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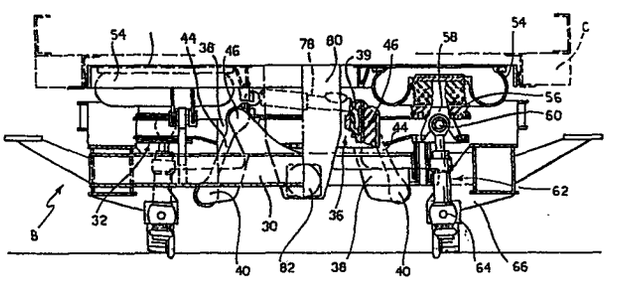
(54) High-speed railway vehicle with a variable-attitude body.

(57) A railway vehicle has a variable-attitude body (C) supported through resilient suspension means by a cross bearer (32) connected to the bogie (10) by two pairs of connecting rods (44). The variations in attitude of the body (C) are effected by means of two hydraulic jacks (62) articulated at their lower ends to the structure of the bogie and at their upper ends to the cross bearer, whose position is such as to support part of the weight of the body during its variations in attitude.



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High-speed railway vehicle with a variable-attitude body

The present invention relates to high-speed railway vehicles with variable-attitude bodies.

In particular, the invention relates to a railway vehicle in which the body is supported by bogies through vertical and transverse resilient suspension means and is rotatable relative to the bogies in a plane transverse the vehicle to vary its attitude in dependence on the running conditions, and in which actuator means are provided for effecting these variations in attitude.

The vehicle according to the invention is characterised in that:

- a cross bearer is interposed between the body and the structure of each bogie to support the body through the suspension means with the interposition of a load-bearing cross member fixed directly to the body, and is connected to the bogie by two pairs of connecting rods each of which is articulated at its upper end to the structure of the bogie and at its lower end to lugs of the cross bearer;
- the actuator means comprise two hydraulic jacks which are articulated at their lower ends to the structure of the bogie and at their upper ends to the cross bearer, and which are disposed in a substantially vertical condition in the neutral position of the cross bearer relative to the bogie, and
- a structure is provided for transmitting traction and braking forces between the body and the bogie, which projects through the cross bearer from the body and carries two opposing longitudinal reaction members in contact with complementary reaction parts of the structure of the bogie.

To advantage, in the vehicle according to the invention, each bogie is provided with a torsion bar device associated with the cross bearer to limit the roll of the body, as well as a calibratable anti-snaking device.

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 side elevational view of part of a railway vehicle according to the invention,

Figure 2 is a view taken on the line II-II of Figure 1,

Figure 3 is a view taken on the line III-III of Figure 2,

Figure 4 is a view taken on the line IV-IV of Figure 3, and

Figure 5 is a view similar to Figure 4 with the body of the vehicle at a different attitude.

In the drawings, the body of a railway vehicle according to the invention is schematically indicated C and is suspended on supporting bogies only one of which is indicated B in the drawings.

The bogie B has a structure constituted by two side members 10 of double swan-neck shape which support at their ends two axles 12 carrying the wheels 14 of the bogie. The axles 12 are supported by the side members 10 through axle boxes 16 and respective connecting rods 18 articulated to the structure of the bogie by

resilient joints 20.

The primary suspension of the bogie B comprises helical springs 22 with respective lower rubber blocks (not shown), and vertical hydraulic shock-absorbers 24.

With a suitable choice of the stiffness of the resilient joints 20 and the springs 22 with their rubber buffers, it is possible to define values of longitudinal and transverse stiffness of the primary suspension ("C_x" and "C_y" respectively) such as to satisfy the resilient requirements of the connection between the axles and the frame of the bogie, consistent with both the need to ensure stability of the bogie with respect to snaking (a condition necessary to give the vehicle a high degree of comfort) and the possibility of the axles disposing themselves radially on bends (thus reducing the forces of interaction between the wheels and the rails), as well as with the possibility of the axles following irregularities in the track without affecting the frame of the bogie.

Four brake units, generally indicated 26, are provided for braking the wheels 14, which are constituted by four brake discs (two per axle) and associated linkages of the operating cylinders. In order to avoid excessive hyperstaticity of the structure of the bogie, the brake units are supported by two crossbeams 28 connected resiliently to the side members 10.

