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A PLUG FOR A SLIP SPLINE ASSEMBLY

This invention relates to a slip spline assembly, for example for torque transmission.

Slip spline assemblies commonly comprise a yoke
5 having a splined bore for slidably receiving a splined portion of a stub shaft. It is usually necessary to provide lubrication between the mating sliding splines. The spline connection may be lubricated for life at assembly, or the yoke may have a lubrication fitting
10 for periodically replenishing lubricant. Usually, the end of the slip yoke opposite that from which the stub shaft projects is sealed with a plug to retain the spline lubricant. The plug may provide total closure of that end of the bore or it may be vented.
15 The method of sealing employed for a spline connection generally depends on its specific design as well as its application. For example, in an internally splined slip yoke used at the transmission output shaft of a vehicle, a solid plug is used at the body end and
20 a boot type seal is provided at the hub end of the slip yoke to protect the splines from dust, dirt, and other foreign matter. In this type of application, it is common practice to remove one of the spline teeth to facilitate the back and forth flow of
25 lubricant during stroking. In applications having a seal retained on the slip yoke hub end in direct sealing contact with the stub shaft, a vented plug

is used to maintain lubricant on the splines and prevent a pressure build-up when the stub shaft slides towards the closed end of the spline yoke.

In the past, numerous methods have been disclosed for retaining sealing plugs in slip yoke bores. The plugs also have taken many shapes. The more conventional types include a Welch plug, which consists of a flat annular disc, and a cup-shaped plug. In each case, the plug is pressed into the hub end of the slip yoke bore and retained in place by welding, staking, or a suitable epoxy cement.

While plugs of the above type function satisfactorily, they require additional operations after being pressed in place for positive retention in the slip yoke bore.

According to the present invention there is provided a yoke member for a slip spline assembly, the yoke member having a splined bore which extends through the yoke member and is provided with an annular groove at a position spaced from one end of the bore, that end of the bore being closed by a plug which comprises an end wall and a side wall integrally connected to the end wall, the side wall having a resilient free end portion which has a radially outwardly extending shoulder engaging the annular groove to lock the plug positively in the bore.

The locking connection achieved by the cooperating resilient portion and groove eliminates the need for providing additional welds, staking or special bonding cement to secure the plug after it has been pressed into the slip yoke bore.

For a better understanding of the present invention and to show how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

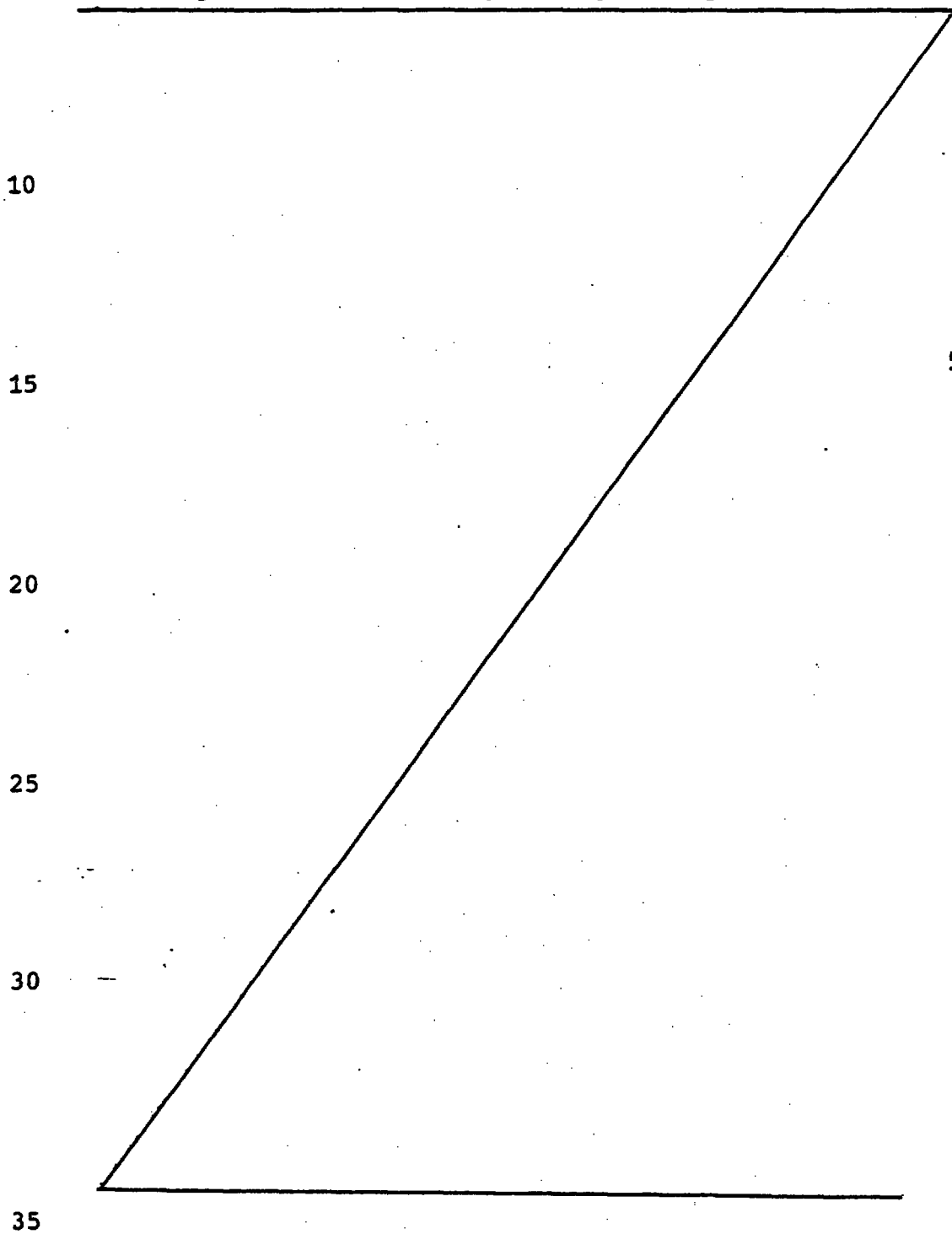
Figure 1 is a longitudinal partial cross-sectional view of a slip spline assembly;

