United States Patent

Marion

[15] **3,671,030**

[45] **June 20, 1972**

[54] **SPRING LEAF AND METHOD OF MAKING**

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[73] Assignee: **North American Rock Corporation,** Pittsburgh, Pa.

[22] Filed: **June 1, 1970**

[21] Appl. No.: **42,289**

[52] **U.S. Cl.** **267/54,** 29/173

[51] **Int. Cl.** **F16f 1/18,** F16f 1/26

[58] **Field of Search** 267/47, 54; 16/128, 171, 172, 16/178; 72/362; 29/11, 173, 434

[56] **References Cited**

UNITED STATES PATENTS

2,608,752	9/1952	Schilling	267/47
2,742,664	4/1956	Weiner	16/128 R
2,568,169	9/1951	Raczynski	29/173
3,389,902	6/1968	Young	29/173

FOREIGN PATENTS OR APPLICATIONS

455,167	1/1928	Germany	267/47

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Attorney—John R. Bronaugh, Floyd S. Levison, E. Dennis O'Connor and Richard A. Speer

[57] **ABSTRACT**

A vehicle spring leaf has at least one of its opposite ends formed with closed eyes for connection to frame or shackle pivots. The spring leaf is slitted parallel to its length near the end and subjected to a deformation operation whereby an intermediate portion of the leaf is oppositely displaced with respect to the displacement of adjacent edge portions to provide opposed semi-cylindrical loops defining the eye. The deformation operation may occur either simultaneously with or subsequent to the slitting of the leaf.

5 Claims, 10 Drawing Figures

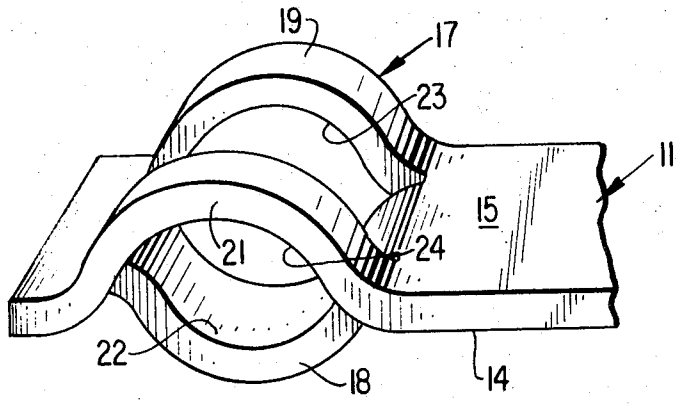
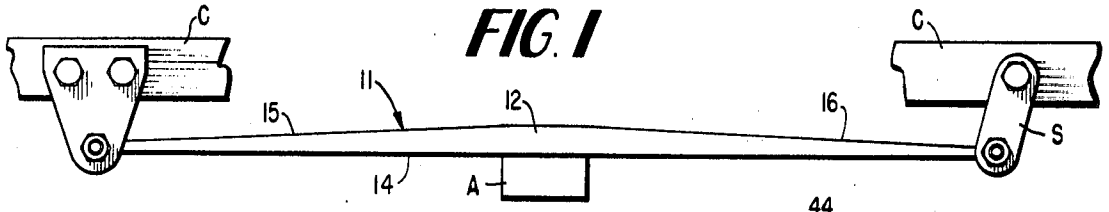


