

July 3, 1951

N. E. LEE

2,558,763

FLEXIBLE MEMBER

Filed Feb. 21, 1946

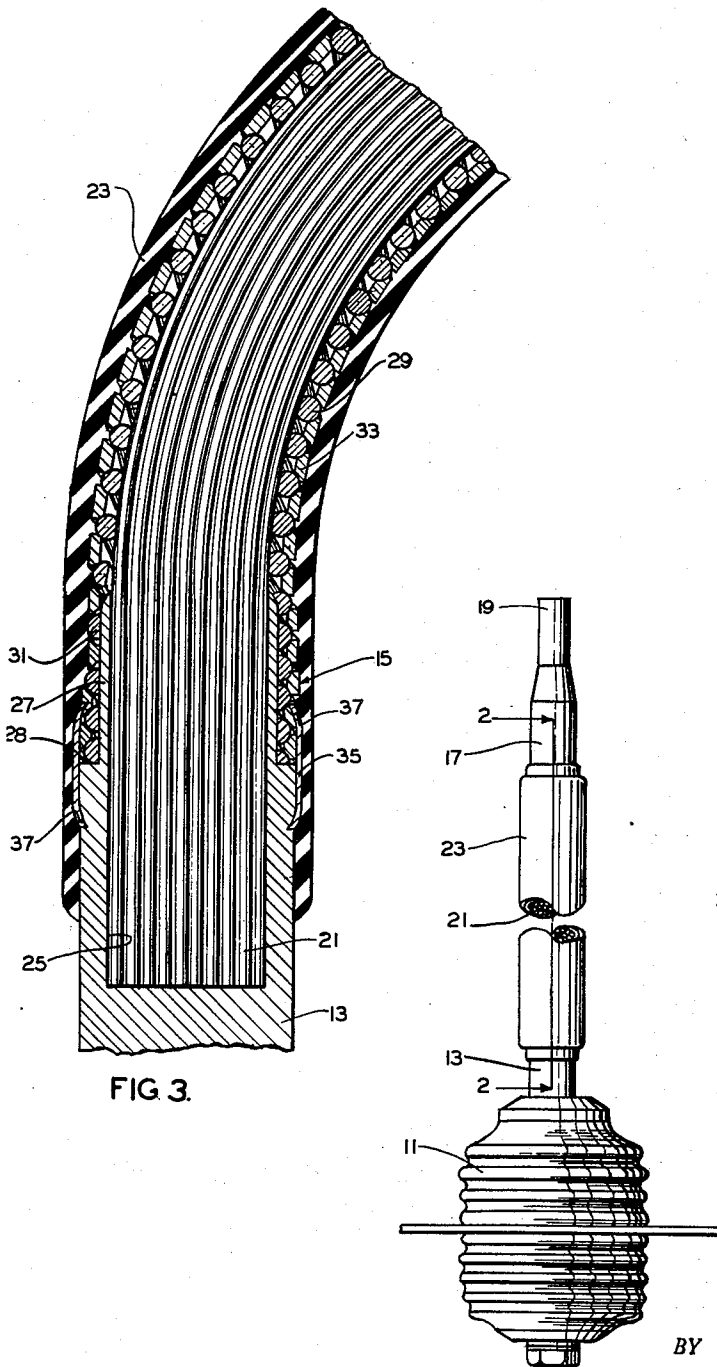


FIG. 3.

