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VERIFICATION OF TRANSLATION

I, Michael Wallace Richard Turner, Bachelor of Arts, Chartered Patent Attorney, European Patent Attorney, technical translator, of 1 Horsefair Mews, Romsey, Hampshire SO51 8JG, England, do hereby declare that I am conversant with the English and German languages and am a competent translator thereof and I state that to the best of my knowledge and belief the following is a true translation of the attached documents in the German language of International Application PCT/EP97/03124.

M W R Turner

(M W R Turner)

Signed this 15th day of December 1998

PCT WORLD INDUSTRIAL PROPERTY ORGANISATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED IN PURSUANCE OF THE PATENT CO-OPERATION TREATY (PCT)

(51) International Patent Classification[6] : A1
B26D 17/00, B60G 13/00

(11) International Publication No:
WO 97/48588

(43) International publication date:
24th December 1997 (24.12.97)

(21) International application No:
PCT/EP97/03124

(22) International filing date:
16th June 1997 (16.06.97)

(30) Priority data:
296 10 634.8 17th June 1996 (17.06.96) DE

(81) Designated States:
AL AM AT AU AZ BA BB BG BR BY CA CH CN CU CZ DE DEK EE ES FI GB GE GH HU IL IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK TJ TM TR TT UA UG US UZ VN YU ARIPO patent (GH KE LS MW SD SZ UG ZW) Eurasian patent (AM AZ BY KG KZ MD RU TJ TM), European patent (AT BE CH DE DK ES FI FR GB GR IE IT LU MC NL PT SE), OAPI Patent (BF BJ CF CG CI CM GA GN ML MR NE SN TD TG).

Published
with international search report.
Before expiry of the period allowed for amendments in the claims. Publication is repeated if amendments are received.

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Camber adjustment arrangement

(57) Abstract

A screw bolt (50) has shank portions (51, 54, 55) of different thicknesses which are arranged along two mutually displaced axes (50a, 50b) and co-operate with securing walls (8, 9) of a spring strut and with a steering knuckle (10) respectively in the manner of cams or eccentrics in order to adjust the camber between the spring strut and the wheel suspension.

Camber adjustment arrangement

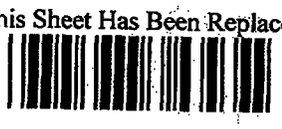
The invention relates to an arrangement for camber adjustment between the spring strut and the wheel suspension having the features set forth in the classifying portion of claim 1.

In four-wheeled automobiles the stub axle of the front wheels does not extend precisely horizontally but is slightly inclined, that angle of inclination or the angle of the plane of the wheel relative to the vertical being referred to as the camber. The camber angle is usually fixed at the factory and under normal circumstances does not have to be re-adjusted before the end of the service life of the automobile. After accidents have occurred however it can happen that the tracking of the wheels of the automobile has changed so that it is desirable to be able to adjust the angles which influence tracking, including camber. The same applies in regard to certain repairs or structural modifications to the vehicle.

It is known for the holder of the spring strut to be provided with at least one slot in order to be able to displace the steering knuckle relative to the spring strut before the screws passing therethrough are tightened. Such displacement is effected when the screws are half-tightened by means of hammer blows and is therefore not very desirable, having regard to measuring instruments used. Therefore, the attempt has also already been made to find a gentler method of adjusting camber and use has been made of a washer with an eccentric contour which bears against an edge bar portion of the holder in order to move the screw shank in the slot when the washer is rotated. That procedure presupposes structural features on the holder, which are present on very few vehicles, not even on newer types of manufacturers of vehicles with the eccentric washer.

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The object of the present invention is to provide a simple way of effecting subsequent camber adjustment.

That object is attained by claim 1 and the further features of the appendant claims are directed to embodiments and further developments thereof.

For the purposes of adjusting camber, use is made of a screw with cam or eccentric, which connects the spring strut to the wheel suspension. Provided on the screw itself is a marking in order to indicate the angular position thereof in respect of the cam or eccentric. Starting from an extreme or limit position, a change in the angular position of the cam or eccentric changes the position of the steering joint in space, and therewith also the camber angle. The position once set is fixed by tightening the nut of the screw connection.

