May 9, 1933. W. H. WALLACE 1,907,912

LEAF SPRING

Filed Nov. 8, 1930 2 Sheets-Sheet 1

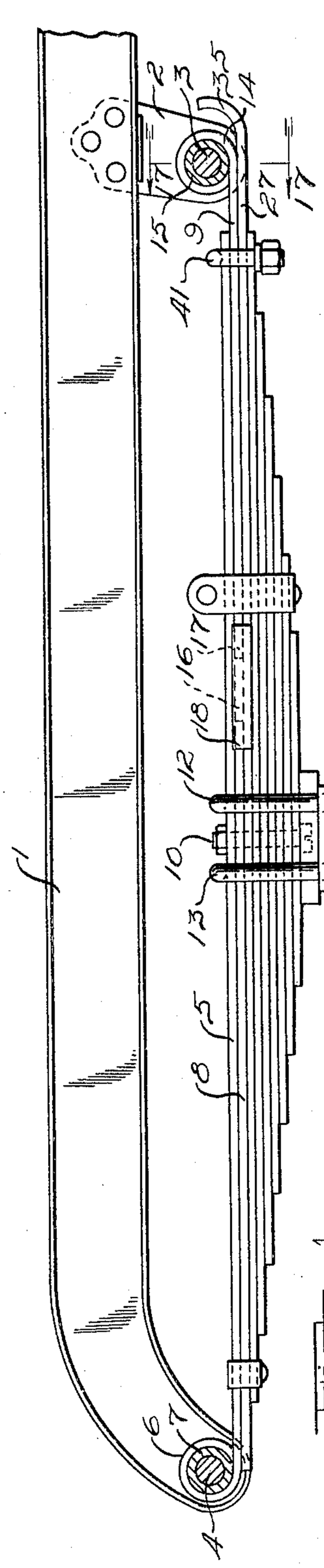

Fig. 1.

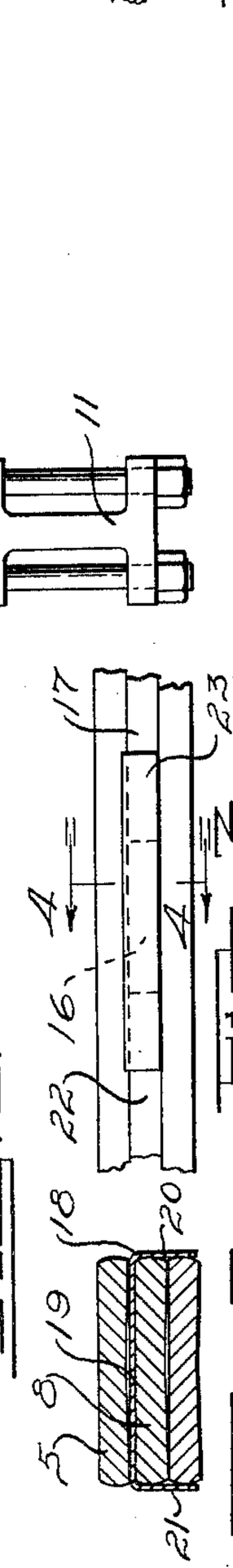

Fig. 2.

Fig. 3.

