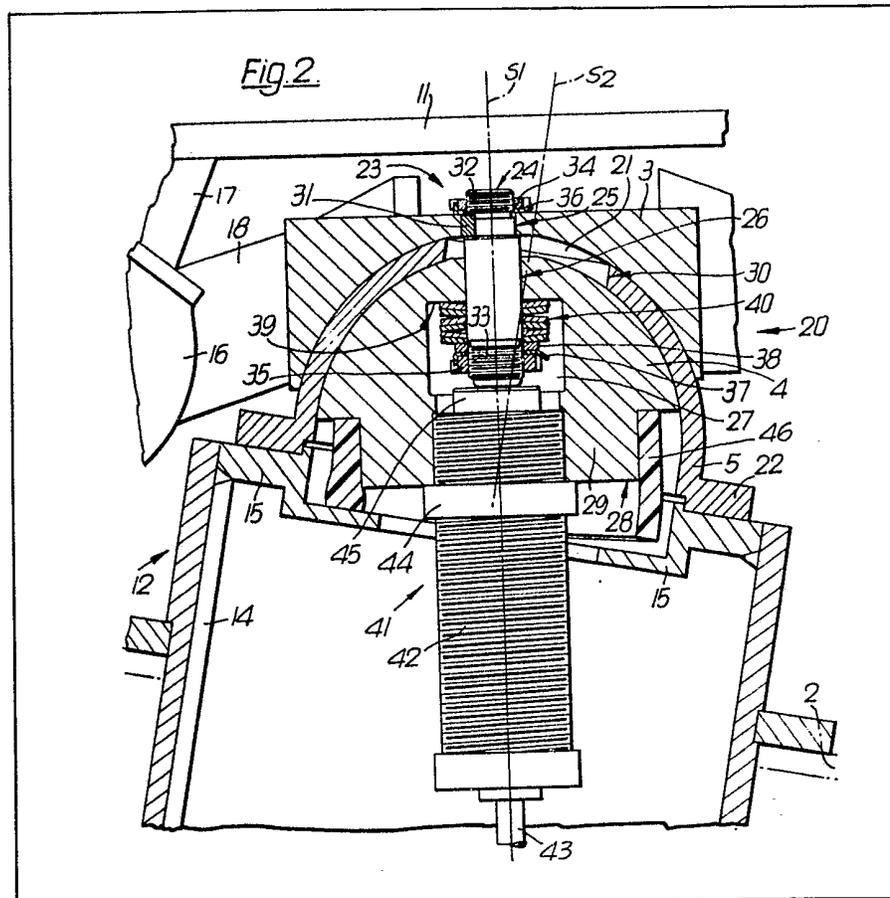


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(54) Lockable ball-and-socket joint

(57) This invention relates to a lockable ball-and-socket joint between two objects. Connected to the one object (11) which may be a driver's seat in a working vehicle is a socket (3) and a ball (4) arranged concentrically with a gap between them. Connected to the other object, which may, for example, consist of a base (12) for a driver's seat, is a coupling element in the form of a spherical shell (5) disposed in the gap between the socket and the ball. The

socket and ball are pressed towards one another by means of powerful cup springs (40) so that the spherical shell (5) is locked firmly and the two objects (11 and 12) to be coupled are thus located in relation to one another. The grip of the spring force can be cancelled by means of a tightening element (42) connected to the ball, as a result of which the coupling again becomes movable so that new positions can be adopted. The coupling can be used in various connections where it is desired to adjust two objects in relation to one another simply, securely and quickly.



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Fig. 1.

