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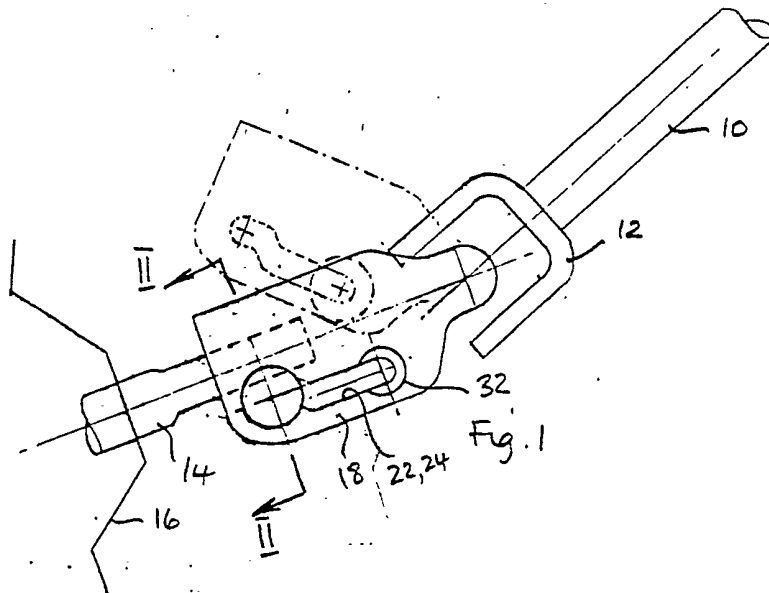
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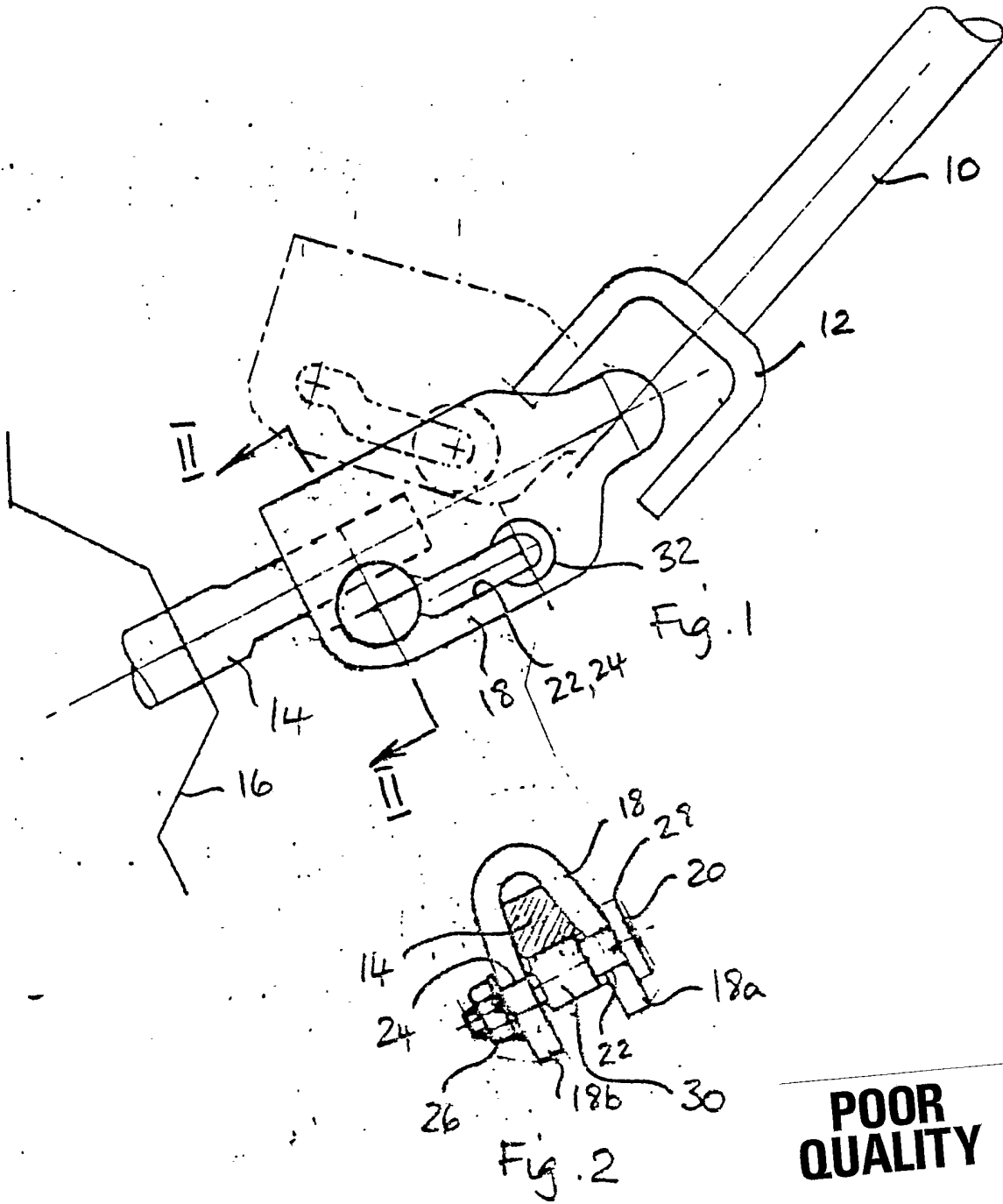
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(54) **Steering column coupling**

(57) A steering column coupling for a motor vehicle has a pivoted link 18 which swings onto a stub shaft 14 from the steering gear. The link has one open side through which the shaft enters, and a captive bolt 20 which can be slid along the link is used to close the open side once the shaft has been positioned.



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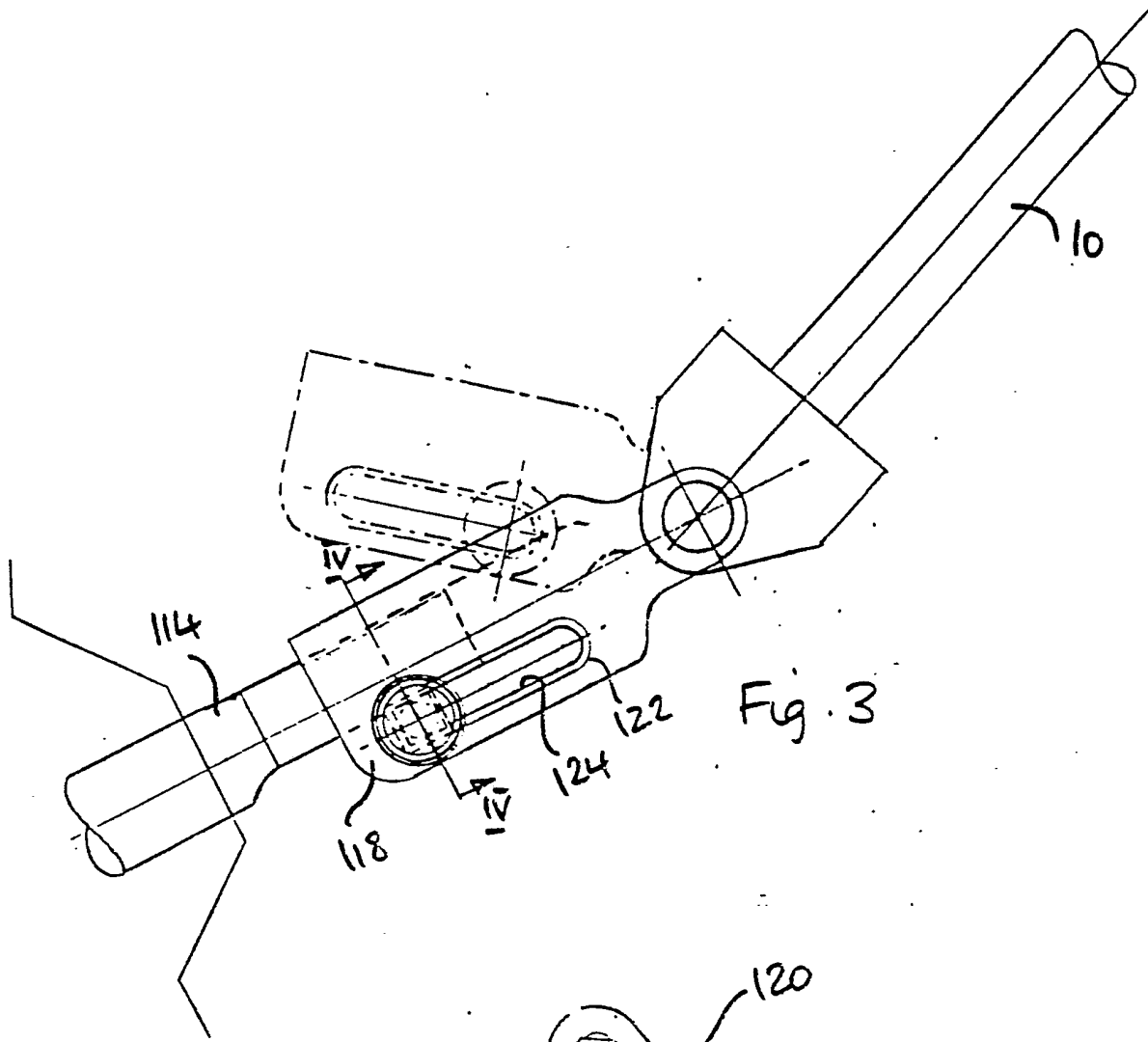


Fig. 3

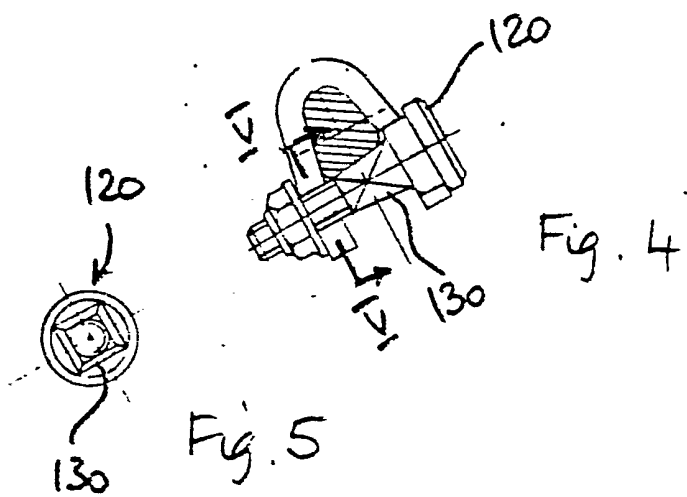
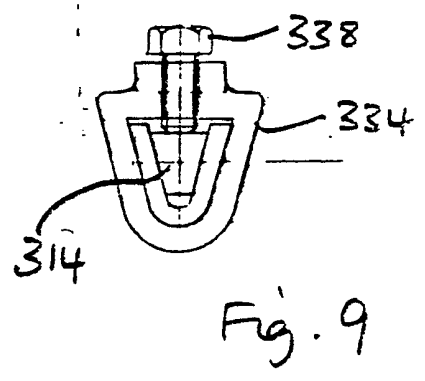
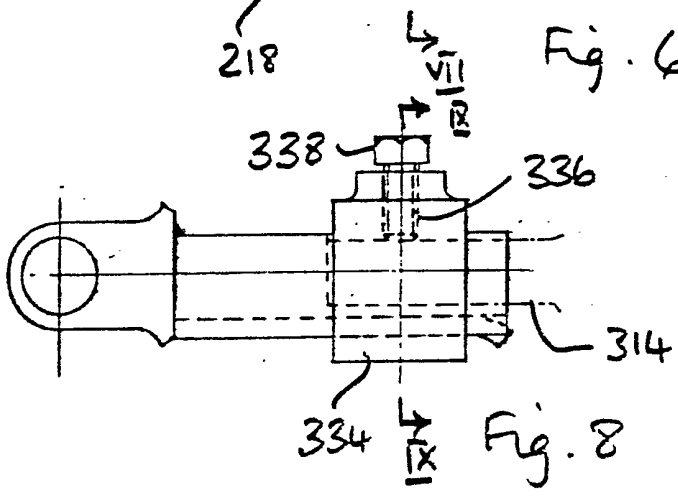
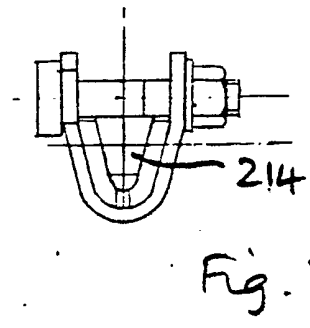
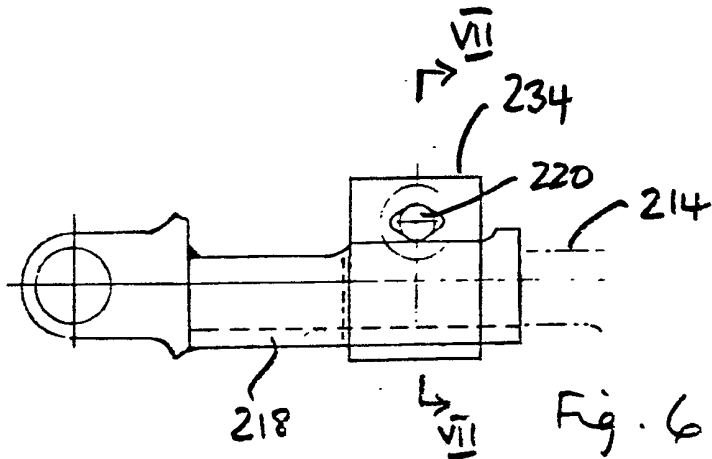


Fig. 4



Fig. 5



## Steering Column Coupling

This invention relates to a steering column coupling for use in a motor vehicle to facilitate the assembly of a steering column shaft into the vehicle.

5 Conventionally, with a rack and pinion steering, the steering rack is mounted in the engine compartment, with a pinion shaft, which drives the steering rack, projecting through a bulkhead into the passenger compartment. The lower end of the steering shaft is then  
10 connected to the pinion shaft. Other types of steering gear may have a similar shaft projecting into the bulkhead, and in this specification, the pinion shaft, or its equivalent, will be referred to as a stub shaft.

It is known to form the mating ends of the stub shaft  
15 and of the steering shaft with telescopically engaging splined portions, but this requires that the two be assembled by relative axial movement which is not always easy in the confined space where engagement has to occur. Particular difficulties arise where the steering  
20 shaft is a three-link design, as it is then difficult to support the rest of the column while engaging the splined ends.

It is also known, from GB-PS 1 223 828, to use a pivoted link with a V-shaped bed in which the stub shaft can be  
25 non-rotatably secured. This avoids the need for the mating ends to approach one another in a purely axial direction, but requires the fitting of a gate to close the V-shaped bed once the stub shaft has been located.

According to the invention, there is provided a steering  
30 column coupling for coupling to a non-round stub shaft which is connected to a steering rack pinion and is adapted to be turned about a longitudinal axis to operate the steering rack, the coupling comprising a

connection link pivoted to the lower end of a steering shaft, the link having a longitudinal recess with a cross-section complementary to that of the stub shaft, the recess being open at one side to receive the shaft and the link including a bolt which can be tightened to clamp the shaft in the recess, the bolt being arranged so that it is captive on the link but can slide longitudinally along the link between a first position where it does not obstruct the side opening of the recess, and a second position where it can be tightened to clamp the stub shaft in the recess.

A coupling of this type requires the tightening of one bolt only in order to properly secure the steering shaft to the stub shaft, and furthermore the bolt is retained captive on the column so cannot be dropped during assembly.

Preferably the bolt is constructed so that it cannot rotate once the stub shaft has been correctly positioned in the recess, and a nut fitted to the bolt can then be tightened with a single tool.

