Oct. 12, 1937.

L. E. ENDSLEY

2,095,545

FRICTION SPRING FOR RAILWAY CARS

Filed May 8, 1936

Fig. 2.

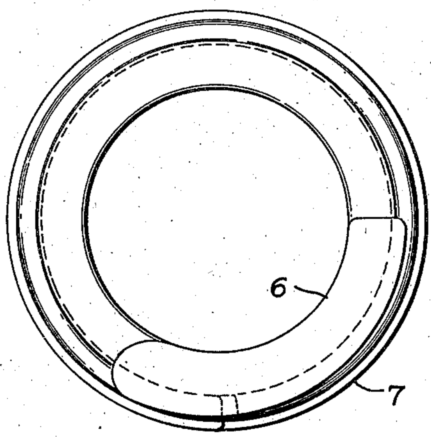


Fig. 3.

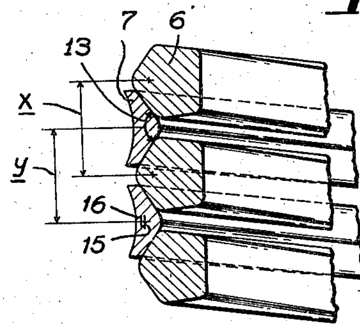


Fig. 6.

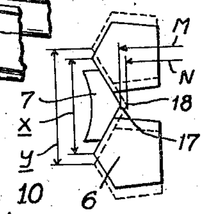
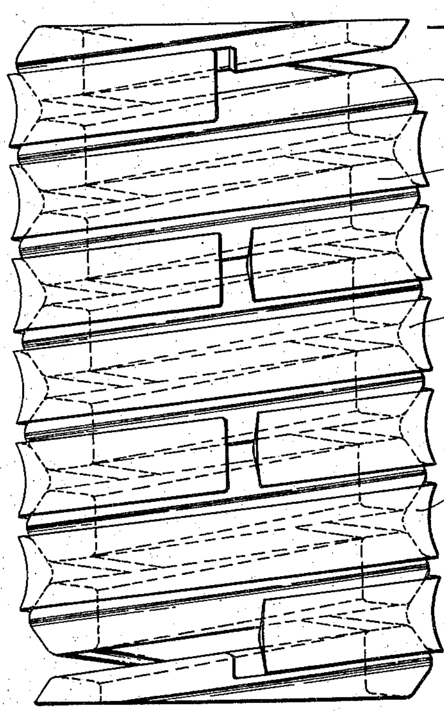


Fig. 1.



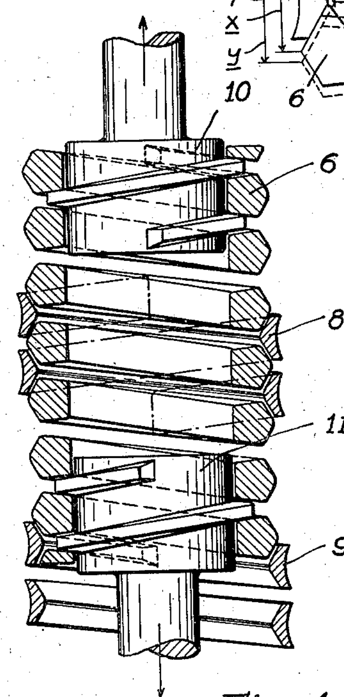
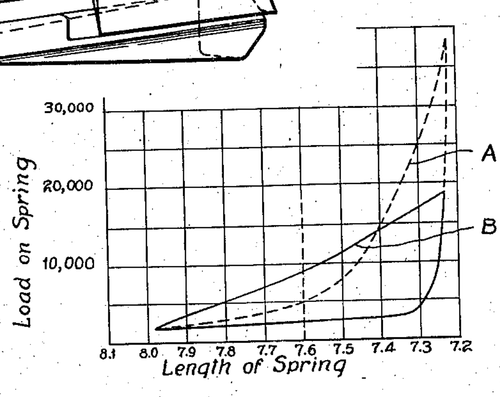


Fig. 4.