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Figure 2 is an enlarged perspective view of a sealing plug of the assembly of Figure 1;

Figure 3 is a partially sectional side view of the sealing plug shown in Figure 2; and

5 Figure 4 is an enlarged fragmentary view showing



part of the assembly of Figure 1.

The slip spline assembly 10 of Figure 1 comprises a slip yoke 12 and a mating slip stub shaft 14. The slip yoke 12 has an internally splined bore 16 for sliding connection with an externally splined portion 18 on the stub shaft 14. The slip yoke 12 comprises a body portion 20 at one end formed with opposed lugs 22. Holes 24 are provided in the lugs 22 for receiving a journal crossmember (not shown) for connection to a conventional end yoke (not shown).

From the body portion 20, the slip yoke 12 extends in the form of an axially elongate tubular hub portion 26 which surrounds the stub shaft splined portion 18. An annular seal 28 is held by a seal retainer 30 against the outer end of the hub portion 26 to provide a sliding seal against the cylindrical outer surface of the stub shaft 14. The outer end of the stub shaft 14 comprises a pilot portion 32 for attachment to a driveline member (not shown).

The body portion 20 of the slip yoke 12 is provided with a counterbore 34 for receiving a cup-shaped sealing plug 36. The purpose of the plug 36 is to retain lubricant on the mating splines 16 and 18 and to prevent ingress of foreign matter. The plug 36 comprises a flat end wall 38 and an integral axially inwardly extending cylindrical side wall 40. A breather or bleed opening 41 is provided in the end wall 38 to prevent pressure build-up in the counter bore 34 when the stub shaft 14 slides toward the closed end of the slip yoke 12.

It will be appreciated from Figure 1 that the splined bore 16 extends completely through the slip yoke 12 thereby defining first and second openings at opposite ends of the splined bore 16, i.e. at the inner body end and outer hub end.

Cooperating fastening means are provided on the open or axially inner end of the plug side wall 40

and in the slip yoke counterbore 34 for securing the plug 36 in place. The fastening means on the plug 36, as seen best in Figures 2 and 3, comprises an annular rib 42 having a plurality of equally spaced notches 44 extending axially inwardly from the free edge of the plug side wall 40. The notches 44 serve to divide the rib 42 and thereby the open end of the side wall 40 into a plurality of resilient portions 46. As most clearly seen in Figures 2 and 3, the resilient portions 46 comprise equally spaced axially extending tab sections.

Referring to Figures 1 and 4, the fastening means on the slip yoke 12 comprises an annular groove 48 in the counter bore 34 for cooperating with the rib 42 on the plug resilient locking portions 46. In assembly, initial pressure applied to the outer face of the plug end wall 38 by a conventional assembly tool (not shown) will result in the tab sections or locking portions 46 being flexed radially inwardly as the rib 42 initially contacts the outer edge of the counterbore 34. Further pressure applied to the plug 36 forces it deeper into the yoke bore 34 until the rib 42 is aligned with the annular groove 48. At this point the resilience of the locking portions 46 causes the rib 42 to snap outwardly into locking engagement with the groove 48 thus serving to lock the plug 36 positively in the counterbore 34 without requiring any additional means or operation to secure the plug 36 in place.

