AUSTRALIAN PATENT ABSTRACT

AUSTRALIA

(12) AUSTRALIAN PATENT ABSTRACT
(19) AU
(11) AU-A-90164/82
APPLICATION FOR A STANDARD/PRIORITY PATENT

I/We (c) GENERAL MOTORS CORPORATION

of (d) P.O. Box 242
Delaware Drive
Milton Keynes, MK15 8HA
England

hereby apply for the grant of a (c) Standard/Priority Patent for an invention entitled

(f) AIR SPRING SHOCK ABSORBER SUSPENSION STRUT FOR A VEHICLE

which is described in the accompanying (a) complete specification.

(Note: The following applies only to Convention applications)

Details of basic application(s)

(h) Insert number, country and filing date for their EACH basic application.

<table>
<thead>
<tr>
<th>Application No.</th>
<th>Country</th>
<th>Filing Date</th>
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<tr>
<td>324490</td>
<td>United States of America</td>
<td>24 November, 1981</td>
</tr>
</tbody>
</table>

Address for Service:

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Dated (i) 3 November, 1982

(k) By their Patent Attorneys:

PHILLIPS ORMONDE & FITZPATRICK.

This invention relates to an air spring shock absorber suspension strut for a vehicle.
In support of the (a) Convention application made by GENERAL MOTORS CORPORATION (hereinafter called "the applicant") for a patent (c) for an invention entitled:-

AIR SPRING SHOCK ABSORBER SUSPENSION STRUT FOR A VEHICLE

1. John Neil Bower Breakwell, Chartered Patent Agent of General Motors Limited, P.O. Box 242, Delaware Drive, Milton Keynes, MK15 8HA, England do solemnly and sincerely declare as follows:-

1. I am authorized under a power of attorney from the applicant granted on 1st January 1975 to make this declaration on behalf of the applicant.

2. (f) Wayne Vincent Fannin
   2098 Upper Bellbrook Road
   Xenia, Ohio 45385
   U.S.A.

   James Mitchell Pees
   634 Britton Drive
   Dayton, Ohio 45429
   U.S.A.

   is/are the actual inventor(s) of the invention and the applicant is entitled to make the application by virtue of a service agreement(s) between the applicant and the inventor(s) as employee(s) and an assignment(s) from the inventor(s) to the applicant.

3. The basic application(s) for patent or similar protection on which the application is/are identified by country, filing date and basic applicant(s) as follows:

   United States of America
   24 November 1981
   Wayne Vincent Fannin
   James Mitchell Pees

4. The basic application(s) referred to in paragraph 3 hereof were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at: Milton Keynes
Dated: 22 October 1982

For and on behalf of GENERAL MOTORS CORPORATION

Under Power of Attorney

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seal for the upper end portion of the tubular sleeve.

Such an air spring shock absorber suspension strut permits an advanced and improved connection and sealing of the tubular sleeve of elastomeric material
Claim

1. An air spring shock absorber suspension strut for connection between sprung and unsprung portions of a vehicle, in which a telescopic shock absorber adapted to be mounted in an upright position in the vehicle comprises an elongate cylindrical support casing having a lower end portion connectible to the unsprung portion of the vehicle, and a motion-damping piston mounted for reciprocatory movement within the casing, with a piston rod therefor extending from the casing and having an upper end portion connectible to the sprung portion of the vehicle, an outer tubular member is mounted at an upper portion thereof on the piston rod and surrounds a portion of the cylindrical support casing, an upper fitting has a cylindrical wall fitted on to an upper portion of the cylindrical support casing, a tubular sleeve of elastomeric material has a lower end portion sealingly connected to the outer tubular member and an upper end portion sealingly connected to the cylindrical wall of the upper fitting, and static fluid seal means is operatively disposed between the upper fitting and the cylindrical support casing to provide a pneumatic seal for the upper end portion of the tubular sleeve.
The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

AIR SPRING SHOCK ABSORBER SUSPENSION STRUT FOR A VEHICLE
AIR SPRING SHOCK ABSORBER SUSPENSION STRUT FOR A VEHICLE

This invention relates to an air spring shock absorber suspension strut for a vehicle.

Prior air spring strut and load levelling shock absorber units, for example as disclosed in our United States Patent 3,063,701 (Long, Jr.) issued November 13, 1962, have provided highly desirable vehicle suspension and levelling characteristics with good service life. Such constructions, although providing exceptional ride and levelling control, often require replacement of the air spring after extended service use or after accidental damage. Prior to the present invention, rebuild of the air spring for levelling type shock absorber and suspension strut units has tended to be relatively difficult and time-consuming.