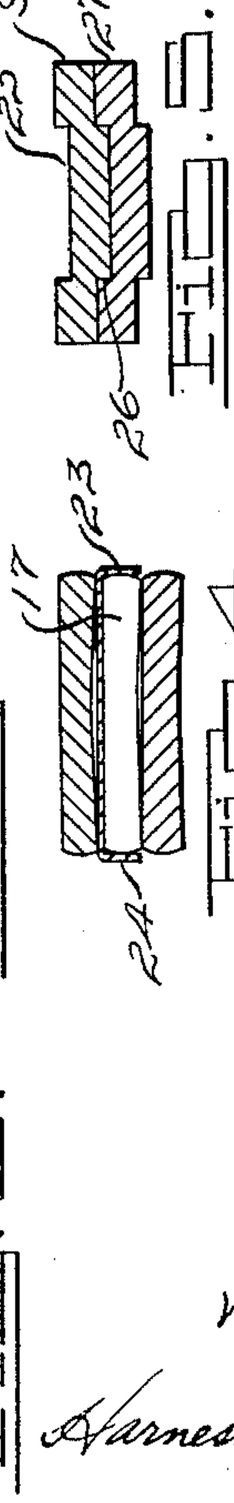

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

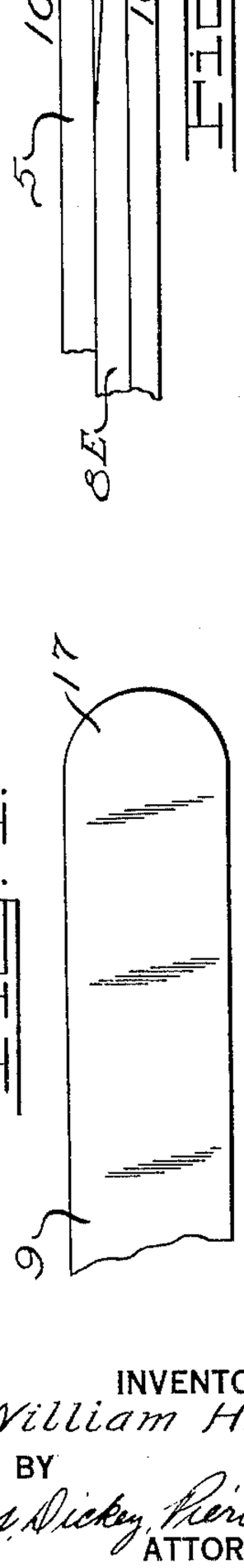

Fig. 8.

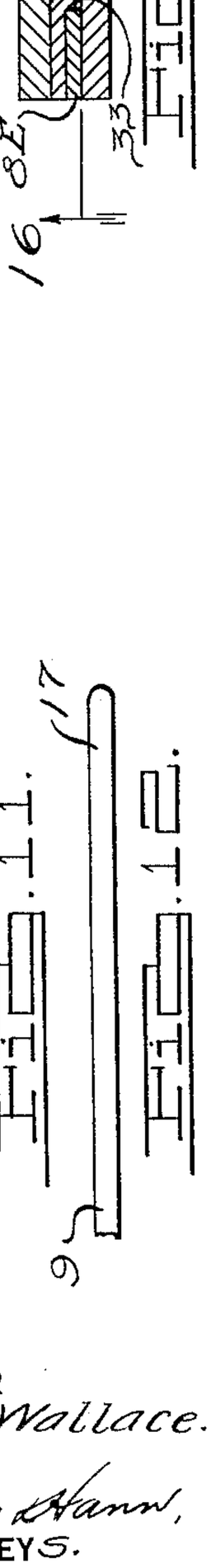

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

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LEAF SPRING

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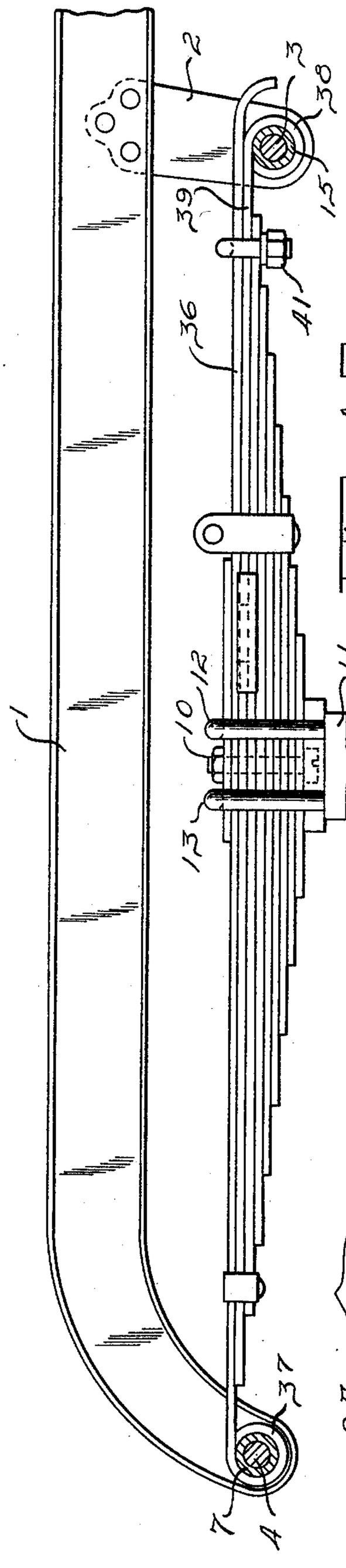

FIG. 15.

