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(54) **Bogie system for a rail vehicle.**

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**DE-B-1 236 348**
**FR-A-1 153 641**
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## Description

The invention relates to an undercar system for a railway vehicle as defined in the preamble of claim 1.

Such undercar system is known and applied in the Talgo train as disclosed in FR—A—1 153 641. Each truck located between two car bodies is provided at each wheel axle bearing with a vertical lever. Together with steering rod pivotable at both ends and connected with the adjacent car bodies these levers constitute a complete steering system arranged in two vertical planes. In travelling through a curve ranging is performed on the inner side which shortens the steering system on the inner side, whereas on the outer side of the curve the lever system concerned is ranged out. The steering means of this known undercar system comprise many pivots.

The invention has for its object to reduce the required number of pivots in an undercar system of the aforesaid kind whilst maintaining a satisfactory directional action of the axles.

This object is achieved by application of the characterizing clause of claim 1.

Consequently there is only one train of horizontal steering beams, which drastically reduces the number of pivots.

This has moreover the advantage that the steering effect of the undercar system is now less disturbed by movements of the car body with respect to the undercar.

When the steering beams are connected with one another and with the trucks by means of spherical pivots, sloping variations of the truck affect the steering effect of the undercar system to a lesser extent.

According to claim 3 the relative distances between a truck and next trucks may be unequal to one another, so that the axles can be arranged below the car bodies at the most favourable places in order to use the structure gauge as satisfactorily as possible. Now the car bodies can be somewhat broader and shorter, so that a more efficient arrangement of seats in the car bodies can be realized.

The system described is suitable for a distribution of trucks below car bodies in a manner such that with adapted car body lengths a largest possible building width becomes possible within the limitations of the cinematic gauge. The wheel sets need not be arranged below the car body ends and this has an advantageous effect of oscillation behaviour of the car body.

In order to realise the advantages of the invention to an even greater extent in relation to wheel sets arranged at the ends of the rail vehicle the characterizing feature of claim 5 is applied.

The aforesaid and further features of the invention will be illucidated hereinafter by way of example with reference to a drawing.

The drawing schematically shows in:

Figs. 1, 2 and 3 a side view, a horizontal sectional view and a bottom view respectively of a rail vehicle embodying the invention,

Fig. 4 an enlarged perspective view of detail IV of Fig. 3,

Fig. 5 an enlarged plane view of detail V of Fig. 3,

Fig. 6 a sectional view taken on line VI—VI of Fig. 5,

Figs. 7 and 8 an enlarged sectional view taken on the lines VII—VII and VIII—VIII respectively of Fig. 4,

Fig. 9 on an enlarged scale a diagram of a fraction of the steering means of the undercar system of Figs. 1 to 8, and

Fig. 10 a plan view of the detail of Fig. 4, tracting and breaking means being added thereto.

The rail vehicle 11 shown in Figs. 1 to 3 comprises three intercoupled car bodies 12 carried by an undercar system 9 embodying the invention, comprising a plurality—in this example eight—of uniaxled trucks numerated in order of succession from the left-hand end indicated in the drawing by 1, 2, 3, 4, 5, 6, 7 and 8. Each truck 1 to 8 comprises a frame 10 with two pivotal arms 14 journalled thereon and carrying each an axle bearing 15 holding a wheel set 16 formed by an axle 17 and two wheels 18 rigidly secured thereto.

The frame 10 is supported by means of spring packets 19 on the pivotal arms 14. Via air springs 20 and rubber springs 21 positioned in series therewith the frame 10 supports the car body 12 located above the same.

The trucks 1 to 8 are coupled with one another by means of steering means 24 for directing the wheel sets 16 towards a curve centre of the passed rail curve.

The steering means 24 comprise steering beams 27 which couple with one another the intermediate trucks 2, 3, 4, 5, 6 and 7 disposed each between two other trucks by means of their long middle portions 28.

Short end portions 29 of these steering beams 27 are relatively articulated by means of spherical pivots 30. The steering beams 27 are pivotally connected between their lond middle and short end portions to the intermediate trucks 2 to 7 by means of spherical pivots 31 to 32. Fig. 3 shows that each intermediate truck 3 to 6 comprises a spherical pivot 31 formed by a ball pivot, the ball 33 of which is embraced in a rubber layer 34, which allows some axial movement of the steering beam 27 relatively to the frame 10.

The spherical pivot 32 of Fig. 8 comprises a bridge piece 37 connected by means of rubber blocks 36 to longitudinal beams 35 of a frame 10 and extending transversely of a steering beam 27.

A pin 38 passes through ears 39 of the frame 10 and through a rubber block 36, so that the bridge piece 37 can slightly tilt about a horizontal axis 59 located at a higher level than the steering beam. The bridge piece 37 has a lower piece 40 accommodating a ball pivot 41, which is not provided with rubber spring cushions and is engaged between two inner walls 42 of the steering beam 27 through a pivot pin 43. This ensures a rigid pivot in transverse direction between the steering beam 27 with respect to the

frame 10 is enabled by the turn of the bridge piece 37 about the axis line 59. Each car body 12 is coupled by means of a coupling rod 49 (Fig. 3) with a steering beam 27.

It should be noted that the steering beam 27 is entirely loose from each car body 12 carried by the coupled trucks 3 to 6 or in other words the trucks are mechanically interconnected while short-circuiting each car body 12. As a result movement of the car body 12 cannot disturb the action of the steering means 24.

The trucks 1 and 8 are identical to one another. The trucks 2 and 7 are also identical to one another, so that hereinafter only the trucks 1 and 2 will be described.

With respect to wheel axle bearing and springs for supporting the car bodies 12 there is no principal difference between the trucks 1 and 2 on the one hand and the trucks 3 to 6 on the other hand.

The frame 10 of truck 1 is provided with an arm 44, which is coupled by means of a spherical pivot 30 with the short end portions 29 of the steering beam 27, which is pivotally connected with the frame 10 of truck 2 by means of a spherical pivot 31. The trucks 1 and 2 are disposed near one another and movably connected with one another by means of the coupling mechanism 45 consisting of a bridge piece 47 corresponding to the bridge piece 37 and extending transversely of the direction of movement 46, said bridge piece 47 being pivotally connected both to the first and the second truck 1 and 2 by means of spherical pivots 48. The arm 44 constitutes a prolongation of the frame 10 extending beyond the coupling mechanism 45 of the truck 1.

The wheel sets 16 of the trucks 1 to 8 have pitch distances $a_1$ to $a_7$ (see fig. 1).

The places of the pivots 30, 31 and 32 in the intermediate trucks 3, 4, 5 and 6 are determined as follows. The pivots 31 and 32 are disposed on both sides of the wheel axle 16 at a relative distance 2v. The wheel set 16 has an eccentrical shift *e* with respect to the middle of the distance 2v. In figs. 1 to 8 *e* is equal to *v*. In the case the eccentricity *e* for the intermediate trucks 3 and 5 is directed to the right and for the intermediate trucks 4 and 6 to the left as shown in the situation of fig. 9 the following formulae apply to the short arm *p* and *q*:

$$p_4=\frac{2v \cdot a_3}{a_3+a_4} \qquad q_4=2v-p4$$

When in the truck 2 the pivot 21 has a distance *d* to the wheel set 16;

when the pivotal mechanism 45 is located in the middle piece between the wheel sets 16 of the trucks 1 and 2; and

when the lengths of the short end portions 29 located on the right side of the pivots 30 are designated by *p* and the lengths of the other end portions 29 by *q* and also at the outer trucks 1 and 8 the distance of the pivot 30 to the wheel axle 16 by *q*;

the following formulae apply:

$$p_2=\frac{(a_1+2_d)\ a_1}{\frac{a_2-2v-2e}{a_2-v-e-d} \cdot a_2+2a_1}$$

$$q_1=a_1+d-p_2$$

$$p_3=\frac{2v \cdot a_2\ (a_2-2d)}{a_3\ (a_2-v-e-d)+a_2\ (a_2-2d)}$$

$$q_3=2d-p_3$$

$$p_4=\frac{2v \cdot a_3}{a_3+a_4}$$

$$q_4=2v-p_4$$

when in total eight axles are provided and the under car system 9 is symmetrical it furthermore applies:

$$p_5=q_4 \qquad q_5=p_4$$

$$p_6=q_3 \qquad q_6=p_3$$

$$p_8=q_1 \qquad q_7=p_2$$

The distances $a_3$ and $a_5$ bridging the bellows couplings 50 between the car bodies 12, are smaller than the distances $a_2$, $a_4$ and $a_6$. At the ends of the car bodies the traction motors 51 are arranged at the distances $a_3$ and $a_5$. They are suspended to the steering beams 27. These axles 17 (see fig. 10) are driven by these traction motors 51 through hollow gear boxes 52 surrounding the axles 17 and through a coupling 53. Moreover, a brake 54 is provided on the axle 17. The space over the distances $a_2$, $a_4$, $a_6$ thus remains free for arranging other apparatuses.

