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(54) ELASTIC COUPLING

(71) We, SOCIETE ANONYME AUTOMOBILES CITROEN, a French Body Corporate, residing at 117—167 quai André Citroën, 75015 Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an elastic coupling or bearing for two rigid elements fitted in each other, having different characteristics of rigidity according to the direction of the stresses to which these elements are subjected.

Couplings for two interfitted rigid elements between which is interposed an elastic sleeve, have been proposed, which react differently according to whether forces are applied thereto in one direction, for which the coupling is rigid, or in another direction, generally perpendicular to the first, for which the coupling is flexible. However, such previously proposed couplings do not satisfactorily solve the problems raised by alternate torque loads exerted about a heoretical axis perpendicular to a plane containing the longitudinal axis of the coupling. This problem is very important in such couplings as the front wheel support arm joint on a chassis element of an automobile vehicle. In fact, in certain automobile axle configurations, the or each wheel support arm is pivoted on the chassis or bodywork about a horizontal axis substantially parallel to the longitudinal axis of the vehicle. In addition, for isolating the connection and damping the oscillations, the hub of the wheel arm is provided with an elastic bearing surface in contact with the pivot pin fast with the body of the hub via an elastic sleeve. Upon deceleration of the vehicle, it is understood that, in the system of forces existing between the wheel and the chassis of the vehicle, a torque is developed at the joint of the wheel arm due to the inertia of the vehicle with respect to the wheels.

If the coupling or bearing is relatively flexible in the horizontal plane, this torque provokes relative rotation of the wheel support arm with respect to the chassis (or bodywork) and is translated by a movement of the wheel at the end of the arm which tends to alter the geometry of the front axle assembly of the vehicle which, by construction, ensures good steering. This alteration therefore disturbs the safety of steering and the bearing must resist this torque to prevent any movement of the arm with respect to the chassis when the brakes of the vehicle are applied.

However, a bearing which is rigid in this plane has the drawback of easily transmitting oscillations. When the vehicle is maintained at an apparently constant cruising speed, it is in fact subjected to an incessant series of micro-accelerations and micro-decelerations which produce oscillations transmitted to the interior of the vehicle by the elastic wheel arm bearings which are theoretically rigid, this being a cause of discomfort. It is therefore necessary to give the bearing a certain flexibility so that it allows play for absorbing these oscillations.

According to the present invention there is provided an elastic coupling for two elements with different rigidity characteristics, said coupling comprising an inner and an outer part, said inner part being in the form of two half-sheaths, two, axially-spaced, elastic half-sleeves connecting the parts, said inner and outer parts being liable, in use, to be subjected to alternate forces acting to cause relative pivoting about a theoretical axis perpendicular to the axis of the coupling, said coupling having two zones of reduced radial rigidity at opposite axial end portions thereof, said zones being symmetrical with respect to each other and with respect to the said theoretical pivot axis and being constituted by free spaces between said outer part and said elastic half-sleeves, said free spaces being provided by recesses in said outer part, each half-sleeve accommodating respective said half-sheaths which half-sheaths are offset in the relaxed condition with respect to the coupling axis and to the other half-sleeve, the off-set of the half-sleeves resulting in pre-compression of portions of each half-sleeve when the coupling is fitted between said two elements, one of which is an axial pin.

Further according to the present invention there is provided an elastic coupling for two elements with different rigidity characteristics, said coupling comprising an inner part, in the form of two half-sheaths, and an outer part with parallel axes, in the relaxed, non-assembled condition between which parts is interposed an elastic connecting sleeve, said inner and outer parts being liable to be subjected, in use, to alternate forces acting to cause relative pivoting about a theoretical axis perpendicular to a plane containing the said parallel axes, said coupling having two zones of reduced radial rigidity provided at its opposite axial ends, said zones being symmetrical with respect to each other and with respect to the theoretical pivot axis and being constituted by free spaces lying between said outer part and said elastic sleeve, said free spaces being defined by recesses in said outer part, said elastic sleeve being constituted by two half-sleeves each of circumferentially varying thickness, each half-sleeve housing respective said half-sheaths which half-sheaths are offset, in the relaxed condition, with respect to the final position of the coupling when incorporated between said elements, said half-sleeves being so disposed in said outer part that their smallest radial thickness is disposed adjacent the said free spaces thus causing precompression of the greatest radial thickness of the half-sleeves when the coupling is incorporated between said elements.

The invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figs. 1 and 2 are respectively a longitudinal and a cross-section of a coupling illustrating some of the underlying concepts of the invention, Fig. 2 being a section on line II—II of Fig. 1;

Fig. 3 is a section similar to Fig. 1 but showing further detail;

Figs. 4 and 5 are longitudinal sections before a pivot pin is located of two couplings embodying the invention; and

Fig. 6 is a view of the bearing of Fig. 5 equipped with the pivot pin and other parts incorporated in a practical coupling.

Referring now to Figs. 1 and 2 of the drawings, a simplified coupling of previously proposed type includes two rigid tubular parts 1 and 2, in the form of coaxial bushes fitted in each other and held together by means of an elastic sleeve 3 are shown, the sleeve being disposed between the parts without substantial stress. This sleeve has at each of its ends a substantially crescent section clearance 4. These clearances or spaces are symmetrical with respect to a theoretical axis 5 perpendicular to the plane of Fig. 1 about which axis 5 the part 1 can rotate with respect to the part 2. The part 2 is assumed to be fixed and a torque A acting in the plane of the Figure is applied to part 1. This torque tends to cause the part 1 to rotate about the theoretical axis 5. This rotation is resisted by the sleeve 3, particularly strongly since with a torque applied in this sense the crescent section clearance 4 is remote from the zone of application of the torque and solid elastic material lies between parts 1 and 2 in the lower half, as shown. For this sense of rotation, the coupling is therefore very rigid.

If a torque B contained in the plane of the Figure is applied to the part 1, the sleeve 3 offers a relatively low resistance to the rotation about the axis 5 because of the clearances 4 lie between the parts 1 and 2 and the zones of application of the torque. This results in a possible pivoting of the part 1 with respect to the part 2 and, for this sense of rotation, the elastic coupling is therefore more supple.

Referring to Fig. 3 the basic features of Figs. 1 and 2 are illustrated as incorporated in an elastic bearing, again as previously prepared. This bearing is that of a support arm 6, for example, of an automobile vehicle hub pivoted about a pin 7 carried by elements 8 fast with the chassis of the vehicle. The bearing is housed in the hub 9 of the arm 6 and comprises an outer bush part 10, an inner bush part 11 and an elastic sleeve 12 extending therebetween. The inner bush part 11 cooperates with the pivot pin 7 through roller bearings 13 and a liner 14. With the aid of parts 13 and 14 the elastic coupling acquires the rigidity of the pin 7. The outer bush part 10 is fast with the bore of the hub 9, into which it is introduced over at least a part of the length of the bush part. The elastic sleeve 12 is accommodated between the two bush parts. It has clearances 15 and 16 similar to those (4) illustrated in Figs. 1 and 2.

The compression of the sleeve 12 is considerable in the zones radially opposite the clearances 15 and 16, either between the two bush parts 10 and 11 opposite clearance 15, or between the bush part 10 and the bore of the hub 9 opposite clearance 16.

It will be assumed that the vehicle provided with this elastic bearing is advancing in the direction of arrow C. A force D is applied to the arm 6, in the case of braking, this force being due to the adherence to the ground of the associated braked wheel. This force D, combined with the inertia of the vehicle which acts in direction C, applies a torque at the elastic bearing. The bush part 10 tends, therefore, to pivot with respect to the bush part 11 in the sense of arrow E. This pivoting is then immediately resisted by the parts of the strongly compressed sleeve 12 opposite the clearances 15 and 16. The bearing being very rigid under these conditions, there is little or no possible displacement of the wheel plane with respect to the longitudinal axis of the vehicle. In the case of the front axle assembly, this results in the steering geometry and therefore the safety of steering being conserved.

If on the other hand the arm 6 is subjected to alternating forces such as F, F1 corresponding to the micro-accelerations and decelerations arising during regular running, the forces of type F1 are withstood by the bearing, since, for their direction, the bearing is rigid, whilst the movements produced by the forces of type F are absorbed by the bearing since, in view of clearances 15 and 16, the bearing is supple and absorbs these deformations. The oscillations of arm 6 are now only partly transmitted to the chassis of the vehicle, this being sufficient to eliminate substantially any longitudinal vibrations of the interior of the vehicle and to maintain the comfort of the passengers.

