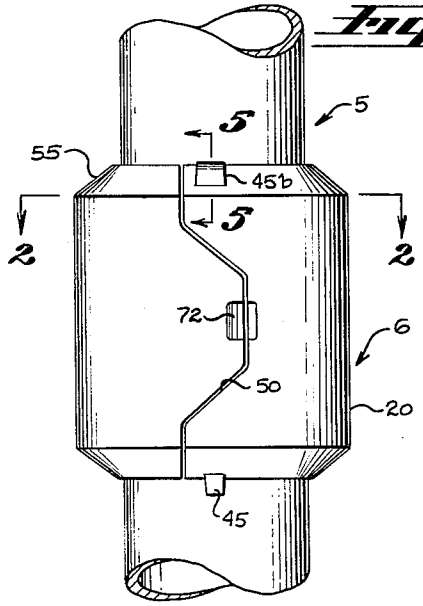
Sept. 18, 1962 B. S. MINOR 3,054,646

SPLIT COLLAR

Filed Sept. 28, 1959 2 Sheets-Sheet 1

Fig. 1



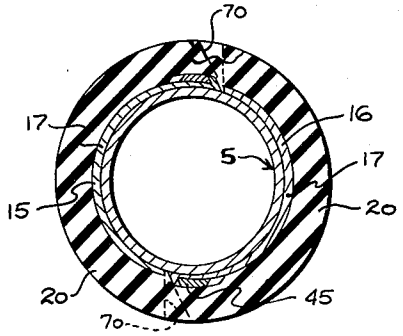


Fig. 2

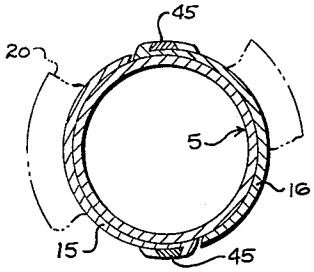


Fig. 4

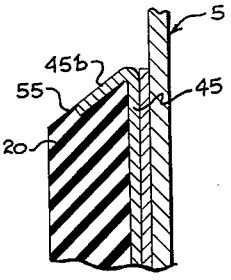


Fig. 5

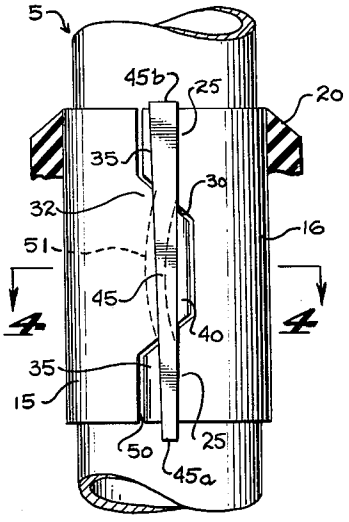


Fig. 3

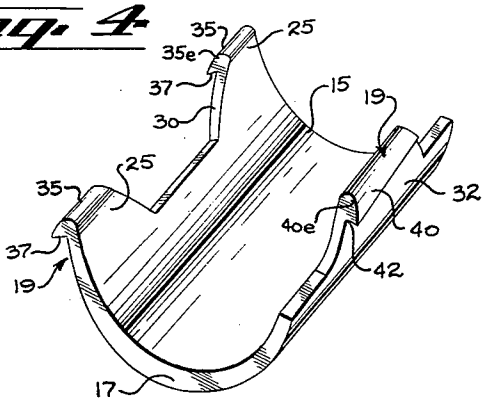


Fig. 6

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ATTORNEYS

Sept. 18, 1962 B. S. MINOR 3,054,646

SPLIT COLLAR

Filed Sept. 28, 1959 2 Sheets-Sheet 2

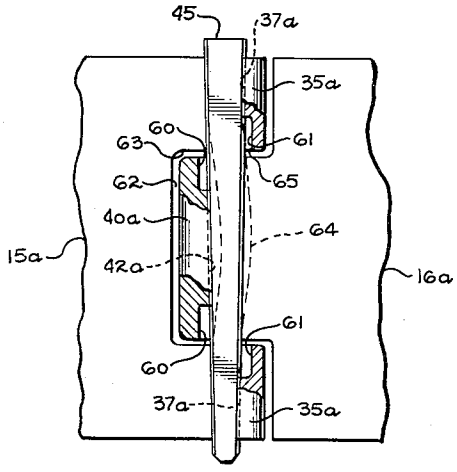


Fig. 8

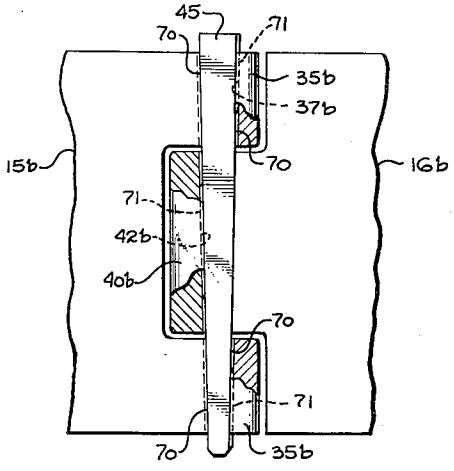


Fig. 9

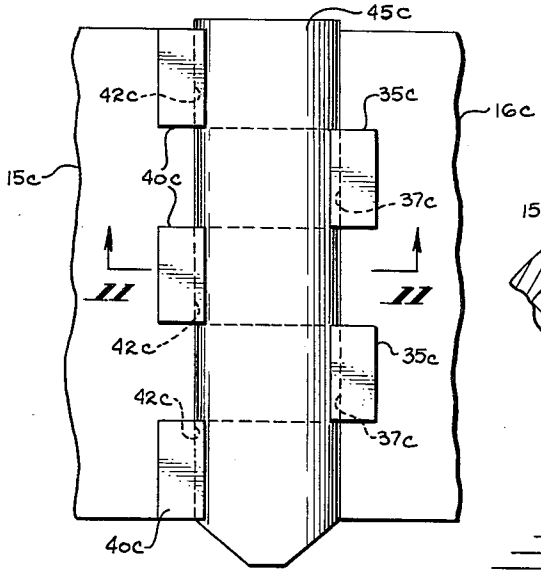


Fig. 10

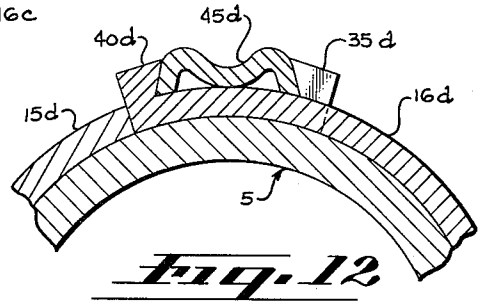


Fig. 12

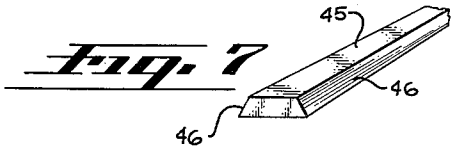


Fig. 7

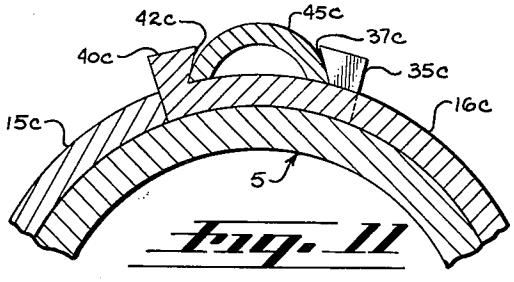


Fig. 11

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United States Patent Office 3,054,646 Patented Sept. 18, 1962

3,054,646

SPLIT COLLAR

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Filed Sept. 28, 1959, Ser. No. 842,868
2 Claims. (Cl. 308—4)

My invention has to do with split sleeves or collars, and while, in its more particular application, it finds its chief utility as a protective sleeve or collar for drill pipe in the drilling of oil wells, it has utility in other applications.

In the drilling of oil wells, the drill equipment is attached to the bottom end of a long string of drill pipe which extends through a metallic casing lining the drill hole. When the drilling is being done by the rotary method, the drill pipe, because of the length of the string, whips laterally in the casing, causing the drill pipe to engage the inner surface of the casing, causing wear on both the pipe and the casing.

To avoid such metal-to-metal contact of the pipe with the casing, and to maintain the pipe substantially centered in the casing, it is conventional practice to mount protective sleeves or collars on the pipe between the joint members. For such a protector to remain effective for its purposes, it is of course essential that the protector so constrict about the pipe that it may not slide along the pipe into abutting relationship with a contiguous joint member, and also the protector should conform to the pipe to prevent entry of corrosive well fluids between the protector and pipe.