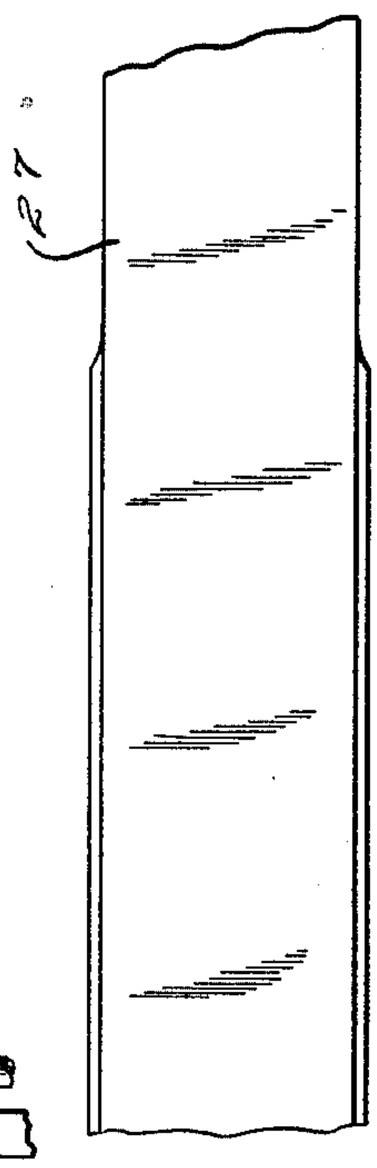

FIG. 14.

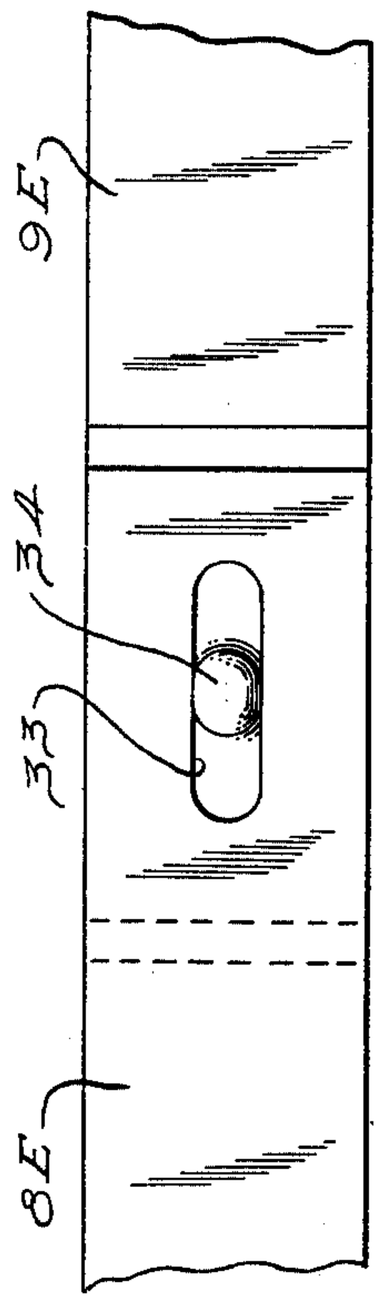

FIG. 16.