FIG. 1



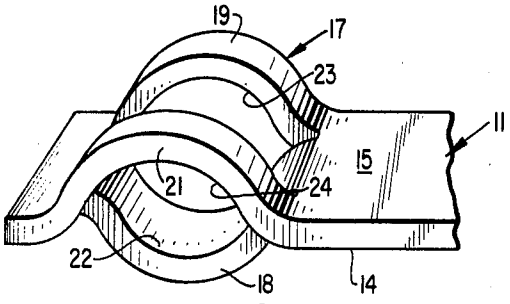


FIG. 2

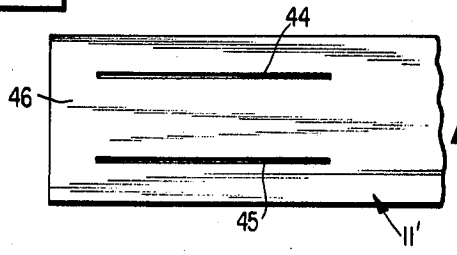


FIG. 9

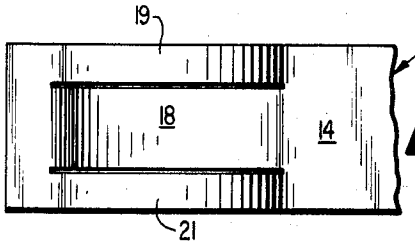
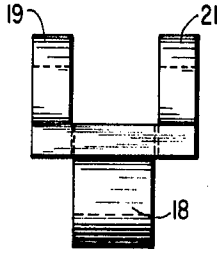


FIG. 3

FIG. 6



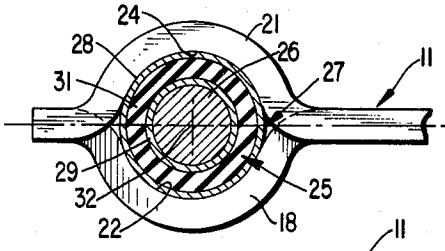
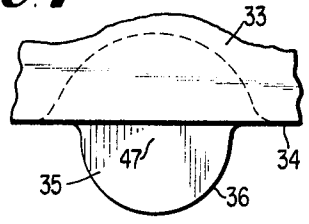


FIG. 5

FIG. 7



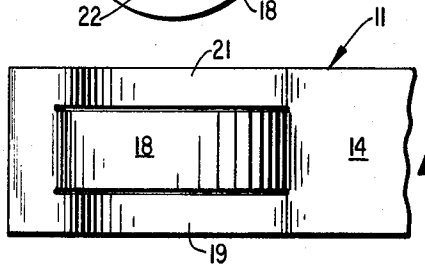


FIG. 4

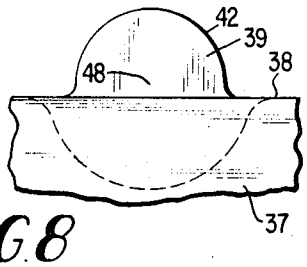


FIG. 8

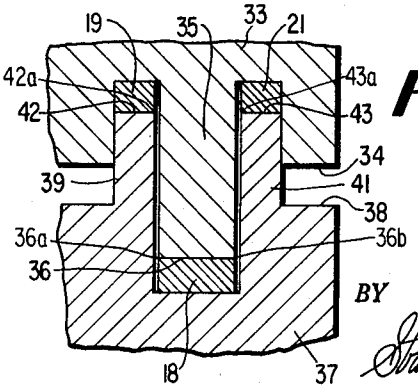


FIG. 10

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SPRING LEAF AND METHOD OF MAKING

This invention relates to leaf spring structure and particularly to the end formation commonly known as the eye for connecting the spring end or ends to frame pivots, shackles and the like.

It has been generally conventional to form a spring eye integral with the spring leaf by suitably turning over the spring end to provide a cylindrical boss-like formation adapted to fit over the pivot or shackle pin. In this conventional eye formation, the eye may be disposed above or below the plane of the leaf, usually above, or with its center in the plane of the leaf which is the so-called Berlin eye. In all forms the leaf end is turned over in a rolling or equivalent operation until the end edge substantially abuts the leaf surface, so that the eye is essentially open along its transverse dimension.

Difficulties have been encountered in these conventional open spring ends in that the rolling operations may induce residual stresses that contribute to early fatigue at these end portions of the spring during normal operation, and in heavy duty spring assemblies the large forces are effective to produce bending movements that may tend to open or otherwise deform the eye and so affect the pivotal connection.

The present invention contemplates a novel leaf spring eye structure and method of attaining it whereby integral oppositely curved loops are formed in one or both of the spring end portions in such manner as to evenly distribute the stresses induced during forming and provide a closed eye or eyes having balanced bearing areas, and this is a major object of the invention.

It is a further object of the invention to provide a novel leaf spring closed eye structure wherein an intermediate region and both adjacent side edge regions at the spring leaf end have been oppositely uniformly displaced.

Another object of the invention is to provide a novel leaf spring eye structure and method of making wherein the eye consists of integrally displaced transversely adjacent regions of the spring leaf end located longitudinally inwardly of that end.

