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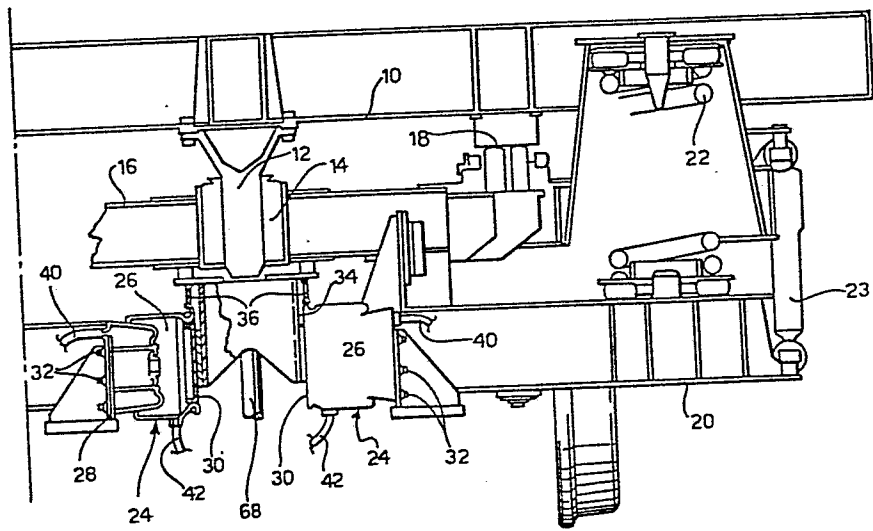
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(54) **Variable characteristic transverse suspension for railway vehicles.**

(57) A railway vehicle has a body (10), bogies (20) articulated to the body (10) and vertical and transverse suspension means between the bogies (20) and the body, the transverse suspension means including pneumatic or hydro-pneumatic springs (24) located substantially horizontally and reacting between the body and the opposite sides of each bogie.

The fluid pressure supply to the springs (24) and hence the forces exerted thereby are adjusted automatically so as to contain transverse movements of the body (10) relative to the bogies (20) within predetermined limits while maintaining the flexibility of the connection practically invariant.

FIG. 1



Variable characteristic transverse suspension for railway vehicles.

The present invention relates to a transverse suspension for railway vehicles including a body and bogies articulated to the body about a substantially vertical axis with the possible interposition of a
5 pivoted cross member and in which resilient vertical and transverse suspension means are interposed between each bogie and the body or pivoted cross member.

The function of the transverse suspension means is to separate the transverse movements, due to vibrational
10 effects, of the body from those of the bogies. The objects which are achieved by this are two-fold: first of all a reduction in the reactions which the keeping of the vehicle on the track causes between the wheels and the rails, and in the second place an
15 improvement in the dynamic behaviour of the body, particularly as regards comfort during travel of the vehicle.

The conformation of the transverse suspension means according to the known art is essentially of two types.
20 The first, widely used until recent times, is based on the pendulous suspension of the body on the bogie by means of vertical or inclined connecting rods and hence uses the force of gravity. The second, mainly used in railway vehicles of more recent manufacture,
25 uses the transverse resilience of vertical suspension means normally constituted by helical springs or pneumatic springs.

These systems come up against the considerable difficulty of allowing substantial transverse resilience while
30 at the same time containing the movement of the body due to the need to keep it within the maximum permitted range of movement. This necessitates the provision of resilience characteristics for the transverse connection between the body and the bogie of a progressive type, that is,

a resilience which decreases as the position of the body relative to the bogie gets further from the longitudinal axis thereof.

This results in the disadvantage that the capacity
5 for damping the transverse forces is considerably reduced during travel of the vehicle around a curve compared with travel in a straight line.

The object of the present invention is to avoid this disadvantage by entrusting the containing and
10 transmission of transverse forces between the body and the bogie to a resilient system the load-yield characteristic of which can be displaced substantially parallel to itself in response to an external command, the characteristic frequency of the connection between
15 the body and the bogie thus being kept constant.

In order to achieve this object, the present invention provides a suspension for railway vehicles of the type defined at the beginning, characterised in that the transverse suspension means include at least one
20 pair of pneumatic or hydro-pneumatic springs which are separate and distinct from the vertical suspension means, disposed substantially horizontally and reacting between the body or the pivoted cross member and the opposite sides of the bogie, and automatic
25 control means for progressively increasing the forces transmitted by the or each spring which is compressed by the action of the transverse forces transmitted between the body or the pivoted cross member and the bogie, on increase of these forces, by means
30 of an increase in the pressure of the fluid contained in the spring.