The invention is described with reference to the drawing in which:

Figure 1 is a side view of a spring strut with steering knuckle screwed thereto,

Figure 2 is a view on an enlarged scale in section taken along line II-II in Figure 1,

Figure 3 is a side view of a camber screw,

Figure 4 is a view in section taken along line IV-IV in Figure 3,

Figure 5 is a view in section through an alternative configuration, and

Figure 6 shows a further adjustment arrangement.

Referring to Figure 1 shown therein is a spring strut 1 which is supported at 2 on the bodywork of the vehicle and which has a spring strut support bearing 3, a coil spring 4, a piston rod 5 and a shock-absorber or damper cylinder 6. Secured to the damper cylinder 6 is a holder 7 which extends around the lower end of the cylinder 6 and can be welded thereto and has two securing walls 8 and 9 of side plate type configuration, for securing a stub axle carrier or steering knuckle 10 thereto. The steering knuckle 10 has a forked extension with two ends 11, 12

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which extend into the intermediate space 13 between the walls 8, 9. Mounted to the lower end of the steering knuckle 10 is a steering joint 20, the axis 21 of which, in space, defines the camber. The steering joint 20 is held by tie links 25 which are pivotably mounted to a front axle carrier (not shown).

As can be seen from Figure 2 the securing walls 8 and 9 of the holder 7 extend in mutually parallel relationship and define the intermediate space 13 into which the forked steering knuckle extension extends, with its ends 11, 12. Extending through the parts 7, 10 (Figure 1) are an upper bore 14 and a lower bore 15 through which extend an upper screw bolt 30 and a lower screw bolt 31 respectively. Accordingly each bore 14, 15 in the holder 7 has a (generally round) insertion bore region 18 (Figure 2) and a (generally round) exit bore region 19 and, in the steering knuckle 10, a cylindrical bore 17.

The screw bolt 30 has a head 32, a cylindrical trunnion portion or collar 33, a cylindrical shank 34 or neck, an eccentric 35 and a screwthreaded region 36. The radial position of the eccentric 35 is marked on the head 32 at 38, for example by a shallow hole, a burn spot or a notch. Fitted on to the trunnion portion 33 and the screwthreaded region 36 are washers 40, 41 and a nut 42 is screwed on to the screw bolt. The nut 42 is provided with a device for preventing the nut from coming undone of its own accord and is immovably tightened after adjustment of the components.

In order to permit adjustment of the components, the diameter of the neck 34 is about 2 mm smaller than the greatest width of the bore region 18. The same applies in regard to the dimensions of 36 and 19 while the eccentric 35 just fits into the bore 17.

The screw 30 can be turned from one piece; it is however also possible to secure a clip-like cam 39 in position in the middle region of the screw shank 34, for example by adhesive means, soldering or welding (see Figure

4). The screw 30 comprises high-strength steel which, in spite of a reduced diameter, can be prestressed to give the necessary contact pressure force of the washers 40, 41 when the nut 42 is tightened.

Adjustment of the camber is effected as follows:

It will be assumed that the screw 30 has been fitted through the bores 18, 17 and 19 with the marking 38 downwardly (that is to say on the connecting line relative to the screw 31) and the nut 42 has been tightened. The nut is screwed on to the screw until the washers 40, 41 bear against the walls 8, 9, more specifically with such a contact pressure that the washers 40 and 41 do not slip when the position of the steering knuckle 10 is adjusted. In that case, the screw 30 is turned clockwise or counter-clockwise, in which case the marking 38 indicates the direction in which the eccentric 35 or the cam points. The double-headed arrow 22 in Figure 1 shows the two directions in which the steering knuckle 10 can be displaced or the axis 21 inclined in order to correctly set the camber. When it has been found by measurement that the camber adjustment is correct, the nut 42 is tightened with a prescribed torque.

Depending on the camber range to be adjusted, one (30) or two (30+31) special screws according to the invention are used. The invention can be used in relation to cylindrical bores 18, 19 in the holder, but also in relation to slots in the holder. Respectively appropriate special screws are provided for different bore sizes so that it is possible to service practically all types of vehicle that occur.