The undercar system is suitable, not only for suspending thereto electric traction motors, but also for suspending thereto combustion engines having electric, hydraulic, hydrodynamic or mechanical transmissions and for suspending apparatus boxes and ducts.

The arrangement of the wheel sets 16 below the car bodies 12 is furthermore such that the free space profile is most satisfactorily utilised and the seat distribution is most efficient. On the side of the passage path each time five seats 56 or four ample seats 57 can be arranged. Thus the useful floor surface per wheel axle 16 is larger.

The undercar system embodying the invention can also be used with wheel sets having independently rotatably journalled wheels.

**Claims**

1. An undercar system (9, 61) for a railway vehicle (11) comprising a plurality of single-axled

trucks (1 to 8), which are intercoupled by means of steering means (24) for directing at least one wheel set (16) towards the curve centre, said railway vehicle being an articulated vehicle and consisting of a plurality of car bodies (12) each of which being supported by at least two of said single-axled trucks, in which there are no common trucks between two successive car bodies, and in which the springs supporting the car bodies permit a yaw movement of the trucks relative to the car bodies, characterized in that each two intermediate successive trucks (3 to 6) are interconnected by one single steering beam (27), and in that at least one intermediate truck (3 to 6) is connected by means of long middle portions (28) of steering beams (27) with two other intermediate trucks (2 to 7), whilst short end portions (29) of these steering beams (27) are pivotally interconnected and these two steering beams are pivotally connected between their middle and end portions (28, 29) with the intermediate truck (3 to 6).

2. An undercar system (9) as claimed in claim 1, characterized in that the steering beams (27) are connected with one another and with the trucks (3 to 6) by means of spherical pivots (30, 31, 32).

3. An undercar system (9) as claimed in anyone of the preceding claims, characterized in that the relative distances ($a_2$ to $a_6$) of intermediate trucks (3 to 6) up to the successive trucks (2 to 7) are unequal and in that the arm lengths (*p, q*) of end portions (29) of the steering beams (27) interconnected in the vicinity of the intermediate trucks (3 to 6) are unequal, whilst their lengths are chosen in dependence on the unequal distance ($a_2$ to $a_6$).

4. An undercar system (9) as claimed in anyone of the preceding claims, characterized in that at least two trucks are spaced apart by a distance ($a_3$, $a_5$) corresponding with the space required for a coupling (50) connecting two car bodies (12) and two traction motors (51) driving the axles (17) of said trucks (3 to 6), whilst the distances ($a_1$, $a_4$, $a_6$) of each of these trucks (3 to 6) from the next following truck ($a_2$ to $a_7$) are larger.

5. An undercar system (9) as claimed in anyone of the preceding claims, characterized in that—in the order of succession of the uniaxled trucks (1 to 8) of this undercar system (9) viewed from the end—the first and the second truck (1, 2) are disposed near one another and movably interconnected by means of a coupling mechanism (45) and the first truck (1) with the second and third truck (2, 3) has a prolongation (44) extending beyond the coupling mechanism (45), which is pivotally connected with an end portion (29) of a steering beam (27).

6. An undercar system (9) as claimed in anyone of the preceding claims, characterized in that the first and the second truck (1, 2) are movably interconnected by means of the coupling mechanism (45) comprising a pivotal rod (47) extending transversely of the direction of movement (46) in upward direction, which rod is pivotally connected to both the first and the second truck (1, 2).

7. An undercar system (9) as claimed in anyone of the preceding claims, characterized in that at least one steering beam (27) is constructed as a carrier of traction means (51) or another vehicle equipment.

8. An undercar system (9) as claimed in anyone of the preceding claims, characterized in that with the frame (10) of at least one intermediate truck (3 to 6) a bridge piece (37) is connected so as to be pivotable about a horizontal transverse axis (59) and carries a spherical bearing (41) located on another level than the horizontal transverse axis (59), in which bearing the steering beam (27) is pivotally journalled.

**Patentansprüche**

1. Fahrwerksystem (9, 61) für ein Schienenfahrzeug (11) mit einer Mehrzahl einachsiger Fahrgestellt (1 bis 8), die durch Steuerglieder (24) derart gekuppelt sind, daß wenigstens ein Radsatz (16) nach dem Krümmungsmittelpunkt der Kurve gerichtet wird, wobei das Schienenfahrzeug ein Gliederfahrzeug ist aus mehreren Wagenkörpern (12) besteht, von denen jeder von wenigstens zwei der einachsigen Fahrgestellt getragen wird, wobei keine gemeinsamen Fahrgestellt zwischen zwei aufeinanderfolgenden Wagenkörpern vorhanden sind, und wobei die Federn, die die Wagenkörper abstützen, eine Gierbewegung der Fahrgestellt relativ zu den Wagenkörper zulassen, dadurch gekennzeichnet, daß je zwei aufeinanderfolgende Zwischenfahrgestelle (3 bis 6) durch einen einzigen Steuerhebel (27) miteinander verbunden sind, und daß wenigstens ein Zwischenfahrgestell (3 bis 6) über die langen Mittelabschnitte (28) der Steuerhebel (27) mit zwei weiteren Zwischenfahrgestellen (2 bis 7) verbunden ist, während die kurzen Endabschnitte (29) dieser Steuerhebel (27) schwenkbar miteinander verbunden sind und diese beiden Steuerhebel schwenkbar zwischen ihrem mittleren Abschnitt und ihrem Endabschnitt (28, 29) mit dem Zwischenfahrgestell (3 bis 6) verbunden sind.

2. Fahrwerksystem (9) nach Anspruch 1, dadurch gekennzeichnet, daß die Steuerhebel (27) miteinander und mit den Fahrgestellen (3 bis 6) über Kugelgelenke (30, 31, 32) verbunden sind.

3. Fahrwerksystem (9) nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die relevanten Abstände ($a_2$ bis $a_6$) der Zwischenfahrgestelle (3 bis 6) bis zu den aufeinanderfolgenden Fahrgestellen (2 bis 7) ungleich sind. und daß die Armlänge (p, q) der Endabschnitte (29) der Steuerhebel (27), die in der Nähe der Zwischenfahrgestelle (3 bis 6) verbunden sind, ungleich sind und ihre Längen gemäß dem ungleichen Abstand ($a_2$ bis $a_6$) gewählt sind.

4. Fahrwerksystem (9) nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß wenigstens zwei Fahrgestelle in einem Abstand ($a_3$, $a_5$) distanziert sind, der dem Raum

entspricht, den eine Kupplung (50) einnimmt, die zwei Wagenkörper (12) und zwei Fahrmotoren (51) verbindet, die die Achse (17) der Fahrgestelle (3 bis 6) antreiben, während die Abstände ($a_1$, $a_4$, $a_6$) eines jeden dieser Fahrgestelle (3 bis 6) bis zum nächsten Fahrgestell ($a_2$ bis $a_7$) größer sind.

5. Fahrwerksystem (9) nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß—betrachtet in der Folge der einachsigen Fahrgestelle (1 bis 8) des Fahrwerksystems (9) von Ende her—das erste und das zweite Fahrgestell (1, 2) nahe zueinander angeordnet und beweglich über einen Kupplungsmechanismus (45) verbunden sind, wobei das erste Fahrgestell (1) mit dem zweiten und dritten Fahrgestell (2, 3) einen Fortsatz (44) aufweist, der sich über den Kupplungsmechanismus (45) erstreckt und schwenkbar mit einem Endabschnitt (29) eines Steuerhebels (27) verbunden ist.

6. Fahrwerksystem (9) nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das erste und das zweite Fahrgestell (1, 2) beweglich über den Kupplungsmechanismus (45) verbunden sind, der eine schwenkbare Stange (47) aufweist, die sich quer zur Bewegungsrichtung (46) nachoben erstreckt und schwenkbar sowohl an dem ersten als auch an dem zweiten Fahrgestell (1, 2) angelenkt ist.

7. Fahrwerksystem (9) nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß wenigstens ein Steuerhebel (27) als Träger der Fahrmotoren (51) oder eines anderen Fahrzeugausrüstungsaufbaus ausgebildet ist.

8. Fahrwerksystem (9) nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß mit dem Rahmen (10) wenigstens eines Zwischenfahrgestells (3 bis 6) eine Brücke (37) so verbunden ist, daß sie um eine horizontale Querachse (59) verschwenkbar ist und ein Kugelgelenk (41) trägt, welches auf einem anderen Hebel als auf der horizontalen Querachse (59) angeordnet ist, an dem der Steuerhebel (27) schwenkbar angelenkt ist.

**Revendications**

1. Système d'essieux (9, 61) destiné à un véhicule ferroviaire (11) comprenant plusieurs bogies à un seul essieu (1 à 8), accouplés entre eux par un dispositif de direction (24) dirigeant au moins un essieu monté (16) vers le centre de courbure, ce véhicule ferroviaire étant un véhicule articulé et consistant en un certain nombre de caisses de voiture (12) supportées chacune par au moins deux des bogies à un seul essieu, dans lequel il n'y a pas de bogie commun à deux caisses de voiture successives et dans lequel les ressorts supportant les caisses de voiture permettent un mouvement d'inclinaison des bogies par rapport aux caisses de voiture, caractérisé en ce que les deux bogies intermédiaires successifs (3 à 6) sont reliés entre eux par une poutre directrice unique (27), et en ce qu'un bogie intermédiaire au moins (3 à 6), est raccordé par des parties médianes longues (28) de poutres de direction (27) à deux autres bogies intermédiaires (2 à 7) alors que des parties extrêmes courtes (29) de ces poutres directrices (27) sont articulés entre elles, et que ces deux poutres directrices sont articulées sur le bogie intermédiaire (3 à 6) entre leurs parties médianes et extrêmes (28, 29).

2. Système d'essieux (9) selon la revendication 1, caractérisé en ce que les poutres directrices (27) sont raccordées les unes aux autres et aux bodies (3 à 6) par des pivots sphériques (30, 31, 32).

3. Système d'essieux (9) selon l'une quelconque des revendications précédentes, caractérisé en ce que le distances relatives ($a_2$ à $a_6$) des bogies intermédiaires (3 à 6) aux bodies successifs (2 à 7), sont inégales, et en ce que les longueurs (p, q) des parties extrêmes (29) des poutres directrices (27) raccordés à proximité des bogies intermédiaires (3 à 6) sont inégales, bien que ces longueurs soient choisies en fonction de la distance inégale ($a_2$ à $a_6$).

4. Système d'essieux (9) selon l'une quelconque des revendications précédentes, caractérisé en ce qu'au moins deux bogies sont séparés par une distance ($a_3$, $a_5$) qui correspond à l'espace nécessiare pour un accouplement (50) raccordant deux caisses (12) de voiture et pour deux moteurs (51) de traction entraînant les essieux (17) des bogies (3 à 6), tandis que les distances ($a_1$, $a_4$, $a_6$) entre chacun de ces bogies (3 à 6) et le bogie suivant $a_2$ à $a_7$) sont plus grandes.

5. Système d'essieux (9) selon l'une quelconque des revendications précédentes, caractérisé en ce que, dans l'ordre de succession des bogies à un seul essieu (1 à 8) du système (9) d'essieux, à partir de l'extrémité, le premier et le second bogie (1, 2) sont disposés l'un près de l'autre et sont raccordés de manière mobile par un mécanisme d'accouplement (45) et le premier bogie (1) avec le second et le troisième bogie (2, 3) a un prolongement (44) dépassant le mécanisme d'accouplement (45), qui est articulé sur un bras de levier court (29) d'une poutre directrice (27).

6. Système d'essieux (9) selon l'une quelconque des revendications précédentes, caractérisé en ce que le premier et le second bogie (1, 2) sont interconnectés de manière mobile par le mécanisme d'accouplement (45) qui comporte une bielle pivotante (47) disposée transversalement à la direction de déplacement (46) vers le haut, cette bielle étant articulée par rapport au premier et au second bogie (1, 2) à la fois.

7. Système d'essieux (9) selon l'une quelconque des revendications précédentes, caractérisé en ce qu'une poutre directrice au moins (27) est construite comme un support d'un dispositif de traction (51) ou d'un autre équipement de véhicule.

8. Système d'essieux (9) selon l'une quelconque des revendications précédentes, caractérisé en ce qu'un élément (37) en forme de pont est raccordé au châssis (10) d'au moins un bogie intermédiaire (3 à 6) afin de pouvoir pivoter autour d'un axe horizontal transversal (59) et porte un palier sphérique (41) disposé à un niveau différent de celui de l'axe horizontal transversal (59), la poutre directrice (27) pouvant tourillonner dans ce palier.

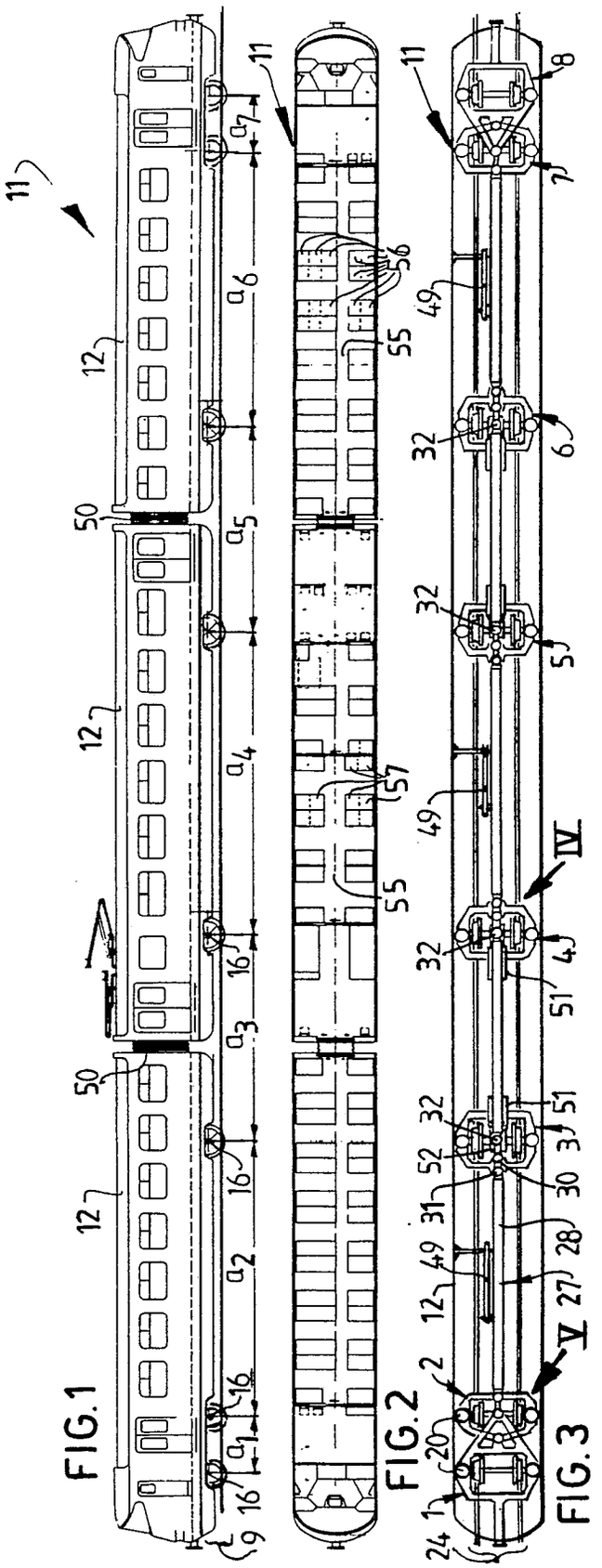
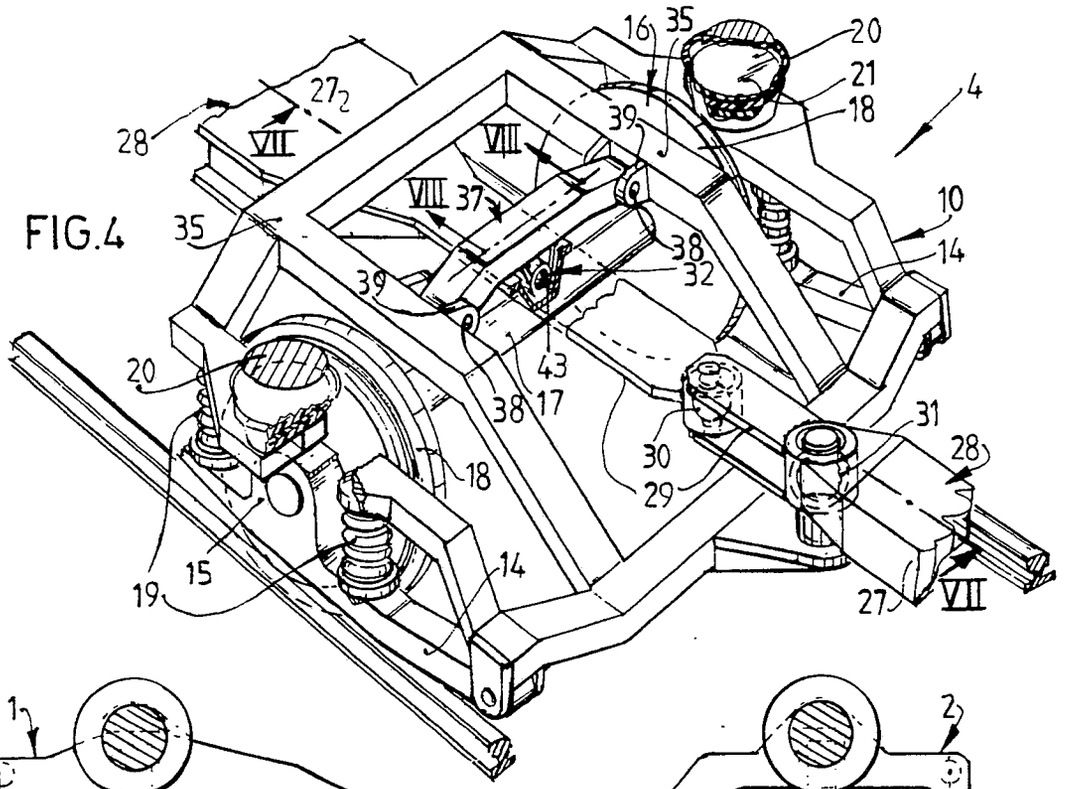



FIG.1 FIG.2 FIG.3

FIG.4



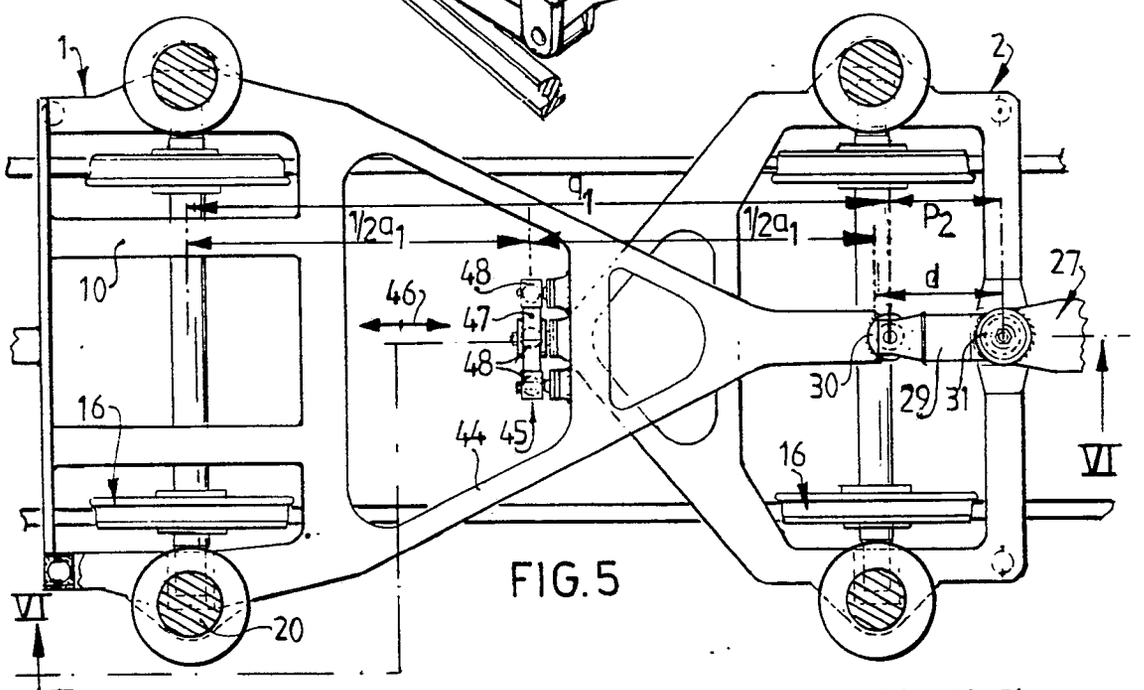




FIG.5

FIG.6

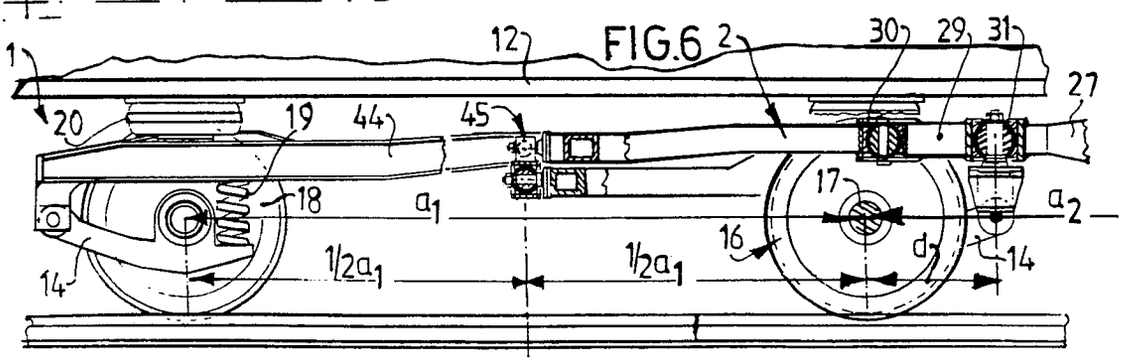