The type of protector which has been in general use for many years is an elastic rubber sleeve which is stretched about the pipe. However, such a protector has to be applied axially over an end of each pipe section before the drill string is assembled or else it is necessary to disassemble the drill string to install the protectors, all which requires considerable labor and special equipment. Also, such elastic sleeves, when applied to the pipe, are necessarily stretched so that the rubber is in stress, easily subjecting it to cuts and abrasions. Also, as a practical matter, it is impossible to remove such a protector from one pipe for use on another pipe.

Because of those disadvantages of the elastic sleeve type of protector, those working in this art have long sought to devise a successful protective collar of the split or segmental type in which rubber covered metal segments are used and which can be applied and removed laterally of the pipe, but, insofar as I am aware, up to the present time, none of the attempts to produce a protector of this type has been sufficiently successful to produce a collar generally usable in the oil drilling industry.

One of the most pronounced causes of failure of such attempts has been the inherent weaknesses of the means used for maintaining the segments comprising the collar secured together in such a manner as to remain in tight, resilient constricting engagement about the pipe and positively to prevent the segments from becoming separated and dropping into the drill hole.

It is to be remembered that when a long drill string is placed in tension by the weight of the string, even though the pipe is several inches in diameter, it stretches and thereby becomes slightly reduced in diameter. Thus even though such a protector be in tight gripping relationship about the pipe when the pipe is not under such tension, it will easily become loose and slip along the pipe when the pipe is placed in such tension unless the protector is maintained in tension. Moreover, when the protective collar becomes loose on the pipe, or fails to conform to the pipe, corrosive well fluids enter between the collar and the pipe. Thus, to be successful, a drill pipe protective collar must be capable of resiliently yielding circumferentially when it is first installed on the pipe, and must retain its resilient gripping force in order to compensate for reduction in diameter of the pipe due to stretching. Also the protector must conform to the pipe to prevent entry of corrosive well fluid.

In the prior art there may be found many unsuccessful attempts to solve this old problem.

One of the most common approaches has been to embed metal segments in segments of rubber, relying upon the resiliency of the rubber section between the metal segments and the pipe to maintain the resiliency necessary to prevent slippage of the protector on the pipe, the metal segments being secured together along the splits my means of providing the sides of the metal segments with interengaging loop or eye-forming portions through which loops or eyes a retaining pin extends. But for several reasons, those approaches have not provided a solution. One of those reasons has been that the rubber layer between the metal segments and the pipe, being constantly under compression and static, and being subjected to the high temperatures encountered in drill holes, becomes set and loses its resiliency, allowing the collar to become loose on the pipe. Another reason for the failures of such prior attempts has been that the loops or eyes, through which the retaining pin extends, become elongated or fractured, allowing the collar to become loose on the pipe. Moreover, it is difficult to install such a device because mechanical means must first be used sufficiently to flow the rubber lining of the metal segments to bring the loops or eyes into registration to permit insertion of the retaining pin.

Another, and perhaps even more important, reason for the failure of such attempts has been that, in the prior devices of this type of which I am aware, the retaining pins are inserted through edge to edge abutting, interengaging loop or eye-forming portions of the segments. Therefore the retaining pins are constantly subjected to tremendous shearing stresses which frequently cause the retaining pins to shear off, allowing the segments to separate and drop into the drill hole.

Another prior approach to a solution of the problem of providing a split protective collar has been the provision of rubber covered resilient metallic segments of less radius than the pipe. However, such a device relies upon the resiliency of the metal of the segments and upon the smaller radius to maintain a resilient gripping force about the pipe. The difficulty with such a protector in actual use is that the metallic segments, in order to exert enough gripping force, have to be made of such thick section that they are so heavy that they are unwieldy to handle and quite expensive to ship. Also, due to the segments having a radius smaller than the pipe, without having any means for applying to them a circumferential constricting force to cause them to conform to the pipe, when the collars engage the well casing during rotation of the pipe the thick segments are flexed, with the result that they fatigue, crystallize and break. Also, due to lack of conformance of the segments to the pipe, corrosive well fluids enter between the collar and the pipe.

It is therefore a general object of my invention to provide a split or segmental drill pipe protector which effectively overcomes the disadvantages and shortcomings of those split or segmental protectors which heretofore have been proposed.