The structure of the bogie B further includes two transverse members 30 which interconnect the central parts of the side members 10 and, in the manner explained below, support a cross bearer, generally

indicated 32. This has a box structure with a central through-aperture 34 which is elongate in a transverse direction and on the sides of which are disposed two lateral stop members 36 with rubber buffer blocks 39. The cross bearer 32 also has four downwardly-projecting attachment lugs 38 each of which is articulated at its lower end 40 to the lower end of a connecting rod 44. The upper end of each connecting rod 44 is articulated at 46 to an attachment part 52 carried by the corresponding transverse member 30 of the bogie B.

The above-described connection through the connecting rods 44 allows the cross bearer 32 to rotate relative to the structure of the bogie B in a plane transverse thereto, or about an axis parallel to the longitudinal axis of the vehicle.

It should be noted that the respective articulations between the connecting rods 44 and the cross bearer 32 and the structure of the bogie B may be achieved by hinges or ball jonts. The disposition of the connecting rods 44 is such as to determine the centre of instantaneous rotation of the body according to the requirements of both passenger comfort and the clearance gauge of the vehicle.

The cross bearer 32 carries the secondary suspension of the bogie, which supports the body C of the vehicle. this secondary suspension comprises, in the embodiment illustrated, a pair of bellows air springs 54 with bases bearing on respective resilient rubber-metal buffers 56 in which respective forked anchoring members 58 carried by the cross bearer 32 are inserted (Figure 4).

To the two forked anchoring members 58 are articulated the upper ends of two hydraulic jacks 62 the lower ends of which are articulated at 64 to support brackets 66 projecting from beneath the side members 10 of the bogie B. The two hydraulic jacks are connected to a regulating system by means of which the cross bearer 32, and consequently the body C supported by it through the secondary suspension, is rotated. Clearly, this rotation is achieved by the extension of one of the jacks 62 and the simultaneous contraction of the other jack, in the manner illustrated in Figure 5. In the neutral or non-rotated position of the cross bearer 32 relative to the bogie B, the two jacks 62 are substantially vertical.

In the embodiment illustrated, the body C rests on the springs 54 of the secondary suspension not directly but with the interposition of a load-bearing cross member 68 rigidly fixed directly to the frame of the body. The load-bearing cross member 68 carries all the members connecting the body to the bogie.

These members include an anti-roll device constituted by a series of four vertical connecting rods 70 articulated at their upper ends to lugs 72 of the load-bearing cross member 68 and at their lower ends to arms 74 connected to the structure of the bogie 10 through transverse torsion bars 76.

Furthermore, two hydraulic shock-absorbers 78 are interposed between the cross member 68 and the cross bearer 32 for the purpose of damping lateral movements of the body. In order to damp vertical movements, air equalisation valves are provided in a

conventional manner between the springs 54 and the auxiliary reservoirs of the suspension, not illustrated in the drawings, which are located on the body C.

It will be clear that the secondary suspension, as well as providing the vertical and transverse suspension for the body, allows the bogie to rotate in a horizontal plane relative to the body on entering bends. Furthermore, by virtue of the arrangement according to the invention, the secondary suspension benefits from the compensation for transverse acceleration due to the variation in attitude.

The load-bearing cross member 68 may also be used for the fitting of any calibratable anti-snaking device for ensuring better stability of the bogie.

In order to transmit traction and braking forces between the body and the bogie, however, a central structure 80 is used which is fixed to the body C and projects downwardly through the aperture 34 in the bearer 32. Two reaction members 82 are fixed to the lower end of the structure 80, each constituted by a series of precompressed rubber elements carrying an end bearing plate which reacts against complementary reaction parts of the transverse members 30 of the bogie B. The structure 80 cooperates laterally with the stops 36 to limit transverse movements of the body relative to the bogie.

It should be noted that, by virtue of the arrangement according to the invention, the neutral, that is, the non-rotated, position of the cross bearer 32 and hence of the body C relative to the bogie is attained simply

by gravity, without the intervention of hydraulic controls, which leads to absolute safety and the vehicle being able to run even in the event of breakdown of the controls (hydraulic or electrical) for attitude variation.

