powered by one actuator.

[0031] As all the pivot axes **34, 36, 42** and **44** are parallel with one another and with the longitudinal direction of the bogie frame, the resultant motion of the linear eddy current brake device between the standby position and the operational position is a planar motion parallel to the vertical transverse plane of Fig. 1, i.e. the speed vector of any point of the assembly is parallel to the transverse plane at any time during the motion.

[0032] The two actuators **28** one each side of the bogie frame **10** can be operated such that the motion of the linear eddy current brake device **18** between the standby position and the operation position is a vertical translation, without rotation and without movement in the transverse or longitudinal directions. If necessary, an inclinometer or an accelerometer or a set of inclinometers and/or accelerometers can be attached to the electromagnetic brake device and electrically connected to an electro-pneumatic valve(s) that feed the pneumatic actuators to ensure that the motion of the linear eddy current brake device **18** between the standby position and the operational position is controlled.

[0033] In case of a loss of pressure, the electromagnetic brake **18** is automatically returned to the standby position by means of the return springs **32.**

[0034] The bogie is further provided with an antiroll bar **48,** which extends transversally in the transversal cavity **24** of the cross beam **12** as illustrated in Figs. 3 and 4.

[0035] The embodiment illustrated in Figs. 5 and 6 differs from the embodiment of Figs 1 to 4 in that the front and rear set of connecting rods **22.1, 22.2** on one side of the bogie frame are provided each with an individual actuator **26,** so that no shaft is necessary between the two sets of connecting rods. As illustrated in Fig. 6, the two actuators **26** are housed within the cavity **24** of the transverse beam **12.**

[0036] The embodiment illustrated in Fig. 7 differs from the previous embodiments in that the actuator **26** extends longitudinally and in that the axes of rotation **34, 36, 42, 44, 136** of the linkage and of the actuator are transverse axes, i.e. horizontal and perpendicular to the longitudinal axis of the bogie frame **10.** The upper connecting rod **38** of the linkage is a lever with an intermediate fulcrum **42** pivotally connected to the bogie frame **10,** one arm pivotally connected to the actuator **26** and one arm pivotally connected to the lower connecting rod **40** via a pivot connection **136.** The actuator **26** in the standby position is received within the cavity **24** of the transverse beam **12** of the bogie frame **10.** The bogie is further provided with an antiroll bar **48,** which extends transversally in the transversal cavity **24** of the cross beam **12.**

[0037] While the above example illustrates preferred embodiments of the present invention, it is noted that various other arrangements may also be considered, which fall within the scope of the appended claims.

[0038] The connection between the bogie frame **10** and a car body of the rail vehicle can include two or four springs, which can be pneumatic or coil springs. It can be with or without bolster and king pin. The bogie frame itself can be H-shaped with a single cross beam or double H-shaped, with two cross beams, in which case the actuator and linkage in the standby position can be located between the two cross beams.

[0039] While one-axis pivot connections are preferred both for the actuator and for the linkage, at least some of these one-axis pivot connections may be provided with a limited degree of freedom of rotation about a secondary axis, preferably with a resilient bushing.

[0040] In a variant of the embodiment of Fig. 7, the actuator in the standby position can be received within a hollow side beam of the bogie frame.

[0041] The electromagnetic device **18** can be a linear motor.

Claims

1. A railway bogie, comprising

- a bogie frame (10),
- an electromagnetic linear motor and/or brake device (18) provided with at least one electromagnet (20),
- at least one linear actuator (26) for actuating the electromagnetic device between an upper, standby position and a lower, operational position,

characterised in that in the standby position, the actuator (26) is housed within the bogie frame (10).

2. The railway bogie of claim 1, wherein in the standby position the actuator (26) is received within a cavity (24) of a hollow beam (12) of the bogie frame (10).

3. The railway bogie of claim 2, wherein the hollow beam is a cross beam (12) of the bogie frame (10).

4. The railway bogie of claim 2, wherein the hollow beam is a side beam of the bogie frame (10).

5. The railway bogie of any one of the preceding claims, further comprising a linkage (22) for linking the electromagnetic device (18) to the bogie frame (10) between the upper standby position and the lower operational position, the linear actuator (26) being directly linked to the linkage (22).

6. The railway bogie of any one of the preceding claims, wherein the actuator is provided with pivot connections with the linkage (22) and with the bogie frame (10).

7. The railway bogie of claim 6, wherein the pivot connections of the actuator (26) with the linkage (22) and with the bogie frame (10) have pivot axes (34, 36) that are parallel to a longitudinal horizontal axis of the bogie frame (10) and spaced apart from one another in a transverse direction of the bogie frame (10).