Figure 5 shows an alternative configuration of the camber adjustment arrangement in a view in section similar to Figure 2. Instead of an integral eccentric 35, this arrangement uses a cam 39 which is fitted on to the screw bolt and which is provided with conical inclined insertion surface portions 39a. The cam 39 is fixedly connected to the shank 34 of the screw bolt 30, as described with

reference to Figures 3 and 4. The head 32 and the trunnion portion 33 however are replaced by a further screwthreaded region 37 and a nut 43. In addition the gaps between the bore regions 18 and 19 and the shank 34 and the screwthreaded region 36 respectively are filled by bushes or sleeves 44 and 45 so that the screwthreaded bolt 30 is held in central relationship with the bore regions 18 and 19. The other parts correspond to the parts described with reference to Figure 2.

Assembly of the screw bolt shown in Figure 5 is as follows:

The damper cylinder 6 with its holder 7 is so oriented with respect to the steering knuckle 10 that the screws 30 and 31 can be fitted through the bores 14 and 15. In that respect, the bevel portions 39a on the cam 39 are advantageous. If not already done, the nut 43 is unscrewed and the damper cylinder 6 or the steering knuckle 10 is moved in such a way that the bushes or sleeves 44 and 45 can be fitted into the bore regions 18 and 19. The washers 40 and 41 are then fitted on to the respective ends of the screw bolt 30 and the nuts 42 and 43 are screwed on. The nut 43 is to be converted in function to act as a screw head, and for that reason it is possible to apply a two-component adhesive to appropriate locations of the screwthread of the nut 43 or the screwthread region 37 respectively, before the nut 43 is screwed on. Provided on the nut 43 is the marking 38 which is turned in the same radial direction as the cam 39. After hardening of the two-component adhesive, camber adjustment can be implemented, as already described with reference to Figure 2.

Fixing of the nut 43 to form the screw head can also be effected by means of a spot weld which can then form the marking 38 at the same time.

The embodiment shown in Figure 5 has the advantage that, besides the cam 39 fitted on to the bolt, it is possible to operate with conventional parts. It will be appreciated that in that respect a high-strength material

is adopted for the screw bolt in order to compensate for the reduction in diameter by about 2 mm which occurs in comparison with the original configuration for securing the damper cylinder and the steering knuckle to each other, when involving cylindrical bores 18 and 19 in the walls 8 and 9 of the holder 7. The invention therefore makes it possible to implement subsequent camber adjustment even in cases when no provision had been made for such camber adjustment from the outset (due to the absence of slots or relatively wide bores).

The embodiment of Figure 5 can also be modified in such a way that the end with the screwthreaded region 37 has a device for rotating the bolt shank 34, for example a recess configuration. In such a case the marking 38 is provided on the bolt shank 34 in order to indicate the radial orientation of the cam 39, on the outside. Similar nuts 42 and 43 are then adopted. This modified embodiment is easier to dismantle although dismantling that is still easy is also afforded by heating the two-component adhesive in the case of the embodiment shown in Figure 5.

Figure 6 shows a further embodiment of the camber adjustment arrangement. Parts which are the same as parts described hereinbefore are denoted by the same references. This arrangement uses a screw 50 with an axis 50a, relative to which an eccentric axis 50b is formed at a spacing e. Disposed on the eccentric axis 50b are a shank portion 51 and a further shank portion 54. The other elements of the screw 50 are disposed symmetrically with respect to the axis 50a, more specifically the head 52, a trunnion portion or shoulder 53, a cam projection 55 and a screwthreaded region 56. The elements 53, 55 and 56 are of the same outside diameter, for example 16 mm. The diameter of the elements 51 and 54 is then 14 mm. It is however also possible to use other dimensions, for example 14 mm for the elements 53, 55 and 56 and 12 mm for the elements 51 and 54. Finally, it is also possible for the elements 53 and 55 to be somewhat thicker than the element 56, for example 17

mm in comparison with M16 of the screwthreaded region 56 or 15 mm in comparison with M14 of the screwthreaded region 56. For the length of the screw without a head, a range of between 75 and 95 mm is envisaged. The screw bolt 50 is drop-forged in the rough condition and the screwthread is produced in conventional manner. The material used for the screw bolt is high-strength steel, the strength of which is greater than that of the screws usually employed for securing the spring strut 1 to the steering knuckle 10.