By the present invention there is provided an air spring shock absorber suspension strut for connection between sprung and unsprung portions of a vehicle, in which a telescopic shock absorber adapted to be mounted in an upright position in the vehicle comprises an elongate cylindrical support casing having a lower end portion connectible to the unsprung portion of the vehicle, and a motion-damping piston mounted for reciprocatory movement within the casing, with a piston rod therefor extending from the casing and having an upper end portion connectible to the sprung portion of the vehicle, an outer tubular member is mounted at an upper portion thereof on the piston rod and surrounds a portion of the cylindrical support casing, an upper fitting has a cylindrical wall fitted on to an upper portion of the cylindrical support casing, a tubular sleeve of elastomeric material has a lower end portion sealingly connected to the outer tubular member and an upper end portion sealingly connected to the cylindrical wall of the upper fitting, and static fluid seal means is operatively disposed between the upper fitting and the cylindrical support casing to provide a pneumatic
seal for the upper end portion of the tubular sleeve.

Such an air spring shock absorber suspension strut permits an advanced and improved connection and sealing of the tubular sleeve of elastomeric material (constituting an air sleeve) with a simple slip fit of the upper fitting to the elongate cylindrical support casing (which may constitute a reservoir tube). This upper fitting, to which the upper end portion of the air sleeve may be previously clamped to provide a pre-installed assembly, has the potential to establish a positive and highly effective air seal to enhance the replacement of used sleeves. After installation of the upper fitting and the replacement air sleeve, the lower end of the air sleeve can be readily attached to the dust tube or like construction by means of a simple and conventional hose clamp.

With this invention, therefore, the upper and lower sealing of the replacement air spring is improved to an extent permitting repair to be readily accomplished by a wide range of users including those with only average mechanical skills.

In the drawings:

FIG 1 is a longitudinal section, with parts broken away and in elevation, of a preferred embodiment of an air spring shock absorber suspension strut in accordance with the present invention;

FIG 2 is an enlarged view of a portion of the suspension strut shown in FIG 1; and

FIG 3 is a cross-sectional view of a factory-build air spring shock absorber suspension strut prior to being serviced with a new elastomeric air spring sleeve in conformity with the present invention.

In the drawing, Figures 1 and 2 show an air spring shock absorber
suspension strut 10 with a rebuilt air spring 12, operatively disposed between sprung and unsprung portions of a vehicle. The strut 10 has an elongate cylindrical support casing constituting a reservoir tube 14 that is mounted in a cup-like retainer 16 connected to an axle, wheel assembly or other part of an unsprung portion 18 of the vehicle. The suspension strut 10 incorporates a valved piston 19 mounted for sliding reciprocal movement in an oil-filled cylinder tube 20. The space between the cylinder tube 20 and the reservoir tube 14 forms a reservoir 21 for hydraulic working fluid (oil) for the strut, and is connected to a compression chamber 22 in the cylinder tube by a base valve 23. A cylindrical piston rod 24 is attached by welding to the piston 19 and extends in an upward direction slidably through a generally cylindrical piston rod guide 26 press-fitted in the upper end portion of the cylinder tube 20. An annular elastomeric seal 28, seated in a counterbore recess in the upper end portion of the rod guide 26, surrounds and sealingly engages the piston rod 24. The seal 28 is held in the recess in the rod guide 26 by a cylindrical end cap 32 press-fitted into the upper end of the reservoir tube 14. The rod guide 26 and seal construction blocks the passage of oil from the interior of the cylinder and reservoir tubes and prevents entry of foreign matter from the exterior into these tubes.

The piston rod 24 extends through the end cap 32 to the exterior, and is connected at its upper end portion to an elastomeric isolator 34 of an upper mount assembly 36 that is in turn secured to the sprung portion 38 of the vehicle. In this preferred embodiment, the piston rod 24 projects through a tubular connector 40 that is embedded in the elastomeric isolator 34, and a nut 42 is threaded on to the end of the piston rod to trap the isolator thereon, as shown in FIG 1. A
sleeve-like carrier member 46 is securely mounted on the piston rod 24 near the upper end thereof for supporting a generally cylindrical elastomeric cushion spring 48. An annular O-ring 49 is disposed between the piston rod and the inner wall of the carrier member 46 to provide sealing in this area. The cushion spring 48 is disposed immediately below the upper mount assembly 36, and, being made of a resilient elastomer material, deflects when the strut components telescope together, to cushion compression loads experienced by the strut.

The cushion spring 48 is grooved at 52 to provide an annular recess to receive a disc-like end plate 54 of an outer tubular member constituting a dust tube 56. The dust tube 56 has a cylindrical wall which extends downwardly from its connection region with the end plate 54 to surround a portion of the reservoir tube 14 as well as the cushion spring 48 and other components of the strut.