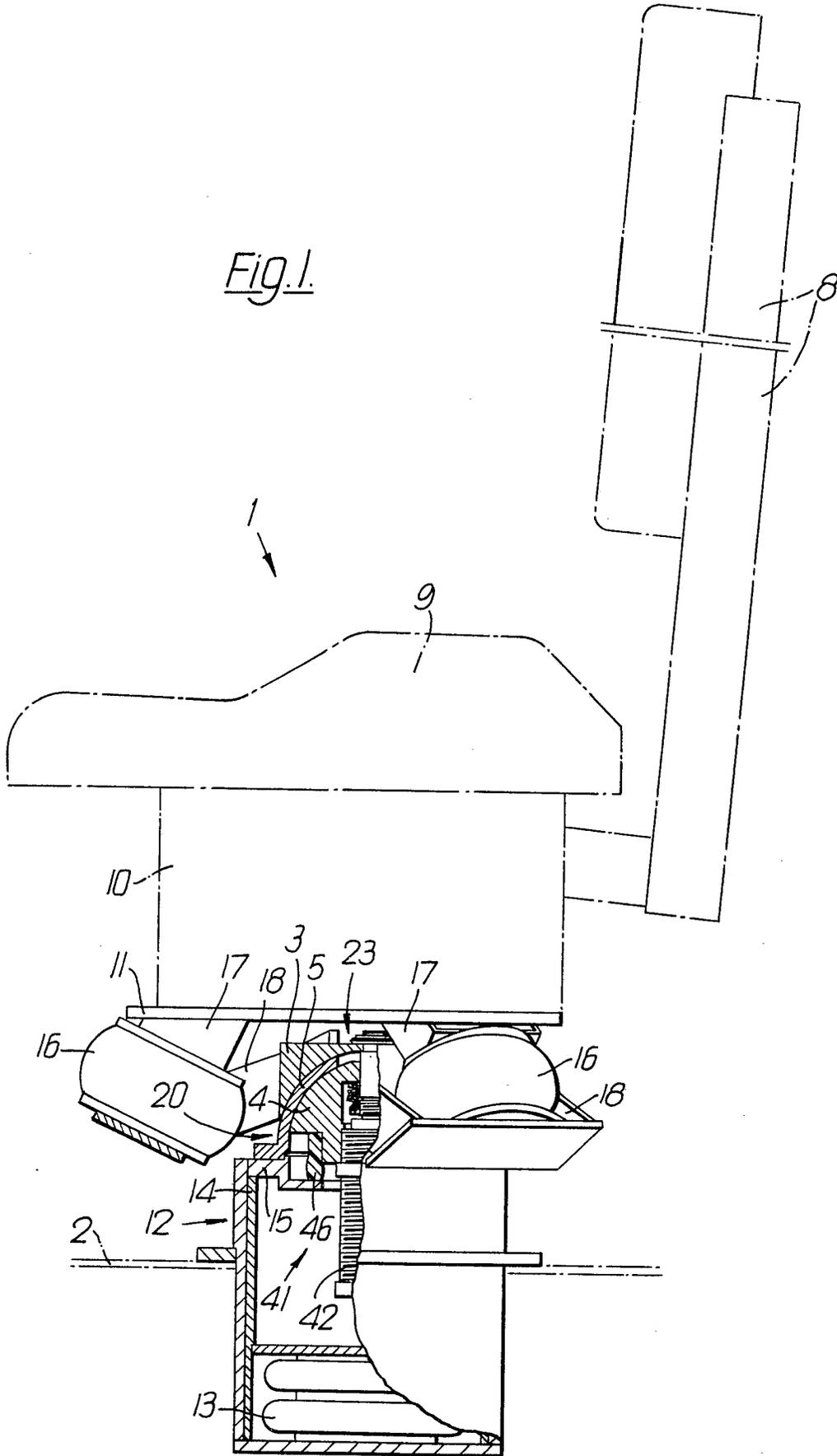
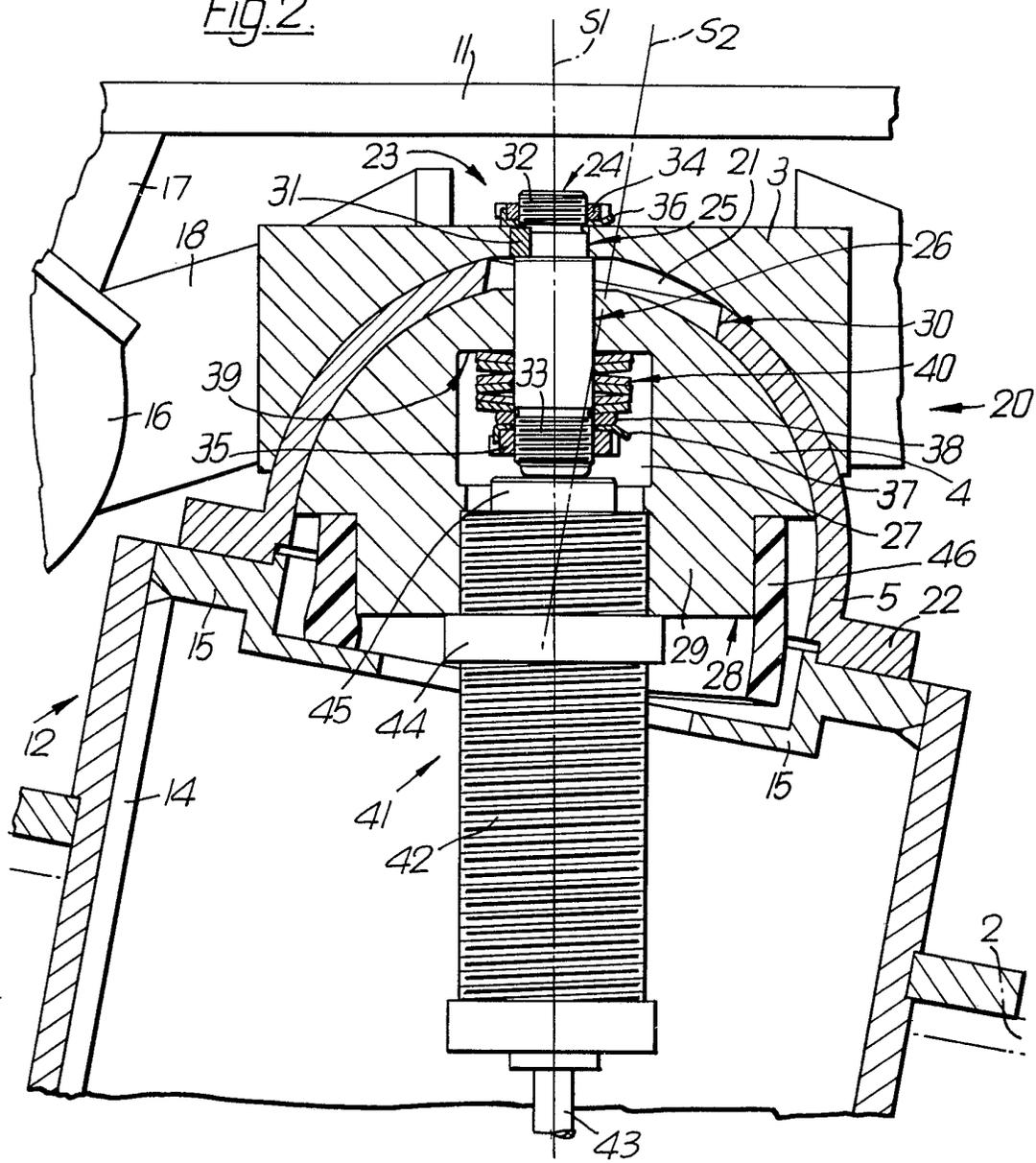


