

May 6, 1969

W. RÖDER ET AL

3,442,170

SLEEVE ADAPTOR

Filed Oct. 5, 1967

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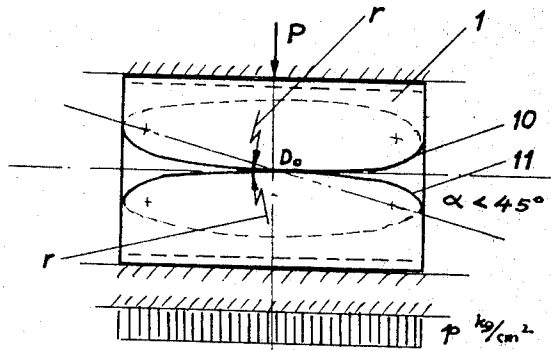


Fig. 1

Fig. 1a

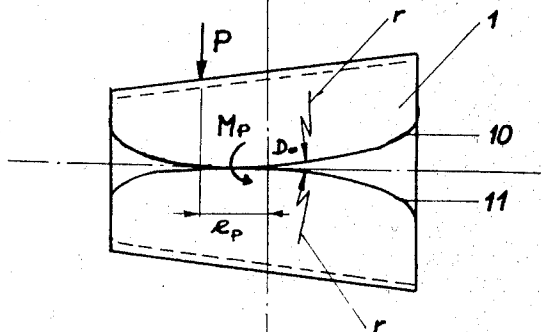


Fig. 2

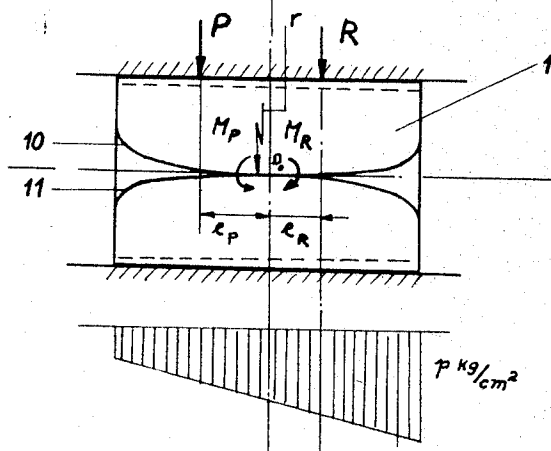


Fig. 3

Fig. 3a

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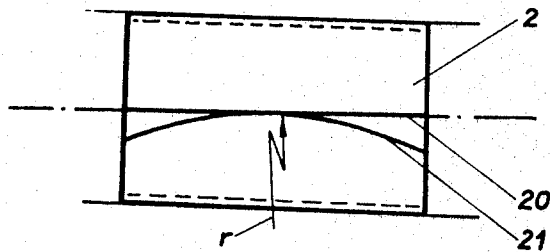