8. The railway bogie of claim 6, wherein the pivot connections of the actuator (26) with the linkage (22) and with the bogie frame (10) have pivot axes (34, 36) that are parallel to a transversal horizontal axis of the bogie frame (10) and spaced apart from one another in a longitudinal direction of the bogie frame (10).

9. The railway bogie of any one of claims 2 to 8, wherein the actuator (26) is a pneumatic actuator.

10. The railway bogie of any one of the foregoing claims, wherein the linkage (22) comprises at least one set (22.1, 22.2) of connecting rods, comprising an upper connecting rod (38) pivotally connected the bogie frame (10) and a lower connecting rod (40) pivotally connected to upper connecting rod (38) and to the electromagnetic device (18).

11. The railway bogie of claim 5 and 10, wherein the connecting rods and the actuator have pivot axes (36, 42, 44, 136) that are parallel to one another, such that the motion of the linkage (22) and of the actuator (26) between the standby position and the operational position is a planar motion.

12. The railway bogie of claim 10 or 11, wherein the linkage comprises four sets of connecting rods, each comprising an upper connecting rod (38) pivotally connected the bogie frame (10) and a lower connecting rod (40) pivotally connected to the upper connecting rod (38) and to the electromagnetic device (18).

13. The railway bogie of claim 12, further comprising at least one shaft (46) that rigidly connects at least two of the four sets (22.1,22.2) of connecting rods to ensure simultaneous joint motion.

14. The railway bogie of any one of the foregoing claims, wherein the actuator (26) further comprises a return spring (32).

15. The railway bogie of any one of the foregoing claims, wherein the electromagnetic device (18) includes a linear eddy current brake device.

16. The railway bogie of any one of the foregoing claims, further provided with an antiroll bar (48) received in a transversal cavity (24) of a cross beam (12) of the bogie.