Among the more particular objects of my invention are the provision of a split drill pipe protective collar;

(*a*) Which embodies novel, effective and durable means for securing and maintaining the segments of the collar in constricting relationship about the pipe under all working conditions;

(*b*) Which, instead of utilizing metal segments which are themselves resiliently circumferentially stretchable,

and instead of using a coating of elastic rubber between the segments and pipe in order to provide the necessary resiliency of the construction, I employ a laterally resilient retaining key for securing the segments together at the split or splits;

(*c*) Wherein the inner surfaces of the segments comprising the collar always maintain a perfect conforming contact with the pipe to prevent entry therebetween of corrosive well fluids;

(*d*) Which is always maintained in resilient, tight, constricting relationship about a pipe so as to compensate for axial stretching of the pipe.

For the purpose of enabling those skilled in the art to make and use my invention, I shall now describe in detail the best mode which I have thus far devised for carrying my invention into practice, and from which description other variations and specific embodiments within the purview of the appended claims will become apparent. For the purpose of said description I shall now refer to the accompanying drawing wherein:

FIG. 1 is a side elevational view of an embodiment of my protective collar installed on a drill pipe;

FIG. 2 is a section taken on line **2—2** of FIG. 1;

FIG. 3 is a view similar to FIG. 1 but with a portion of the outer covering of rubber-like material broken away for illustration purposes;

FIG. 4 is a section taken on line **4—4** of FIG. 3;

FIG. 5 is an enlarged fragmentary sectional view;

FIG. 6 is a perspective view of one of the metallic segments used in carrying out my invention;

FIG. 7 is a fragmentary perspective view of the retaining member;

FIG. 8 is an elevational fragmentary view showing a modified form of my invention;

FIG. 9 is a fragmentary elevational view, partly in section, showing a further modified form of my invention;

FIG. 10 is a side elevational view of a further modified form of my invention;

FIG. 11 is a section taken on line **11—11** of FIG. 10; and

FIG. 12 is a fragmentary sectional view showing a further modified form of my invention.

Referring now to the drawing (FIGS. 1–7), the numeral **5** generally designates a typical section of drill pipe such as is used in the drilling of oil wells, and the numeral **6** generally designates my protective collar.

The collar **6** comprises a pair of opposed metallic segments **15, 16** having end portions **19**. Each of the segments has bonded to its outer surface a covering of elastic, rubber-like material **20**, although when my device is used on drill pipe which is rotated in a drill hole which is not lined by a metallic casing, the rubber covering **20** may be eliminated. Each of the segments preferably has a relatively thickened portion **17** medially between and tapering to its ends to provide it with better beam characteristics.

One of the end portions **19** of each of the segments is provided with a pair of bifurcations **25** which define therebetween a circumferentially opening slot **30** which preferably is somewhat wedge-shaped—that is the contiguous side walls of the bifurcations converge to a straight axially disposed bottom portion of the slot. The opposite end portion **19** of each segment has a wedge shaped tongue portion **32**. When the segments are assembled about a pipe, the tongue portion **32** of one segment engages between the bifurcations **25** of the other segment.

Each segment **15, 16** is curved in cross section preferably about a radius smaller than the radius of the pipe **5**, it being my preference to make the radius differential of the order of about 1/16 inch. Also each segment is arched in excess of 180°, preferably about 210°, to provide for the inter-engaging of the tongue and bifurcation portions.

As best shown in FIGS. 3 and 6, each of the bifurcations **25** has an end extremity portion which is relatively thickened so as to present a radial boss or lug **35** which provides a circumferentially facing, undercut shoulder **37**. The shoulders **42** and **37** face circumferentially in opposite directions. Also the shoulder surfaces are tapered from one end to the other so that the shoulders **37** of one segment and the shoulder **42** of the other segment together define a tapered or wedge-shaped key passageway therebetween disposed transversely of the structure.

Also it is important to observe that in the embodiment of FIGS. 1–7 the shoulders defining each passageway are spaced apart transversely of the segments a distance, preferably at least equal the width of the key member to be described, depending upon the shear strength of the keys to be described. The purpose of this spacing will become apparent hereinafter.

Each pair of interengaging portions are secured together by means of a longitudinally tapered, laterally resilient metal retaining member or key **45** of rectangular cross section, there being one of said keys driven into each of the passageways defined by said opposed shoulders, the tapering preferably being of the order of one-half inch per foot, and the tapering of the passageways defined by the opposed shoulders being of the same order. Each key **45** is heat treated to the desired spring tension.