Figs. 4 and 5 show two coupling constructions embodying the invention, particularly concerning the production of the parts constituting it and their assembly. These Figures show an incomplete elastic bearing before the pivot pin is incorporated. The joint of an axle support arm on a chassis element will also be considered. This arm will be rigid with the hub 9 in which the elastic bearing is housed. The hub 9 comprises a central bore 18 and two counter-bores 19 and 20 outwardly of each of the ends of the bore 18. The counter-bore 19 is upwardly offset by a distance *a* with respect to the axis of the bore 18 and counter-bore 20 is offset by the distance *a* with respect to the bore axis of the 18, opposite the offset of the counter-bore 19, so that the offset of bore 19 with respect to bore 20 is equal to 2*a*. The elastic bearing is itself constituted by two identical half-bearings 21 and 22. Each comprises a half-sheath 21*a*, 22*a*, an outer ring 21*b*, 22*b* and an elastic half-sleeve 21*c* and 22*c*. By construction of the elastic half-sleeves, the half-sheaths 21*a* and 22*a* are offset by value *b* with respect to the common axis of the rings 21*b* and 22*b*. The common axis of the rings is coincident with the axis of the bore. Finally, the outer rings 21*b* and 22*b* each comprise a flange 21*d* and 22*d*, whose diameter is slightly smaller than the diameter of the counter-bores 19 and 20 and each flange is offset with respect to the outer surface of the outer rings in opposite directions.

In Fig. 4, the thick part of the half-sleeves 21*c*, 22*c* in the relaxed condition, as shown, is disposed adjacent the larger dimension of the flanges 21*d*, 22*d* respectively.

In contrast, in the embodiment of Fig. 5, the thick part of the half-sleeves 21*c*, 22*c* is disposed adjacent the smaller dimensions of the flanges 21*d*, 22*d*, or in other words the thick part of the half-sleeves 21*c*, 22*c* is disposed diametrically opposite the larger dimensions of the flanges 21*d*, 22*d*. In this way, there is a false elignment of the half-sheaths 21*a* and 22*a* with respect to the axis of the coupling, that is the axis of the bore 18 and of the outer part in the form of outer rings 21*b* and 22*b* by a value equal to 2*b*, in the same direction as the off-setting of the counter-bores 19 and 20 in the case of Fig. 5 and in an opposite direction for Fig. 4. The flanges 21*d* and 22*d* serve as means for centering the sleeves and sheaths on the ring and of the half-bearings 21 and 22 in the hub 9.

Fig. 6 shows the elements of Figs. 4 and 5, when mounted, with the same references. In order to correct the false alignment of the half-bearings 21 and 22, a floating ring 23 is provided, on which is borne the ends within the bore of the hub of the half-sheaths 21*a* and 22*a* each provided with an adequate shoulder. The pivot pin 7 and roller bearings 24 and 25 may therefore be more easily placed in position.

By this re-alignment of the half-bearings, pre-compression stresses are created in the half-sleeves 21*c* and 22*c* enabling a more stable bearing to be obtained which is better adapted to the function for which it is intended. It will be noted that the off-set of the counter-bores 19 and 20 defines clearances 26 and 27, which will allow the desired pivoting about the theoretical axis 5 of the arm 6 with respect to the pin 7. In the preferred embodiments, the desired effects are advantageously obtained without resorting the manufacture of special parts of complicated shape, but on the contrary by means of a judicious assembly of parts which are simple to manufacture.

The invention finds advantageous application in the domain of mechanical couplings in automobile vehicles.

WHAT WE CLAIM IS:—

1. An elastic coupling for two elements with different rigidity characteristics, said coupling comprising an inner and an outer part, said inner part being in the form of two half-sheaths, two, axially-spaced, elastic half-sleeves connecting the parts, said inner and outer parts being liable, in use, to be subjected to alternate forces acting to cause relative pivoting about a theoretical axis perpendicular to the axis of the coupling, said coupling having two zones of reduced radial rigidity at opposite axial end portions

thereof, said zones being symmetrical with respect to each other and with respect to the said theoretical pivot axis and being constituted by free spaces between said outer part and said elastic half-sleeves, said free spaces being provided by recesses in said outer part, each half-sleeve accommodating respective said half-sheaths which half-sheaths are offset in the relaxed condition with respect to the coupling axis and to the other half-sleeve, the off-set of the half-sleeves resulting in pre-compression of portions of each half-sleeve when the coupling is fitted between said two elements, one of which is an axial pin.

