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(54) IMPROVEMENTS IN VEHICLE SUSPENSIONS

(71) We: GIRLING LIMITED, a British Company of Kings Road, Tyseley, Birmingham 11, 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 improvements in suspension units for vehicle wheels, the suspension unit being of the kind in which a stub axle is carried by a substantially vertical telescopic strut of which the lower end is articulated by linkage to the vehicle chassis or frame and the upper end is supported in an anchorage allowing a limited degree of angular movement, the unit including a helical compression spring.

In U.K. Patent Specification No. 1,073,473 we have described and claimed a suspension unit of that kind in which the strut comprises a single tube hydraulic damper of which the cylinder carries a stub axle for the wheel and which incorporates an air or gas spring adapted to support a part of the load on the wheel and comprising a volume of air or gas under pressure located within the cylinder.

In the suspension unit described in that specification the air or gas spring is formed by a volume of air or gas under pressure confined between the closed lower end of the cylinder and a separator piston slidably mounted in the cylinder or a rolling diaphragm of which the periphery is secured to the cylinder wall.

According to our present invention, in a suspension unit of the kind set forth and as claimed in Claim 1 or 2 of U.K. Patent Specification No. 1,073,473 the volume of air or other gas which forms the gas spring is not confined but is allowed to rise to the upper end of the damper cylinder above the oil, and the piston-rod is carried through an assembly at the upper end of the cylinder incorporating a seal and a reservoir for oil in contact with the seal.

This oil lubricates the seal and prevents it from becoming dry and warping or cracking as might happen if the vehicle is out of action for prolonged periods.

One form of suspension unit embodying our invention is illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a longitudinal section of the unit; and

Figure 2 is a fragmentary section of a modified form of bearing and seal for the piston-rod of the damper.

In the unit shown in Figure 1, the damper comprises a cylinder 10 in which works a piston 11 carried by a piston-rod 12 extending through a bearing and seal at the upper end of the cylinder as described in more detail below. Passages through the piston 11 are controlled in the usual way by a valve or valves (not shown) allowing flow of oil through the piston in both directions against resistances determined by the loading of the valve or valves.

The lower end of the cylinder is secured into a socket in a fitting 13 which carries a stub axle 14 and is articulated to the vehicle frame for substantially vertical movement relative to the frame.

The upper end of the piston-rod is rotatably mounted in a bearing 15 in a rubber or other flexible mounting 16 on the frame, the mounting allowing a limited degree of angular movement.

Adjacent to the upper end of the cylinder the piston-rod 12 extends upwardly through a bearing sleeve 17 fixed in the cylinder. The bore of the sleeve may be fitted with a liner 18 of P.T.F.E. to reduce friction, or the surface of the bore may be impregnated with a material having a low co-efficient of friction.

The bearing sleeve is located axially in the cylinder by a circlip 19 received partly in an annular groove in the cylinder wall and partly in a registering annular recess in the sleeve. In another arrangement (not shown) a part of the recess in the sleeve is enlarged to receive

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the ends of the circlip and to allow the ends to be gripped by a pair of pliers or other tool for contracting the circlip and disengaging it from the groove in the cylinder wall when it is required to withdraw the sleeve from the cylinder.

Above the bearing sleeve 17 there is an oil seal 22 and above that there is an annular support 23 for the seal.

A scraper ring 24 is mounted in an annular recess in the upper surface of the seal support 23 which is retained in position by a spring ring 24' engaged in an annular groove in the cylinder wall.

There is an annular space 25 around the piston-rod between the underside of the oil seal 22 and the upper end of the bearing sleeve 17 which forms a reservoir for oil.

The cylinder is partially filled with oil and there is forced into it air or other gas at a pressure which will usually be of the order of 150 pounds per square inch.

The air or gas is not confined or kept separate from the oil and rises to the upper end of the damper cylinder above the oil.

The compressed air or gas in the damper cylinder acts as a spring which takes part of the load on the suspension, the remainder being taken by a helical compression spring 26 which fits over the upper part of the cylinder between abutments 27 and 28 on the cylinder and the piston-rod respectively.

When the vehicle is in use sufficient oil is carried up on the surface of the piston-rod past the bearing sleeve 17 to keep the space 25 full of oil. This oil lubricates the seal and keeps it flexible.

In the modified arrangement of the bearing sleeve and seal shown in Figure 2 the sleeve 17 is located axially by a circlip 29 which is contracted into an annular groove 31 in the periphery of the sleeve while the sleeve is inserted into the cylinder and expands into a complementary groove in the wall of the cylinder as the sleeve reaches its final position. An annular groove 32 is formed in the upper end of the bearing sleeve to increase the effective capacity of the reservoir.

WHAT WE CLAIM IS:—

1. A suspension unit for a vehicle wheel of the kind in which a stub axle for the wheel is carried by a substantially vertical telescopic strut of which the lower end is articulated by linkage to the vehicle frame and the upper end is supported by an anchorage allowing a limited degree of angular movement, the unit including a helical compression spring, and in which the strut comprises a single tube hydraulic damper of which the cylinder carries the stub axle and incorporates a gas spring adapted to support a part of the load on the wheel, characterised in that the gas spring is formed by a volume of air or other gas under pressure which is located within the cylinder and is not confined to any part of the cylinder but is allowed to rise to the upper end of the cylinder above the oil, and the piston-rod of the damper is carried through an assembly at the upper end of the cylinder incorporating an oil seal and a reservoir for oil in contact with the seal.

2. A suspension unit as in Claim 1 wherein the piston-rod extends through a bearing sleeve located in the upper part of the cylinder below the oil seal, and the reservoir for oil is formed by a space around the piston-rod between the bearing sleeve and the oil seal.

3. A suspension unit as in Claim 2 wherein part of the oil reservoir is formed by an annular groove in the upper end of the bearing sleeve.

4. A suspension unit as in Claim 1 wherein a scraper ring is located in the upper end of the oil seal and reservoir assembly.

5. A suspension unit for a vehicle wheel substantially as described with reference to and as shown in the accompanying drawings.

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There is an annular space 25 around the piston-rod between the underside of the oil seal 22 and the upper end of the bearing sleeve 17 which forms a reservoir for oil.

The cylinder is partially filled with oil and there is forced into it air or other gas at a pressure which will usually be of the order of 150 pounds per square inch.

The air or gas is not confined or kept separate from the oil and rises to the upper end of the damper cylinder above the oil.

The compressed air or gas in the damper cylinder acts as a spring which takes part of the load on the suspension, the remainder being taken by a helical compression spring 26 which fits over the upper part of the cylinder between abutments 27 and 28 on the cylinder and the piston-rod respectively.

When the vehicle is in use sufficient oil is carried up on the surface of the piston-rod past the bearing sleeve 17 to keep the space 25 full of oil. This oil lubricates the seal and keeps it flexible.

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WHAT WE CLAIM IS:—

1. A suspension unit for a vehicle wheel of the kind in which a stub axle for the wheel is carried by a substantially vertical telescopic strut of which the lower end is articulated by linkage to the vehicle frame and the upper end is supported by an anchorage allowing a limited degree of angular movement, the unit including a helical compression spring, and in which the strut comprises a single tube hydraulic damper of which the cylinder carries the stub axle and incorporates a gas spring adapted to support a part of the load on the wheel, characterised in that the gas spring is formed by a volume of air or other gas under pressure which is located within the cylinder and is not confined to any part of the cylinder but is allowed to rise to the upper end of the cylinder above the oil, and the piston-rod of the damper is carried through an assembly at the upper end of the cylinder incorporating an oil seal and a reservoir for oil in contact with the seal.

2. A suspension unit as in Claim 1 wherein the piston-rod extends through a bearing sleeve located in the upper part of the cylinder below the oil seal, and the reservoir for oil is formed by a space around the piston-rod between the bearing sleeve and the oil seal.

3. A suspension unit as in Claim 2 wherein part of the oil reservoir is formed by an annular groove in the upper end of the bearing sleeve.

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