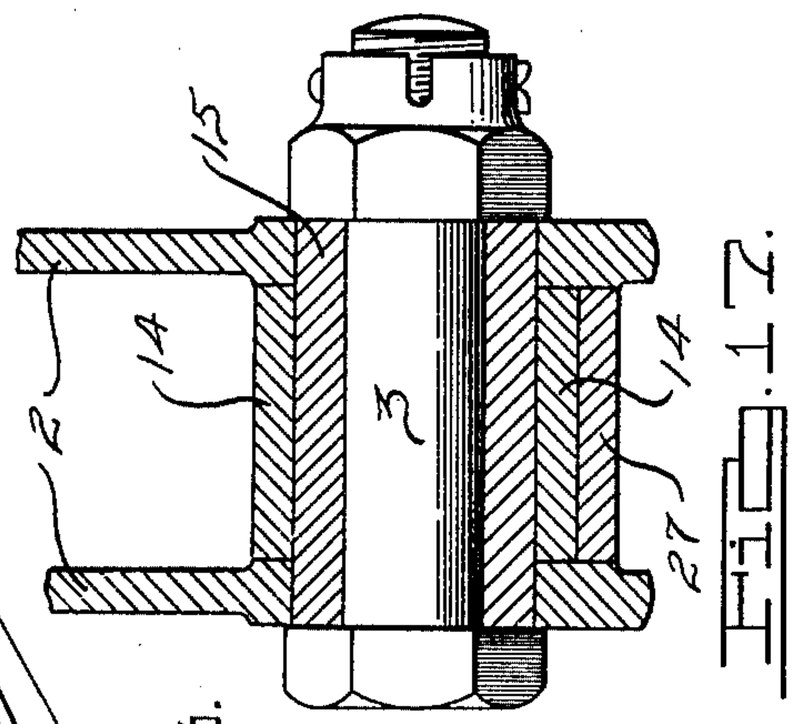

FIG. 17.

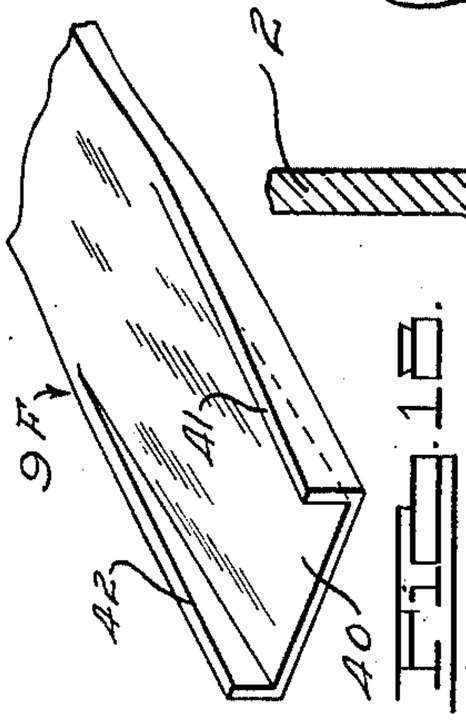

FIG. 18.

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UNITED STATES PATENT OFFICE

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LEAF SPRING

Application filed November 8, 1930. Serial No. 494,366.

This invention relates to multiple leaf springs of the type adapted to be secured to fixed points.

The main objects of this invention are to provide an improved form of multiple leaf spring which will eliminate the use of swinging shackle connections customarily used at the present time; to provide an improved form of strongly constructed leaf spring in which one of the hanger leaves is formed in two sections, one of which is movable relative to the other; to provide improved means for preventing relative lateral displacement of the sectional leaf; to provide improved means for limiting the flexure of the spring by limiting the amount of travel of the movable hanger leaf; to provide improved means for relieving the movable hanger leaf from side strains and slap; and to provide improved means for increasing the frictional resistance to sliding of the movable leaf in proportion to the load on the spring.

Illustrative embodiments of this invention are shown in the accompanying drawings, in which

Fig. 1 is a view in side elevation partly in section of the front of an automobile chassis frame provided with my improved form of spring.

Fig. 2 is a transverse vertical sectional view of the top three leaves of the spring taken at the point where the aligning clip is provided.

Fig. 3 is a fragmentary view in side elevation of the first three leaves showing a modified form of aligning clip applied thereto.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3, looking in the direction indicated.

Fig. 5 is a vertical transverse sectional view of a pair of adjacent spring leaves showing a modified form of means for preventing relative lateral displacement.

Fig. 6 is a similar view showing another modified form.

Fig. 7 is a similar view showing a further modified form.

Fig. 8 is a similar view showing still another modified form of the same.

Fig. 9 is an enlarged fragmentary view in side elevation of a different embodiment of my invention.

Fig. 10 is a sectional view taken on the line 10—10 of Fig. 9 looking in the direction indicated.

Fig. 11 is an enlarged plan view of the inner end of the longitudinally movable hanger leaf.

Fig. 12 is a view in edge elevation of the same.

Fig. 13 is a view of the rear end of the spring shown in Fig. 1 with the parts in a different position.

Fig. 14 is a plan view of the rear end of the spring leaf immediately below the movable hanger leaf showing how the side edges are ground away to provide flat bearing surfaces.

Fig. 15 is a view in side elevation of a form of my improved multiple leaf spring in which the spring eyes are in inverted position.

Fig. 16 is a bottom plan view of the complementary tapered overlapping sectional leaf portions of the embodiment shown in Figs. 9 and 10.

Fig. 17 is an enlarged sectional view taken on the line 13—13 of Fig. 1, looking in the direction indicated.

Fig. 18 is a view in perspective of a modified form of tapered and spring leaf in which the side edges of the tapered portion have been turned to form flanges for embracing a next adjacent leaf.

Heretofore in the construction of multiple leaf springs in which the ends of the spring are attached to fixed points as distinguished from those in which one or both ends are attached to swinging or oscillating shackles, there has been a number of different problems, the solving of which has not been satisfactorily accomplished.

In this particular type of spring, I have overcome these difficulties and at the same time increased the efficiency and effectiveness of the spring very materially by providing a construction in which the resistance of the spring increases proportional to its loading so that the greater the load placed upon the spring, the greater will be the frictional re-

sistance to govern the flexing of the spring relative to its points of attachment.

In carrying out this general type of construction, I have provided one of the hanger leaves of relatively short length embraced between other leaves and slidable longitudinally with respect thereto. This longitudinally slidable hanger leaf, as embodied in prior art structures, has been quite unsatisfactory, due to the fact that the free end which slides between adjacent leaves has caused excessive wear on the adjacent leaves, thus weakening them at that point and thereby causing them to break. This difficulty has been overcome in my improved construction by rounding the end of the movable leaf both in vertical and horizontal section, thus preventing any sharp lines of wear from being made straight transversely across the adjacent leaves and the rounding of the end in vertical section has reduced the wear on the adjacent leaves to a minimum.

In the construction shown in the drawings, the side rail of an automobile chassis frame 1 is shown provided with a rigidly mounted depending bracket 2, in the lower end of which is mounted a transversely extending rigidly secured spring bolt 3.

A similar spring bolt 4 is rigidly mounted in parallel relation thereto in the forward turned down end of the chassis frame 1 in the usual manner, thus providing a pair of fixed points 3 and 4 to which the multiple leaf spring is secured.

My improved form of multiple leaf spring comprises a main hanger leaf 5 which is provided with a cylindrical eye 6 in one end thereof in the usual manner. The eye 6 is adapted to be mounted on the spring bolt 4 with a cylindrical bushing 7 of bronze, rubber, fiber, or similar material interposed between the bolt and the eye. The leaf 5 extends substantially the length of the spring with the end thereof, opposite to the end provided with the eye, terminating in slightly spaced relation to the opposite end of the spring.

The next lower leaf of my improved multiple spring is made in two sections 8 and 9, the section 8 extending from near the eye 6 of the leaf 5 through the middle portion, where the leaves of springs of this character are ordinarily tied together by a bolt 10 and bound to an axle 11 by U-shaped clips 12 and 13. The section 9 of the second leaf has one end thereof provided with a cylindrical eye 14 for mounting on the spring bolt 3 with a cylindrical bushing 15 of bronze, rubber, fabric, or the like, interposed therebetween.

The end 17 of the leaf section 9 opposite to the eye 14 terminates in spaced relation to the terminating end 22 of the leaf section 8, thus providing a space 16 therebetween.

Means are provided for preventing the lateral displacement of the leaf section 9 relative to the other leaves of the spring and particularly for holding the inner end 17 of section 9 from lateral displacement. In the construction shown in Figs. 1, 2, 3 and 4, a channel-shaped clip 18 is provided with its webbed portion 19 interposed between the spring leaves 5 and 8 and with its flanges 20 and 21 extending down the sides of the spring leaves so as to cover the space 16 between the sections 8 and 9 and snugly embrace the adjacent ends 17 and 22.

In the form shown in Figs. 1 and 2, the flanges 20 and 21 extend a distance equal to the thickness of the two spring leaves and in the form shown in Figs. 3 and 4, the flanges extend a distance equal only to the thickness of one leaf, these shorter flanges being numbered 23 and 24 in these two figures of the drawings.

