Coil spring with an elastomer having a hollow coil cross section.

Priority: 20.03.90 US 496329

Date of publication of application: 09.10.91 Bulletin 91/41

Publication of the grant of the patent: 30.11.94 Bulletin 94/48

Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

References cited:
EP-A- 0 161 149
DE-A- 1 930 805
DE-A- 3 331 462
NL-A- 7 301 351
US-A- 2 948 527

Proprietor: Balsells, Peter J.
17592 Sherbrook Drive
Tustin, California 92680 (US)

Inventor: Balsells, Peter J.
17592 Sherbrook Drive
Tustin, California 92680 (US)

Representative: KOHLER SCHMID + PARTNER
Patentanwälte
Ruppmannstrasse 27
D-70565 Stuttgart (DE)

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).
Description

The present invention generally relates to a spring assembly according to the preamble of claims 1 and 11 and to a method for manufacturing of a spring assembly according to the preamble of claim 17. A spring assembly of this kind is known in the art from U.S. Patent No. 4,655,462 to Balsells.

It is well known that canted coil springs can be manufactured so that within a certain range of deflection thereof the force developed remains relatively constant and the advantages of these types of springs are pointed out in U.S. 4,655,462. Although the coil size, coil spacing, wire diameter, the angle the coils are canted with a centerline of the spring have been widely investigated in order to tailor the resilient characteristics of the spring to meet the needs of a proposed application, investigation continues in order to provide a wider range of spring resilient characteristics in order to expand the usefulness of the canted coil spring in industry.

Hereofore, there has been no attempt, however, to utilize an elastic or plastic in order to modify the force exerted by the spring assembly in response to deflection of the spring along a loading direction. Prior use of plastic material in combination with a canted coil spring has been limited to the use of a canted coil spring imbedded in an elastic material to provide a reinforcement therefor, totally sacrificing any load-deflection characteristics of the spring.

It is well known that when an O-ring is loaded, the force developed thereby is generally directly proportional to the deflection, thus in the case of U.S. Patent No. 3,183,010 to Bram, when the canted coil spring is imbedded in the O-ring elastomer, it only provides, in combination therewith, a higher force which is directly proportional to the deflection. Thus any advantage that a canted coil spring may otherwise provide is sacrificed in this combination.

Due to the above-mentioned deficiencies in the prior art it is the purpose of the present invention to provide for a spring assembly and a method of manufacture of a spring assembly according to the preambles of claims 1, 11 and 17 which not only maintains the important force deflection characteristics of the canted coil spring, but may be used to enhance advantageous characteristics thereof, in addition to facilitating the tailoring of the combination to meet the demands of apparatus configurations not possible by a canted coil spring alone, an O-ring, or a combination thereof.

This purpose is achieved by the characterizing portions of claims 1, 11 and 17 in combination with their respective preambles.

SUMMARY OF THE INVENTION

A spring assembly in accordance with the present invention generally includes a plurality of coil means which are interconnected with one another in a spaced-apart relationship for causing the spring assembly to exert a force in a loading direction approximately normal to a tangent of the centerline thereof in response to deflection of the coil assembly along the loading direction. An elastic material is disposed around and between the plurality of coil means and a hollow cross section is provided for modifying the force exerted by the spring assembly in response to the deflection of the spring along the loading direction. In one embodiment of the present invention, the plurality of coils are interconnected in a manner causing the spring assembly to exert a generally constant force in a loading direction approximately normal to a tangent of the centerline.

In this invention, the elastic material may be generally tubular in shape and the plurality of coil means may be disposed within the generally tubular shaped elastic material. More particularly, the coil means may be disposed at an acute angle to a centerline thereof and disposed within the elastic material in a stretched spaced-apart relationship in which case the elastic material has sufficient resistance to hold the plurality of coils in the stretched spaced-apart relationship. The spacing between the coil means in the stretched spaced-apart relationship may be greater than the spacing between the coil means when not held in the spaced-apart relationship by the elastic material.

Alternatively, the spring may be disposed within the elastic material in a preloaded condition in which the plurality of coils are deflected along the loading direction. This is to be distinguished from the hereinabove recited embodiment in which the coils are in a stretched configuration but not deflected along the loading direction while disposed within the elastic material. By stretching the hollowed elastomeric filled spring, a combination of radial and compression load can be developed that provides substantially improved sealing ability, especially when loading radially on a shaft, or the like.

In another embodiment of the present invention the coil means may have an oval perimeter and the elastic material may include means for defining a circular hollow center portion thereof. Alternatively, the elastic material may include means for defining a plurality of hollow areas within the elastic material and inside the plurality of coil means.

In yet another embodiment of the present invention, the coil means may have an oval perimeter and the elastic means may include means for defining a generally rectilinear hollow center portion.
thereof.

In yet another embodiment of the present invention, an elastic coating may be provided which is disposed on the plurality of coil means for modifying the magnitude of the generally constant force exerted by the plurality of coils in response to deflection of the spring assembly along the loading direction.

The elastic means may include means, defining a shape thereof, for positioning the plurality of coils in order that the loading direction is approximately perpendicular to the centerline tangent. The elastic means shape may include dependent portions substantially larger than the diameter of the plurality of coil means for effecting the positioning thereof.

The present invention, the spring assembly may include a first plurality of coil means as hereinabove described, and a second plurality of coil means, interconnected with one another in a spaced apart relationship and disposed within the first plurality of coil means in a cooperating relationship therewith for causing the spring assembly to exert a generally constant force in a loading direction approximately normal to a centerline of said first and second plurality of coil means in response to deflection of the spring assembly along the loading direction.

The first and second coil means may be canted in the same direction along a common centerline thereof or cantied in opposite directions along the common centerline. Further, at least one of said first and second plurality of coil means may be disposed in the elastic material and in a stretched-apart relationship as hereinbefore described or, alternatively, at least one of the first and second plurality of coil means may be disposed in the elastic material in a preloaded condition as hereinabove described.

A method is provided by the present invention for the manufacture of an assembly which includes the steps of fabricating a wire to produce coils interconnected with one another in a spaced-apart relationship and thereafter disposing an elastomer material in and around the coils while not filling the interior portion of the coils along the centerline thereof. One embodiment of the present invention, a step is included in the method of manufacture in which the ends of the wire and the elastic material are joined to form a continuous spring assembly. In addition, a step may be provided in which the coils are deflected while the elastic material is disposed in and around the coils. Further, a step may be provided which includes stretching the coils apart from one another while disposing the elastic material in and around the coils.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention may be had from the consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a partially cut-away perspective view of a spring assembly in accordance with the present invention generally showing a plurality of coil means disposed within an elastic material having a hollow center;

Figure 1a, is a cross-sectional view of the spring assembly shown in Figure 1 with a fugative material therein which is later removed in accordance with the method of the present invention;

Figure 1b is a round spring embodiment of the present invention filled with an elastomer with a hollow core;

Figure 2 is an axial canted coil spring in accordance with the present invention with the coils being canted in a clockwise direction;

Figure 3 is a view taken along the line 3-3 of the spring shown in Figure 2 illustrating a back angle on an inside diameter of the spring and a front angle on an outside diameter of the spring;

Figure 4 is a spring in accordance with the present invention in which the coils are cantied in a counter-clockwise manner;

Figure 5 is a view showing the spring in Figure 4 taken along the line 5-5 illustrating a back angle on an outside diameter of the spring and a front angle on an inside diameter of the spring;

Figure 6 is a plane view of a radial spring in accordance with the present invention which is canted in a clockwise direction along the centerline thereof, with the back angle on the top;

Figure 7 is a canted coil radial spring in accordance with the present invention in which the coils are cantied in a counter-clockwise direction of the back angle disposed in the bottom thereof;

Figure 8 shows a typical load-deflection curve for a spring assembly in accordance with the present invention for the purpose of defining the nomenclature thereof;

Figure 9 shows an axial spring with an irregular shape in accordance with the present invention having a hollow interior;

Figures 10-13 show various inner cross-sectional configurations in accordance with the present invention;

Figures 14-16 show variations in encapsulation of the coils of the present invention with an elastomer;

Figure 17 is a spring, in accordance with the present invention, with a plurality of coils showing specific dimensions thereof;
Figure 18 are curves showing the effect of hollowed elastic material on the force-deflection curve of a canted coil spring;

Figure 19A-C shows in cross-sectional manner a spring disposed within an elastomer in a preloaded condition;

Figure 20 shows the effect on the force-deflection curve of a spring held in a preloaded condition by the elastomer;

Figures 21A-C shows a spring in a free position and imbedded in an elastomer in a stretched configuration;

Figure 22 is an alternative embodiment of the present invention showing a first plurality of coils with an elastic material thereabout and a second plurality of coils coaxially disposed therein with an elastic material thereabout;

Figure 23a and b are views of an alternative embodiment of the present invention similar to that shown in Figure 22 with the first and second plurality of coil means being canted in the same direction along the common centerline and separated from one another;

Figure 24a and b shows an alternative embodiment of the present invention in which the first and second plurality of coil means being canted in opposite directions, and the elastic material has a substantially greater dimension than the diameter of the plurality of coils which provides a means for positioning the plurality of coils in order that the loading direction is approximately perpendicular to the centerline tangent;

Figure 25 is a sectional view of an alternative embodiment of the present invention showing the mounting of the spring assembly utilizing portions of an elastic member to position the coils;

Figure 26 is a cross section view of Figure 25 taken along the line 26-26; and

Figure 27 is an alternative embodiment of the present invention showing an alternate shape of the elastic member.

DETAILED DESCRIPTION

Turning now to Figures 1a and 1b, there is generally shown a spring assembly 10, in accordance with the present invention, which includes a plurality of coils 12 interconnected with one another in a spaced-apart relationship for causing the spring assembly 14 to exert a generally constant force in a loading direction, normal to a tangent to a centerline 16, as will be hereinafter described in greater detail. An elastic material 18 which is disposed around and between the plurality of coils 12 includes a hollow cross-section 20 which provides means for modifying the force exerted by the spring assembly 14 in response to deflection of the spring assembly 10 along a loading direction as hereinafter described in greater detail. As shown in Figure 1b, the spring assembly 14 may include circular coils, not canted to a centerline thereof, or as hereinafter described, canted coil assemblies.

Figures 2 through 7 show a number of canted coil assemblies 30, 32, 34, 36, suitable for use in the present invention, each including a plurality of coils 38, 40, 42, 44. The springs 30 and 32 have the coils 38, 40 interconnected in a manner forming a circular spring having a primary load-deflection characteristic along an axial direction of the circular spring 30, 32. Spring 30 shown in Figures 2 and 3 has a clockwise canting coil, with the coils 38 interconnected so that a back angle 48, which defines a trailing portion 50, is along an inside diameter 52 of the spring 30 and a front angle 56, which defines a leading portion 58 of the coil 30, is along an outside diameter 60 of the spring 30.

Turning to Figures 4 and 5, the axial spring 32 therein has coils 40 interconnected in a manner having a counter-clockwise canted coils with a back angle 64 defining a trailing portion 66 along an inside diameter 68 of the spring 32 and a front angle 70, defining a leading portion 72 along an outside diameter 74 of the spring 32.

Turning now to Figures 6 and 7, there is shown springs 34, 36 having a plurality of coils 42, 44 which are interconnected in a manner forming a circular spring having a primary load-deflection characteristic along a radial direction indicated by the arrows 76, 78, respectively. As shown in Figure 6, the coils are interconnected in a manner for providing a clockwise canting with a back angle 82 defining a trailing portion 84 along a top 86 and a front angle 88 defining a leading portion 92 disposed along the bottom 100 of the spring 34.

