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BELLOWS FOR MOTOR VEHICLE

The invention relates to a bellows according to the preamble to the Main Claim.

Such bellows are used above all in private cars. The material is not rubber but a material of the Hytrel type (registered trade mark of Messrs. Dupont). The walls of the bellows are thin. In their magnitude, they weigh 80 to 90 g. If such a bellows were to be made from rubber, then it would weigh, for instance, 140 g. The material used is expensive. It costs 18.-- DM per kg. It is true that rubber would be cheaper but it would not satisfy the demands in the same way. The demands are numerous in many directions: the steering deflection on the front wheel axle amounts to 43 to 46°. The bellows must follow this steering deflection. This is also true when the vehicle is moving. Then, the tendency of bellows is no longer to return to their original position, being to a certain extent pretensioned in the wrong direction. The axles of private cars can turn at 1500 r.p.m. The bellows have also to perform the steering turn-in as well as the speeds of revolution.

Also the bellows provided on the gearbox - farther inwards - nevertheless have to withstand a spring travel of about 15°.

From the temperature point of view, too, the bellows are subject to heavy loadings. They have to remain usable at temperatures from + 140°C to -40°C. The -40°C naturally comes from the outside temperature. The +140°C comes from the fact that particularly where the inner bellows are concerned, the heat radiated from the engine is an important factor.

The bellows must also withstand the gravel test, in which gravel is shot at the bellows, in the same way as occurs, for example, when a vehicle is running on crushed chippings. Then, furthermore, the bellows has to withstand chemical loadings caused by grease and oil. Furthermore, the material must not flow when clips are applied to the smaller diameter collar and the larger diameter collar. The bellows must be of such a form that mass production is possible. At present, about five per minute can be produced in multiple moulds.

On top of all this, the bellows must withstand considerable flexion work, and also when the bellows has been fitted with alignment errors which can never be entirely avoided. Although the bellows ought not to have any initial tension, when the steering lock is 0° and when the spring travel is in the neutral range, installation errors nevertheless occur which will occasion initial tension anyway and a bellows must be capable of withstanding this, too.

The object of the invention is to indicate a bellows which both combines all the hitherto enjoyed properties, sacrificing none of them, and also having a longer effective life, whether because there is less flexion work or whether the centrifugal forces are smaller because the mass is smaller, or whether it be that it cleans itself better or because the uniform thickness of the walls is better controlled.

According to the invention, this problem is resolved by the characterising part of the Main Claim. If the pitch of the spiral is selected the right way, then even any grease will be constantly transported to the joint, for example even if it tends to run off when the vehicle is at an angle. With such a spiral there is, of course, a continuously extending spiral bottom and an equally continuously extending spiral rib. This continuity is advantageous from the most widely diverse points of view.

In particular the features of Claim 2 mean that flexion work is

reduced because the total length of what is now the "single" crease is shorter than the overall length of the annular creases. In addition, weight is also saved, which is reflected in the costs and the reduced centrifugal force. Generally speaking, it can be said that a spiral bellows is also cleaned better.

The features according to Claim 2 again minimise the flexion work and less of the expensive material is required for production. Attention should be drawn to the fact that with mass produced items, a saving in the percentage range is already an extraordinary fact because other properties are also improved.

By reason of the features according to Claim 3, the spiral still folds up quite satisfactorily even with a considerable steering lock.

The optimum range is distinguished by the features of Claim 4.

The features of Claim 5 simplify manufacture.

As a result of the features according to Claim 6, the axle cuff becomes increasingly softer in relation to its possible degree of bend on steering lock, the closer one comes to the smaller diameter collar. This makes it possible for the cuff to adapt itself to the curvature then necessary. It further reduces the amount of flexion work. The restoring force is less.

By virtue of the features according to Claim 7, the bellows becomes softer in the area where bending of the bellows is intended to be at its greatest, according to whichever joint is to be protected.

Simplification of production is also provided for by the features according to Claim 8.

The features of Claim 9 make it possible better to adapt to the bellow bending requirements, which provides yet a further advantage particularly when the pitch of the spiral becomes smaller in this area.

The same can be said of the features according to Claim 10, if such behaviour is required in the larger diameter collar.

A less disturbing run-out is provided for by the features according to Claim 11.

The features of Claim 12 make it possible to provide for greater degrees of pitch while nevertheless the bellows can be finely sub-divided.

The invention will now be described with reference to preferred embodiments shown in the accompanying drawings, in which:

- Fig. 1 is a side view of a partly broken-away bellows;
- Fig. 2 is a view according to the arrow 2 in Fig. 1;
- Fig. 3 is a view similar to Fig. 1 but of a second embodiment;
- Fig. 4 is a view similar to Fig. 1 but of a third embodiment;
- Fig. 5 is a view similar to Fig. 2 but in the case of an embodiment having two bellows ribs.

A bellows 11 has a wall thickness 12 of 1.4 mm and is blown from Hytrel (R) (registered trade mark of Messrs. Dupont). The bellows 11 has a geometrical longitudinal axis 13 which in operation is also the geometrical longitudinal axis of the axle provided on a vehicle. Naturally, this axle only coincides with the geometrical longitudinal axis 13 when the joint to be protected is in its neutral position. In this case, the bellows 11 is without tension. Provided on the left is a circularly-cylindrical collar 14 which is coaxial with the longitudinal axis 13 and which ends on the left in a terminal rib 16.

The inner periphery of the collar 14 fits onto a corresponding but not shown projection on a vehicle and if correctly installed there is on the collar 14 a clip so that this portion is fluid-tight. Extending rightwardly from the collar 14 is a spiral 17. This has a sawtooth profile with, commencing on the left, a shallower flank 18 which extends rectilinearly in the manner

shown. This is followed by a bellows ridge 19 of relatively large radius (2 to 3 mm) and this is in turn followed by a flank 21 which likewise extends substantially rectilinearly but substantially more steeply to the longitudinal axis 13. The angle of the flank 21 to the longitudinal axis 13 amounts to about 80° while the angle of the flank 18 is about 60° .

The flank 21 extends downwardly into a bellows trough 23 which likewise has a relatively large radius. The bellows trough 23 is then followed by the next flank of that portion of the bellows rib which has run on through about 360° , and so on. The amplitude 22 between bellows ridge 19 and bellows trough 23 is constant from the left-hand portion to the right and only becomes lower when the spiral 17 merges into an approximately radial end wall 24. This end wall is approximately as steep as the flank 21, also for reasons of mould removal.

In Fig. 1, if one proceeds from the left rightwardly, then after 360° , the bellows trough 23 has reached its final depth and at about 360° before the end wall 24, the bellows trough rises again so that bellows trough 23 and bellows ridge 19 (as also in the left-hand region) meet again and merge into the outer curvature 26 of the end wall 24.

After a sharp angle 27 of about 100° , the end wall 24 merges into a collar 28 of smaller diameter which is disposed circularly and coaxially of the longitudinal axis 13. It ends on the right in a terminal rib 29 so that a fixing clip located there cannot slip off.

If the front wheels are turned to maximum lock and the vehicle travels, then the spiral acquires its shape. In this case, the flanks 18, 19 flex and rest on one another, in fact not only loosely but with the application of pressure. On the opposite side, the spiral is correspondingly expanded, i.e. is virtually fully stretched.

This stressing instance occurs when the bellows bridges those

joints of the axle which are close to the wheel. From the point of view of deformation, the bellows close to the engine does indeed have an easier time but is subjected to the heat radiated from the engine.

As can be seen from Fig. 3, in this example, the amplitude of the spiral diminishes rightwardly and the frequency increases. This means that the bellows becomes more flexible rightwardly and that also more flank length is available per length of geometrical longitudinal axis 13, which under difficult conditions facilitates adaptation of the bellows.

According to Fig. 4, here it is the left-hand zone where the amplitude is less and the frequency increases, i.e. here the left-hand zone is more flexible and more adaptable, which is desirable with other joints.

According to Fig. 5, two spirals 31, 32 are provided which start at points 33, 34 which are offset by 180° in respect of each other. Where these spirals 31, 32 are concerned, either the pitch can be twice as great as in the preceding examples of embodiment, in which case there will still be the same number of bellows ribs, or a greater number of bellows ribs will be provided if the pitch is made smaller.



CLAIMS:

1. Oil and grease-proof bellows for enclosing joints on axles of motor vehicles, the said bellows being produced from thin thermoplastics elastomers and using hollow body production techniques, with a relatively small diameter collar, with a collar of relatively large diameter and with, disposed between these collars, a bellows device of which the inner envelope and outer envelope decreases in diameter towards the collar of smaller diameter, characterised in that the bellows device has at least one bellows rib extending spirally from one collar to the other.
2. Bellows according to Claim 1, characterised in that the length of the spiral is shorter than the sum of the lengths of the bellows ribs of rotationally symmetrical comparable bellows devices.
3. Bellows according to Claim 1, characterised in that the pitch of the spiral is less than 15° .
4. Bellows according to Claim 1, characterised in that the pitch of the spiral is smaller than 10° but greater than 2° .
5. Bellows according to Claim 1, characterised in that the pitch of the spiral is constant.
6. Bellows according to Claim 1, characterised in that the pitch of the spiral diminishes towards the smaller diameter collar.
7. Bellows according to Claim 1, characterised in that the pitch of the spiral diminishes towards the larger diameter collar.
8. Bellows according to one or more of the preceding Claims,



characterised in that the height of the bellows rib is constant, becoming smaller only in the region of the collars at each outlet zone.

9. Bellows according to one or more of Claims 1 to 7, characterised in that the height of the bellows ribs becomes smaller towards the smaller diameter collar.
 10. Bellows according to one or more of the preceding Claims 1 to 7, characterised in that the height of the bellows ribs diminishes towards the larger diameter collar.
 11. Bellows according to one or more of the preceding Claims, characterised in that the smaller diameter collar is followed by an approximately radial area, the spiral ending in the circumference thereof.
 12. Bellows according to Claim 1, characterised in that more than one bellows rib is provided.
 13. Bellows as claimed in Claim 1 substantially as described with reference to Figures 1 and 2, Figure 3, Figure 4 or Figure 5 of the accompanying drawings.
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