By virtue of the invention, during travel of the railway vehicle in a straight line or in curves in conditions in which there is complete compensation
35 for transverse accelerations, the two springs of the transverse suspension have identical characteristics.

and, by working in counter-parallel, give rise to a force-displacement characteristic which has its zero point in the middle of the vehicle.

When however the travel of the vehicle around curves gives rise to an almost static transverse force other
5 than zero applied to the body as a result of over- or under- compensation for the transverse acceleration, the characteristic of the spring of the side towards which the body tends to move is modified by the automatic control means so as to move the origin (zero point)
10 in the opposite direction from the translation of the body. This gives rise to the application to the body of a transverse force identical to that which, for a given displacement, would occur in a straight line, increased by an almost constant value corresponding to that
15 generated by the almost static transverse acceleration.

Consequently:

1. The characteristic frequencies of the transverse suspension remain practically invariant with respect to the straight line of movement conditions;
- 20 2. The capacity to absorb deformation energy due to irregularities is increased.

The automatic control means to advantage comprise a circuit including valve means controlled by the transverse relative movements between the body or the pivoted
25 cross member and the bogie.

The invention will now be described in detail with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 is a schematic partially sectioned view
30 of part of a railway vehicle provided with a suspension according to the invention, and

Figure 2 is a schematic view of automatic control means for the suspension.

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Referring initially to Figure 1, the chassis of the body of a railway vehicle is generally indicated 10 and below the middle part thereof is fixed a king-pin 12 inserted in an orientable bush 14 carried by a pivoted cross member 16 on which the chassis 10 of the body bears by means of shoes or bearing rollers 18. The chassis of one of the bogies of the vehicle is generally indicated 20 and is connected in known manner to the pivot cross member 16.

Between the chassis 20 of the bogie and the pivoted cross member 16 there is interposed a secondary suspension system including a pair of vertical suspension helical springs 22 with which respective telescopic shock absorbers 23 are associated, and a pair of transverse suspension springs 24.

According to the invention, the two springs 24 are of the opposing, horizontal-axis, hydro-pneumatic or pneumatic type with force-displacement characteristics which are variable in dependence on the pressure of the fluid within them.

In the example illustrated, each spring 24 is constituted by an air-tight flexible casing 26 having end covers 28, 30 the first of which is rigidly fixed at 32 to the chassis 20.

The covers 30 of the two springs 24 bear against a central appendage 34 of the pivoted cross member 16 and are each supported by two connecting rods, only one of which, indicated 36, is shown in Figure 1, disposed at 90° to each other with respective axes perpendicular to the axes of the springs 24 themselves.

The casings 26 of the two springs 24 are each connected to a respective auxiliary compressed air reservoir

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38 by pipe 40 in order to allow the regulation of the force-displacement and shock-absorbing characteristics. The casings 26 are also connected by respective pipe 42 to a pneumatic control circuit generally indicated 5 44 in Figure 2.

The circuit 44 includes a pair of three-way selector valves 46 each of which is connected on one side to the pipe 42 of one of the springs 24 and on the other side to a respective supply duct 48 and to an exhaust 10 duct 50.

The supply ducts 48 are in their turn connected to the main pneumatic duct 52 of the vehicle through a cock 54, a supply valve 56 and a pressure reducer 58 and to a compressed air supply reservoir 60.

15 The exhaust duct 50 is connected to the atmosphere through a calibrated relief valve 62.

The two valves 46 are operated by means of two linkage levers generally indicated 64 and are movable simultaneously from a central position in which the two springs 20 24 are both in communication with the exhaust duct 50. When the two linkages 64 are displaced towards the right relative to Figure 2, the valve 46 associated with the left hand spring 24 keeps communication between this spring and the exhaust duct 50 open while 25 the valve 46 associated with the right hand spring 24 is disposed initially in a first position in which the right hand spring 24 is isolated both from the supply duct 48 and from the exhaust duct 50 and subsequently in a second position in which communication between this spring 30 and the supply duct 48 is open while communication with the exhaust duct 50 is closed.

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Upon movement of the levers 64 in the opposite sense, that is towards the left with respect to Figure 2, the conditions described above are inverted.

The operation of the valve 46 is effected automatically
5 for example by means of a transmission 66 connected to a control member 68 fixed to the appendage 34 of the pivoted cross member 16.

The operation of the transverse suspension described above is as follows.

10 During movement of the vehicle in a straight line or around curves in a condition of complete compensation for transverse accelerations, the two levers 64 are maintained in their central position whereby the two springs 24 are supplied at a given constant pressure
15 (for example, 2 kg/cm^2) and thus have identical characteristics, working in counter-parallel. The lateral loads are thus opposed by the normal deformation of the two springs 24 and the springs 22.

When, however, movement around a curve generates an almost
20 static transverse force due to over- or under- compensation for transverse accelerations (as a result of, for example, the outer rail of the track having too high an elevation), one of the two springs 24 (that is, the compressed spring) is connected, after a first movement into the position
25 of complete isolation from the supply duct 48 and exhaust duct 50, to the supply duct 48. The other spring 24 remains connected to the exhaust duct 50.

The supply of compressed air (through the duct 48, the valve 46 and the duct 42) to the spring 24 which is compressed, modifies
30 its characteristics, increasing the force which it exerts and causing the return of the vehicle body and hence of the valve 46 into the position in which this spring 24 is isolated from the exhaust duct 50 and

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from the supply duct 42 while the opposite spring 24 remains connected to the exhaust duct 50.

In this situation there is equilibrium between the
5 transverse inertial forces to which the body is subject and the forces exerted by the springs 24 of the transverse suspension.

On cessation of the transverse inertial forces, the spring 24 which opposes them thrusts the body towards
10 the centre, where the two springs 24 are both connected to the exhaust duct 50 whereby it returns to the straight line travel position.

Thus the characteristic frequencies of the transverse suspension and the deformation energy storage capacity remain
15 practically the same, during movement around a curve, as those during movement in a straight line, the dynamic behaviour of the body thus remaining unchanged.

It should be noted that the invention also applies to the case in which the connection between the body 10
20 and the bogie does not include the use of a pivoted cross member 16, that is, both the case in which the body 10 is pendulously suspended from the chassis 20 of the bogie and the case in which the springs 22 are interposed directly between the body and the bogie,
25 without the pivoted cross member.

Naturally, the principle of the invention remaining the same, constructional details and embodiments may be varied widely with respect to that described and illustrated without thereby departing from the scope
30 of the present invention.

Thus, the conformation and the number of the pneumatic springs 20 could differ from those of the example. Moreover the pneumatic springs 24 could conveniently be replaced by hydro-pneumatic springs and the operation of the valves 46 could be effected by various devices arranged to achieve the conditions described above.

CLAIMS.

1. Suspension for railway vehicles including a body and bogies (20) articulated to the body about substantially vertical axes, possibly with the interposition of a pivoted cross member (16), in which vertical (22,23) and transverse (24) suspension means are interposed between each bogie and the body or pivoted cross member, characterised in that the transverse suspension means include at least one pair of pneumatic or hydro-pneumatic springs (24), which are separate and distinct from the vertical suspension means (22), disposed substantially horizontally and reacting between the body (10) or the pivoted cross member (16) and the opposite sides of the bogie (20), and automatic control means (44,66, 68) for progressively increasing the forces transmitted by the spring (24) which is compressed by the action of the transverse forces transmitted between the body (10) or the pivoted cross member (16) and the bogie (20), upon increase of these forces, by means of an increase in the pressure of the fluid contained in the spring (24).
2. Suspension according to Claim 1, characterised in that the springs (24) are fixed at one end to the bogie or to the body and at the opposite ends are kept in a horizontal position by connecting rods (36) or equivalent guide systems so as to transmit only horizontal forces.
3. Suspension according to Claim 1 or Claim 2, characterised in that it includes a single pair of opposing springs (24) and in that the automatic control means comprise a control circuit (44) including a pressurised fluid source (56), controlled exhaust means (50, 62) normally connected to the two springs (24), valve means (46) arranged to control the communication between each of the two springs (24) and, respectively, the source (52) and the exhaust means (50, 62), and actuator

means (64) operated by transverse relative displacements
between the body (10) or the pivoted cross member (16)
and the bogie (20) to control the valve means (46)
automatically so as to close communication between
5 the spring (24) subject to compression and the exhaust
means (50) in a first phase and to open communication
between this spring and the pressurised source (52)
in a second phase, communication between the other
spring (24) and the exhaust means (50, 62) being
10 maintained in both these open phases.