Alternatively, as shown in Figure 7, spring 36 may have coils 44 connected in a manner causing a canting of the coils in a counter-clockwise direction with a back angle 98 defining a trailing portion 100 along a bottom 102 of the spring 36 and a front angle 106 defining a leading portion 108 along a top 110 of the spring 36.

As hereinafter described, all of the springs 30, 32, 34, 36, may have a generally constant force deflection characteristic within a working deflection thereof.

Yet another structural arrangement of the canted coil assemblies 30, 32, 34 and 36 is their orientation within the elastomer 18. As described in U.S. Patent No. 4,893,795 issued January 16, 1990, to Balsecons, entitled,"Radially Loaded Canted-Coil Springs With Turn Angle," the spring assembly may be held in a turn angle orientation by the elastomer.

Figure 7a shows in schematic form, a cross-section of the canted coil spring 34, in accordance
with the present invention, with a turn angle of $\theta$, a measured coil width of C.W., a measured coil height of C.H. and a measured spring height H of the spring 34. As shown in Figures 7a, the turn angle may be clockwise (bold lines) or counterclockwise. (Dashed lines). The turn angle $\theta$ may be defined as an angle formed by a generally circular spring forming a cone or inverted cone, depending on the position of the spring, and measuring the turn angle for the horizontal to the intersection through the centerline 112 of the spring 34.

Figure 8 shows a representative load-deflection curve A for springs 30, 32, 34, 36 in which the spring exhibits a generally linear load-deflection relationship as shown by the line segment 124, until it reaches a minimum load point 126, after which the load-deflection curve remains relatively constant within a working deflection 130 between the minimum load point 126 and a maximum load point 132. Between the minimum load point 126 and the maximum load point 132, the load-deflection curve may be constant, or show a slight increase as shown in Figure 8.

The area between the minimum load point 126 and the maximum load point 132 is commonly referred to as the working range 130 of the spring. The spring 30, 32, 34, 36 is normally loaded for operation within this range as indicated by the point 134.

Loading of the spring 30, 32, 34, 36 beyond the maximum load point 132, results in an abrupt deflection response until it reaches a butt point 136, which results in a permanent set of the spring as a result of overloading. Also indicated in Figure 8 is a total deflection range of 138 representing the deflection between a zero point 140 and the maximum load point 132.

The elastomer, or elastic material, 18, (See FIG. 1) suitable for the present invention, may be any synthetic or natural material capable of recovering its original size and shape after deformation. That is, the material is resilient.

While the spring assembly 10 shown in Figure 1 has a generally circular shape, it should be appreciated that any irregular shape such as the spring assembly 150 shown in Figure 9 as long as the cross-section thereof is hollow in cross-section. Alternatively, the spring 12 may not be joined, for example, as shown in Figure 1. In this instance, the length of elastomer coated, or filled, coils may be used in applications suitable for linear springs.

The spring 14 may be filled by any manufacturing method suitable for the elastomer employed, such methods including extrusion, molding, spraying or any other suitable method for introducing elastomer 18 in and around the coils 12 of the spring 14, while leaving a hollow cross section 20 along the centerline 18. Such other methods may include the fusing of two tubular parts (not shown), one disposed on the inside of the spring 14 and one disposed on the outside of the spring 14 with the fusing of the parts filling of the spaces between the coils 12.

Alternatively, the elastomer 18 may be formed in and around the coils 12 while a rod 151 of fugative compound 150 is disposed within the coils 12. (See Figure 1a). Thereafter the fugative compound is dissipated or removed by heat or solution, as is well known in the art.

Various embodiments of the present invention are shown in Figures 10 through 15. In Figure 10, coils 152 with an interior elastomer 154 are shown with the coils 152 having an elliptical shape and the elastomer 154 having a circular shaped void 156 therethrough. Figure 11 shows elliptically shaped coils 156 having an elastomer 158 with an offset, or generally rectangular, hollowed cross-sectional opening 160 therethrough, while Figure 12 shows an elliptically shaped coils 162 having an elastomer 164 with an irregularly shaped opening 166 comprising to generally circular cross-sectional areas 168, 168'.

As hereinbefore mentioned, the elastic material may be disposed within the coils 152, 156, 162 as shown in Figures 10, 11 and 12 or, alternatively, as shown in Figure 13, an elastomer 168A may be disposed on one side 170A of coils 172A. This embodiment is most useful in applications in which a greater distribution of the load is desirable on the one side 170A of the coils 172A.

Other embodiments 170, 172, 174, of the present invention, shown respectively in Figures 14 through 16, said embodiments 171, 172, 174 including coils 178, 180, 182 and elastomers 186, 188, 190. The embodiment 170 includes an open area 190 through the coils 178 in order to facilitate the passage of fluid (not shown) for pressure variation cooling or lubrication purposes.

As can be seen from Figure 15, the elastomer 188 may be disposed as a coating both the inside 194 and outside 196 of the coil 180, while Figure 16 shows the elastomer 190 disposed along the outside and through the coils 182. All of these embodiments differently affect the force-deflection characteristics of the embodiments 171, 172, 174 depending upon the application of the embodiment 171, 172, 174.

The ability to maintain a relatively constant force within a certain deflection is affected by a number of parameters, all of which are taken into consideration, which include the cross-section of the elastomer and the disposition thereof as indicated in Figures 10 through 16, the thickness of the elastomer, the flexibility of the elastomer, the degree of bonding between the springs 152, 154, 170, 186, 188, 190 and corresponding elastomers.
154, 156, 168, 186, 188, 190, the spacing between
the coils 152, 154, 170, 178, 180, 182, the wire
diameter, coil height and coil width, among other
considerations.

It is to be appreciated that when a canted-coil
spring is filled with an elastomer, especially in an
outer portion of the coil, the force applied thereon
is transmitted more uniformly and the stress acting
on the mating parts is substantially lower. In appli-
cations where the canted-coil spring assembly
10 is used in connection with the sealing device, it
provides substantially better sealing ability and re-
sults in a substantial increase in the seal perfor-
man and seal life.

The ability of the hollowed canted-coil spring
filled with an elastomer having a hollow center to
achieve a high degree of deflection and maintain a
relatively constant load within a high deflection
decreases the total amount of force that is needed
to affect sealing and this offers a significant advan-
tage, especially in dynamic situations. The ability
of the hollowed elastomer filled spring to stretch
facilitates its assembly in a single groove construc-
tion, similar to that as can be found in O-ring
applications for both mounting the assembly 10 in
a piston (not shown) or in a housing (not shown).

Another very important feature of the
elastomer-filled spring 14 with hollow cross section
20 is its use as a seal itself. Heretofore, elastomers
have used the canted-coil spring as a loading
means in order to maintain intimate contact be-
tween the sealing surfaces of the elastomer. In
many prior art applications, the elastomer tends to
age or relax due to aging stiffness of the elastomer,
or due to temperature cycling, and the spring is
used to force the elastomer in contact with the
sealing surfaces. In the present invention, by com-
bining the elastomer 18 within the spring 14 and
providing a hollow cross section 20, both items can
be accomplished in one, with a higher degree of
reliability and sealing ability, and this can be done
in reciprocating, rotating, oscillating, and static ap-
lications.

Another important feature is to use the spring
assembly 10 as a loading means to provide more
uniform loading on a sealing surface (not shown)
which results in substantially better performance
because it enables the use of a smaller wire thus
uniformly distributing the load which results in
more effective sealing ability and longer seal life.

In all these applications, the elastomer 18 may
be any type of elastomeric material such as silico-
ne, Buna N, nitrile, fluoroelastomers, PTFE,
elastomers, etc. Also, certain types of plastics that
have the properties of elastomers can be used due
to their high coefficient of friction, their operating
temperature, etc.

A specific example of the force-deflection char-
acteristics for the spring 14, with coils 12 is set
forth in Figure 17, is shown in Figure 18 as curve
A. When an elastomer, such as Dow Corning
Silastic 732 RTV was filled between the coils 12
and interior thereof to a thickness of 0.016 inches
with a cross-section as shown in Figure 10, the
resulting force-deflection curve obtained is illus-
trated as curve B in Figure 18. The same
elastomer was disposed between the coils 12 and
within the coils 12 to a thickness of 0.026 inches
with a cross-section shown in Figure 12. The re-
sulting force-deflection curve is shown as curve C
in Figure 18.

As shown by the curves A, B and C of Figure
18, the force-deflection curve of the spring assem-
bles 152, 160, which remains relatively constant
but greater than the spring 12 without elastomer
shown curve A. As the amount of elastomer is
increased or as a cross-section is varied by adding
elastomer on the outside diameter or on the inside
diameter of the coil, the force developed increases.

Turning now to Figure 19a, there is shown as
spring assembly 200 in accordance with the
present invention in which the spring 202, shown
also in Figures 19b and c, includes a plurality of
cols 204 which are preloaded before being imbed-
ded in an elastomer 206. This further enables the
tailoring of the force-deflection curve of the spring
assembly 200. Curve A in Figure 20 shows the
force-deflection curve for the spring 202 only while
curve B shows the load-deflection curve for the
preloaded spring and elastomer. It should be ap-
preciated that while the deflection of the spring is
limited, a higher load is produced and, furthermore,
with a 17.5 percent deflection in preloading shown
as point C in Figure 20.

Figure 21a shows a radial spring 210 filled with
an elastomer material 212 having a hollow center
214.

In this case, the spring is in a free position
when filled with material. It should be contrasted
with the Figure 21b in which the spring 210 is
stretched, with greater spaces as indicated by the
arrow 220 between the coils 210 when filled with
the elastomer material 218, the latter having a
hollow core 214 as shown in Figure 21c. The force
developed by the spring 210 depends on the
amount of stretch with the mechanical of the
elastomer, degree of bonding, spacing between the
cols, ratio of the coil height to coil width, etc. A
spring of this type may be used in order to provide
an extension load or can be used to provide a
combination of extension load and compression
load. In either case, stretching of the coils can be
used to further modify the force-deflection curve of
the spring 210.
In the manufacture of the spring assembly 10, the spring 14 may be made longer than necessary to complete a circle within a groove 250 as shown in Figure 22, the groove 250 being in a piston or housing, not shown. In this instance, the excessive spring length will cause the elastomer 18 to butt and therefore eliminate any gap between the spring ends.

Turning to Figure 23a and b, there is an alternate embodiment of the spring assembly 300 which includes a first plurality of coils 302 interconnected with another in a spaced-apart relationship for causing the spring assembly 300 to exert a generally constant force in a loading direction normal to a tangent to a centerline 304. As hereinbefore described in connection with the plurality of coils 12, an elastic material 306 is disposed around and between the plurality of coils 302 a hollow cross section 308 which provides means for modifying the force exerted by the spring 302 assembly 300 in response to deflection of the spring assembly 300 along a loading direction as hereinbefore described.

Disposed within the plurality of coils 302 is a second plurality of coils 310 interconnected with one another in a spaced apart relationship and disposed in a cooperating relationship inside the first plurality of coils for causing the spring assembly 300 to exert a generally constant force in a loading direction approximately normal to the centerline 304.

An elastic material 312 disposed around and between the plurality of coils 310 and includes a hollow cross section 314. Figure 23b shows a cross sectional view of the spring assembly 300 and also showing that the elastic materials 306, 312 may be separate from one another with a gap 320 therebetween to allow relative movement therebetween as the spring assembly 300 is loaded.