Fig 5.



INVENTOR
Louis E. Endsley,
By Archworth Martin,
Attorney.

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FRICTION SPRING FOR RAILWAY CARS

Louis E. Endsley, Pittsburgh, Pa., assignor to The Frost Railway Supply Co., Detroit, Mich., a corporation of Michigan

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7 Claims. (Cl. 267—61)

My invention relates to friction springs of the type wherein inner and outer coil springs are arranged in coaxial relation cooperating to serve as cushioning or snubbing elements. The invention is particularly useful in connection with springs such as are interposed between the body bolsters and the truck bolsters of railway cars, but it will be understood that they may have other uses also.

Heretofore, the inner and outer coils in this type of spring have each been of one piece construction, and the inner coil takes most of the load, commencing with the initial compressive movement and during the major portion of compression travel. During the early stages of compression movement on the inner coil, it has effective load resisting engagement with the outer coils mainly at the end turns of the coils, with the result that the various turns of the outer coil do not become fully effective to resist impacts until after the inner coil has been compressed to perhaps one-third or one-half of its full extent. For this reason, the cushioning resistance of the spring structure is very low at small compressions and very great towards the point of complete closure of the spring, as indicated by the dotted load-curve line in Fig. 5 of the accompanying drawing, in that the resistance to compression is initially very low and will then increase very sharply instead of increasing more uniformly, as shown by the full-line load-curve of said figure.

In the old two-coil constructions referred to, owing to the manner in which the coils must be assembled, there is initial clearance between the inner and outer coils throughout substantially their entire lengths, and a considerable compression of the inner coil is necessary before the inner and outer coil come together with any appreciable force. Thus the friction is absent in early compression. After this, the end turns of the respective coils are brought into cooperative relation, and the major portion of the frictional wear between the two coils occurs in the end turns. The result is that there is rapid wear on the end turns and the springs will have a much shorter life than would be the case if this wear were more widely distributed in the various turns of the spring.

One object of my invention is to provide a spring structure of such form that the inner coil of an inner and outer coil spring arrangement will have initial effective working engagement not only with the end turns of the outer spring, but also with intermediate turns thereof, and throughout substantially the entire working range of the spring structure.

Another object of my invention is to provide a spring structure of the character referred to, wherein various turns of the inner coil at points throughout the length thereof will have initial tensional or compression engagement with the turns of the outer spring.

Still another object of my invention is to provide a frictional spring structure consisting of an inner and outer coil, in which the outer coil is formed with a greater pitch than the inner coil. Thus when the inner coil is stretched equivalent to the greater pitch of the outer coil, the outer coil can be wound on the inner coil easily, and after releasing the load on the inner coil, the inner and outer coils impinge firmly.

A further object of my invention is to provide an outer coil arrangement of such form that although the cross-sectional area of the material is reduced in order to provide for better radial yield ability or flexure, the area of frictional contact between the inner and outer coils is not thereby affected.

A spring embodying my invention is shown in the accompanying drawing wherein Figure 1 is an elevational view of a spring; Fig. 2 is an end view of the spring; Fig. 3 is a sectional view of a portion of the structure of Fig. 1; Fig. 4 is a sectional view showing a manner in which the spring elements may be conveniently assembled; Fig. 5 is a diagram showing load curves of spring structures, and Fig. 6 is a diagrammatic view illustrating one feature of my invention.

The inner spring is shown of one piece construction and is indicated by the numeral **6**. The outer spring is divided into three sections, **7**, **8** and **9**, each having approximately two turns or convolutions. It will be understood that the number of outer spring sections can be varied and that they can be of any length desired.

The pitch of the coil **6** as indicated at x may conveniently be 1.16 inches initially, and the pitch of the outer turns may initially be 1.22 inches, as indicated at y. These dimensions, of course, can be varied to suit particular conditions, but it is desirable to have the pitch of the outer coils somewhat greater than the pitch of the inner coil.

In order to assemble the inner and outer springs, the inner spring is stretched so as to make its pitch substantially equal to the pitch of the outer coils. This stretching may conveniently be effected by the use of threaded plugs **10** and **11**, turned into engagement with the inner spring and then pulled away from one another, as indicated by the arrows in Fig. 4.

The outer coils may then be rotated onto or threaded on the spring **6**. The plugs **10** and **11** can then be removed and the spring is ready for use.

Assuming that the spring **6** has an initial length of 8⅛ inches, it can be stretched to 8½ inches. After placing of the outer coils and disengagement of the plugs **10** and **11**, the inner coil will contact axially for about ¼ inch, thereby making tensional engagement with each of the outer spring sections **7**, **8** and **9**, with intimate contact between each turn of the inner coil and adjacent turns of the outer coils. The total initial tension as between the inner and outer spring may be in the neighborhood of 400 lbs., for springs intended for use on railway cars. The assembled springs may have a free length of approximately 8¼ inches.

In Fig. 6 I diagrammatically illustrate a manner in which I obtain additional initial frictional engagement between the inner and outer coils. With the inner coil **6** of less pitch than the outer coils, as above explained, and with the spring as intially formed, if the frictional sides are extended or propagated until they meet at an apex indicated by the numeral **17**, the diameter of the coil, measured between apices **17** at opposite sides of the coil as indicated by the line M, may be 4.20 inches. Upon stretching of the coil, the said diameter will be reduced to perhaps 4.17 inches as measured between apices indicated by the line N. The outer coils may be wound on a mandrel so that they will initially have an internal diameter of 4.18 inches between the apex of angles propagated from their frictional surfaces, corresponding to the points **17**. That is, there will be a clearance of .01 inch between the diameters of the outer coils and the stretched inner coil, measured as above described, so that the coils may be threaded together when the inner coil is stretched to the said .01 inch clearance.

If the springs be now assembled and the tension on the inner spring released, the tendency of the inner spring will, of course, be to return to the position indicated in full lines in Fig. 6, and thereby engage the frictional surfaces of the outer coils and tend to expand the same and cause the coils to have initial tensional engagement, even at no load. This will give additional radial tension between the inner and outer coils and add to the axial initial engagement obtained by forming the coils of different pitch.

When installed in a car, the springs will have a "riding" length of perhaps 7.6 inches, and owing to the said initial tension between the inner coil and the outer coil sections, all turns of the inner and outer springs will be effective, for all flexures, to absorb impacts, with the result that under a ¾ inch vibration, for example, ⅜ in. above and below the riding line as shown in Fig. 5, I obtain an absorption capacity which is the same absorption capacity as that obtained with the old one-piece outer coil structure, as indicated by the dotted line A of Fig. 5. However, by my structure the same absorption capacity is obtained with a very much less maximum pressure upon the three-piece outer coil spring, with the added advantage of reducing the maximum force coming on the car bolsters, because the curve B is almost a straight line. That is, when the spring vibrates ⅜ of an inch below the riding line, or to a height of 7.225 inches, the line B which represents such deflection shows a maximum pressure of only about 18,500 lbs. With the old one-piece coil, this same deflection produced a pressure of 38,000 lbs. on the spring, as indicated by the dotted line A.

The contacting surfaces between the sides of the inner and outer coils are formed with an included angle of approximately 112°, as indicated at **13**. I am enabled to employ a smaller angle as compared to the angles of the old structures wherein angles of perhaps 8° to 10° larger were employed, because of my short outer coil lengths, whereby the total radial expansion of the outer coil sections may be effected without such high total stresses on the outer coil. The smaller angle and extended friction area referred to also increases the life of the spring as compared to structures wherein the angle of the contacting sides is materially larger.

Another important advantage of my invention resides in the form or shape of the outer coils **7**, **8** and **9**, and particularly their cross-sectional shape. In my structure where the inner and outer coils are wound together under initial compression, by a given deflection, the movement of the outer coil radially is much greater than where only one piece was used, or by the old method of assembling them, with the same pitch for the inner and outer coils. Thus, to take care of this larger radial movement, I have designed my outer coil with a cross-sectional shape that has a much less distance from the center of gravity or neutral point to the innermost surface of the outer coil. This shape allows a greater radial movement of the outer coil than would be possible with an outer coil of the same radial over-all dimensions and not relieved in its outer surface, and eliminates the danger of overstraining the outer coil in compressing the spring solid, and without reducing the length of frictional surface, or area of friction of the inner and outer coils.