A further object of the invention is to provide a novel leaf spring end eye structure wherein the spring end is longitudinally slitted and subjected to a punching or equivalent forming operation for oppositely displacing regions at opposite sides of the slits. The forming operation may occur simultaneously with or subsequent to the slitting of the leaf.

Further objects of the invention will appear as the description proceeds in connection with the annexed claims and the appended drawing.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a side elevation showing a spring leaf according to a preferred embodiment of the invention;

FIG. 2 is a fragmentary substantially perspective side elevation showing one end of a spring leaf formed according to the invention;

FIG. 3 is a top plan view of the spring end of FIG. 2;

FIG. 4 is a bottom plan view of the spring end of FIG. 2;

FIG. 5 is a fragmentary side elevation illustrating a pivotal mount of the spring end, the pivot being shown in section;

FIG. 6 is an end view of the formed spring;

FIGS. 7 and 8 are fragmentary views showing respectively upper and lower spring end forming dies;

FIG. 9 is a fragmentary plan view showing the spring end slitted prior to forming by the dies according to a modified form of the method of the invention; and

FIG. 10 is a fragmentary section illustrating the die forming action at the spring end.

PREFERRED EMBODIMENTS

FIG. 1 shows a single tapered spring leaf 11 incorporating the invention. The spring leaf is an integral member of some alloy steel or carbon steel conventionally used for vehicle springs. This spring leaf may be of the type having a center

section 12 of maximum thickness, usually medially secured to an axle indicated at A, and end sections that gradually reduce in thickness from the center section toward the spring ends. The spring leaf may be of constant or varying width from end to end although the former is illustrated, and is of uniform size at the opposite end sections. The illustrated spring leaf 11 has a flat planar surface 14 along its entire length at one side, and at the other side the tapered surfaces 15 and 16 extend at the same angle relative to surface 14. It should be understood, however, that the invention may be applied to any spring leaf, including for example the types disclosed in Green et al. U.S. Pat. No. 3,238,072; Komarnitsky U.S. Pat. No. 3,339,908 and Schilling U.S. Pat. No. 2,608,752, and the top leaf of a multileaf spring bundle.

Referring to FIGS. 2–6, there is shown one end of spring leaf 12 which is an integral member composed of the steel usually used for vehicle spring leaves. The other end of leaf 12 is identical although it should be recognized that some applications of leaf springs require an eye at only one end of the leaf. The spring end is integrally formed to provide a pivotal mount structure 17 adapted to connect the spring end to a pivot on the chassis C or on a shackle S (FIG. 1).

The spring end has a portion 18 parallel to its length and midway between its opposite edges displaced in one direction out of the plane of the leaf to form a loop, and two transversely similar and aligned opposite edge portions 19 and 21 also parallel to the length of the leaf displaced in the opposite direction out of the plane of the leaf to form aligned loops.

Loop 18 has an internal surface 22 of circular cylindrical curvature, and loops 19 and 21 have circular cylindrical internal surfaces 23 and 24 that are transversely aligned but curved oppositely to surface 22.

Preferably loops 19 and 21 are of equal uniform width, and each is about one-half the width of loop 18, so that as will appear the spring eye has substantially equal bearing area around the pivot.

Loops 18, 19 and 21 combine to form a spring eye having a cylindrically curved inner periphery for fitting upon a suitable cylindrical pivot structure such as that indicated at 25 in FIG. 5. Here a central pivot pin 26 is surrounded by a resilient bushing 27 consisting of metal shells 28 and 29 spaced by a bonded rubber or like elastic sleeve 31. Such a pivot structure is for example disclosed in Brownyer et al. U.S. Pat. No. 3,231,258.

As shown in FIG. 5, the center of curvature 32 of eye surfaces 22–24 lies preferably on the longitudinal centerline of the spring leaf, and that provides a centralized pivot mount at the spring ends.

Referring to FIGS. 7–10, the novel method of forming the spring eyes is illustrated. Here an upper die 33 has a flat surface 34 except for the medially intermediate downward projection 35 which has a semicylindrical lower forming face 36. The side edges of face 36 are designated 36*a* and 36*b*. Lower die 37 has a flat surface 38 except for two identical spaced projections 39 and 41 that have transversely aligned cylindrical forming faces 42 and 43 respectively. The inner side edges of faces 42 and 43 are designated by reference numerals 42*a* and 43*a* respectively. Die surfaces 36, 42 and 43 have equal radii.