As shown in Figs. 11 and 12, the end 17 of the hanger leaf 9 is rounded in both vertical and horizontal section. The end being rounded in horizontal section eliminates any tendency to wear straight transverse grooves across the faces of the adjacent leaf springs which embrace the opposite sides of this movable end, thereby minimizing the liability of breakage. The end being rounded in vertical section, as shown in Fig. 12, minimizes the tendency of the spring end to bite or dig into the adjacent spring leaves when moved longitudinally during use.

Another means for preventing lateral displacement of the movable leaf section is illustrated in Fig. 5 of the drawings in which a leaf section 9A is provided with a broad shallow U-shaped channel 25 in the upper surface thereof and a depending square edged rib portion 26 on the lower face thereof. The next adjacent spring leaf, in this instance a leaf 27, immediately below the leaf section 9A, is similarly formed so as to have complementary portions interfitting with the leaf 9A and thus hold the two leaves in registry while permitting relative longitudinal movement therebetween.

In the embodiment illustrated in Fig. 6 of the drawings, a leaf section 9B is provided with longitudinally extending, medially disposed shallow depressions 28 in the upper and lower faces thereof, and the next adjacent spring leaf 27B is formed in a similar manner. The two leaves are prevented from having lateral displacement by the provision of a key 29 which fits in the adjacent registering depression 28 of the two spring leaves, a portion of the key being embraced by the depression of each leaf.

In the embodiment illustrated in Fig. 7 of the drawings, the adjacent faces only of the spring leaves 9C and 27C are provided with medially disposed longitudinally extending shallow depressions in registry with each other for receiving a key member 30.

In the embodiment shown in Fig. 8, of the drawings, a leaf section 9D is provided on one side with a medially disposed longitudinally extending shallow depression 31 and the next adjacent leaf 27D is provided on its top surface with a mediallv disposed longitudinally extending rib portion 32 which fits within the depression 31, thus providing complementary interfitting parts which prevent lateral displacement of one leaf relative to the other.

In the embodiment shown in Figs. 9, 10 and 16 of the drawings, the adjacent ends 8E and 9E of the two piece spring leaf, are shown formed in complementary tapered overlapping relationship and embraced between the spring leaves 5 and 27. One of these tapered overlapping ends, shown in Fig. 10 as the end 8E is provided with a medially disposed longitudinally extending slot 33, and the other tapered overlapping end 9E is provided with a medially disposed, longitudinally extending, short rib 34 which fits within the slot 33 and prevents lateral displacement of the two ends. In this construction, end 9E is the movable one which has longitudinal travel relative to the other leaves of the spring and with this arrangement the tapered end moving toward the other complementary tapered end, has a wedging action which increases frictional resistance as the two tapered ends are forced together. Normally the spring is in a downwardly bowed position so that additional flexure will cause these tapered ends to increasingly overlap and in this manner the frictional resistance is increased directly proportional to the loading of the springs.

As shown in Fig. 16 of the drawings, the slot 33 is of limited length and the rib 34 which slides therein is of relatively short length so that the travel of the tapered ends relative to each other is limited and determined by the rib 34 reaching one end or the other of the slot 33. This prevents the hanger leaf 9E from being withdrawn or pulled out from the spring assembly.

Means are provided for limiting the amount of flexure in the spring as a whole thereby preventing withdrawal of the hanger leaf 9 from the remainder of the spring leaves under extreme flexure conditions. The spring leaf 27, which is next below the hanger leaf 9, is provided with a curled up end 35 which is curved upwardly on a radius slightly greater than the radius of the outside of the spring eye 14 and is normally disposed in spaced relation to such eye.

Extreme downward flexure due to rebound and separation of the chassis frame 1 from the axle 11 will cause the curled end 35 to move into wedging contact with the spring eye 14 and gradually bring the relative movement between the two parts to a stop in view of the fact that the leaf 27 is rigidly secured to the main body of the multiple leaf spring by the tie bolt 10 and axle clips 12 and 13.

Providing the leaf 27 with an extended end, upon which the turned up portion is formed, also serves and performs an additional extremely useful and important function. As shown most clearly in Figs. 14 and 17 of the drawings, the spring leaves, the opposite edges of which are ordinarily rounded in manufacture, are ground away slightly so as to provide plain flat edge surfaces. The flat edges are snugly embraced between the depending lower ends of the rigid perch or mounting clip 2 so as to prevent the spring from having any side slap in use, due to the fact that leaf 27 is rigidly secured in the main body of the spring.

Referring to the construction shown in Fig. 15 of the drawings, there is illustrated a multiple leaf spring having the same essential characteristics as that shown in the other illustrated embodiments except, however, that the eyes on the hanger leaves are disposed in inverted position from that shown in Fig. 1 of the drawings. In this embodiment, a hanger leaf 36, having a downwardly turned eye 37 at one end thereof, has the opposite end thereof extended beyond the eye 38 of the movable hanger leaf 39 and is curled downwardly, as shown at 40, in normally spaced relation to the eye 38. The curled end 40 slides relatively to the eye 38 upon flexure of the spring and at the predetermined limit of flexure comes into wedging engagement with the eye 38 to limit the amount of such flexure. Otherwise, the form and function of the other elements of this embodiment are the same as shown in the preceding figures.

In the operation of this improved spring, it is secured to a chassis frame at fixed points by the bolts 3 and 4 and the medial portion of the spring is tightly clamped to the axle 11 by the usual U-shaped clips 12 and 13. Upon relative movement between the axle 11 and the chassis frame 1, the spring is permitted to flex by longitudinal movement of the hanger leaf 9 relative to the other leaves of the springs.

Normally the spring is of such shape that the distance from eye to eye measured along the arc of the spring is greater than the distance from eye to eye measured in a straight line. Upon loading of the spring, the inner end 17 of the hanger leaf 9 slides inwardly toward the adjacent end 22 of the leaf section 8, the free end being held down and frictionally engaged by reason of a spring clamp 41 which is adjustable so as to vary the tension of the free extending end of the hanger leaf 5.

Lateral displacement of the longitudinally movable hanger leaf 9 relative to the other leaves of the assembly is prevented by any

one of the forms shown in Figs. 1 to 10, inclusive.

If the form of spring illustrated in Figs. 9 and 10 is employed, the limit of longitudinal movement of the movable hanger leaf is limited by the rib 34 reaching one end or the other of the slot 33 within which it slides and in this form of the invention, the camming action, by reason of the overlapping tapered ends, will increase the frictional resistance to sliding of the movable spring leaf in proportion to the amount of its loading.

The movable hanger leaf 9 is relieved from side strains and slapping when in use by reason of the extended end of the leaf 27 which is continuous in form and rigidly clamped at the axle and secured to the other leaves of the spring. This extended end fits snugly between the depending arms of the mounting perch or bracket 2, as shown most particularly in Fig. 17 of the drawings, thus maintaining the spring in alignment at all times. The curled up end 35 being formed on a slightly greater radius than the outside diameter of the eye 14 will wedgingly engage the eye and thereby limit the amount of flexure by stopping outward movement of the hanger leaf 9 relative to the other leaves. This is particularly true when the spring is subjected to excessive rebound which tends to widely separate the axle 11 from the chassis frame 1.

It is to be noted that that section of the spring secured to the axle clips 12 and 13 is so rigidly bound that it does not function as a spring and, therefore, the smaller the proportion of spring so bound, the more economical will be the assembly and likewise the fewer number of leaves necessary to build up the multiple leaf spring, the more economical will be the spring.

As illustrated in Figs. 1 and 15, the end of the top spring leaf, opposite to the end provided when the attaching eye, extends beyond the middle portion so as to cover the space between the ends of the next lower two-piece leaf, one piece of which is the movable hanger leaf 9. Utilizing this extending end of the top hanger leaf as a binding means for the second hanger leaf saves the provision of an additional leaf for this purpose which would mean a waste of several inches of spring leaf bound by the axle clips.

Although the illustration in Fig. 1 of the drawings shows the spring in nearly a straight line position, it is preferable that under normal loads the spring have a normal downward bow or camber and that any additional load to which the spring is subjected will cause it to approach a straight line position thus causing the movable hanger leaf 9 to move inwardly toward the middle of the spring as it approaches such straight line position. This is particularly advantageous in connection with the form of springs shown in Figs. 9 and 10.