The air spring 12 of the strut comprises a tubular sleeve 60 of resilient elastomeric material having its upper end secured in fluid-tight fashion by an annular hose clamp 68 to the cylindrical wall 64 of an upper fitting 66. The upper fitting 66 is formed as a metallic cup-like member which has a central opening 70 in its upper end wall to permit passage of the piston rod 24.

The cylindrical wall 64 of the upper fitting 66 closely fits over the wall of the reservoir tube 14, and is formed with inwardly extending tang-like depressions, dimples or an annulus, to provide a spring retainer 72 for the upper fitting. This spring retainer 72 is received in push-on fashion in an annular retainer groove 74 formed in the reservoir tube 14, and thereupon retained by a radially extending wall of the groove, such that the upper fitting 66 is secured to the reservoir tube 14. Disposed below the mechanical attachment
provided by the spring retainer 72 and retainer groove 74 are a pair of O-rings 76 disposed in an annular groove 77 formed in the reservoir tube; these O-rings 76 sealingly engage the inner wall of the upper fitting 66, and so contribute to pneumatic sealing of the upper end portion of the sleeve 60. Washer-like spacers 78 are installed on the end cap 32 prior to installation of the fitting 66.

The hose clamp 68 is factory-constricted, for example by magneforming (magnetic deformation), to sealingly connect the upper end portion of the sleeve 60 to the upper end region of the upper fitting 66. The sleeve 60 and upper fitting 66, and the O-ring seals 76, may be supplied as a repair or replacement kit for the original-equipment strut shown in FIG 3.

From the magneformed hose clamp 68, the sleeve 60 extends downwardly around the reservoir tube 14 and is reversely curved to form an annular rolling lobe 80. From the lobe 80 the sleeve extends upwardly around the lower end portion of the dust tube 56, to which it is secured by a clamping band 82. This clamping band 82 has a worm screw 84 that is fixed to one end of the band and engages a series of slots 86 formed in the other end portion of the band, the band being tightened or loosened as desired by appropriate turning of the worm screw 84, for example by a screwdriver or other tool. With the band 82 sufficiently tightened around the lower end of the sleeve 60, a pneumatic seal is accomplished to complete the air spring 12. Suitable fittings (not illustrated) can be provided in the wall of the dust tube for connection to a level control system such as that shown in U.S. Patent 4,168,840 (Graham), issued September 25, 1979.

FIG 3 shows the strut as originally manufactured with an upper end portion of an elastomeric tubular sleeve.
30 fastened directly to the reservoir tube 14 by a hose clamp 92 magneformed or otherwise constricted to provide a pneumatic seal between the sleeve and the reservoir tube. Annular grooves 74 and 77 formed in the reservoir tube accommodate the spring retainer tangs 72 and the O-ring seals of the rebuild kit as explained in connection with FIGS 1 and 2. The lower end portion of the sleeve 90 is secured to a lower end portion of the cylindrical wall 56 of the dust tube and by a hose clamp 94 magneformed or otherwise shrunk to provide the pneumatic seal required to establish the original air suspension spring.

If the original air spring of FIG 3 should require replacement, the hose clamp 94 can be severed and removed. After uncoupling of the upper mount assembly 36 from the sprung portion 38 of the vehicle, the nut 42, the upper mount assembly cushion spring 48, the dust tube 56 and the worn sleeve 90 and upper clamp 92 are removed from the strut. After such removal, the washer-like spacers 78 are stacked on the end cap 32 and the O-ring seals are installed in the groove 77. The new air spring tubular sleeve 60 is then axially advanced over the reservoir tube until the upper fitting 66 slips into its fitted position on the reservoir tube, with the retainer tangs 72 snapping into the annular retainer groove 74. The hose clamp 58, previously factory installed, co-operates with the seal provided by the O-rings 76 to complete the sealing of the upper end of the air spring. The free end of the sleeve 60 is then reversely curved and the lower end thereof is stretched around the lower end of the dust tube, re-assembled with the cushion spring 48, to receive the clamping band 82 which can be readily installed by the ordinary mechanic. With the new air sleeve and the upper mount assembly and nut in position, the rebuilt air strut vehicle can be re-installed on the vehicle and re-attached to the levelling system for levelling or
In this way there is provided a new and improved serviceable vehicle suspension unit in which a replacement elastomeric air sleeve is connected at one end to a special fitting which slip-fits with pneumatic sealing on to one end of a tubular component of the suspension unit, so permitting the ready attachment of the other end of the air sleeve to the unit by the application of a simple hose clamp construction to establish an air suspension spring.
The claims defining the invention are as follows:

1. An air-spring shock absorber suspension strut for connection between sprung and unsprung portions of a vehicle, in which a telescopic shock absorber adapted to be mounted in an upright position in the vehicle comprises an elongate cylindrical support casing having a lower end portion connectible to the unsprung portion of the vehicle, and a motion-damping piston mounted for reciprocatory movement within the casing, with a piston rod therefor extending from the casing and having an upper end portion connectible to the sprung portion of the vehicle, an outer tubular member is mounted at an upper portion thereof on the piston rod and surrounds a portion of the cylindrical support casing, an upper fitting has a cylindrical wall fitted on to an upper portion of the cylindrical support casing, a tubular sleeve of elastomeric material has a lower end portion sealingly connected to the outer tubular member and an upper end portion sealingly connected to the cylindrical wall of the upper fitting, and static fluid seal means is operatively disposed between the upper fitting and the cylindrical support casing to provide a pneumatic seal for the upper end portion of the tubular sleeve.

2. An air spring shock absorber suspension strut according to claim 1, in which the elongate cylindrical support casing comprises a reservoir tube of the telescopic shock absorber, an elongate cylinder tube having a hydraulic fluid therein is mounted within the reservoir tube and disposed inwardly therefrom to form an annular reservoir chamber for hydraulic fluid from the cylinder tube, the piston is slidably mounted in the cylinder tube, a piston rod guide slidably receives the piston rod and is mounted in the cylinder tube and closes the upper end thereof, and the outer tubular member comprises a dust tube that is sealingly connected to the upper end portion of the piston rod for movement with
An air spring shock absorber suspension strut according to claim 1 or 2, in which the cylindrical wall of the upper fitting is adapted to interlock with the elongate cylindrical support casing, to provide a pneumatically sealed mounting for the upper end of the tubular sleeve of elastomeric material to the elongate cylindrical support casing.

4. An air spring shock absorber suspension strut according to claim 3, in which the upper fitting has a push-on mechanical interlock with the elongate cylindrical support casing, constituted by inwardly extending tang-like depressions, dimples or an annulus on the upper fitting, for co-operation with an annular retainer groove formed in the cylindrical support casing.

5. An air spring shock absorber suspension strut according to any one of claims 1 to 4, in which the upper fitting has a cup-shaped configuration.

6. An air spring shock absorber suspension strut according to any one of claims 1 to 5, in which the lower and upper end portions of the tubular sleeve of elastomeric material are sealingly connected to the outer tubular member and to the cylindrical wall of the upper fitting respectively by means of respective annular clamping bands encircling the respective end portions.

7. An air spring shock absorber suspension strut according to claim 6, in which the tubular sleeve of elastomeric material, the upper fitting and the respective clamping band together constitute a pre-installed assembly which, for replacement purposes, is adapted to be installed by push-fitting the cylindrical wall of the

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the piston rod, with the tubular sleeve of elastomeric material constituting an air suspension spring operative between the sprung and unsprung portions of the vehicle.
upper fitting into a position of sealed locking engagement with the elongate cylindrical support casing of the telescopic shock absorber, with the outer tubular member temporarily removed, and then replacing the outer tubular member in position and sealingly connecting the lower end portion of the tubular sleeve of elastomeric material to the outer tubular member by applying an annular clamping band around the lower end portion of the tubular sleeve.

8. A method of servicing an air spring suspension strut according to any one of claims 1 to 7 having a hydraulic shock absorber operatively mounted within an outer support tube and having a worn cylindrical air sleeve of rubber-like material with one end connected by first encircling clamp means to the support tube and the other end connected by second encircling clamp means to a dust tube of the strut, the dust tube being removably connected to an upper end of a reciprocably movable piston rod of the shock absorber and co-operating with the air sleeve to form a chamber to receive pressurized air and provide a pneumatic spring between sprung and unsprung vehicle components, comprising the steps of removing the dust tube and the worn air sleeve from the strut, axially moving a replacement air sleeve and cylindrical upper fitting therefor over the outer support tube until the fitting locks in an air-tight manner on to the support tube, re-installing the dust tube to the strut, stretching the lower end of the replacement air sleeve around the lower end of the dust tube, and clamping the lower end of the air sleeve to the dust tube in an air-tight manner to complete the air sleeve replacement so that the interior of the air sleeve can be subsequently charged with pressurized air.

9. An air spring shock absorber suspension strut for connection between sprung and unsprung portions of a vehicle, substantially as hereinbefore particularly described and as shown in Figures 1 and 2 of the drawing.

DATED: 3 November, 1982

PHILLIPS ORMONDE & FITZPATRICK, Attorneys for: GENERAL MOTORS CORPORATION
DRAWINGS