2. An elastic pivot bearing housed within a hub of an axle support arm of a chassis element of a vehicle, said bearing comprising a pivot pin fast with said chassis element mounted to rotate in a sheath elastically fast with said support arm carrying an elastic coupling as claimed in claim 1, wherein said half-sheaths of the coupling constitute said sheath and said outer part constitutes said hub, said hub comprising two axially outer counter-bores oppositely offset with respect to a central bearing surface of the hub, each said half-sleeve having an outer ring provided with a flange offset with respect to the body of said ring by the same value as the off-setting of said counter-bores, the alignment of said two half-sheaths mounted in said hub being assisted by a floating ring for centering said parts with respect to each other.

3. An elastic coupling for two elements with different rigidity characteristics, said coupling comprising an inner part, in the form of two half-sheaths, and an outer part with parallel axes, in the relaxed, non-assembled condition between which parts is interposed an elastic connecting sleeve, said inner and outer parts being liable to be subjected, in use, to alternate forces acting to cause relative pivoting about a theoretical axis perpendicular to a plane containing the said parallel axes, said coupling having two zones of reduced radial rigidity provided at its opposite axial ends, said zones being symmetrical with respect to each other and with respect to the theoretical pivot axis and being constituted by free spaces lying between said outer part and said elastic sleeve, said free spaces being defined by recesses in said outer part, said elastic sleeve being constituted by two half-sleeves each of circumferentially varying thickness, each half-sleeve housing respective said half-sheaths which half-sheaths are offset, in the relaxed condition, with respect to the final position of the coupling when incorporated between said elements, said half-sleeves being so disposed in said outer part that their smallest radial thickness is disposed adjacent the said free spaces thus causing precompression of the greatest radial thickness of the half-sleeves when the coupling is incorporated between said elements.

4. An elastic pivot bearing housed within a hub on an axle support arm of a vehicle chassis element, comprising a pivot pin fast with said chassis element mounted to rotate in a sheath elastically fast with said support arm carrying said elastic coupling as claimed in claim 3, wherein said half-sheaths constitute said sheath and said outer part forms said hub, said hub comprising two axially outer counter-bores oppositely offset with respect to the central bearing surface, each said half-sleeve having an outer ring provided with a flange off-set with respect to the body of said ring by the same value as the off-setting of said counter-bores, the alignment of said two half-sheaths mounted in said hub being assisted by a floating ring for centering said parts with respect to each other.

5. An elastic coupling substantially as hereinbefore described with reference to Fig. 4, Fig. 5 or Fig. 6 of the accompanying drawings.

6. An elastic pivot bearing incorporating a coupling as claimed in claim 5.

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1574148 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1

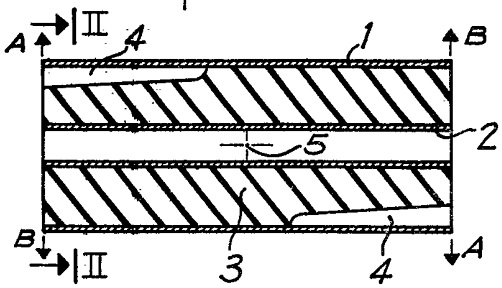

Fig. 2

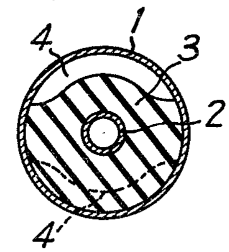

Fig. 3

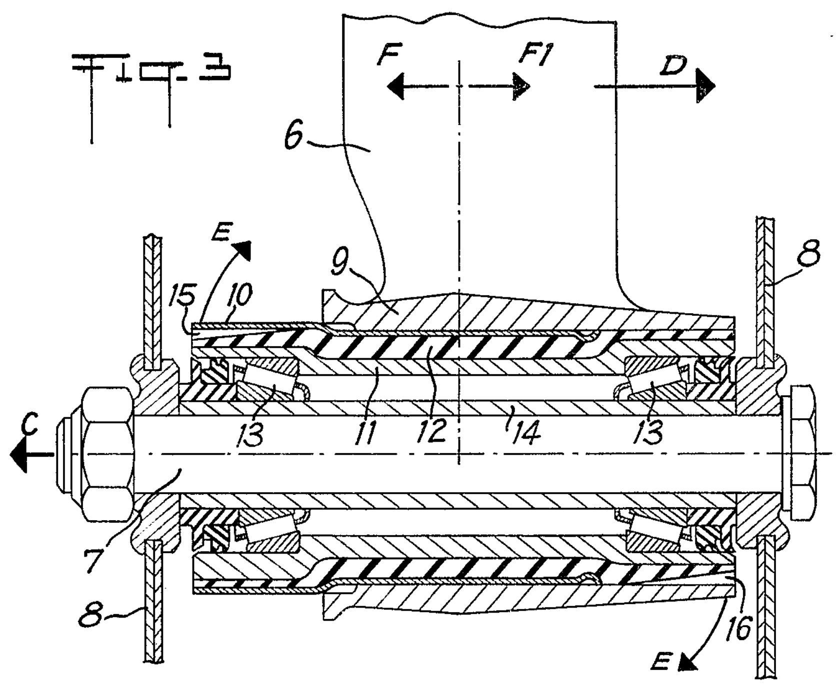

Fig. 4

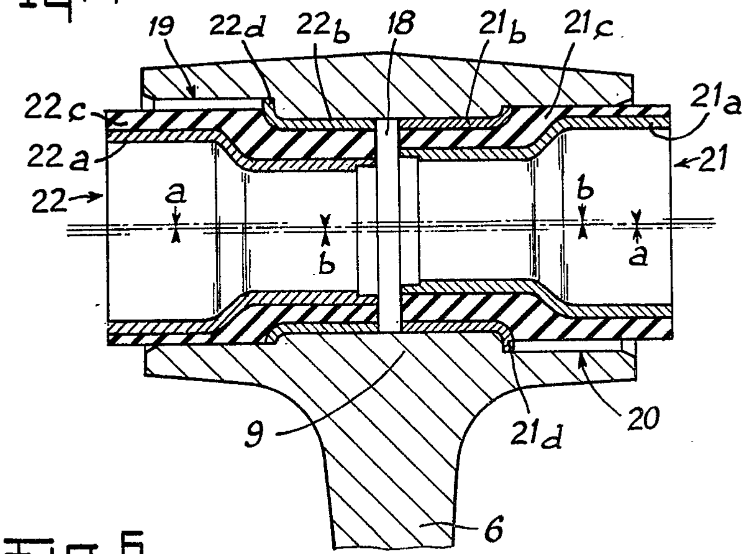
19
22d
22b
18
21b
21c
22c
21a
22a
21
22
a
b
b
a
9
21d
20
6

Fig. 6

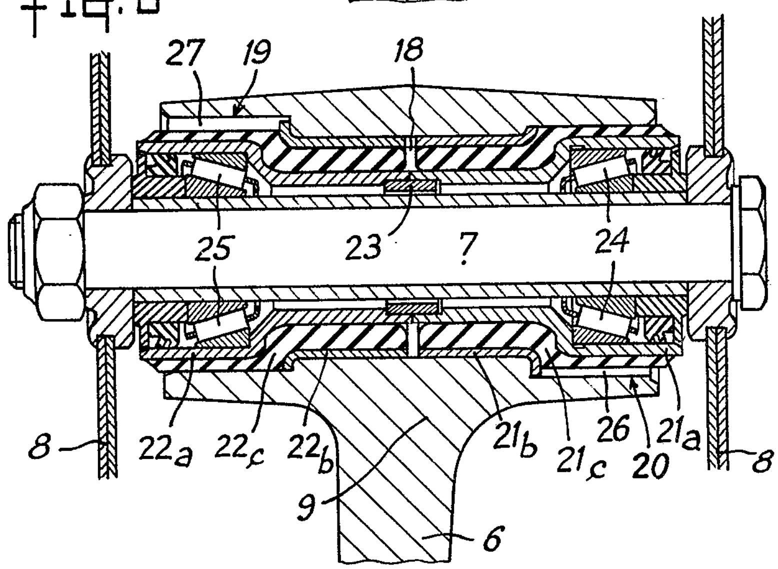
27
19
18
25
23
7
24
8
22a
22c
22b
21b
21c
26
20
21a
8
9
6

Fig. 5