The recess can conveniently be a generally V-shaped channel which can be formed from a metal plate suitably folded. The two opposing flanks which define the open side of the recess can have parallel slots in them, and the bolt can pass through these slots and be longitudinally slidable in the slots. The slots may be parallel to the axis of the recess or may have two connected parallel regions at different distances from the centre of the slot, so that the bolt is directed towards the centre of the recess as it approaches one end of the slot.

The bolt can have a region between its ends which is non-round and which is arranged to locate against the stub shaft to prevent rotation of the bolt while a nut

is being tightened on it. If the non-round region on the bolt is larger than the width of the slot where the bolt lies in its pinion-securing position, then even if the nut on the bolt should work loose, the stub and steering shafts will remain connected.

The bolt may have a tapered non-round region so that as a nut is tightened on the bolt, the shaft is forced tightly into the recess on the connecting link.

The bolt may be secured to a sleeve which can slide along the link between the first and second positions. The sleeve can have two spaced sides with the bolt extending between them. Tightening of a nut on the bolt then draws the two sides together to clamp the pinion. Alternatively, the sleeve may completely encircle the link and the bolt may be directed radially through a threaded bore on the sleeve and may be tightened directly against the stub shaft in the recess. In this case, no separate nut is required.

The invention also relates to a steering column arrangement in a motor vehicle where a steering column with a coupling as set forth above is connected to a stub shaft attached to a steering gear operating member, typically the pinion of a rack and pinion steering gear.

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

Figure 1 is a side view of a first embodiment of a steering column coupling in accordance with the invention;

Figure 2 is a cross section through the coupling of Figure 1 on the line II-II;

Figure 3 is a side view of a second embodiment of a steering column coupling in accordance with the invention;

5 Figure 4 is a cross section through the coupling of Figure 3 on the line IV-IV;

Figure 5 is a section through the bolt of Figure 4 on the line V-V;

10 Figure 6 is a side view of a third embodiment of a steering column coupling in accordance with the invention;

Figure 7 is a cross section through the coupling of Figure 6 on the line VII-VII;

15 Figure 8 is a side view of a fourth embodiment of a steering column coupling in accordance with the invention; and

Figure 9 is a cross section through the coupling of Figure 8 on the line IX-IX.

20 Figure 1 shows the lower end 10 of a steering column ending in a fork 12, and a stub shaft 14 which projects through a bulkhead 16 and is attached to a steering gear (not shown) on the other side of the bulkhead.

25 Connected to the fork 12 at the lower end of the column, through a conventional universal joint, is a link 18. As can be seen in Figure 2, the link is formed from sheet metal bent to form a V-shaped channel, and the stub shaft end 14 (which has a complementary shape) fits into the recess.

The two sides 18a and 18b of the link are connected by a bolt 20 which passes through slots 22, 24 and carries a



nut 26. The bolt has a head 28 and an enlarged centre 30 which is non-round. Neither the head nor the enlarged centre can pass through the slot 22, but at one end the slot 22 has an opening 32 through which the bolt can be assembled to the link.

The slots 22, 24 have a dog-leg shape so that most of the longitudinal sliding movement is carried out away from the position of the shaft 14. It is just in the final part of this movement that the bolt approaches the stub shaft and the non-round portion 30 jams against the shaft so that the bolt is held against rotation, and the nut 26 can be tightened. It will however be apparent from the dispositions of all the parts that even if the bolt 26 should work loose or even fall off the bolt, the bolt will still secure the shaft 14 and the link 18 together and enable steering efforts to be transmitted.

In use, the bolt is slid to the top end of the slots, nearest the bottom end of the column 10. The column is positioned in the vehicle and the link is positioned as shown by the chain-dotted lines in Figure 1. Once the bottom end of the column and the stub shaft 14 are correctly aligned, then the link 18 is pivoted so as to locate on the stub shaft. The bolt 20 is slid along the slots 22, 24 to the lower ends of the slots, and is tightened there.

Figures 3, 4 and 5 show an alternative arrangement where the slots 122, 124 are straight and where the bolt 120 has a tapering, square non-round portion 130. The slot 122 is wider than the slot 124 to allow the bolt to be positioned. Because of the cross-sectionally asymmetric shape of the stub shaft 114, tightening of the nut on the tapered bolt both squeezes the two sides of the link and also forces the stub shaft into the base of the V-shaped recess.