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

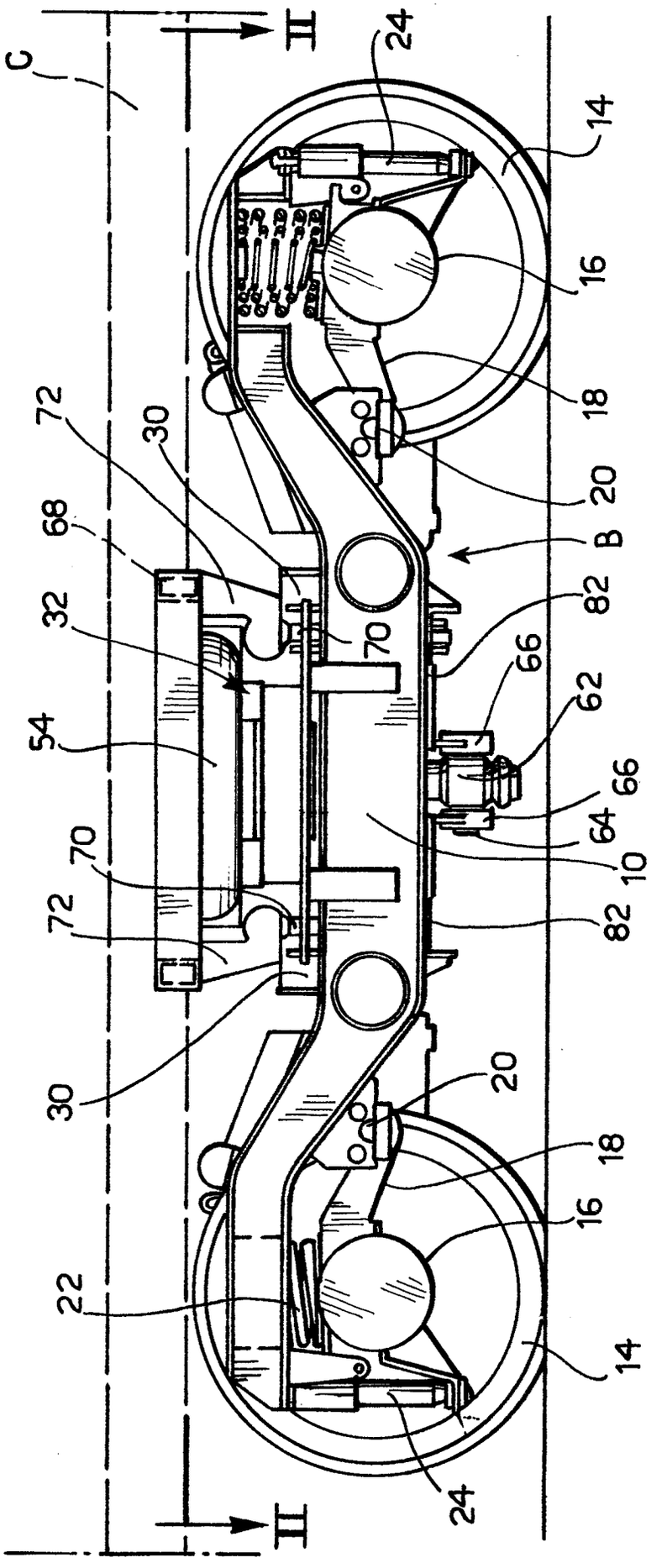
CLAIMS

1. Railway vehicle in which the body (C) is supported by bogies (B) through vertical and transverse resilient suspension means (54, 56) and is rotatable relative to the bogies about axes parallel to the longitudinal axis of the vehicle to vary its attitude in dependence on the running conditions, and in which actuator means (62) are provided for effecting the variations in attitude, characterised in that a cross bearer (32) is interposed between the body (C) and the structure of each bogie (10) to support the body (C) through the suspension means (54, 56) with the interposition of a load-bearing cross member (68) fixed directly to the body (C), and is connected to the bogie (B) by two pairs of connecting rods (44) each of which is articulated at its upper end to the structure (30) of the bogie (B) and at its lower end to a lug (38) of the cross bearer (32), in that the actuator means comprise two hydraulic jacks (62) which are articulated at their lower ends to the structure of the bogie (30) and at their upper ends to the cross bearer (32), and which are disposed in a substantially vertical condition in the neutral position of the cross bearer relative to the bogie, and in that a structure (18) is provided for transmitting traction and braking forces between the body and the bogie, which projects through an aperture (34) in the cross bearer (32) and carries two opposing longitudinal reaction members (82) in contact with complementary reaction parts (30) of the structure of the bogie (B).

2. Railway vehicle according to Claim 1, characterised in that it further includes a torsion bar device (36) interconnecting the structure (10) of the bogie (B) and the load-bearing cross member (68) to limit the rolling

motion of the body (C).

3. Railway vehicle according to any one of the preceding claims, characterised in that the resilient suspension means include a pair of air springs (54) associated with auxiliary resilient buffers (56), and transverse shock absorbers (78), the suspension means being arranged to allow relative rotation between the body and the bogie in a horizontal plane.


II
C
24
14
16
18
20
72
30
68
B
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66
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24
II

FIG. 1

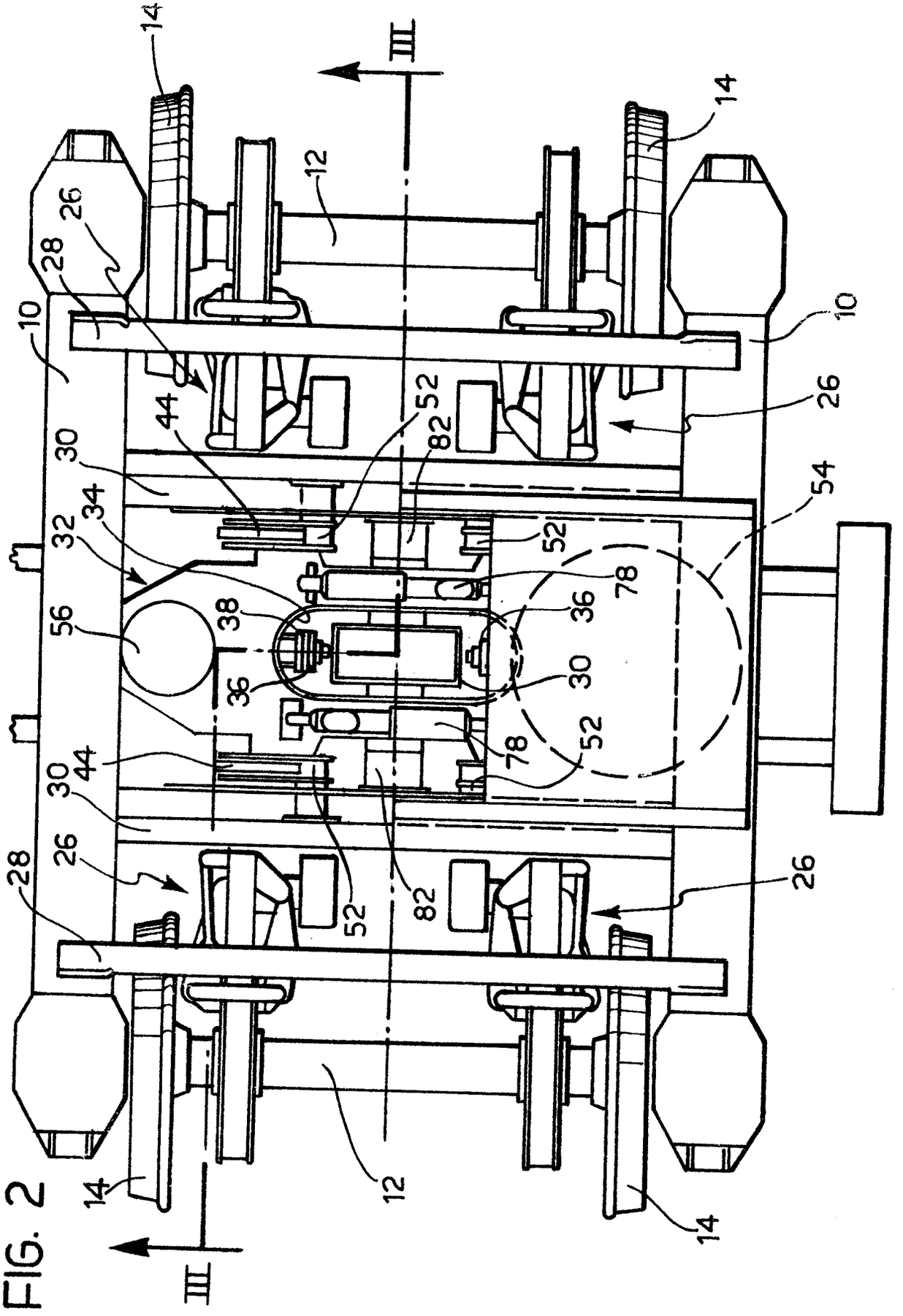
III
III
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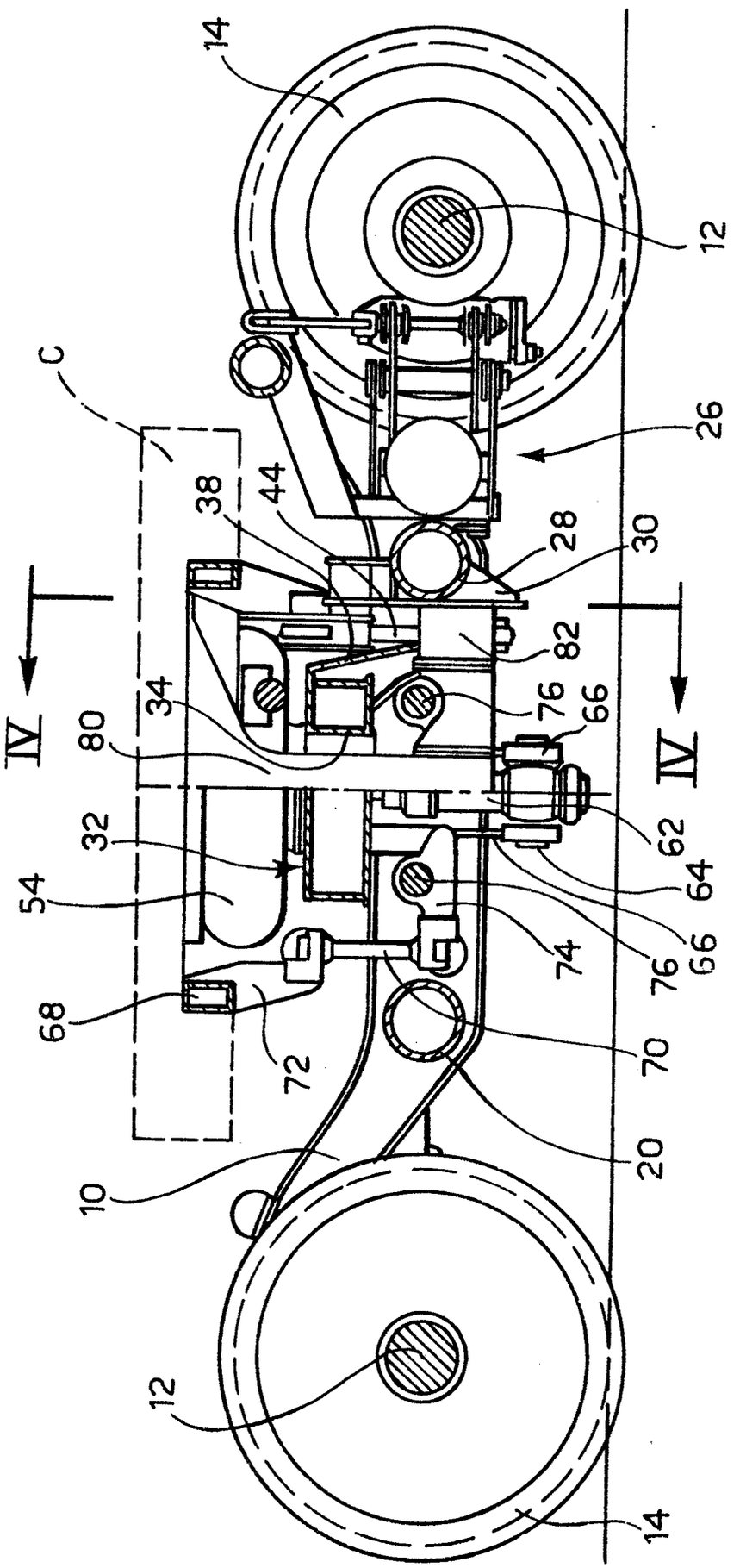
FIG. 2