Referring specifically to Figure 4, it will be seen that the groove 48 defines inner and outer radially extending walls 50 and 52 respectively which are disposed at right angles to the groove bottom. In the preferred embodiment, for clearance purposes, the outer diameter of the rib 42 is less than the inner diameter of the groove bottom and greater than the outer diameter of the plug side wall 40 thereby

defining inner and outer radial walls 54 and 56 respectively on the rib 42. The axial length of the rib 42, i.e., the distance between the walls 54 and 56, is slightly less than the axial distance between the groove walls 50 and 52. For assembly purposes, the radially outer portion of the wall 56 has a chamfer 58 which serves as a camming means for flexing the section 46 inwardly as the plug 36 is initially pressed into the counterbore 34. The respective mating outer walls 50 and 54 in the groove outer wall 50 thereby serve to lock the plug 36 positively in the counterbore 34.

A slight chamfer is provided on the outer wall 54 to allow the shoulder 42 to be cammed into the groove 48 when alignment occurs between the rib 42 and the groove 48. If desired, the outer wall 54 may be formed parallel to the mating inner groove wall 50 so that when locked in place they will be in surface contact.

While the above description relates to a slip spline assembly that is designed for periodic replenishing of lubricant, it may also be used in assemblies that are lubricated for life. In such assemblies, the bleed opening 41 (see Figures 2 and 3) would be eliminated and a boot type seal would be employed in place of the seal 28 and retainer 30. In typical applications of this type, one of the spline teeth is removed to prevent pressure build-up and facilitate back and forth flow of lubricant during stroking.

Also, the flexibility of the locking portions 46 may be reduced by reducing the number of the notches 44 which extend from the end of plug side wall 40 or increased by increasing the number of notches.

The sealing plug 36 may be a stamped metal part which is finished machined or, alternatively, a one piece molded part made from a suitable plastics material

such as nylon or a nylon/glass filled combination.

From the foregoing description it will be appreciated that the advantages of the present invention result from the combined relationship of the resilient locking portions of the sealing plug and its cooperation with the annular locking groove in the yoke bore. The arrangement provides a positive and economical spline assembly that eliminates the need for providing additional welds, staking, or the use of a special bonding cement to secure the plug in place at assembly.

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CLAIMS

1. A yoke member for a slip spline assembly, the yoke member having a splined bore which extends through the yoke member and is provided with an annular groove at a position spaced from one end of the bore, that end of the bore being closed by a plug which comprises an end wall and a side wall integrally connected to the end wall, the side wall having a resilient free end portion which has a radially outwardly extending shoulder engaging the annular groove to lock the plug positively in the bore.

2. A yoke member as claimed in claim 1, in which the resilient free end portion comprises an axially extending tab section on which the shoulder is provided.

3. A yoke member as claimed in claim 2, in which the side wall comprises a circumferential skirt extending from the end wall, the resilient tab section extending from the end of the skirt away from the end wall.

4. A yoke member as claimed in claim 3, in which the tab section is one of a plurality of tab sections extending from the skirt.

5. A yoke member as claimed in any one of claims 2 to 4, in which the or each shoulder is provided with camming means for engagement with the wall of the bore, upon insertion of the plug into the bore, to cause the respective tab section to be deformed radially inwardly of the bore.

6. A yoke member as claimed in claim 5, in which the camming means comprises a chamfer at a leading portion of the shoulder, with respect to the direction of insertion of the plug into the bore.

7. A yoke member as claimed in any one of the preceding claims, in which, upon insertion of the plug into the bore, the resilient free end portion engages the groove with a snap action.



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8. A yoke member as claimed in any one of the preceding claims, in which a vent opening is provided in the plug.

5 9. A yoke member as claimed in any one of the preceding claims, in which the plug is made from plastics material.

10 10. A yoke member as claimed in any one of the preceding claims, in which the plug is made from a glass-filled composition.

11. A yoke member for a slip spline assembly, substantially as described herein with reference to, and as shown in, the accompanying drawings.

12. A slip spline assembly comprising a yoke member, as claimed in any one of the claims, and a splined shaft extending into the yoke member from the end of the bore opposite the end closed by the plug, the splines on the shaft slidably engaging the splines in the bore.

13. A slip spline assembly substantially as described herein with reference to, and as shown in, the accompanying drawings.

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