Fig. 2.



SPECIFICATION

Coupling of the ball-and-socket joint type

The present invention relates to a coupling of the ball-and-socket joint type between two objects, comprising coupling members to be connected to each object. One of said objects may consist, for example, of a work table, a tool, a weapon or instrument holder while the other object may consist for example, of a stand, a foot or a base to be connected to a said one object.

A particularly advantageous field of application for the coupling according to the invention is for driver's seats in working vehicles such as forestry machines, agricultural machines, earth movers and excavators. The technical development of this type of vehicle has been very rapid. The same applies to the development on the military side, for example of tanks. The development of driver ergonomics has not kept pace, however. In certain cases — despite the fact that the driver's technical aids have certainly been improved — it may even be maintained that driver ergonomics have become worse since the stresses have increased in keeping with factors such as the better traversability of the terrain, and the higher speeds of travel. There are therefore still great deficiencies, both in older and in newly constructed machines, with regard to driver's seats *inter alia*, and cases of sickness directly related to faulty ergonomics are common. In order to avoid various forms of fatigue through faulty positioning of the body, therefore, the driver's working milieu must be radically renewed and an ergonomically logical development of the seat must take place. Particularly noteworthy is the need for devices for maintaining the driver's seat horizontal in working vehicles in forestry and agriculture, in mines and other work places where the vehicle may be inclined, in use. In forestry it is extremely tiring to work for long shifts in a machine which is standing on inclined ground, without any possibility of making the work seat horizontal. In agriculture, ploughing work involves heavy stresses on the back as a result of the fact that the machine is inclined the whole time. The need for couplings by means of which the driver's seat can be made horizontal or otherwise be adjusted in relation to a base is therefore very great.