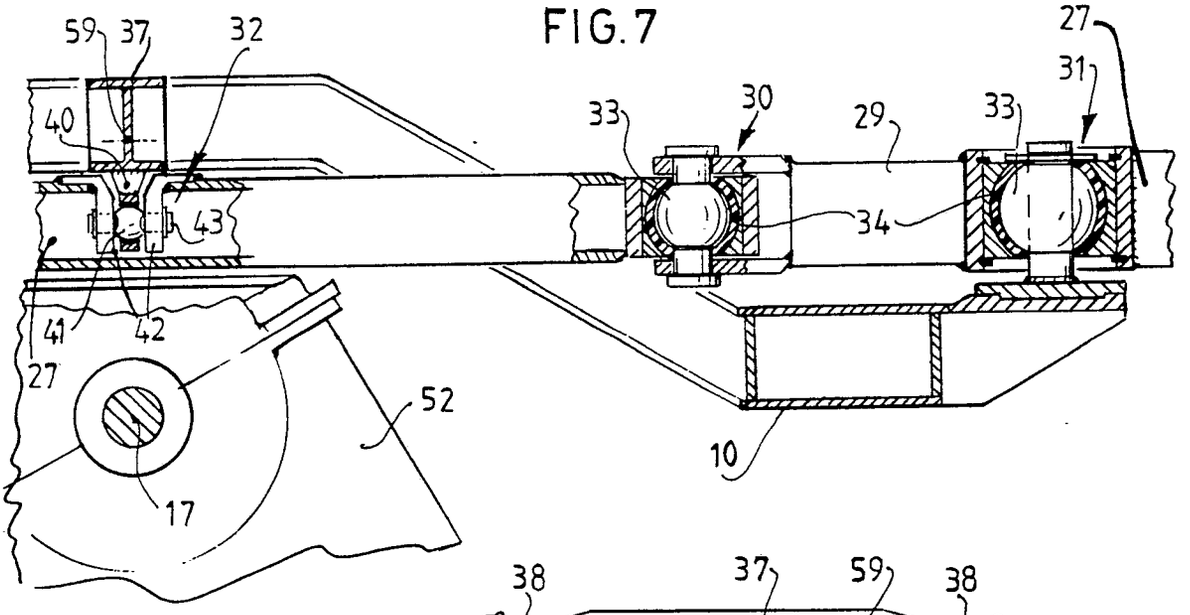


FIG.7



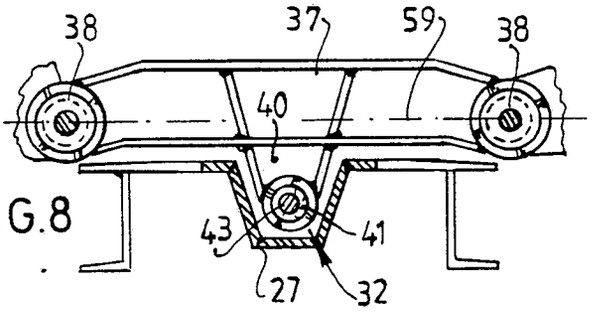




FIG.8

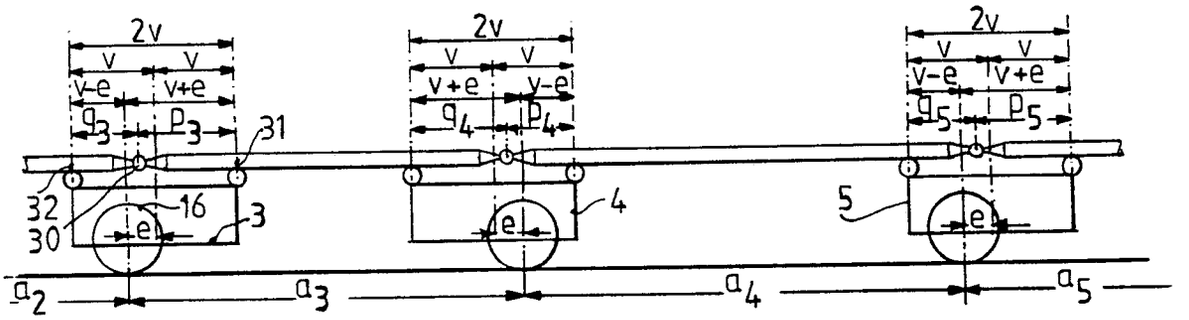



FIG.9

FIG. 10