The camber adjustment arrangement is used as follows:

First of all the wheel camber of the vehicle at which camber adjustment is to be effected is ascertained. The wheels on the axle in question of the vehicle are removed. The screw at the position 30 in Figure 1 is released and removed. In its place, the screw 50 is fitted at the bore 14 which is now empty. It is to be noted that the correct screw size and length are to be selected from the set provided. Additional holders which were possibly previously removed are fitted as previously. Thereafter, the camber is set to its maximum negative or positive angular value, with the marking 58 on the screw 50 facing inwardly for negative camber and outwardly for positive camber. By applying a pulling or pushing force, the wheel carrier of the vehicle is moved into an end position as corresponds to the position of the marking 58 on the screw 50. The connection formed is arrested by slightly tightening the nut 42 so that no change in the camber occurs when the loading due to the weight of the vehicle is applied. The wheel or wheels is or are now fitted and the measuring apparatus for measuring camber is installed. The screw 50 is rotated at the screw head 52, whereby the walls 8 and 9 of the holder 7 are displaced relative to the steering knuckle 10. The head 52 is rotated until the desired camber angle is achieved. The wheel in question is then carefully removed again without changing the camber adjustment made. The screw connection is fixed by tightening the nut 42 (without altering the position of the head 52) and by tightening the

nut on the screw 31, using a torque of between 90 and 110 Nm. The wheel is fitted again and the wheel bolts or nuts are tightened to the prescribed torque. Care is taken to ensure that the tire of the wheel has sufficient spacing relative to all fixed parts of the vehicle.

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CLAIMS

1. An arrangement for camber adjustment between a spring strut and a wheel suspension, comprising the following features:

the spring strut (1) has a holder (7) which is secured to the damper cylinder (6) and has two parallel securing walls (8, 9) which define an intermediate space (13) and are provided with two bores (14, 15) which each have an insertion bore region (18) and an exit bore region (19);

the wheel suspension has a steering joint (20) which is connected to the holder (7) by way of a steering knuckle (10), wherein the steering knuckle (10) extends with a steering knuckle extension (11, 12) into the intermediate space (13) of the holder (7) and the steering knuckle extension has two transverse bores (17) which are aligned with the bores (18, 19) of the holder (7);

screw bolts which extend through the bores in the holder and the transverse bores in the steering knuckle extension secure the steering knuckle (10) to the spring strut (1) by virtue of nuts (42) which are each screwed on to a respectively associated screwthreaded region (36, 56);

characterised by the following features:

at least one screw bolt is in the form of an adjustment screw bolt (30, 50) and has shank portions (34, 36; 51, 54; 35; 39; 55) of different thickness dimensions, which are partially displaced with respect to the axis of the screw bolt, wherein there is an axis displacement between the shank portions (34, 36; 51, 54) co-operating with the securing walls (8, 9) and the shank portion (35; 39; 55) co-operating with the steering knuckle (10); and

the adjustment screw bolt (30, 50) includes a marking (38, 58) which indicates the angular position of the axis displacement.

2. An arrangement as set forth in claim 1 characterised in that the adjustment screw bolt (30) has a

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shank portion (34) and a further shank portion with screwthreaded region (36) of smaller diameter for co-operation with the securing walls (8, 9) and a cam or eccentric region (35; 39) of larger thickness dimension for co-operation with the steering knuckle (10).

3. An arrangement as set forth in claim 1 characterised in that the adjustment screw bolt (50) has two shank portions (51, 54) of smaller diameter for co-operation with the securing walls (8, 9) and a shank portion (55) of larger diameter for co-operation with the steering knuckle (10).

4. An arrangement as set forth in claim 3 characterised in that the screwthreaded region (56) is of a diameter which is larger than the smaller diameter and which can correspond to the larger diameter.

5. An arrangement as set forth in one of claims 1 through 4 characterised in that the axis displacement is about 2 mm.

6. An arrangement as set forth in one of claims 1 through 5 characterised in that the screw bolt includes a screw head (32, 52) on which the marking (38, 58) is provided.

7. An arrangement as set forth in one of claims 1 through 5 characterised in that the screw bolt has a shank (34) with screwthreaded regions (36, 37) at both ends, that the shank (34) is surrounded by bushes (44, 45) to fill gaps in relation to the securing walls (8, 9) of the holder, and that an end of the shank (34) is prepared for rotation of the shank.

8. An arrangement as set forth in claim 7 characterised in that the end of the shank, which is

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prepared for rotary actuation, includes a nut (43) which is secured by adhesive to the screwthreaded region (37) of the prepared end.

9. An arrangement as set forth in claim 7 characterised in that the end of the shank, which is prepared for rotary actuation, has a recess configuration.

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