In particular the present invention should provide a coupling which can for example be used to make a driver's seat in a working vehicle horizontal, or be otherwise adjusted in a desired manner in relation to a base, so as to meet the justified demand for comfort and good ergonomics. This adjustment should be able to be carried out very simply, securely and quickly.

Although the invention sprang from the need in the ergonomics of working vehicles, its use is not restricted to this field which has already been discussed in the introduction; the invention aims to offer a coupling by means of which two objects can be adjusted in relation to one another simply, securely and quickly, for example an instrument in

65 relation to a stand to aim the instrument at a target; a tool in relation to a tool-holder in order to machine a workpiece etc.

Accordingly the invention provides a coupling of the ball-and-socket joint type between two objects, comprising coupling members adapted to be connected to each said object, wherein one of said coupling members comprises on the one hand a spherical socket and on the other hand a ball with a radius smaller than that of the socket, the central axis of the ball coinciding with that of the socket so that a gap exists between the socket and ball with a width corresponding to the difference between the internal radius of the socket and the external radius of the ball; the other said coupling member comprising a spherical shell disposed between said socket and ball and having outer and inner radii substantially the same as the radii of said socket and ball so that said shell can completely fill the gap between the socket and ball can be displaced in various directions by sliding in said gap; gripping means being provided to urge said ball and said socket towards one another so that the said shell can be locked in the desired position whereby the two coupling members are locked in the desired position in relation to one another.

In order that the present invention may more readily be understood the following description is given, merely by way of example, with reference to the accompanying drawings which show a preferred embodiment and application of the coupling according to the invention. In the drawings:

Figure 1 is a side elevational, partly sectional, view of a coupling which constitutes a connection between a driver's seat and a base; and

Figure 2 shows the same coupling in more detail, and is a vertical section illustrating how the coupling can be used to make the seat horizontal when the vehicle is inclined.

Referring first to Figure 1, there will be seen a driver's seat 1, illustrated diagrammatically, in a working vehicle. The floor 2 of the driver's cab is in this case horizontal. The seat 1 comprises a seat back 8, a seat base 9 and a frame 10 with a frame bottom or base 11. Disposed below the bottom 11 of the frame are three rubber vibration dampers 16 which are distributed evenly round a symmetrical axis S_1 (Figure 2). Upper and lower supporting arms for the vibration dampers 16 are designated 17 and 18 respectively. The upper supporting arms 17 are connected to the bottom 11 of the frame 10 of the seat 1.

A base 12 is partially sunk in the floor 2 and is telescopic so as to allow variation of the height of the seat 1 above floor 2. For this purpose, a pair of hydraulic bellows cylinders 13 are provided to press up a telescopically disposed inner drum 14, the upper part of which is designated by 15.

Disposed between the seat 1 and the base 12, or more specifically between the lower support arms 18 for the vibration dampers 16 and the upper part 15 of the base, is a coupling generally designated 20. The construction of the coupling

20 is shown in more detail in Figure 2. The coupling members, which are connected to the seat 1 *via* the frame 10 and the vibration dampers 16, comprise on the one hand a socket 3 with a given spherical radius R, and on the other hand a concentric hemispherical ball 4 with a smaller radius *r* than that of the joint socket. The axis of symmetry S_1 of the ball 4 coincides with that of the socket and a gap 21, with a width corresponding to the difference (R-r) between said radii, is formed between the socket 3 and the ball 4. The lower supporting arms 18 of the vibration dampers 16 are connected to the cylindrical wall of the socket 3. The socket 3 and the ball 4 each comprise an axial through bore 25 and 26 respectively. The ball 4 further comprises a cavity 27 which extends from the planar bottom 28 of the ball and occupies a considerable proportion of the volume of the ball. The ball further comprises a neck 29.

The coupling member which is connected to the base 12 comprises a spherical shell 5 which is disposed in the gap 21 between the socket 3 and the ball 4. More specifically, the spherical shell 5 is hemispherical with outer and inner radii R and *r* respectively (i.e. radii coinciding with those of the socket 3 and the ball 4), so that the spherical shell 5 completely fills the width of the gap 21. At the bottom, the hemispherical shell 5 comprises an out-turned surrounding flange 22 which is connected to the upper part 15 of the base 12. A circular opening extending axially through the cap of the shell 5 is designated 30.