Figures 6, 7, 8 and 9 show further alternative constructions. In Figures 6 and 7, a sleeve 234 supports the bolt 220 and slides along the link 218 between two end positions. The non-round region of the bolt will prevent the bolt from turning by contacting either the stub shaft 214 or the side walls of the link 218, or both.

In Figures 8 and 9, a sleeve 334 has a tapped hole 336, and a set screw 338 is threaded into the hole. The sleeve is slidable along the link as in the embodiment of Figures 6 and 7, and once it is finally positioned, the screw is tightened against the stub shaft 314.

Using the constructions described here, it is possible to secure the steering column/steering rack joint without having to position any loose small parts such as nuts and bolts in the cramped working area of a vehicle footwell. The column itself can be accurately positioned and secured before the joint is secured, and tightening of the joint to complete the securing process requires only one tool to torque up a nut on a thread which is held fast against rotation.

In the embodiment of Figures 1 and 2 in particular, even if the nut 26 works loose, or falls off the joint will still stay secure.

CLAIMS

1. A steering column coupling for coupling to a non-round stub shaft which is connected to a steering rack operating member and is adapted to be turned about a longitudinal axis to operate the steering rack, the coupling comprising a connection link pivoted to the lower end of a steering shaft, the link having a longitudinal recess with a cross-section complementary to that of the stub shaft, the recess being open at one side to receive the shaft and the link including a bolt which can be tightened to clamp the shaft in the recess, the bolt being arranged so that it is captive on the link but can slide longitudinally along the link between a first position where it does not obstruct the side opening of the recess, and a second position where it can be tightened to clamp the stub shaft in the recess.

2. A coupling as claimed in Claim 1, wherein the bolt is constructed so that it cannot rotate once the stub shaft has been correctly positioned in the recess, and so that a nut fitted to the bolt can then be tightened with a single tool.

3. A coupling as claimed in Claim 1 or Claim 2, wherein the recess is a generally V-shaped channel.

4. A coupling as claimed in Claim 3, wherein the recess is formed from a metal plate suitably folded.

5. A coupling as claimed in any preceding claim, wherein two opposing flanks which define the open side of the recess have parallel slots in them, and the bolt can pass through these slots and be longitudinally slidable in the slots.

6. A coupling as claimed in Claim 5, wherein the slots are straight and parallel to the axis of the recess.

5 7. A coupling as claimed in Claim 5, wherein the slots have two connected parallel regions at different distances from the centre of the slot, so that the bolt is directed towards the centre of the recess as it approaches one end of the slot.

10 8. A coupling as claimed in any preceding claim, wherein the bolt can have a region between its ends which is non-round and which is arranged to locate against the shaft to prevent rotation of the bolt while a nut is being tightened on it.

15 9. A coupling as claimed in Claim 8, wherein the non-round region on the bolt is larger than the width of the slot where the bolt lies in its shaft-securing position.

20 10. A coupling as claimed in Claim 8 or Claim 9, wherein the bolt has a tapered non-round region so that as a nut is tightened on the bolt, the shaft is forced tightly into the recess on the connecting link.

11. A coupling as claimed in any preceding claim, wherein the bolt is secured to a sleeve which can slide along the link between the first and second positions.

25 12. A coupling as claimed in Claim 11, wherein the sleeve can have two spaced sides with the bolt extending between them.

30 13. A coupling as claimed in Claim 11, wherein the sleeve completely encircles the link and the bolt is directed radially through a threaded bore on the sleeve so that it may be tightened directly against the shaft in the recess.

14. A steering column arrangement in a motor vehicle where a steering column with a coupling as claimed in any preceding claim is connected to a stub shaft attached to a steering gear operating member.

5 15. A steering column arrangement as claimed in Claim 14, wherein the steering gear operating member is the pinion of a rack and pinion steering gear.

16. A steering column coupling, substantially as herein described with reference to any one of the  
10 embodiments shown in the accompanying drawings.