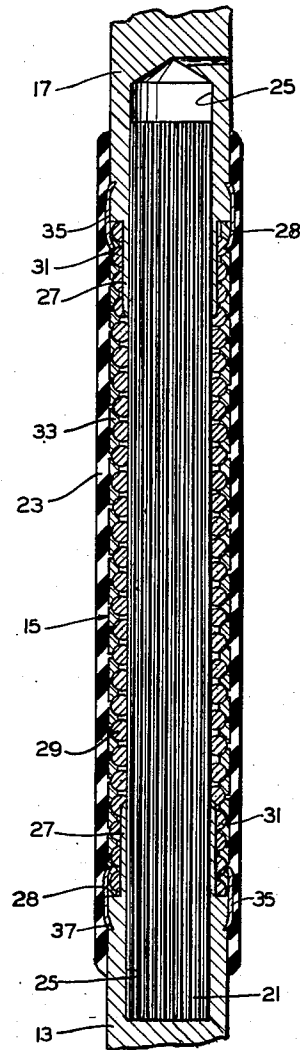


FIG. 2

INVENTOR.
NORMAN E. LEE

BY

William D. Hall,

ATTORNEY

UNITED STATES PATENT OFFICE

2,558,763

FLEXIBLE MEMBER

Norman E. Lee, Forest Hills, N. Y., assignor to the
United States of America as represented by the
Secretary of War

Application February 21, 1946, Serial No. 649,448

12 Claims. (Cl. 267—1)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

1

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

The present invention relates to flexible members, and is particularly directed to such members as are adapted to be used in antenna masts and the like, as disclosed and claimed in my co-pending application for patent on improvements in "Antenna Mast Base," filed on February 11, 1944, and bearing Serial No. 521,964 which was issued on September 9, 1947, as Patent Number 2,427,008.

Innumerable devices in many arts incorporate flexible members of one kind or another. Examples of such flexible members are flexible couplings for the transmission of power, tachometer cables, multiple conductor electrical cables carrying current to moving units, flexible hose for liquids and many others. Another application, and one which will be used in the present case for purpose of illustration, is the base for an antenna mast installed on a motor vehicle or watercraft.

Most flexible members of the prior art are so constructed that they have one or more weak points where breakage is likely to occur long before the balance of the structure has outlived its usefulness. The construction of some members allows nonuniform flexibility throughout their lengths which is objectionable for some uses. Again other flexible members cause electrical effects, either capacitive or inductive, which make them highly unsatisfactory in some applications, such as an antenna mast base.

It is therefore an object of the present invention to provide a flexible member which is not subject to undue strain at any point and therefore is less liable to breakage.

It is a further object to provide a flexible member wherein the degree of flexibility is substantially constant throughout its length.

It is still another object to provide such a flexible member in which electrical disturbances are eliminated or at least reduced to a minimum.

It is yet another object to provide a flexible member which is durable and capable of sustaining the shocks and vibrations ordinarily incident to its use.

It is still another object to provide a flexible member which may be utilized as an electrical conductor.

A further object is to provide a flexible member which is relatively light in weight and inexpensive to fabricate.

2

These and other objects will become apparent from the following description of one embodiment of the present invention which is exemplified in the structure hereinafter described and shown in the drawings, wherein

Figure 1 is an elevational view of a motor vehicle type antenna mast base embodying the present invention;

Figure 2 is an enlarged fragmentary vertical sectional view of the mast base of Figure 1 showing the parts in unflexed condition; and

Figure 3 is a further enlarged view similar to Figure 2, except that the flexible member is shown in a flexed condition as might be caused by deflections of the antenna mast during use.

Referring now more particularly to the drawings, the antenna mast base shown therein includes a support insulator 11, a lower socket 13 secured to said insulator 11, a flexible sheath 15, secured to said lower socket 13, an upper socket 17 secured to the upper end of said flexible sheath 15, an outer cover 23 surrounding said sheath 15, an antenna ferrule 19 secured to the upper socket 17 and a sheaf of spring wires 21 extending between the lower and upper sockets 13, 17 and within the flexible sheath 15.

The lower socket 13 is a cylindrical metal cup which is provided with a cylindrical, coaxially disposed, bore 25 facing upwardly. The upper end of said socket 13 is circumferentially rabbeted to form a relatively thin, upwardly extending, tubular flange 27 of less outside diameter than the balance of the socket 13 and an upwardly facing exterior circumferential shoulder 28. The lower end of the upper socket 17 is provided with a similar bore 25 and is likewise circumferentially rabbeted to form a similar tubular flange 27, which extends downwardly, and a similar shoulder 28, facing downwardly.

A plurality of juxtaposed spring wires 21, such as lengths of piano wire, extend into the bore 25 of the lower socket 13 at one end and into the bore 25 of the upper socket 17 at the other end. The lower ends of said wires 21 are secured to each other and into the bore 25 of the lower socket 13 by welding or any other suitable means. Said spring wires 21, however, throughout the balance of their lengths are free to slide longitudinally against one another when subjected to bending. The upper ends of the spring wires 21 do not extend completely into the bore 25 of the upper socket 17, thereby allowing sufficient room for sliding, within said upper socket, upon deflection.

The flexible sheath 15 is made up of a tightly

3

wound multiple helical spring 29 comprising four steel wires of circular cross section. It is to be noted that a plurality of steel wires is preferably used in the present application so as to give added springiness to the sheath 15. However, for other applications one or any other number of wires may be used in the spring 29.

For compactness and reduced weight, the inner surfaces of the turns of the helical spring 29 are preferably flattened out slightly, by grinding or otherwise. After such flattening, the inside diameter of the helical spring 29 should equal the inside diameter of the tubular flanges 27. The opposite ends of said spring 29 surround the tubular flanges 27 of the lower and upper sockets 13, 17 and abut the shoulders 28 thereon. The inner surfaces of a number of turns 31 at both ends of said helical spring 29, which surround said flanges 27, are suitably flattened, to a greater extent than throughout the intermediate portion of said spring, by grinding or otherwise, to allow them to encompass said tubular flanges 27. Said turns 31 are preferably flattened internally so that they are approximately semicircular in cross section. After such flattening the inside diameter of said end turns 31 should be equal to the outside diameter of the tubular flanges 27. This allows them to encircle the flanges 27 and also gives them increased flexibility, the importance of which will become apparent hereinafter.

Four strands of soft wire 33 are wound about the helical spring 29 and are staggered relative to the turns of said helical spring 29, so that the turns of soft wire 33 are forced into the interstices between the successive turns of the spring 29 and push said successive turns of the spring 29 apart slightly. When so constructed said turns of soft wire 33, when in place, in cross section, are flat on the outside and have two concave surfaces on the inside to allow intimate intermeshing with the turns of the helical spring 29. After the soft wire 33 has been forced into place, the spacing between successive turns of the spring 29 should preferably be approximately the same as the spacing between successive turns of the soft wire 33.

The opposite ends of the flexible sheath 15 (made up of the spring 29 and the soft wire 33) are secured to the lower and upper sockets 13, 17 by means of two tubular sleeves 35 which are slipped respectively over the sockets 13, 17 so as to extend partly over said sockets 13, 17 and partly over the opposite ends of said sheath 15. The said sleeves 35 are swaged into tapered indentations 37 ground into the sheath 15 and into the sockets 13, 17 at several points about their peripheries. Said sleeves 35, in addition, may be brazed or soldered to the ends of the sheath 15 and to the sockets 13, 17.

The entire flexible assembly is then embedded in and surrounded by a cover 23 of elastic material, such as real or synthetic rubber, which cover should completely encase the flexible sheath 15, the sleeves 35 and portions of the sockets 13, 17.

In the operation of the device just described, when the assembly is flexed in any direction (as shown in Figure 3), the spring wires 21 will flex and, except at their lower anchored extremities, will slide lengthwise along each other. The sheath 15 should preferably surround said bundle of wires 21 with sufficient snugness so that the wires, in sliding against each other, set up a certain amount of friction therebetween, thus

4

damping the motions of the antenna and curtailing extreme gyrations thereof.

During such flexure of the assembly, successive turns of the spring 29, on the outside of the bend, will separate some to allow the turns of soft wire 33 therebetween to move slightly inwardly between said turns, and successive turns of the spring 29, on the inside of the bend, will move closer together and will force the intermediate turns of soft wire 33 slightly outwardly. Near opposite ends of the sheath 15, where it surrounds the tubular flanges 27, flexure will cause the lighter substantially semicircular turns 31 of the helical spring 29, on the outside of the bend, to pull apart to a greater extent than the heavier intermediate turns of said spring 29.

This protects said heavier turns from undue strain at the crucial points of the assembly, namely at the ends of the tubular flanges 27 and prevents breakage at these points. It also prevents gaps between successive turns in the sheath 15 at these points, which gaps would upset the continuity of electrical contact between turns and give rise to harmful electrical disturbances in some applications.

It is to be noted that the tubular flanges 27 should preferably be of sufficiently thin metal so that they are sufficiently flexible so that they can assume a somewhat oval configuration in cross section during flexure of the wires 21 to better facilitate such flexure.

Although the flexible member herein is illustrated in the drawings in connection with a plurality of spring wires 21, it will be understood that it can be used in other applications, such as where the interior is hollow, as in gasoline hose and the like.

Although the spring wires 21 of the illustrated embodiment are anchored in one of the sockets 13, it will be understood that they need not be so anchored, but may be individually free to slide back and forth longitudinally. It is merely necessary that the distance from the blind end of the bore 25 of one socket 13, 17 to the blind end of the bore 25 of the other socket be somewhat longer than the spring wires 21 so as to allow said wires to bend freely when the assembly is flexed.

Since many changes may be made in the above construction and many apparently widely different embodiments of this invention may be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a flexible member, a pair of spaced opposing sockets, tubular flanges extending toward each other on said sockets respectively, a flexible sheath extending between said sockets and encircling said flanges at its opposite ends, the ends of said sheath being anchored respectively to said sockets, said sheath including a helical spring and a helix of soft wire, said spring being of thinner material throughout its end portions which encircle the flanges so as to be weaker in extension throughout said end portions, and said helix of soft wire being wound around said spring and of similar pitch and disposed in the interstices between the turns of said spring.

2. In a flexible member as defined in claim 1, wherein a plurality of spring wires extend longitudinally within the flexible sheath and partly into the sockets.

3. In a flexible member as defined in claim 1, wherein a plurality of spring wires extend longitudinally within the flexible sheath and partly into the sockets and wherein the flanges are flexible.

4. In a flexible member a pair of spaced opposed sockets, tubular flanges on said sockets extending toward each other, a helical spring extending between said sockets and encircling said flanges, the turns of the spring encircling said flanges and immediately adjacent said flanges being less stiff than the balance of said spring.

5. In a flexible member as defined in claim 4, a helix of soft metal wound about the spring and intermeshed into the interstices thereof.

6. In a flexible member as defined in claim 4, a helix of soft metal wound about the spring and intermeshed into the interstices thereof so as to force the turns of said spring into spaced relationship.

7. In a flexible member as defined in claim 4, wherein the tubular flanges are flexible.

8. In a flexible member, a pair of cylindrical spaced opposing sockets, tubular flanges respectively on said sockets facing toward each other, a helical spring extending between said sockets and encircling said flanges, a helix of relatively soft wire wound around said helical spring and wedged into the interstices between successive turns thereof, the spring being of less cross sectional area and less stiff throughout its end portions which encircle the flanges than throughout the balance of its length, means for anchoring the opposite ends of the helical spring and the helix of soft wire to the sockets.

9. A flexible member as defined in claim 8, wherein the sheath is surrounded by a cover of elastic material.

10. A flexible member as defined in claim 8, wherein a plurality of juxtaposed spring wires extend longitudinally through the interior of the spring.

11. In a flexible member as defined in claim 8, wherein the flanges are flexible.

12. A flexible member as defined in claim 8, wherein a plurality of juxtaposed spring wires extend longitudinally through the interior of the spring and wherein the flanges are flexible.

NORMAN E. LEE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,053,394	Hubbell	Feb. 18, 1913
1,385,821	Goodall	July 26, 1921
1,433,537	Elliott	Oct. 31, 1922
1,661,835	Keller	Mar. 6, 1925
1,588,900	McGrath	June 15, 1926
1,684,554	Riefenstahl	Sept. 15, 1928
1,882,943	Ross	Oct. 18, 1932
2,346,426	Hait	Apr. 11, 1944

FOREIGN PATENTS

Number	Country	Date
279,399	Great Britain	Jan. 12, 1928
301,865	Great Britain	Feb. 3, 1930