14
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C
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38
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34
76
66
80
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54
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66
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68
72
70
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20
12
14

FIG. 3

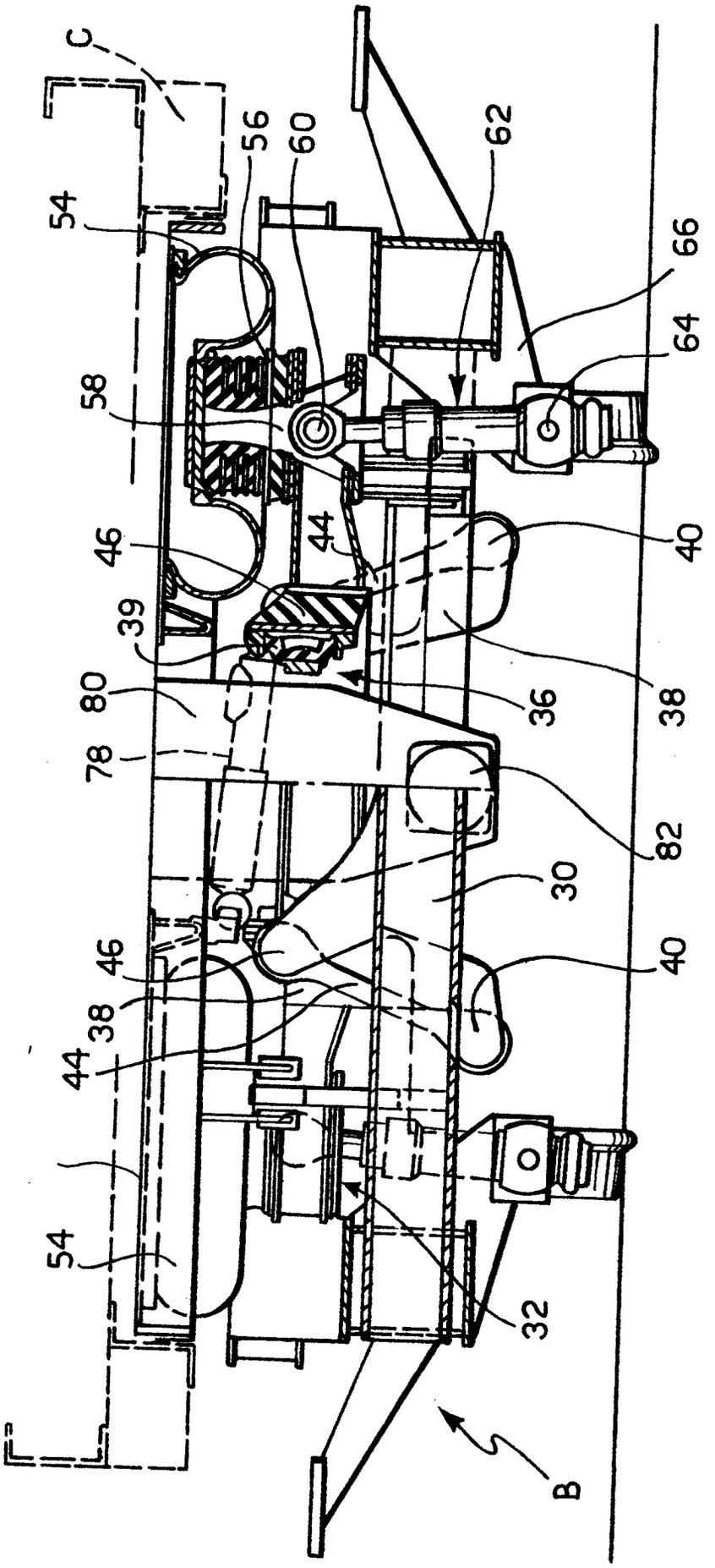

FIG. 4

FIG. 5