Fig. 4

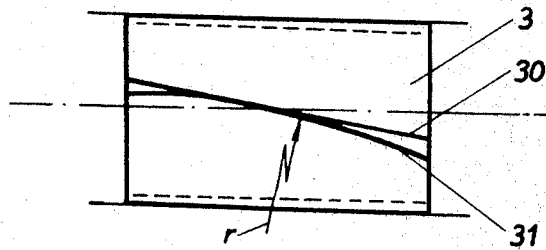


Fig. 5

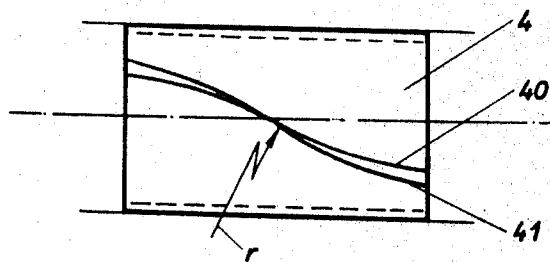


Fig. 6

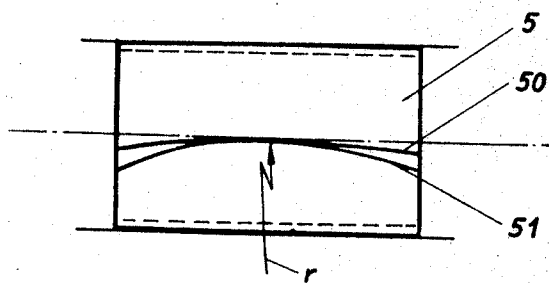


Fig. 7

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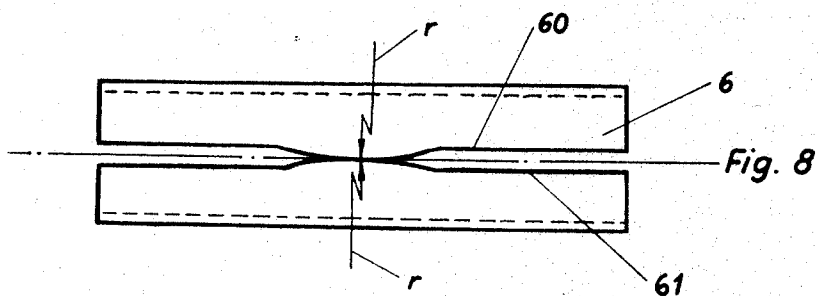
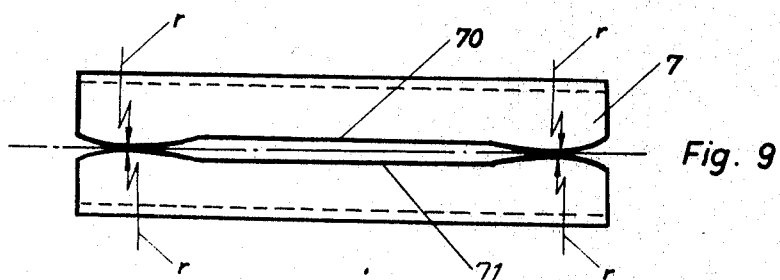
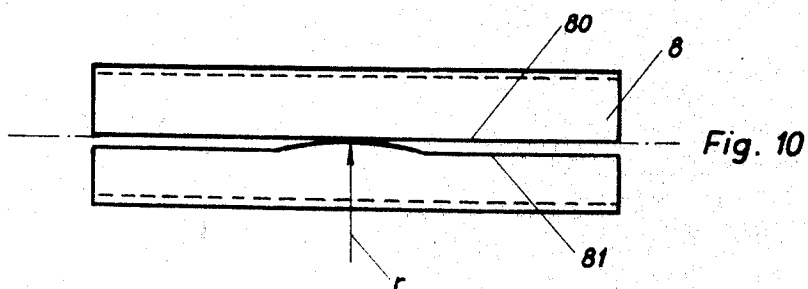
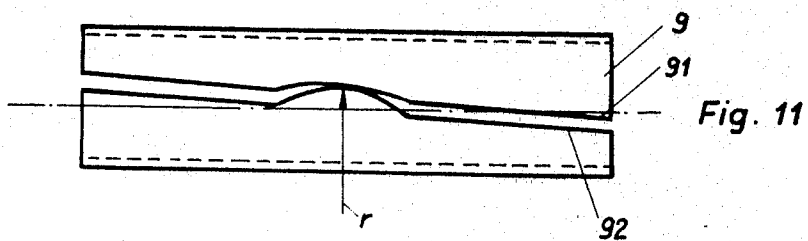
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SLEEVE ADAPTOR

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9 Claims

ABSTRACT OF THE DISCLOSURE

A split sleeve adaptor having a longitudinal slit transversing from one end of the sleeve cylinder to the other. At least one edge of said slit is developed to provide a curved or rolling track for cooperation with the remaining edge of said slit. Such a sleeve construction results in more even distribution of stresses throughout the sleeve and its cooperating members and facilitates reuse of the sleeve.

Background of the invention

This invention generally relates to an improved sleeve adaptor having a continuous longitudinal slit over its entire length and more particularly relates to an improved sleeve adaptor having a substantially axial slit wherein at least one edge defining the slit is developed to provide a curved rolling track for cooperation with the opposing edge when the adaptor is subjected to compressional force.

Split sleeve adaptors of the general type with which the illustrated embodiment is concerned are relatively well known. Conventional open-profile sleeves with non-force-locking slit areas are often manufactured with straight-line, oblique, or arrow-type slits. The edges defining the slit are not usually machined. Such conventional sleeves have the disadvantage of losing their initial dimensions when the elastic limit of the sleeve material is exceeded. The adaptor then becomes permanently deformed, often preventing the maintenance of a tight seal and reuse of the sleeve for additional applications. Moreover, such conventional sleeves do not have a uniform bearing strength over the entire peripheral area of the sleeve. In order to eliminate certain of such disadvantages, adaptors are frequently provided with denticulations of staggered and opposed teeth along the length of the wall slit of the sleeve. Upon compression of the sleeve, the surfaces of the teeth are forced into contact, whereupon radial as well as axial spanning of the sleeve results. The contact points of the surfaces of the teeth serve as bridges which distribute the localized normal and torsional stresses from one side of the wall slit to the other. This so called force-locking or gear slit results in increased seating strength. Further, during manufacture, such an arrangement offers the advantage of facilitating surface treatment of the sleeve edges defining the wall slit. Such centerless sleeves are often reusable. This form of sleeve adaptor has certain disadvantages in that uniform stress conditions cannot generally be achieved over the entire length of the slit. Such nonuniform stress conditions usually occur due to inadequate manufacturing tolerances which fail to eliminate small differences in the pitch of the various teeth, resulting in a variation in the bearing capacity of the various teeth. During use, deformation of the teeth frequently occurs, producing uneven contact

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between the surfaces of cooperating teeth. The teeth frequently broaden, causing them to bind and lock.

As a result of structural tolerance variations, a sleeve adaptor acting as the connecting element between two or more machine parts, whether used as shear pin or joint bolt, is frequently not compressed and stressed evenly over its complete length. When subjected to compressional forces, the opposing surfaces of the teeth occasionally slide over each other causing an axial shift in the wall of the sleeve. Since the interlocking teeth permit only an even torsion of the sleeve, the various surfaces of the teeth will be subjected to uneven stresses, producing an overstrain in individual teeth. Such sleeves when subjected to compressive or shock loads are particularly unsatisfactory. Further, when such an adaptor is under bending stress wherein the axis of the slit is normal with respect to the general direction of the bending force, the spacing between the teeth in the upper edge of the wall defining the slit of such an adaptor tends to reduce forcing the teeth together. The percussive power produced is thus absorbed by the teeth. This result increases the rigidity of the sleeve, effectively creating a single large notch and producing an accumulation of stress peaks at the surfaces of the teeth. Under continued dynamic stress, such a sleeve adaptor displays low durability wherein a large portion of the load limits are mathematically non-determinable.

A characteristic feature of the adaptor of the preferred embodiment is that at least one edge of the wall defining the slit is developed into a continuous curve or rolling track, the radius of curvature of which is preferably greater than the radius of the wall forming the sleeve. In accordance with the preferred embodiment, the two tracks display equal curvatures which may be shaped in the form of congruent logarithmic spirals or ellipses. An alternate sleeve embodiment including certain features of this invention comprises a straight edge wall edge adjacently opposed by a wall edge displaying a curved rolling track formed by two circular arcs of different diameters. Movement of the opposing slit edges under stress produces deformation of the sleeve which alters the load distribution in the bore receiving the adaptor so as to create a force component which is directionally opposite the stressing force, thereby balancing the force moments. In this manner, localized overload will not generally occur. This feature proves to be of special advantage during the application of dynamic compressive and shock loads which are not usually controlled by conventional sleeves.

The sleeve elements of the illustrated embodiment readily allow radial deformation. When the edges of the slit are forced into contact, additional deformation is accommodated through the occurrence of a rocking motion of the rolling track. Such deformations are readily accommodated by a degree of freedom in the circumferential direction and allow a change in the load distribution in the receiving bore until the forces of action and reaction between the sleeve and the bore are in equilibrium. Sleeves suitable for use as bolts and bushings having varying diameters can be sectionally fabricated with parallel, longitudinal slots which serve as torsion springs.

A particular feature of the illustrated embodiments is that localized forces will not cause rupture of the sleeve material. A further advantage of the illustrated embodiments is that stresses within the sleeve can be calculated, a possibility which considerably expands the field of application of flexible structural elements.

Brief description of the drawings

FIGURE 1 is a side view of a split sleeve adaptor in accordance with this invention, the edges defining the slit being elliptically shaped.

FIGURE 1a is a force distribution diagram of the sleeve bearing pressures under the application of a symmetrically applied load.

FIGURE 2 is a side view of the adaptor of FIGURE 1 subjected to unilateral stresses, the deformative frusto-conical shape of which is exaggerated for illustrative purposes.

FIGURE 3 is a side view of the sleeve of FIGURE 1 within a suitable receiving bore and subjected to stress loads.

FIGURE 3a is a force distribution diagram of the bearing pressures upon the sleeve of FIGURE 3.

FIGURES 4 through 7 are side view illustrations of various adaptors each of which includes certain features of this invention.

FIGURES 8 through 11 are side view illustrations of alternate embodiments of sleeve adaptors in accordance with this invention which have a high length-to-diameter ratio.

Description of the illustrated embodiments

Referring to FIGURES 1 through 3 inclusive, a split sleeve adaptor 1 is illustrated wherein each of the edges 10 and 11 of the sleeve wall defining the slit are shaped in the form of a portion of an ellipse with a radius curvature r so as to provide rolling tracks. The radius r is preferably greater than the radius of curvature of the sleeve wall. The sleeve is illustrated subjected to a force P passing through the center D_0 of the sleeve. The force distribution over the sleeve is illustrated in FIGURE 1a in kilograms per square centimeter.

With reference to FIGURE 2, the adaptor of FIGURE 1 is shown subjected to an external stress exerted by a force P , eccentric by a distance R_p . The sleeve is caused to contract radially on the load side, whereas the counter side expands. With relation to a point D_0 about which the force moments are created, a moment M_p is created by the force P under external stress.

As shown in FIGURE 3, the adaptor 1 is chucked and subjected to an eccentric stress exerted by a force P . The resulting bearing reaction force acting at a distance R_R from the center of the sleeve produces a counter moment M_R with relation to the center point D_0 . A balance of moments is established in the receiving bore of the chuck as determined by the external stresses and the bearing reactions. Localized overstrain often produced by conventional sleeve adaptors will not occur with regard to the split sleeve adaptor illustrated in FIGURES 1 through 3. It will be appreciated that application of active loads creates a variation or modulation in the stresses about the center point D_0 , thus permitting the sleeve to absorb compressive and shock loads in a static-free manner. The force distribution over the sleeve is illustrated in FIGURE 3a.

The edges of a split sleeve adaptor 2 illustrated in FIGURE 4 define a longitudinal slit. One edge 20 of the adaptor is straight, and the remaining edge 21 is curved along a radius r forming a rolling track. The straight edge 20 is generally parallel to the axis of the sleeve adaptor 2.

A sleeve adaptor 3 illustrated in FIGURE 5 is similar to the embodiment of FIGURE 4 with the exception that an edge 30 is inclined with respect to the axis of the sleeve 3, and an edge 31 adjacently positioned and tangent to the edge 30 is curved along a radius r .

In the embodiment of FIGURE 6, edges 40 and 41 defining the slit are inclined with respect to a wall of a sleeve adaptor 4 and follow a double reverse curve having a radius of curvature r . The edges 40 and 41 are tangent proximate their midpoint.

With respect to the sleeve embodiment of FIGURE 7, adjacently disposed edges 50 and 51 define a slit and

are generally parallel to the axis of the sleeve 5 and are curved with their respective radii of curvature r lying upon the same side of the slit. The edges 50 and 51 of the slit are tangent proximate their midpoint.

The embodiment illustrated in FIGURE 8 comprises a split sleeve adaptor 6 wherein the edges defining the slit are generally parallel to the axis of the sleeve. Over a considerable portion of their length, the edges 60 and 61 are relatively straight and parallel. Proximate the midpoint of the slit the edges 60 and 61 are bowed or arced inwardly about a radius r and are tangent proximate the midpoint thereof. The radius of curvature of each of the arcs being equal and lying upon opposite sides of the slit. Under stress, the rolling action of the edges 60 and 61 is restricted to the arcuate portion thereof and not across the entire length of the slit.

Referring to the alternate embodiment of FIGURE 9, a slit is cut through a sleeve adaptor 7 and located substantially parallel to the axis thereof. Edges 70 and 71 define the slit and are substantially parallel to each other over a considerable portion of their length. Proximate the ends of the sleeve the edges are bowed inwardly forming two bowed segments, each of which is in registration with a bowed segment of the opposite edge and tangent thereto. The radii of curvature of each pair of the cooperating curved edges lie on opposite sides of the slit.

Referring to FIGURE 10, one edge 80 of the slit of the adaptor illustrated therein lies along a plane parallel to an opposing edge 81 and to the wall 8 of the sleeve adaptor. The central portion of the edge 81 is bowed inwardly toward the slit 80 about a radius of curvature r and is tangent thereto.

Referring to the embodiment of FIGURE 11, a slit is defined by a pair of opposing edges 91 and 92 of a split sleeve 9. The edges 91 and 92 are substantially parallel and located along a plane inclined with respect to the axis of the sleeve 9. Proximate the midpoint of the slit the edges are bowed and tangential proximate their midpoint. The radius of curvature of each of the bows differs and lies upon the same side of the slit.

Although several preferred embodiments of the invention have been described in detail, it is to be understood that various changes, substitutions, and alterations can be made therein.

What is claimed is:

1. A split sleeve adaptor having a substantially cylindrical member, the wall of said cylindrical member being generally longitudinally split providing disposed edges which define a continuous slit, characterized by at least one of said edges being developed over a portion of its length in the shape of a continuous, arcuate, rolling track and further characterized by said edges being noncomplementary so that under the application of normal stress only a relatively small portion of the edges are in surface contact so as to facilitate distribution of the load forces throughout the sleeve thereby minimizing the creation of localized stress within the sleeve.

2. A sleeve adaptor in accordance with claim 1 wherein the radius of curvature of said developed edge is greater than the radius of curvature of said sleeve wall.

3. A sleeve adaptor in accordance with claim 2 wherein each of said slit defining edges is developed over a portion of its length in the shape of a continuous, arcuate, rolling track.

4. A sleeve adaptor in accordance with claim 3 wherein the curved portions of said tracks are adjacently disposed.

5. A sleeve adaptor in accordance with claim 4 wherein the radii of curvature of each of said developed portions of said edges lie upon opposite sides of said slit.

6. An apparatus in accordance with claim 4 wherein the radii of curvature of said developed portions of said edges both lie upon the same side of said slit.

7. A sleeve adaptor in accordance with claim 6 wherein the outer surface of said cylinder is in the shape of a frustum of a cone.

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8. A sleeve adaptor in accordance with claim 2 wherein the edges of said slit are substantially parallel to the axis of the sleeve.

9. A sleeve adaptor in accordance with claim 2 wherein the edges of said slit lie generally along a plane which is nonparallel to the axis of the sleeve.

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MARION PARSONS, Jr., *Primary Examiner.*

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