Fig.1

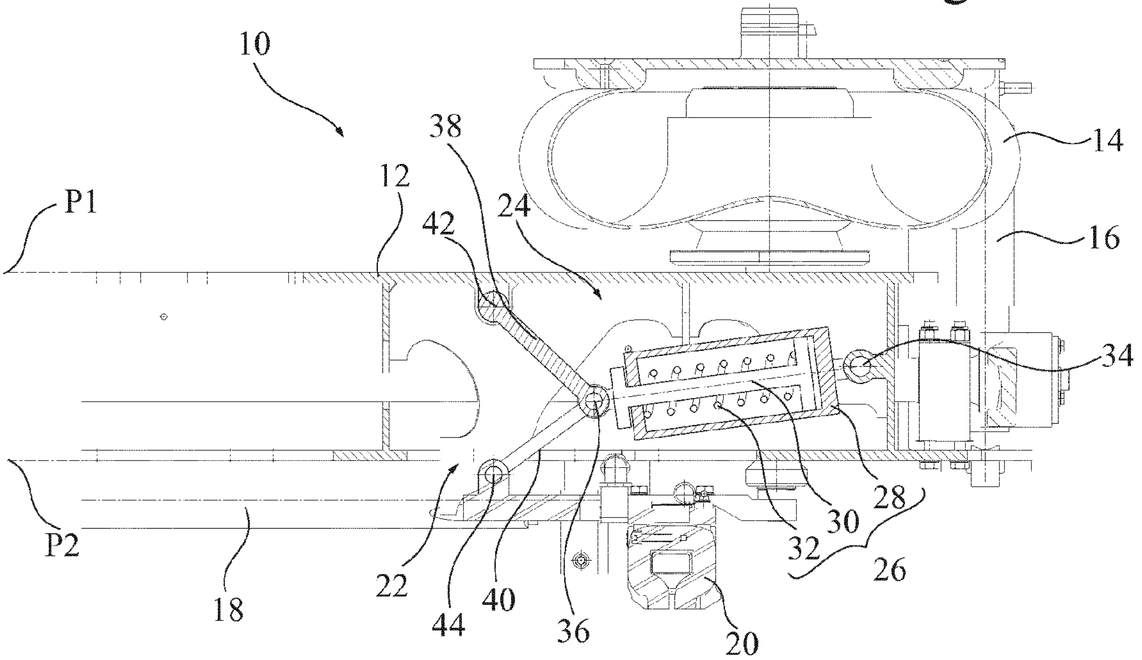

10
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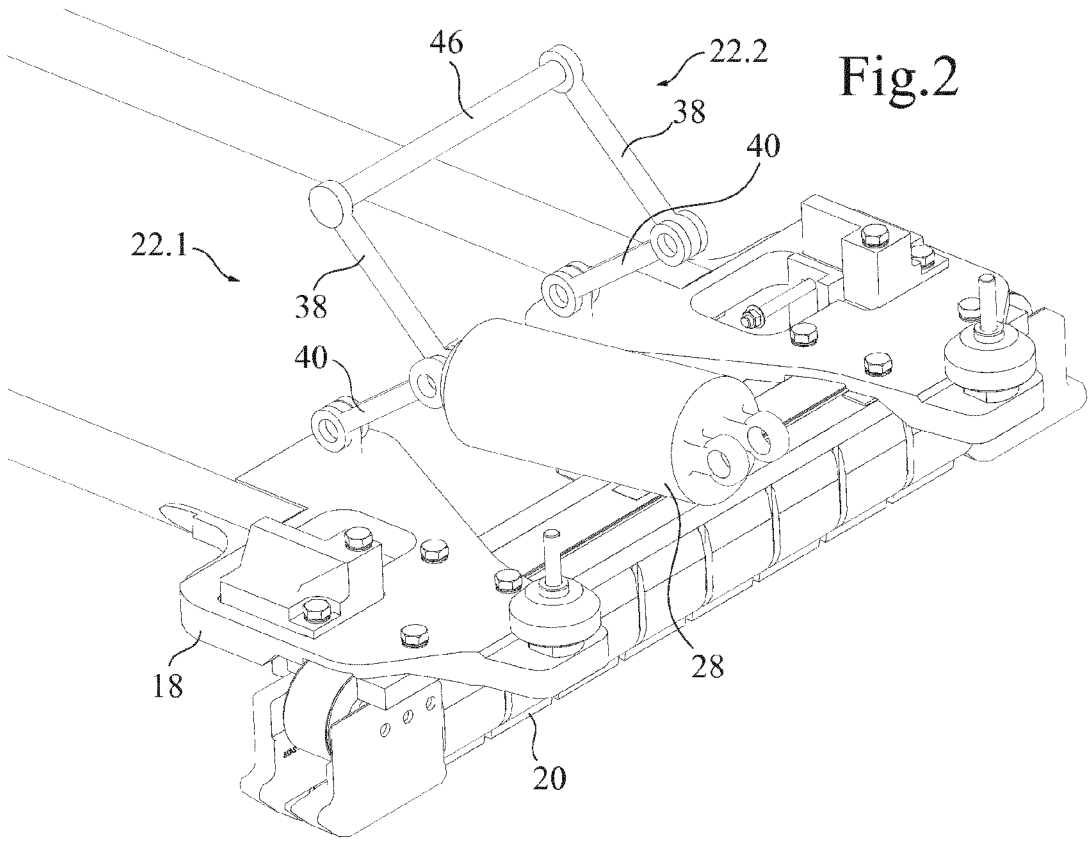
Fig.2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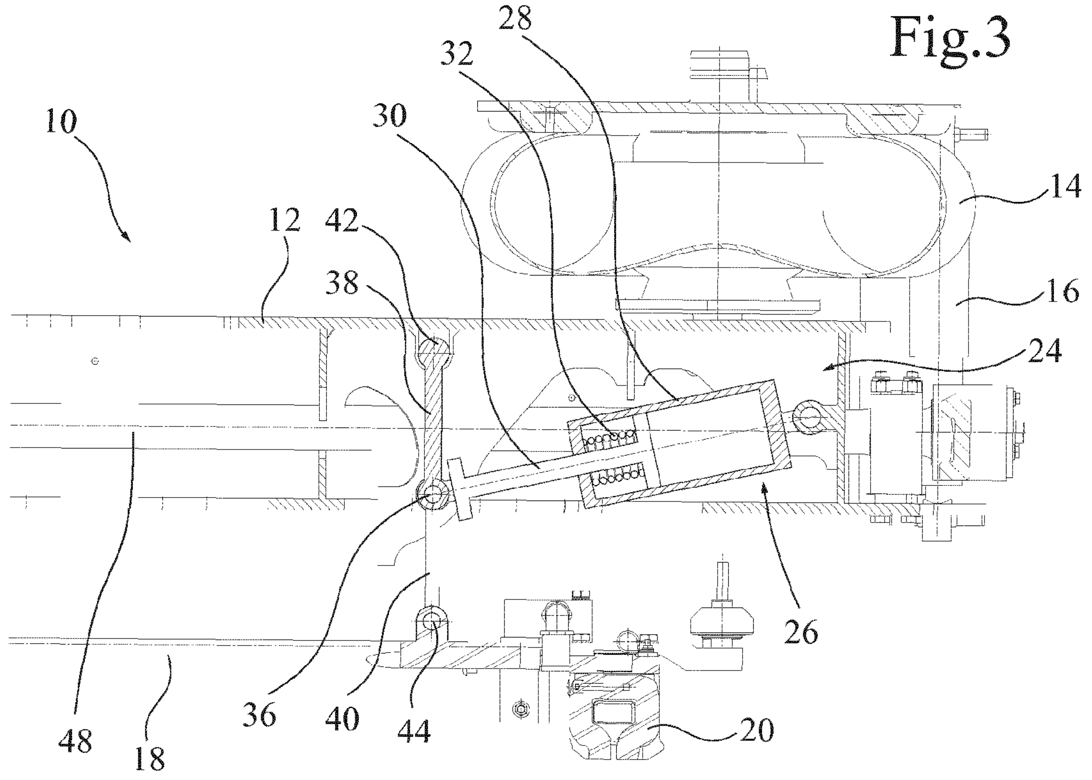
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Fig.3

