SWAGING OPERATION FOR RELIEVING STRESS FROM A BUSHING FLANGE

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ABSTRACT
A swaging process is utilized for reducing the diameter of an outer ring of a bushing using a swaging tool including a gap or profile in the area of a flange of the outer ring in order to prevent or reduce the stresses that are formed in the flange radii area.
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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/159,834, filed on Mar. 13, 2009. The entire disclosure of the above application is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to bushings for supporting an end portion of a suspension arm on a vehicle body, the suspension arm can be for suspending a wheel of a motor vehicle.

BACKGROUND AND SUMMARY

[0003] This section provides background information related to the present disclosure which is not necessarily prior art.

[0004] With reference to FIG. 1, bushings 10 are commonly used for supporting an end portion of a suspension arm 12 on a vehicle body. As shown in FIG. 2, known bushings 10 include an outer ring 14 and an inner support member 16 as well as a rubber element 18 disposed between the outer ring 14 and the inner support member 16. The outer ring 14 can be provided with a radially outwardly extending flange 14a at a proximal end thereof. In the known bushings 10, the rubber element 18 is vulcanized into a gap between the outer ring 14 and the support member 16. This method tends to cause the rubber element 18 to shrink during the cooling of the bushing 10 that follows vulcanization, resulting in internal tension in the rubber element 18 which can be disadvantageous. In order to reduce the internal tension on the rubber element 18, it has been known to swage the outer ring 14 to reduce its diameter thereby relieving the internal tension of the rubber element 18.

[0005] As illustrated in FIG. 3, the swaging process is typically performed by a segmented swaging tool 20. The segmented swaging tool 20 can include a plurality of semi-cylindrical segments 22 that, when compressed radially inward together combine to generally form a cylindrical wall having an inner diameter smaller than an outer diameter of the pre-swaged outer ring. According to a known example swaging process, it has been known to reduce the outer diameter of the ring by 3 mm, from 69 mm to 66 mm, in order to relieve internal tension from the rubber element 18.

[0006] Upon insertion of the bushing 10 into the suspension arm, it has been known to flare the distal end 14b of the outer ring 14 in an outward direction by a forming process in order to retain the bushing in an aperture in the suspension arm. The forming process used to flare the distal end 14b of the outer ring 14 applies significantly higher forces on the flange 14a of the outer ring 14 than the forces typically applied in inserting the outer ring 14 into the end of the suspension arm 12. By way of non-limiting example, a force required for press fitting the bushing 10 into the end of the suspension arm 12 can be approximately 16 kN while the force required for flaring the distal end 14b of the outer ring 14 can be approximately 60 kN. It has been found that the larger force applied for flaring the distal end of the outer ring can cause cracking in the radii area of the flange 14a of the outer ring 14.

[0007] It is a discovery of the present disclosure that the swaging process utilized for reducing the diameter of the outer ring 14 creates internal stresses located at the radii area at the intersection of the flange portion 14a with the cylindrical body of the outer ring 14. Accordingly, to prevent these stresses, the swaging tool, according to the present disclosure, is provided with a gap or profile in the area of the flange in order to prevent or reduce the stresses that are formed in the flange radii area.

[0008] This section provides a general summary of the disclosure and is not a comprehensive disclosure of its full scope or all of its features.

[0009] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

[0010] The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0011] FIG. 1 is a plan view of a portion of a conventional suspension control arm having a bushing inserted therein;

[0012] FIG. 2 is a cross-sectional view of a conventional bushing;

[0013] FIG. 3 is a schematic illustration of a conventional swaging process applied to a bushing;

[0014] FIG. 4 is a schematic illustration of a swaging process applied to a bushing according to the principles of the present disclosure;

[0015] FIG. 5 is a cross-sectional view of a bushing formed according to the swaging process illustrated in FIG. 4;

[0016] FIG. 6 is a schematic illustration of an alternative swaging process applied to a bushing according to the principles of the present disclosure;

[0017] FIG. 7 is a cross-sectional view of a bushing formed according to the swaging process illustrated in FIG. 6.

[0018] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

[0019] Example embodiments will now be described more fully with reference to the accompanying drawings.

[0020] Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

[0021] Spatially relative terms, such as “inner,” “outer,” “beneath,” “below,” “lower,” “above,” “upper,” and the like, may be used herein for ease of description to describe one element or feature’s relationship to another element(s) or feature(s) as illustrated in the figures. Spatially relative terms may be intended to encompass different orientations of the
device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” the other elements or features. Thus, the example term “below” can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0022] With reference to FIG. 4, a swaging tool 120 includes a plurality of semi-cylindrical segments 122. The number of semi-cylindrical segments 122 can be greater than two, and more preferably, about 12. The semi-cylindrical segments 122 each include a semi-cylindrical wall portion 124 that is designed to engage the outer ring 14 over a majority of the axial length of the outer ring 14. The semi-cylindrical segments 122 also include a profile portion 126 at an end edge thereof that is designed to be adjacent to the flange 14a of the outer ring 14 during the swaging process. The profile portion 126 can gradually extend away from the semi-cylindrical wall section 124 or can be stepped in order to provide a relief area 128 between the radius region 130 of the flange 14a and the profile portion 126. The relief area 128 provided by the profile portion 126 allows for the swaging process of FIG. 4 to form an outer ring 14 shown in FIG. 5, having an increased thickness region 132 in the radius area 130 that has reduced internal stress.

[0023] With reference to FIG. 6, the swaging tool 220 includes a plurality of semi-cylindrical segments 222. The semi-cylindrical segments 222 each include a semi-cylindrical wall portion 224. The semi-cylindrical wall portion 224 of each segment 222 is spaced from the flange 14a of the outer ring 14 by a gap distance G.

[0024] The swaging process illustrated in FIG. 6 results in an outer ring 14 that includes a free forming profile 140 spaced from the flange 14a about a distance equal to the gap G. This swaging process results in a radius area 130 that has reduced internal stress. It is noted that the distance of the gap G can be determined based upon a specific application, however, it has been noted during testing that gaps of ¼ inch and ½ inch have been found to be sufficient in order to remove the stress risers from the radii region 130 such that the outer ring 14 can be subjected to the forces required to flare the distal end 14b of the outer ring 14 without causing damage to the radii region of the flange 14a.

[0025] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the invention, and all such modifications are intended to be included within the scope of the invention.

What is claimed is:

1. A swaging operation for an outer ring of a bushing having a rubber element disposed between the outer ring and an inner support member, comprising:
   inserting said bushing in a segmented swaging tool, said segmented swaging tool including a plurality of semi-cylindrical segments that, when compressed radially inward together combine to generally form a cylindrical wall having an inner diameter smaller than an outer diameter of the pre-swaged outer ring, said semi-cylindrical segments each including a profile portion at an edge thereof in an area of a flange of the outer ring, said profile portion extending radially outward from a semi-cylindrical wall section of said semi-cylindrical segments.

2. The swaging operation according to claim 1, wherein said profile portion gradually extends away from said semi-cylindrical wall section of said semi-cylindrical segments.

3. The swaging operation according to claim 1, wherein said profile portion is stepped away from said semi-cylindrical wall section of said semi-cylindrical segments.

4. A swaging operation for an outer ring of a bushing having a rubber element disposed between the outer ring and an inner support member, comprising:
   inserting said bushing in a segmented swaging tool, said segmented swaging tool including a plurality of semi-cylindrical segments that, when compressed radially inward together combine to generally form a cylindrical wall having an inner diameter smaller than an outer diameter of the pre-swaged outer ring, said semi-cylindrical segments each including an edge portion nearest a flange of the outer ring being spaced from said flange of the outer ring by a gap.