The coupling 20 is adapted to be locked firmly, when located in the desired position, by a locking means generally designated 23. The locking means 23 is adapted to face the ball 4 and the socket 3 by force towards one another so that the interposed shell 5 can be locked in the desired position thus also locking the seat 1 in the desired position in relation to the base 12 and the floor 2. The locking means 23 comprises a cylindrical locking pin 24 which fits in the clearance holes 25 and 26 in the socket 3 and the ball 4; the locking pin 24 passes through the opening 30 in the hemispherical shell 5, and the diameter of opening 30 is three times as large as that of the part of the pin 24 which lies in the opening 30. The locking pin 24 is prevented from twisting in the holes 25 and 26 by means of a locking key 31. The upper and lower ends 32 and 33 respectively of the locking pin 24 are threaded. Screwed onto the threaded portions are respective so-called ballbearing nuts 34 and 35 having respective locking washers 36 and 37. An ordinary flat washer 38 is arranged immediately above the locking washer 37 on the lower end of locking pin 24, and between the washer 38 and the end face 39 of the cavity 27 is a set of cup springs 40 stacked on one another and held together by the locking pin 24. By screwing the nuts 34 and 35 together to a suitable extent, the springs 40 are pressed together until an adequate gripping force is reached between the socket 3 and the ball 4 for the interposed shell 5 to be locked firmly with

sufficient force to be able to hold the seat 1 fixed in relation to the base in the position adopted.

In order to be able to release the coupling 20, for example when it is desired to adjust the seat 1 in a fresh position in relation to the base 12 and the floor 1, the coupling is also equipped with disengagement means generally designated 41. The disengagement means comprises a pneumatic-hydraulic tightening element 42 consisting of a pneumatic-hydraulic two-stage cylinder driven by compressed air. A connection to a compressed-air source is designated by 43. The necessary hydraulic oil is accommodated in the tightening element 42. Tightening elements of this type are manufactured by Leibfried Maschinenbau GmbH of the Federal Republic of Germany and provide tightening forces of 3 to 30 kN with an operating pressure to 1 to 10 bar, despite small installation dimensions. The wall of the tightening element 42 is threaded so that the tightening element can be screwed by its front portion into the outer threaded portion of the cavity 27 in the wall 4; the wall is held firmly by means of a locking ring 44. The tightening element 42 further extends through a circular opening which is formed in the upper portion 15 of the base 12 and has a considerably larger diameter than the tightening element 42 so that the tightening element can swing in various directions in the opening 46. The same applies to the freedom of the locking pin 24 to move in the opening 30 in relation to the shell 5.

In the tightening element 42 there is a piston, the front portion 45 of which extends out of the casing of the tightening element. In this text, this part is called the piston rod 45. The piston rod 45 bears against the lower end of the locking pin 32. The conduit 43 is connected to the pneumatic system of the vehicle through a valve (not illustrated). This valve can be opened by remote control, preferably by a control on the instrument panel of the vehicle, to give operating pressure to the tightening element 42.

The axis of symmetry of the base 12 is designated by S_2 . In order that the seat 1 may automatically assume a horizontal position when the base 12 has its axis S_2 completely vertical and the coupling 20 is disengaged, that is to say in order that the axes of symmetry S_1 and S_2 may be caused to coincide, a return member is provided.

This return member also serves to prevent the coupling from losing all stability when it is disengaged. Said return member may, in principle, consist of springs of various types and construction between the ball 4 and the upper portion 15 of the base 12, for example a steel spring having its upper end passed over the neck 29 of the ball 4.

It is also possible to conceive of a plurality of resilient members disposed between said elements to serve as return means.

In this embodiment, however, one resilient element, in the form of a collar 46 of a resilient material, is provided. The collar 46 is fitted with a given tension round the neck 29 of the joint ball 4

and extends coaxially towards the upper portion 15 of the base. When the ball 4 is inclined in relation to the base 12, the collar 46 is compressed at one side which gives the necessary stability to the coupling when it is disengaged. A suitable material for the collar 46 is a plastics rubber which is known under the trade name of ADIPRENE and which has very good elasticity and suitable resistance to deformation for this application. When the base 12 is coaxial with the socket 3, the collar 46 bears evenly on the upper portion 15 of the base 12.