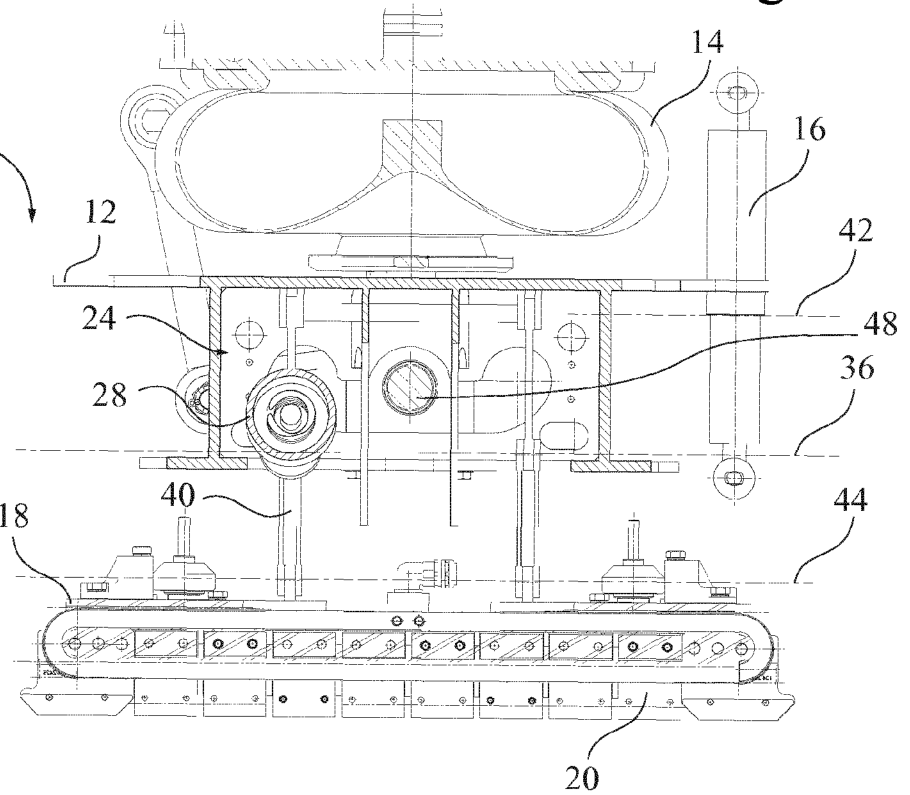
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Fig.4

Fig.5

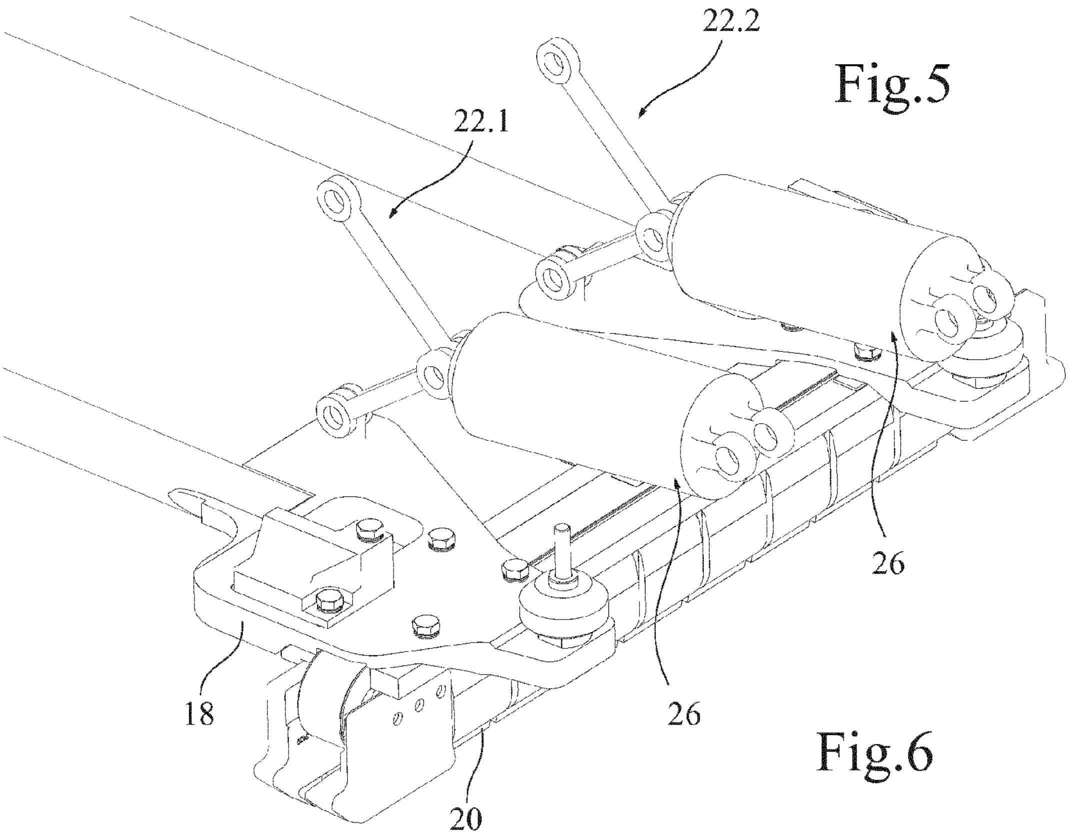
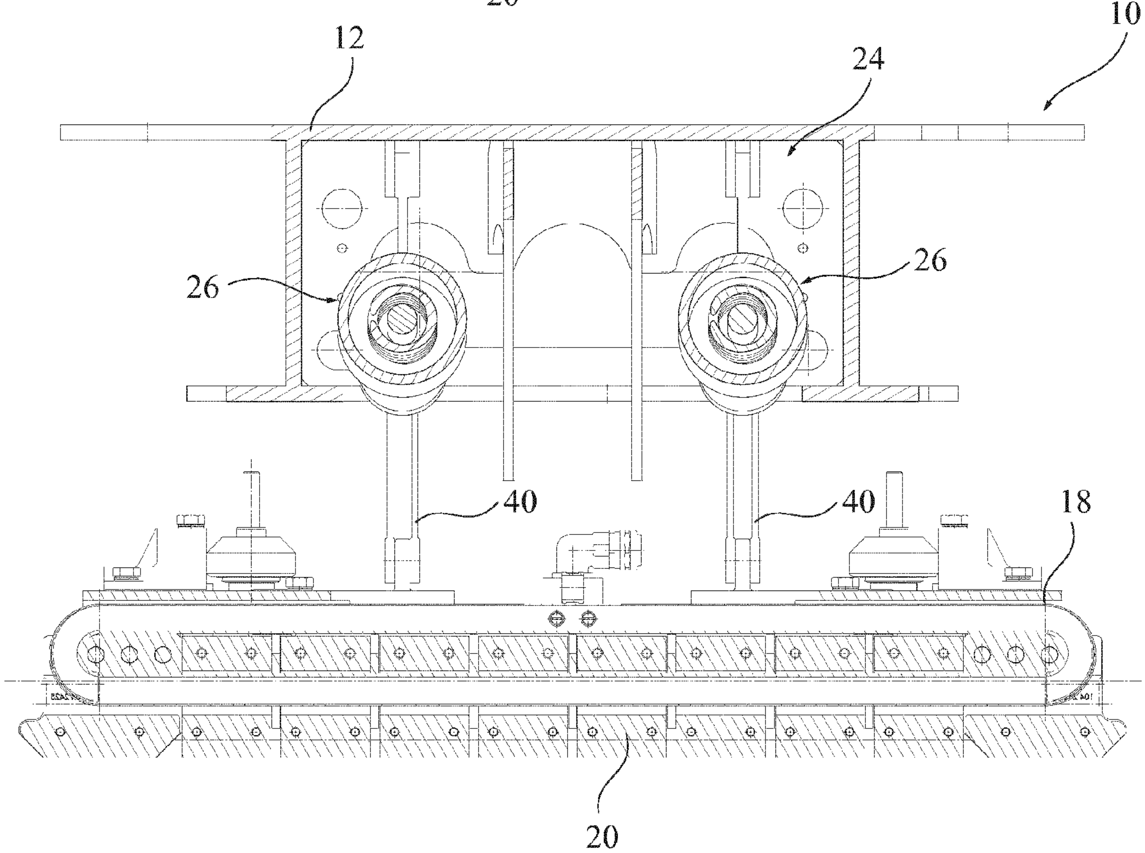