Each of the retaining keys **45** has side edges **46** beveled to conform to the angle of the undercut shoulders, so that when the keys are driven between the shoulders they cannot escape radially from between opposed shoulders.

As best shown in FIG. 3 the circumferential length of the respective segments in relation to the pipe is such that a space **50** of at least about 1/8 inch in width is provided between the interengaging end portions of the segments. As keys **45** are driven into position between the opposed shoulders, the metallic segments are constricted about the pipe, and the engaging of opposite side edges of each key by the shoulders at points spaced apart longitudinally of the keys, will subject the keys to bending stresses between their ends rather than shearing stresses. Since the keys are resilient, they resiliently yield to the bending stresses but maintain a resilient constricting force on the segments. As best shown in FIG. 3 the key will become resiliently bowed in a direction circumferentially of the segments, the bowing or yielding taking place between the contiguous end portions of the shoulders **37** acting as fulcrums. This bowed condition is shown by the broken line **51** in FIG. 3. Thus even though there is no rubber compressed between the segments and the pipe, and even though the modulus of elasticity of the metal segments is such that they will not appreciably resiliently yield circumferentially, the resiliency of the keys causes the segments to be resiliently drawn together and maintained constricted resiliently about the pipe sufficiently to compensate for any wear or axial stretching of the pipe or to successfully oppose being otherwise moved axially of the pipe. Also, even though the radius differential between the segments and pipe will normally cause the segments to tend to bow away from the pipe at substantially diametrically opposite points, the circumferential tension placed on the segments by the retaining keys will draw the segments into true conforming relationship to the pipe and maintain them in that relationship.

The shoulder-providing bosses **35, 40** should each be of substantial width, commensurate with the shear strength of the metal of the bosses, to prevent their being bent or sheared off by the longitudinal stresses imposed upon the shoulders **37, 42** and the bosses preferably should be formed integral with the respective segments. In a preferred example I make the segments of extruded aluminum and make the medial portions of the segments 5/16" thick and taper them to have a thickness of 3/16" at the bosses except that, at the thickened end portions providing the bosses, it has a maximum thickness of 9/16", the outer surfaces of the boss portions being somewhat curved in cross section to their side extremities shown at **35***e*, **40***e* (FIG. 6). The width of each boss portion, between the bottoms of the undercuts and the side edges is

preferably approximately ½". Also, in a preferred example, for a collar 7" in length, the transverse length of each of the shoulders **42** preferably should be 2¼", since each boss **40** must withstand twice the circumferential stress which each of the bosses **35** must withstand, in use. Also, in said preferred example, in which the keys are under a high spring tension, each shoulder **42** is spaced axially of each of the contiguous shoulders **37** approximately 1¼". The segments in this example are heat treated to provide them with the desired degree of spring tension, and in this example the segments are heat treated to a 92,000 lbs. tensile strength. Also in this preferred example the major width of each of the keys **45** at its widest end is preferably ⅞" while the major width of each of said keys at the bottom end of the bevelled side edges is ½", the keys being 5/16" in thickness and the angle of the bevels of the side edges being preferably 15°.

To install my device on a drill pipe, the two segments are applied laterally to the pipe in opposed relationship with the tongue and bifurcations portions in inter-engagement. Since each of the segments is arched in excess of 180° and has resiliency, the segments will snap on the pipe. The keys are then driven between the opposed shoulders causing the inner surfaces of the segments to conform to and snugly resiliently engage the outer surface of the pipe.

As best shown in FIG. 5, I preferably provide the keys **45** with a somewhat pointed bottom end portion **45***a* and bend the top end portion **45***b* of each key at an acute angle to the major length portion thereof, so that when the keys are fully inserted between the opposed shoulders the portion **45***b* becomes counter-sunk or recessed in and flush with the outer surface of the elastic rubber-like material of the outer covering **20** at the bevelled end portion **55** thereof. The said bent portion **45***b* provides a tool engaging surface to facilitate removal of the keys, and limits the extent to which the keys may be driven into the passageways. Also the bending of the end of each key prevents the end from the projecting and being engaged by handling equipment. Inasmuch as the segments arch in excess of 180° about a pipe, and preferably have sufficient resiliency to grip about the pipe, the segments do not automatically release from the pipe when the keys are removed. Therefore, I provide, through the rubber-like covering **20**, in register with the spaces **50**, holes **72** for inserting a suitable tool to pry the segments apart and off the pipe.