To this end I have formed peripherally-extending depressions in the outer coil sections, of a depth equal to approximately 20% to 30% of the over-all radial thickness of the outer coil section, thereby bringing the center of gravity toward the innermost surface of the outer coil. This results in reducing the maximum stress for a given extent of radial deflection.

By way of example, the over-all radial thickness of the outer coils may be .4 inch. With the said peripheral recess made to a depth of .10 inch, the center of gravity of the sections will be shifted 15% closer to the innermost side of the coil than it was before the coil was relieved, and thus the maximum fibre stress produced by a given radial expansion would be only 85% of what it would be if the coil did not have this relief. In other words, the center of gravity of the sections will be at the point **15** instead of at the point **16**, as indicated in Fig. 3.

In the structure just described, the convolutions of the inner coil **6** will have an axial width of .90 inch, and before assembly will have spacing therebetween of approximately .26 inch. The pitch of inner coil, being 1.16 inches when manufactured will, when assembled, be increased to 1.175 inches which will then be the pitch of both the inner and outer coils. The strength of the outer coils is only about ⅓ the strength of the inner coil as a spring, and the distance between convolutions of the inner coil will therefore be .275 inch.

If desired, the inner coil could be made of greater pitch than the outer coils and they could be assembled by stretching the outer coil, but such an arrangement would throw most of the spring work on the inner coil during early stages of compression, because (if the spring were put solid) the outer coil would not carry any of the spring load until its pitch had been reduced to a point below its initial pitch by compressive movement on the springs. However, the initial pressure and extended area of contact between the inner and outer coils would be retained by this arrangement, as in the structure heretofore described.

I claim as my invention:—

1. Friction spring structure comprising an inner coil and outer coils of different pitch than the inner coil, the coils being assembled so that at various points throughout the length of the spring structure, turns of the inner coil will have frictional engagement with adjacent turns of the outer coils, the coils being assembled with initial tensional frictional engagement.

2. Friction spring structure comprising an inner coil and outer coil sections, the inner coil being initially of a pitch less than the outer coils, and the spring being assembled by stretching the inner coil to approximately the pitch of the outer coils and then releasing the inner coil after the outer coils have been positioned thereon.

3. Friction spring structure comprising inner and outer coils initially of different pitch, wherein the turns of one coil have first been forced to a position where their pitch will conform approximately to the pitch of the other coil when assembling the coils, the deflective force being thereafter removed from the said one coil, the coils being of such length that there is frictional contact between the inner and outer turns throughout substantially the entire length of the spring.

4. Friction spring structure comprising a single-piece inner coil and a plurality of outer coil sections threaded on the inner coil, the inner coil and the outer coils having angularly arranged contacting surfaces, and the outer coils being coiled with a greater pitch than the inner coil, before assembling.

5. Friction spring structure comprising a single-piece inner coil and a plurality of outer coil sections threaded on the inner coil, the inner coils and the outer coils having angularly arranged contacting surfaces, the outer coils being formed with a greater pitch than the inner coil, before assembling, and the outer coils having a circumferentially extending recess of such depth as to substantially reduce the resistance to radial expansion.

6. Friction spring structure comprising a single-piece inner coil and a plurality of outer coil sections threaded on the inner coil, the inner coils and the outer coils having angularly arranged contacting surfaces, and the outer coils having a circumferentially extending recess of such depth as to substantially reduce the resistance to radial expansion.

7. Friction spring structure comprising a single-piece inner coil and a plurality of outer coil sections threaded on the inner coil, the inner coil and the outer coils being assembled with initial tensional frictional engagement therebetween throughout substantially the entire length of the outer coils.

LOUIS E. ENDSLEY.