Although the operation of the coupling should be clear from the above description, an explanation of the operation will nevertheless be given. In the fixed position, the socket 3 and the ball 4 are pressed towards one another by means of the cup springs 40. The transmission of force is effected by means of the locking pin 24, and the spring force is pre-adjusted by the nuts 34 and 35. When it is desired to alter the position of the seat 1, for example in order to make it horizontal when the vehicle floor is inclined, or to incline the seat forwards or backwards to vary the working position, or to turn the seat in a fresh direction (perhaps without varying the direction of the seat axis S), the coupling is disengaged. The driver does this by means of a control (not illustrated) for example a button or lever on the instrument panel in the vehicle. The above mentioned valve is thus opened so that compressed air is fed into the tightening element 42 through the conduit 43. Via an air-hydraulic power ratio, the piston rod 45 is pressed upwards with great force. The power ratio and the stroke length of the piston rod 45 are selected so that the piston rod 45, against the resistance from the springs 40, lifts up the locking pin 24 a little so that the nut 34 is relieved. The coupling 20 is now disengaged and a new position can be adopted by rocking or turning the seat 1. However, the resilient collar 46 offers a certain resistance to such rocking movements by being resiliently deformed. When the desired position is reached, the feed pressure to the tightening element 42 is interrupted, whereupon the piston rod 45 returns to the rest position and the cup springs 40 again firmly lock the elements of the coupling.

CLAIMS

1. A coupling of the ball-and-socket joint type between two objects, comprising coupling members adapted to be connected to each said object, wherein one of said coupling members comprises on the one hand a spherical socket and on the other hand a ball with a radius smaller than that of the socket, the central axis of the ball coinciding with that of the socket so that a gap exists between the socket and ball with a width corresponding to the difference between the internal radius of the socket and the external radius of the ball; the other said coupling member comprising a spherical shell disposed between said socket and ball and having outer and inner radii substantially the same as the radii of said

socket and ball so that said shell can completely fill the gap between the socket and ball and can be displaced in various directions by sliding in said gap; gripping means being provided to urge said ball and said socket towards one another so that the said shell can be locked in the desired position whereby the two coupling members are locked in the desired position in relation to one another.

2. A coupling as claimed in claim 1, wherein said gripping means comprise a locking pin which extends between the socket and the ball and which is adapted to be able to press the socket and the ball towards one another with spring force, locking said spherical shell therebetween.

3. A coupling as claimed in claim 2 wherein the spring force of said gripping means is developed by at least one spring on the side of the socket and/or the ball remote from said gap, said at least one spring being gripped between said side and a stop on the locking pin.

4. A coupling according to claim 3, wherein said at least one spring comprises a stack of dished washers on the inside of said ball.

5. A coupling as claimed in claim 1, 2, 3 or 4, and including disengagement means to release the coupling when fresh positions are to be assumed, said disengagement means being a unit independent of said gripping means.

6. A coupling as claimed in claim 5 when appendant to claim 3 or 4, wherein said disengagement means comprises a tightening element fixed to said socket or said ball against which said at least one spring is gripped, and said tightening element is adapted to be able to compress said at least one spring to a sufficient extent to cancel the gripping force so that the coupling is released.

7. A coupling as claimed in claim 6, wherein said disengagement means is adapted to be remote-controlled.

8. A coupling as claimed in claim 2 or in any one of claims 3 to 7 when appendant thereto, wherein the locking pin extends through axial holes in the socket and the ball and through an opening in the spherical shell which opening is larger than the pin and permits displacement of the shell in relation to the socket and the ball without hindering the locking pin, and said at least one spring is disposed in a cavity in the ball on one end of the locking pin.

9. A coupling as claimed in claim 8, wherein the tightening element is disposed axially in relation to the locking pin and has a piston rod adapted to bear against the said one end of the locking pin in said cavity in the ball.

10. A coupling as claimed in any one of claims 1 to 9, wherein a return member is provided to return the said coupling members to a position of symmetry and to damp movements of the coupling when said coupling is disengaged.

11. A coupling as claimed in claim 10, wherein said return member comprises one or more flexible elements between the back of the joint ball and a body to which the spherical shell is connected.

12. A coupling of the ball-and-socket type constructed and adapted to operate substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

5 13. A coupling as claimed in any one of the preceding claims wherein said hemispherical shell

is connected to the body of a vehicle and said ball and socket are connected to a seat of the vehicle.

10 14. A coupling as claimed in claim 13, wherein said hemispherical shell is secured to raisable pillar adjustably mounted on the floor of said vehicle.