From the foregoing description, it will be apparent that my sleeve does not require any special equipment to install it on a pipe, it only being necessary to laterally apply the segments in opposed relationship about a pipe and use a hammer to drive the retaining keys between the opposed shoulders. Inasmuch as the keys are urged in one direction circumferentially of the sleeve by the shoulders **37** and urged in the opposite direction, between the shoulders **37**, by the shoulders **42**, the segments may be initially constricted about the pipe tightly enough to cause the retaining keys to bow circumferentially between the shoulders **37**. The keys, being resilient, are always resiliently urging the segments towards each other, so that if the pipe becomes reduced in diameter, the keys draw the segments closer together to compensate for the change in diameter. And of extreme importance is the fact that due to the spacing of the shoulders **42** from the shoulders **37** in a direction transversely of the sleeve, the retaining keys are subjected only to a bending stress rather than to any shearing stress.

In the embodiment of FIG. 8, I show a modification wherein the shoulders **37***a*, **42***a*, provided by the bosses **35***a*, **40***a* of the segments **15***a*, **16***a* are cut away at their contiguous ends, as shown at **60**, **61**, so that the points at which the key **45** engage the opposed shoulders are spaced apart transversely of the segments even though the bosses are not spaced apart and even though the slot **62** between the bifurcation portions has parallel sides **63**. In this form of my invention, when the segments are constricted or clamped about a pipe or other member of round cross section, the key will resiliently yield laterally as shown by the broken lines **64**, between its points of engagement with shoulders **37***a*. Also in this form of my invention the yielding of the key may be limited, if desired, by engagement of the side edges of the key with the inner edges **65** of the bosses at their contiguous ends.

In the embodiment of FIG. 9, the modification is like that shown in FIG. 8 except that, instead of the contiguous end portions of the shoulders **37***b*, **42***b* provided by the bosses **35***b*, **40***b* of the segments **15***b*, **16***b* being cut away, the key **45** has its opposite side edge portions cut away at **70** so that only its wider or uninterrupted portions **71** engage the opposed shoulders.

In the embodiment of FIGS. 10 and 11, I show a collar construction like that of FIGS. 1–7, except that the shoulders **42***c*, **37***c*, provided by the bosses **40***c* and **35***c* of segments **15***c* and **16***c*, are not necessarily transversely spaced apart, although they may be so spaced if desired; and except that I here employ a spring tempered resilient key **45***c* of arched cross section whose opposite side edges engage the opposed shoulders or abutments. Thus, in this form of my invention, the key will resiliently yield by arching in cross section rather than by laterally bending. The key **45***c* is shown as having parallel side edges, instead of being tapered, and the opposed shoulders are also shown as being parallel instead of tapered. However the key **45***c* as well as the keyway formed by the shoulders, may be tapered if desired.

In the embodiment of FIG. 12 the collar is as shown in the embodiment of FIGS. 10–11 except that here the spring tempered resilient key **45***d* is sinusoidal in cross section. This embodiment also includes the segments **15***d*, **16***d* having integral bosses **40***d*, **35***d*.

While in each of the embodiments described, I have shown the sleeve as being comprised of segments having interengaging portions at one end, it will be understood of course that, in the broader aspects of my invention, it is not necessary to employ a segmental sleeve, and that the sleeve may be continuous except for a single transverse split.

I claim:

1. The combination, with a transversely split sleeve having oppositely circumferentially extending, interengaging free end portions presenting at their free ends oppositely circumferentially facing abutments, of a resiliently flexible key member of rectangular cross section extending transversely of said sleeve between and having its opposite side edge portions engaging said opposed abutments; said abutments being spaced apart transversely of said sleeve a distance at least equal to the width of said key.

2. A sleeve-like band adapted to be resiliently constructed about a member of round cross section and having circumferentially interengaging end portions presenting opposed, circumferentially facing, transversely spaced, radial abutments, and means for resiliently retaining said band constricted about said member comprising a spring-tempered resilient metallic key interposed between and having its opposite side edges engaging opposed ones of said abutments at points substantially spaced apart longitudinally of said key whereby to prevent shearing stresses from being imposed upon said key by said opposed abutments when said band is constricted about said member.

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