The spring leaf end is disposed between dies 33 and 37 which are then brought together to form loops 18, 19 and 21 by displacement out of the plane of the leaf. As the deformation of the leaf end begins edges 36*a* and 42*a* of the upper and lower dies 33 and 37 respectively cooperate as shear elements to form a first longitudinal slit in the leaf. In like manner edges 36*b* and 43*a* cooperate to form a second longitudinal slit parallel to and spaced from the first slit. This slitting of the blank occurs simultaneous with the deformation thereof and this procedure constitutes the preferred embodiment of the method of this invention in that it allows formation of mount section 17 in a single operational step.

The center of curvature of face 36 is shown at 47, and the center of curvature faces 42 and 43 is shown at 48. The dies

33 and 37 are brought together until these centers 47, and 48 coincide. By locating centers 47 and 48 a distance from the respective flat die surfaces equal to one-half the thickness of the spring leaf end portion between the dies, such insures that the respective dies will abut opposite sides of the spring leaf to arrest the forming action when the proper size of loops is attained. The foregoing cutting and punching operation may result in some roughness or projection at the edges of the formed loops but this can be removed by a suitable machine operation so that the internal surfaces of the eyes are of smooth cylindrical contour.

FIG. 9 shows the end of a spring leaf 11' that has been preslit as a preparation for a subsequent forming operation according to a modification of the method of this invention. Parallel longitudinal slits 44 and 45 are cut through the leaf by conventional means such as a rotary cutting tool. These slits are spaced apart the width of loop 18, and are equally spaced from and parallel to the leaf edges. The spring leaf terminal 46 outwardly of the slits remains imperforate. Subsequent to the slitting operation, the leaf of FIG. 9 is placed between dies 33 and 37 and the dies are closed to form the desired spring eye.

Test results show that spring eyes formed according to the invention possess about 3.3 times the tensile strength of conventional bent over eyes. It is believed that these beneficial advantages arise in part from the fact that the spring eyes of the invention are closed, as compared to the open eyes provided in conventional springs. A further advantage of the invention is that even though one or even two of the loops comprising the eye should fracture, the remaining loops or loop would retain a load support function for some time. This is a safety factor.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A metal spring leaf having at least one end formed with a closed eye structure by which said leaf may be secured to other structure, said closed eye structure consisting essentially of opposite edge portions similarly projecting a distance in one direction out of the plane of the leaf and an intermediate portion projecting oppositely substantially the same distance out of the plane of the leaf, said eye structure being positioned on said leaf such that said end has an imperforate end region outwardly of said eye.

2. The spring leaf defined in claim 9, wherein said displaced edge portions have aligned internal cylindrical surfaces of equal curvature, and said oppositely displaced intermediate portion has an internal cylindrical surface of the same curvature, whereby said eye has a substantially continuous cylindrical inner periphery for pivotal connection to a vehicle frame or shackle.

3. The spring leaf defined in claim 9, wherein said displaced portions are arcuate and the internal bearing area of the intermediate portion equals the sum of the internal bearing areas of the edge portions.

4. A method of making an integral eye structure at an end of a metal spring leaf which comprises the steps of longitudinally slitting the spring leaf adjacent but spaced from an end to provide opposite edge regions and at least one intermediate region separated from the spring end by an imperforate region, and oppositely displacing said edge regions and said intermediate region out of the plane of the leaf end substantially equal distances to form opposed loops substantially circumferentially defining said spring eye, said slitting and displacing steps being performed simultaneously.

5. An elongate metal load bearing member having at least one end formed in a flat configuration with a closed eye structure by which said member may be secured to other structure, said closed eye structure consisting essentially of opposite edge portions similarly projecting a distance in one direction out of the plane of the member and an intermediate portion projecting oppositely substantially the same distance out of the plane of the member, said eye structure being positioned on said member such that said end has an imperforate end region outwardly of said eye.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,671,030 Dated June 20, 1972

Inventor(s) JOHN P. MARION

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 10, change "9" to read "1";

line17, change "9" to read "1".

Signed and sealed this 30th day of January 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents