July 1, 1969 R. DIXON 3,452,974

LEAF SPRINGS

Filed July 20, 1966

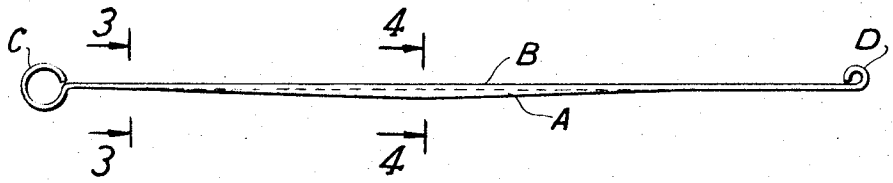


FIG. 1

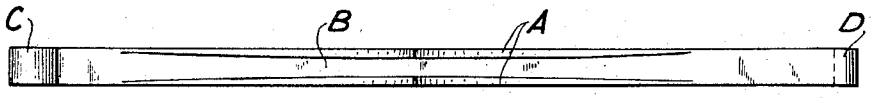


FIG. 2

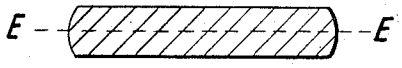


FIG. 3

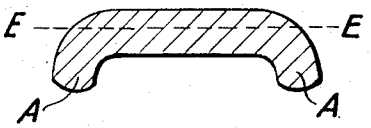


FIG. 4

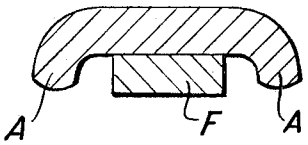


FIG. 5

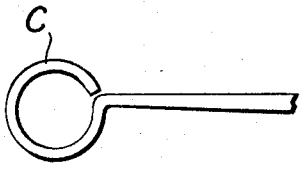


FIG. 6

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LEAF SPRINGS

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Int. Cl. F16f 1/18
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ABSTRACT OF THE DISCLOSURE

Leaf spring includes a leaf produced from an initially flat bar of substantially constant width and thickness. Longitudinal margins of bar bent to form lateral flanges to give bar channel-shaped cross-section. Channel is narrowest and deepest at point of maximum bending stress of the leaf and becomes progressively wider and shallower in direction away from that point.

This invention relates to leaf springs which, as employed in the suspension system of road vehicles, have hitherto almost always been of laminated construction, a master leaf being permanently united, centrally or at one end, to several auxiliary leaves of progressively shorter length, and the thickest part of the resultant assembly (which is usually cambered in the unstressed condition) being anchored to the vehicle axle or body according to the arrangement of the spring.

The expression "leaf spring" is used herein to define a spring substantially flat transversely of its length and usually of cantilever or semi-elliptic form, adapted to be so mounted as to support a load by providing resilient resistance to bending in its length and includes a single leaf or multi-leaf assemblies.

The conventional leaf spring above described is a relatively expensive item, due to the time and labour involved in appropriately cambering and assembling the several leaves, and the considerable mass of material used, which forms a significant proportion of the total unsprung weight of the vehicle and necessitates powerful shock-absorbers if a reasonably smooth "ride" is to be obtained, besides which the holes made in the several leaves for the connecting bolt or rivet are a potential source of fracture.

Since steel is stronger in compression than in tension, a spring leaf is normally designed to take the maximum tensile stress which the part of its volume lying above the neutral axis is required to withstand, and with a plain rectangular cross-section this means that the lower or compression half of the leaf is relatively lightly stressed.

In order to save weight, and to produce a more uniform stress distribution throughout the cross-section of a spring leaf, it is known practice to pre-roll the compression face thereof with one or more longitudinal grooves, another known technique being to taper the thickness of such groove bar, and thereby progressively reduce the stiffness thereof, from its central or anchorage part towards both ends, but without correspondingly increasing its width.

The object of the present invention is to provide an improved form of leaf spring which will obviate the above-mentioned drawbacks of the conventional laminated type, whilst retaining the carrying capacity and characteristics associated therewith, and which will likewise be substantially cheaper to produce than the known single-leaf springs formed from pre-grooved material.

According to this invention, the improved leaf spring is characterised in that the leaf, for at least the greater part of its length, is substantially flat transversely and is

modified in shape to have longitudinal edges extending in arcuate flange-like shape beyond the plane of the substantially flat part and so that the overall thickness of the leaf is not greater than twice the thickness of the said flat part.

In a preferred embodiment of the invention the leaf-spring aforesaid consists of a single leaf produced from a plain flat bar whose cross-section, for at least the greater part of its length, is modified in shape, but without substantial change of area, by progressive arcuate deformation of its edges in uniform flange-like shape so that the spring's stiffness diminishes progressively in a direction away from its point of maximum bending stress.

The aforesaid modification of the leaf's cross-sectional shape should be such as will result in a redisposition of the neutral axis whereby, for a given bending moment, the surface stresses anywhere along the deformed part of the spring are substantially uniform.

In the accompanying drawings,

FIG. 1 is a side elevation of one form of the improved spring;

FIG. 2 is an underside plan view;

FIGS. 3 and 4 are enlarged sections on the lines 3—3 and 4—4, respectively of FIG. 1;

FIG. 5 is a section similar to FIG. 4 showing a second leaf accommodated between the flanges of the first leaf; and

FIG. 6 is an enlarged fragmentary view of one end of the spring shown in FIG. 1.

In the example illustrated, a half-elliptic vehicle spring is formed from a flat steel bar $1\frac{1}{32}$ inch thick and initially having a constant width of two inches, these dimensions being somewhat greater than those of the master leaf of a laminated spring of similar load capacity.

The central portion of the bar aforesaid is subjected to a rolling or other process whereby both lateral edges thereof are flanged (as at A) in the same direction and to an extent which increases progressively toward what will be the anchorage region B of the spring. In the case of a bar initially 59½ inches in length, the flanged portion may be 32¾ inches long, the flanges A having a maximum depth of ⅛ inch and increasing the overall thickness of the bar to $1\frac{5}{32}$ inch. Preferably such flanges are formed with a substantial radius of curvature at their junction with the medial part of the bar, which thus has a flattened C section at and adjacent the anchorage region B.

Although the overall width of the bar is little affected by the formation of these flanges A, even at the anchorage region B, its effective width is appreciably "waisted" towards such region.

During the production of the spring as aforesaid, it may be cambered lengthwise in the direction of flanging, the flange A being mutually parallel at the region B and curving slightly away from one another to points about 13¼ inches from each end of the bar, the terminal portions of the bar retaining their original flat section and being rolled up in known manner to form eyes C, D.

The reduction in depth of the flanges A in a direction away from the anchorage region B of the spring gives the latter a correspondingly diminishing resistance to deflection in the same direction and so equalizes the strains along its length.

It will be noted from FIGS. 3 and 4 that the flanging operation has the effect of shifting the neutral axis E—E of the bar appreciably towards its upper or tensile face so that, for any given load, the tensile stress in the upper part of the cross-section is reduced, and the compressive stress in the lower part increased, as compared with the initial flat bar.

The maximum compressive stress may be controlled by taper-rolling or otherwise progressively thinning the

terminal flat-section parts of the bar, as shown in FIG. 6, but without substantially increasing their width.

Obviously the flanges A bounding the compression face of the spring provide a convenient means of locating a flat-section auxiliary spring F (FIG. 5) of different camber in engagement with such face, or alternatively an auxiliary spring flanged in accordance with the invention may be superimposed upon a flat-section primary spring.

Whilst the invention has been described hereinbefore with particular reference to the production of half-elliptic springs such as are still most commonly employed in the rear suspensions of motor vehicles, it is also applicable to quarter-elliptic or cantilever springs in which case the flanged edges A will of course diverge in one direction only, and likewise to C springs which are anchored at their ends only.

A leaf spring produced as above described will have great advantages over the conventional laminated article, the chief of these being the tremendous saving (probably 70 percent or more) in material and weight, coupled with simplified production and greatly reduced cost as compared with laminated springs and single-leaf springs produced from pre-grooved bars.

What is claimed is:

1. A leaf spring comprising at least one leaf produced from an initially plain flat bar of substantially constant width and thickness, the longitudinal margins of said bar being bent to form lateral flanges along at least a part of the length of the bar, said flanges being of greatest height at the point of maximum bending stress of the leaf and becoming progressively shorter in a direction away from that point, whereby the leaf has a channel-shaped cross-section which is narrowest and deepest at the point of maximum bending stress of the leaf and becomes progressively wider and shallower in a direction away from that point.

2. A leaf spring according to claim 1 wherein said point of maximum bending stress is at substantially the center of the length of said leaf.

3. A leaf spring according to claim 1 wherein said flanges project in a direction opposite to the direction of deflection of the spring under load.

4. A leaf spring according to claim 1 wherein said leaf has a longitudinal camber in the direction in which said flanges project.

5. A leaf spring according to claim 1 wherein at least one end region of said bar is devoid of flanges, and said end region is of progressively reduced thickness toward the end of the bar so as to maintain the stress within the leaf uniform.

6. A leaf spring according to claim 1 including a second leaf accommodated between said flanges.

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