Similar to the spring assembly 300, a spring assembly 330 shown in Figures 24a and b include a first plurality of coils 332 with an elastic material 334 disposed therearound and a second plurality of coils 336 within the elastic material 338 therearound. The configuration of the first and second plurality of coils 332, 336 and elastic material 334, 338 is similar to the coil assembly 300 shown in Figure 23a and b except that the first plurality of coils 332 is canted in an opposite direction from the second plurality of coils 336 along a centerline 342. The performance of the embodiments shown in Figures 23a and b and 24a and b are similar to that hereinbefore described in connection with the spring assembly 10 further extending the design range capability of the forced deflection curves thereof.

Turning now to Figures 25-27, there is shown alternative embodiments 350, 352 of the present invention which include a plurality of coils 354, 356 within the elastic material 358, 360 thereabout. The feature of the embodiments of 350, 352 is the shape of the elastic 358, 360 which includes depending portions 364, 366 and 368, respectively, which provide a means for positioning the plurality of coils 354, 356 in order that the loading direction is approximately perpendicular to the centerline 370, 372, respectively.

Although there has been hereinabove described a specific arrangement of a spring assembly in accordance with the present invention, for the purposes of illustrating the manner in which the invention may be used to advantage, it should be appreciated that the invention is not limited thereto. Accordingly, any and all modifications, variations, or equivalent arrangements which may occur to those skilled in the art, should be considered to be within the scope of the invention as defined in the appended claims.

Claims

1. A spring assembly (10) having a plurality of coils (12) interconnected with one another in a spaced-apart relationship, for causing the spring assembly (10) to exert a force in a loading direction approximately normal to a tangent to a centerline (16) of said plurality of coils (12) in response to deflection of the spring assembly (10) along said loading direction characterized in that an elastic material (18) is disposed around and between the plurality of coils (12) with the elastic material (18) having a hollow cross-section, for modifying the force exerted by the spring assembly (10) in response to deflection of the spring assembly (10) along said loading direction.

2. The spring assembly according to claim 1 further characterized in that said elastic material has a shape designed for positioning the plurality of coils (12) in order that the loading direction is approximately perpendicular to the centerline (16) tangent.

3. The spring assembly (10) according to claim 3 further characterized in that the elastic material (18) shape includes dependent portions substantially larger than a diameter of said plurality of coils (12).

4. A spring assembly (10) according to claim 1 further characterized in that the elastic material (18) has a generally tubular shape and the plurality of coils (12) are interconnected with one another in a spaced-apart relationship and disposed within said generally tubular shaped...
elastic material (18) for causing the spring assembly to exert a generally constant force in a loading direction approximately normal to a tangent to a centerline (16) of said plurality of coils (12) in response to deflection of the spring assembly (10) along said loading direction, said force being generally constant over a range of deflection of the spring assembly (10) along the loading direction.

5. The spring assembly (10) according to claim 4 further characterized in that the plurality of coils (12) are disposed within said elastic material (18) in a stretched spaced-apart relationship, the elastic material (18) having sufficient resistance to hold the plurality of coils (12) in said stretched spaced-apart relationship, the spacing between coils in said stretched spaced-apart relationship being greater than the spacing between coils when not held in a stretched-apart relationship by the elastic material (18).

6. The spring assembly (10) according to claim 4 further characterized in that the plurality of coils (12) are disposed within said elastic material (18) in a preloaded condition in which the plurality of coils (12) are deflected along the loading direction.

7. The spring assembly (10) according to claim 1 or 4 further characterized by the fact that an open passage through the elastic material (18) is provided for enabling passage of fluid therethrough.

8. The spring assembly (10) according to claims 1 or 4 further characterized by the fact that the coils (12) have an oval perimeter and the elastic material (18) includes a circular hollow center portion.

9. The spring assembly (10) according to claims 1 or 4 wherein the coils (12) have an oval perimeter and the elastic material (18) includes a plurality of hollow areas within said elastic material (18) and inside of said plurality of coils (12).

10. The spring assembly (10) according to claims 1 or 4 wherein the coils (12) have an oval perimeter and the elastic material (18) includes a generally rectilinear hollow center portion.

11. A spring assembly (300) having a first plurality of coils (302), interconnected with one another in a spaced-apart relationship, for causing the spring assembly (300) to exert a generally constant force in a loading direction approximately normal to a tangent to a centerline (304) of said plurality of coils (302) in response to deflection of the spring assembly (300) along said loading direction characterized in that a second plurality of coils (310) is provided and interconnected with one another in a spaced-apart relationship and disposed within said first plurality of coils (302) and in a cooperating relationship therewith, for causing the spring assembly (300) to exert a generally constant force in a loading direction approximately normal to a tangent to a centerline (304) of said second plurality of coils (310) in response to deflection of the spring assembly (300) along said loading direction, and an elastic material (306) is disposed around and between said first and second plurality of coils (302, 310) and having a hollow cross-section, for modifying the force exerted by the spring assembly (300) in response to deflection of the spring assembly (300) along said loading direction.

12. The spring assembly according to claim 11 further characterized in that the elastic material (304) comprises an outer portion (306) disposed around the first plurality of coils (302) and an inner portion (312) disposed around said second plurality of coils (310), said outer and inner portions (306, 312) being separate and unattached to one another.

13. The spring assembly (300) according to claim 12 further characterized in that the first and second coils (302, 310) are canted in the same direction with respect to a common centerline (304).

14. The spring assembly (330) according to claim 12 wherein said first and second coils (332, 336) are canted in opposite directions with respect to a common centerline (342).

15. The spring assembly (300, 330) according to claim 11-14 further characterized in that at least one of said first and second plurality of coils (302, 310) is disposed within said elastic material (306) in a stretched spaced-apart relationship, the elastic material (306) having sufficient resistance to hold the stretched apart plurality of coils (302, 310) in said stretched spaced apart relationship, the spacing between coils (302, 310) in said stretched spaced part relationship being greater than the spacing between coils when not held in a stretched apart relationship by the elastic material (306).
16. The spring assembly (300, 330) according to claim 11-14 further characterized in that at least one of said first and second plurality of coils (302, 310) is disposed within said elastic material (306) in a preloaded condition in which the plurality of coils (302, 310) are deflected along the loading direction.

17. A method for manufacturing a spring assembly (10) in which a wire is fabricated to produce coils (12) interconnected with one another in a spaced apart relationship characterized by disposing an elastic material in and around said coils (12) while not filling an interior of the coils (12) along a centerline thereof.

18. The method according to claim 17 further characterized by deflecting the coils (12) while disposing the elastic material 18 in and around the coils.

19. The method according to claims 17 further characterized by stretching the coils (12) apart from one another while disposing the elastic material (16) in and around the coils (12).

20. The method according to claim 17 further characterized by disposing a rod of fugitive compound within the coils disposing an elastic material in and around said coils and around said rod, and removing the rod of fugitive compound to provide hollow interior to said coils (12) with elastic material (18) thereafter.

Patentansprüche

1. Federanordnung (10) mit einer Vielzahl von Spulen (12), die miteinander voneinander be- standet verbunden sind, um zu bewirken, daß die Federanordnung (10) eine Kraft in ei- ner zu einer Tangente einer Mittellinie (16) der Vielzahl von Spulen (12) ungefähr senkrechten Belastungsrichtung in Reaktion auf eine Ablenkung der Federanordnung (10) entlang der Belastungsrichtung ausübt, dadurch gekennzeich- net, daß ein elastisches Material (18) zwischen den und um die Vielzahl von Spulen (12) her- um angeordnet ist, wobei das elastische Material (18) einen hohen Querschnitt aufweist, um die von der Federanordnung (10) ausgeübte Kraft in Reaktion auf eine Ablenkung der Fe- deranordnung (10) entlang der Belastungsrich- tung zu modifizieren.

2. Federanordnung nach Anspruch 1, weiterhin dadurch gekennzeichnet, daß das elastische Material eine Form hat, die zum Positionieren der Vielzahl der Spulen (12) gestaltet ist, damit die Belastungsrichtung ungefähr senkrecht zu der Tangente der Mittellinie (16) ist.

3. Federanordnung (10) nach Anspruch 3, weiter- hin dadurch gekennzeichnet, daβ die Form des elastischen Materials (18) abhängige Abschnitte beinhaltet, die wesentlich größer sind als ein Durchmesser der Vielzahl der Spulen (12).

4. Federanordnung (10) nach Anspruch 1, weiter- hin dadurch gekennzeichnet, daβ das elastische Material (18) eine im allgemeinen rohrförmige Form hat und die Vielzahl der Spulen (12) miteinander voneinander beabstandet verbunden und innerhalb des im allgemeinen rohrförmigen elastischen Materials (18) angeordnet ist, um zu bewirken, daβ die Federan- ordnung eine im allgemeinen konstante Kraft in einer Belastungsrichtung ungefähr senkrecht zu einer Tangenten zu einer Mittellinie (16) der Vielzahl der Spulen (12) in Reaktion auf eine Ablenkung der Federanordnung (10) entlang der Belastungsrichtung ausübt, wobei die Kraft im allgemeinen über einem Ablenkbereich der Federanordnung (10) entlang der Belastungsrichtung konstant ist.

5. Federanordnung (10) nach Anspruch 4, weiter- hin dadurch gekennzeichnet, daβ die Vielzahl der Spulen (12) innerhalb des elastischen Mat- erials (18) gespannt voneinander beabstandet angeordnet ist, wobei das elastische Material (18) ausreichend Widerstand hat, um die Viel- zahl der Spulen (12) in dem gespannten beab- standeten Verhältnis zu halten, wobei der Ab- stand zwischen gespannten beabstandeten Spulen größer ist als der Abstand zwischen Spulen, wenn sie nicht durch das elastische Material (18) in einem voneinander beabstan- det gespannten Verhältnis gehalten sind.

6. Federanordnung (10) nach Anspruch 4, weiter- hin dadurch gekennzeichnet, daβ die Vielzahl der Spulen (12) innerhalb des elastischen Ma- terials (18) in einem vorbelasteten Zustand angeordnet ist, in welchem die Vielzahl der Spu- len (12) entlang der Belastungsrichtung abge- lenkt ist.

7. Federanordnung (10) nach Anspruch 1 oder 4, weiterhin gekennzeichnet durch die Tatsache, daβ ein offener Durchgang durch das elasti- sche Material (18) vorgesehen ist, durch wel- chen Flüssigkeit hindurch gelangen kann.

8. Federanordnung (10) nach Anspruch 1 oder 4, weiterhin gekennzeichnet durch die Tatsache, daβ die Spulen (12) einen ovalen Umfang au-
weisen und das elastische Material (18) einen kreisförmigen hohen Mittelabschnitt aufweist.

9. Federanordnung (10) nach Anspruch 1 oder 4, wobei die Spulen (12) einen ovalen Umfang haben und das elastische Material (18) eine Vielzahl von hohen Bereichen innerhalb des elastischen Materials (18) und innerhalb der Vielzahl der Spulen (12) aufweist.

10. Federanordnung (10) nach Anspruch 1 oder 4, wobei die Spulen (12) einen ovalen Umfang haben und das elastische Material (18) einen im allgemeinen geradlinigen hohen Mittelabschnitt aufweist.

11. Federanordnung (300) mit einer ersten Vielzahl von Spulen (302), die voneinander beabstandet miteinander verbunden sind, um zu bewirken, daß die Federanordnung (300) eine im allgemeinen konstante Kraft in einer Belastungsrichtung ungefähr senkrecht zu einer Tangente zu einer Mittellinie (304) der Vielzahl von Spulen (302) in Reaktion auf eine Ablenkung der Federanordnung (300) entlang der Belastungsrichtung ausübt, dadurch gekennzeichnet, daß eine zweite Vielzahl von Spulen (310) vorgesehen ist und voneinander beabstandet miteinander verbunden und innerhalb der ersten Vielzahl von Spulen (302) in derart zusammenwirkender Weise angeordnet ist, um zu bewirken, daß die Federanordnung (300) eine im allgemeinen konstante Kraft in einer Tangente zu einer Mittellinie (304) der zweiten Vielzahl von Spulen (310) ungefähr senkrecht in der Belastungsrichtung in Reaktion auf eine Ablenkung der Federanordnung (300) entlang der Belastungsrichtung ausübt, und daß ein elastisches Material (306) um und zwischen der ersten und zweiten Vielzahl von Spulen (302, 310) angeordnet ist und einen hohen Querschnitt aufweist, um die von der Federanordnung (300) in Reaktion auf die Ablenkung der Federanordnung (300) entlang der Belastungsrichtung ausübt, Kraft zu modifizieren.

12. Federanordnung nach Anspruch 11, weiterhin dadurch gekennzeichnet, daß das elastische Material (304) einen äußeren Abschnitt (306), der um die erste Vielzahl von Spulen (302) herum angeordnet ist und einen inneren Abschnitt (312), der um die zweite Vielzahl von Spulen (310) herum angeordnet ist, aufweist, wobei der äußere und innere Abschnitt (306, 312) separat sind und nicht miteinander verbunden sind.

13. Federanordnung (300) nach Anspruch 12, weiterhin dadurch gekennzeichnet, daß die ersten und zweiten Spulen (302, 310) in derselben Richtung in bezug auf eine gemeinsame Mittellinie (304) gekippt angeordnet sind.

14. Federanordnung (330) nach Anspruch 12, wobei die ersten und zweiten Spulen (332, 336) in entgegengesetzte Richtungen in bezug auf eine gemeinsame Mittellinie (342) gekippt angeordnet sind.


17. Verfahren zum Herstellen einer Federanordnung (10), bei der ein Draht gefertigt wird, um Spulen (12), die voneinander beabstandet miteinander verbunden sind, herzustellen, gekennzeichnet durch Anordnen eines elastischen Materials in und um die Spulen (12) herum, wohingegen das Innere der Spulen (12) entlang einer ihrer Mittellinien nicht gefüllt wird.

18. Verfahren nach Anspruch 17, weiterhin gekennzeichnet durch Ablenken der Spulen (12), während das elastische Material 18 in und um die Spulen herum angeordnet wird.

19. Verfahren nach Anspruch 17, weiterhin gekennzeichnet durch Auseinanderziehen der Spulen, während das elastische Material (18) in und um die Spulen (12) herum angeordnet wird.
20. Verfahren nach Anspruch 17, weiterhin gekennzeichnet durch Anordnen einer Stange einer flüchtigen Zusammensetzung innerhalb der Spulen, Anordnen eines elastischen Materials in und um die Spulen und um die Stange herum und Entfernen der Stange der flüchtigen Zusammensetzung, um ein hohles Inneres für die Spulen (12) mit elastischem Material (18) darum bereitzustellen.

Revendications

1. Ensemble de ressort (10) comportant une pluralité d’éléments bobinés (12) interconnectés les uns aux autres dans une relation d’espacement, afin d’amener l’ensemble de ressort (10) à exercer une force dans une direction de sollicitation approximativement perpendiculaire à une tangente à l’axe (16) de ladite pluralité d’éléments bobinés (12) en réponse à une déflexion de l’ensemble de ressort (10) le long de ladite direction de sollicitation, caractérisé en ce qu’un matériau élastique (18) est disposé autour de et entre la pluralité d’éléments bobinés (12), le matériau élastique (18) présentant une section transversale creuse, afin de modifier la force exercée par l’ensemble de ressort (10) en réponse à la déflexion de l’ensemble de ressort (10) le long de la direction de sollicitation.

2. Ensemble de ressort selon la revendication 1, caractérisé en outre en ce que le matériau élastique (18) a une forme conçue afin de positionner la pluralité d’éléments bobinés (12) de sorte que la direction de sollicitation soit approximativement perpendiculaire à la tangente à l’axe (16).

3. Ensemble de ressort (10) selon la revendication 3, caractérisé en outre en ce que la forme du matériau élastique (18) comprend des parties en excroissance de taille sensiblement plus importante qu’un diamètre de ladite pluralité d’éléments bobinés (12).

4. Ensemble de ressort (10) selon la revendication 1, caractérisé en outre en ce que le matériau élastique (18) a une forme généralement tubulaire, et en ce que la pluralité d’éléments bobinés (12) sont interconnectés les uns aux autres dans une relation d’espacement et sont disposés à l’intérieur dudit matériau élastique (18) de forme généralement tubulaire afin d’amener l’ensemble de ressort à exercer une force généralement constante dans une direction de sollicitation approximativement perpendiculaire à une tangente à l’axe (16) de ladite pluralité d’éléments bobinés (12) en réponse à la déflexion de l’ensemble de ressort (10) le long de ladite direction de sollicitation, ladite force étant généralement constante sur une plage de déflexion de l’ensemble de ressort (10) le long de la direction de sollicitation.

5. Ensemble de ressort (10) selon la revendication 4, caractérisé en outre en ce que la pluralité d’éléments bobinés (12) sont disposés à l’intérieur dudit matériau élastique (18) dans une relation d’espacement en étièrement, le matériau élastique (18) ayant une résistance suffisante pour maintenir la pluralité d’éléments bobinés (12) dans ladite relation d’espacement en étièrement, l’espacement entre les éléments bobinés dans ladite relation d’espacement en étièrement étant supérieur à l’espacement entre les éléments bobinés lorsqu’ils ne sont pas maintenus par le matériau élastique (18) dans une relation d’espacement en étièrement.

6. Ensemble de ressort (10) selon la revendication 4, caractérisé en outre en ce que la pluralité d’éléments bobinés (12) est disposée à l’intérieur dudit matériau élastique (18) dans une condition préchargée dans laquelle la pluralité d’éléments bobinés (12) sont défléchis le long de la direction de sollicitation.

7. Ensemble de ressort (10) selon l’une ou l’autre des revendications 1 et 4, caractérisé en outre par le fait qu’un passage ouvert est prévu à travers le matériau élastique (18) afin de permettre le passage de fluide à travers celui-ci.

8. Ensemble de ressort (10) selon l’une ou l’autre des revendications 1 et 4, caractérisé en outre par le fait que les éléments bobinés (12) ont un périmètre ovale, et en ce que le matériau élastique (18) présente une partie circulaire creuse au centre.

9. Ensemble de ressort (10) selon l’une ou l’autre des revendications 1 et 4, dans lequel les éléments bobinés (12) ont un périmètre ovale, et en ce que le matériau élastique (18) comprend une pluralité de zones creuses à l’intérieur du matériau élastique (18) et à l’intérieur de ladite pluralité d’éléments bobinés (12).

10. Ensemble de ressort (10) selon l’une ou l’autre des revendications 1 et 4, dans lequel les éléments bobinés (12) ont un périmètre ovale, et le matériau élastique (18) comprend une partie creuse centrale généralement rectiligne.
11. Ensemble de ressort (300) comportant une première pluralité d'éléments bobinés (302), interconnectés les uns aux autres dans une relation d'espacement, afin d'amener l'ensemble de ressort (300) à exercer une force généralement constante dans une direction de sollicitation approximativement perpendiculaire à une tangente à un axe (304) de ladite pluralité d'éléments bobinés (302) en réponse à une déflexion de l'ensemble de ressort (300) le long de ladite direction de sollicitation, caractérisé en ce qu'il est prévu une seconde pluralité d'éléments bobinés (310) interconnectés les uns aux autres dans une relation d'espacement et disposés à l'intérieur de ladite première pluralité d'éléments bobinés (302), et en relation de coopération avec celle-ci, pour amener l'ensemble de ressort (300) à exercer une force généralement constante dans une direction de sollicitation approximativement perpendiculaire à une tangente à un axe (304) de ladite seconde pluralité d'éléments bobinés (310) en réponse à une déflexion de l'ensemble de ressort (300) le long de ladite direction de sollicitation, et en ce qu'un matériau élastique (306) est disposé autour de et entre ladite première et ladite seconde pluralité d'éléments bobinés (302, 310) et présente une section transversale creuse, pour modifier la force exercée par l'ensemble de ressort (300) en réponse à la déflexion de l'ensemble de ressort (300) le long de ladite direction de sollicitation.

12. Ensemble de ressort selon la revendication 11, caractérisé en outre en ce que le matériau élastique (304) comprend une partie extérieure (306) disposée autour de la première pluralité d'éléments bobinés (302) et une partie intérieure (312) disposée autour de ladite seconde pluralité d'éléments bobinés (310), lesdites parties extérieures et intérieures (306, 312) étant séparées et non attachées l'une à l'autre.

13. Ensemble de ressort (300) selon la revendication 12, caractérisé en outre en ce que les premiers et les seconds éléments bobinés (302, 310) sont en oblique dans la même direction par rapport à un axe commun (304).

14. Ensemble de ressort (330) selon la revendication 12, dans lequel lesdits premier et seconds éléments bobinés (332, 336) sont en oblique dans des directions opposées par rapport à un axe commun (342).

15. Ensemble de ressort (300, 330) selon les revendications 11 à 14, caractérisé en outre en ce que l'une au moins desdites première et seconde pluralité d'éléments bobinés (302, 310) est disposée à l'intérieur dudit matériau élastique (306) dans une relation d'espacement en étièrement, le matériau élastique (306) présentant une résistance suffisante pour maintenir la pluralité d'éléments bobinés (302, 310) dans ladite relation d'espacement en étièrement, l'espacement entre les éléments bobinés (302, 310) dans ladite relation d'espacement en étièrement étant supérieure à l'espacement entre les éléments bobinés lorsqu'ils ne sont pas maintenus par le matériau élastique (306) dans une relation d'espacement en étièrement.

16. Ensemble de ressort (300, 330) selon les revendications 11 à 14, caractérisé en outre en ce que l'une au moins desdites première et seconde pluralité d'éléments bobinés (302, 310) est disposée à l'intérieur dudit matériau élastique (306) dans une condition préchargée dans laquelle la pluralité d'éléments bobinés (302, 310) sont déformés le long de la direction de sollicitation.

17. Procédé de fabrication d'un ensemble de ressort (10), dans lequel on fabrique un fil afin de produire des éléments bobinés (12) interconnectés les uns aux autres dans une relation d'espacement, caractérisé par le fait qu'on dispose un matériau élastique à l'intérieur et autour desdits éléments bobinés (12) tandis que l'on ne remplit pas une zone intérieure des éléments bobinés (12) le long de l'axe de ceux-ci.

18. Procédé selon la revendication 17, caractérisé en outre par le fait qu'on déforme les éléments bobinés (12) tandis qu'on dispose le matériau élastique (18) à l'intérieur et autour des éléments bobinés.

19. Procédé selon la revendication 17, caractérisé en outre en ce qu'on éloigne les uns des autres tandis qu'on dispose le matériau élastique (16) à l'intérieur et autour des éléments bobinés.

20. Procédé selon la revendication 17, caractérisé en outre en ce qu'on dispose une tige d'un composé volatile à l'intérieur des éléments bobinés lorsqu'on dispose un matériau élastique à l'intérieur et autour desdits éléments bobinés et autour de ladite tige, et en ce qu'on enlève la tige de composé volatile afin de réaliser dans lesdits éléments bobinés (12) une zone intérieure creuse avec du matériau élastique.
(18) autour de celle-ci.