Fig.6



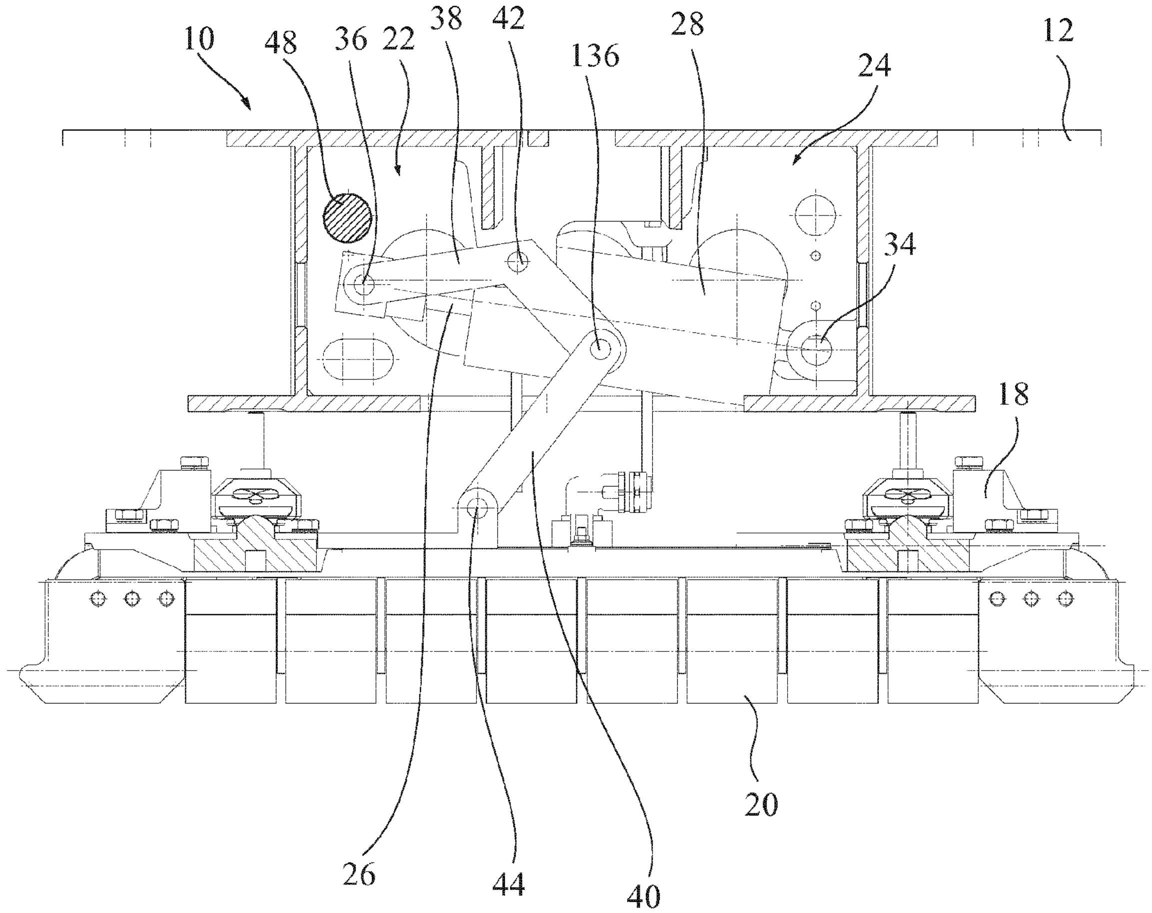


Fig.7

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 0573

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B61H

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 November 2013	Schroeder, Rainer

CATEGORY OF CITED DOCUMENTS

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