4. Suspension substantially as described and
illustrated and for the purposes specified.

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FIG. 1

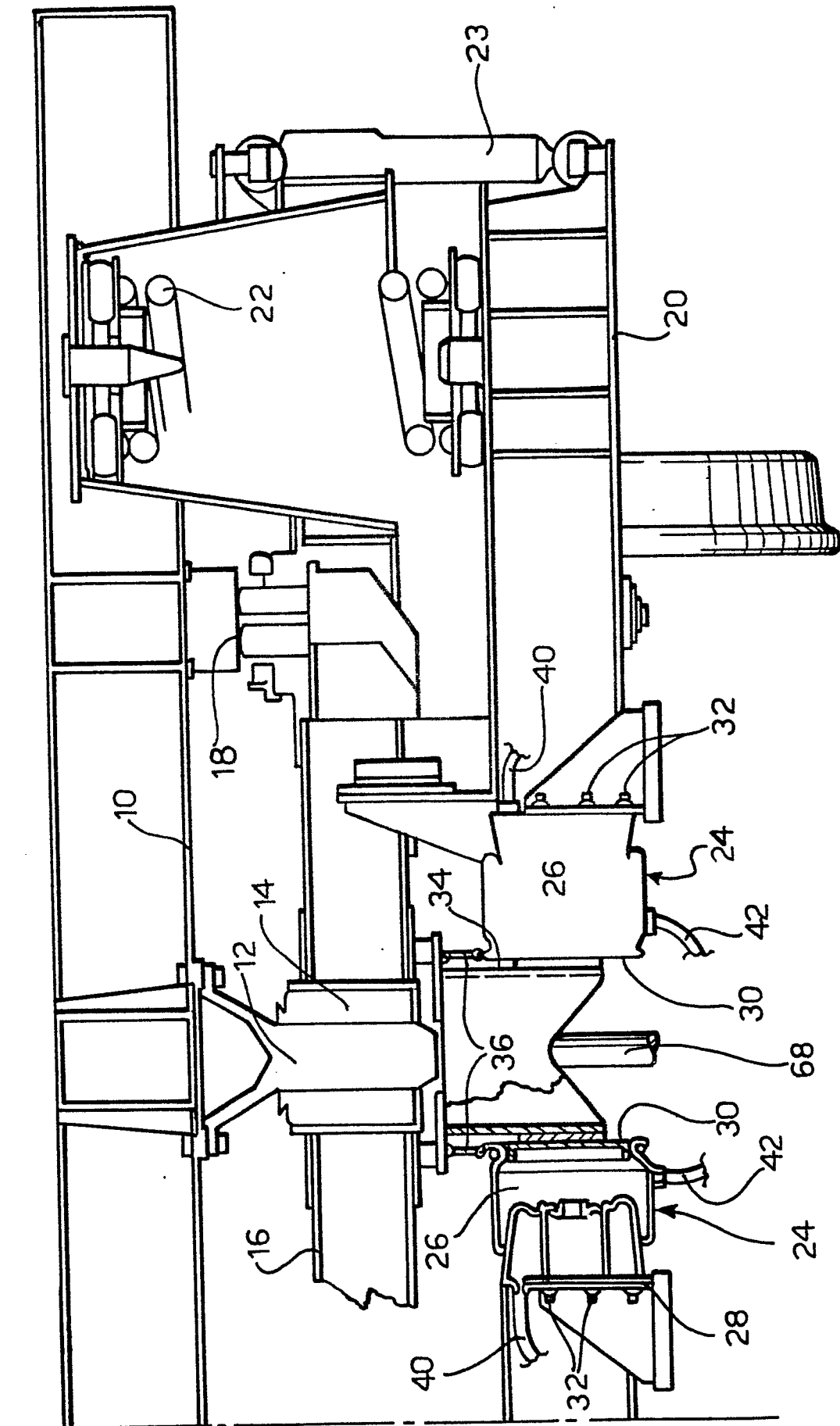


FIG. 2