In the modified form shown in Fig. 18 of the drawings, the tapered end 40 of a movable hanger leaf 9F is shown provided with integrally formed transversely extending flanges 41 and 42 formed at the side edges of the tapered portion which embrace the edges of the next adjacent leaf for preventing lateral displacement of the tapered end relative to such adjacent leaf. In tapering the end of the movable leaf 9F, the metal flows laterally as well as longitudinally during the tapering process, thus providing triangular shaped edge portions which are adapted to be turned up to form the flanges 41 and 42.

The use of a yielding bushing, such as of rubber, in the eye of a spring of this character is of considerable importance due to the fact that normally the spring is loaded so that the movable leaf thereof is in substantially a horizontal position, that is, it is in substantial alignment with the other eye to which the spring is attached. Therefore, during normal use of the spring the movable leaf is continually being pivoted above and below this normal horizontal position and each time that it moves in either direction, the eye end of the leaf is subjected to either a pushed or pulled blow or force by reason of the frictional resistance caused by the other leaves of the spring embracing the movable leaf.

By using a bushing such as of rubber between the eye and the bolt upon which the spring is mounted, the bushing embraces and contacts with both the inside of the spring eye and the outside of the mounting bolt at all times, even though the eye is moved slightly first in one direction and then in the other by reason of the repeated strains in reversed direction to which it is submitted. In other words, the yielding bushing eliminates any actual play or loose fit between the eye and mounting bolt and at the same time permits limited movement from a concentric to an eccentric position while at all times maintaining a tight grip around the mounting bolt and a tight fit within the spring eye.

Although several embodiments of this invention have been herein shown and described, it will be understood that other details may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. In a multiple leaf spring adapted for attachment to fixed points, a hanger leaf formed in two sections with their adjacent ends in spaced relation, other leaves embracing opposite sides of said two piece hanger leaf and overlapping the space between said adjacent ends, and a channel-shaped clip having its web interposed between and embraced by spring leaves and its flanges overlapping

the said space and adjacent spring ends for preventing relative lateral displacement of said hanger spring leaf.

2. In a multiple leaf spring adapted for attachment to fixed points, a hanger leaf formed in two sections with their adjacent ends in spaced relation, other leaves embracing opposite sides of said two piece hanger leaf and overlapping the space between said adjacent ends, one of said adjacent ends being rounded in vertical section for minimizing wear on the adjacent embracing leaves.

3. In a multiple leaf spring adapted for attachment to fixed points, a hanger leaf formed in two sections with their adjacent ends in spaced relation, other leaves embracing opposite sides of said two piece hanger leaf and overlapping the space between said adjacent ends, one of said adjacent ends being rounded in both vertical and horizontal section for minimizing wear on the adjacent embracing leaves.

4. The combination of a chassis frame, a multiple leaf spring having a hanger leaf attached to said frame on a fixed point, said hanger leaf having longitudinal sliding movement with respect to another leaf of said spring, said other leaf having a portion rigidly bound to the main body of leaves, and an end thereof extending to the fixed point of attachment of said slidable hanger leaf, and rigid means included in said fixed point of attachment embracing opposite edges of said other leaf end for relieving said slidable hanger leaf of side strains.

5. In a multiple leaf spring adapted for attachment to fixed points, a hanger leaf having an eye end attachable to a fixed point, said leaf being slidable longitudinally with respect to an adjacent leaf, such adjacent leaf having an extended end embracing said hanger leaf eye in normally spaced relation for limiting relative movement between said leaves.

6. In a multiple leaf spring adapted for attachment to fixed points, a hanger leaf having an eye end attachable to a fixed point, said leaf being slidable longitudinally with respect to an adjacent leaf, such adjacent leaf having an extended curved end embracing said hanger leaf eye in normally spaced relation for limiting relative movement between said leaves.

7. In a multiple leaf spring adapted for attachment to fixed points, a two-piece hanger leaf, one of which is longitudinally movable relatively to the other, said two-pieces normally having a space between the adjacent ends thereof, and a second hanger leaf adjacent said two-piece leaf, said second hanger leaf having one end attachable to a fixed point and the other end thereof overlapping the space between the adjacent ends of said one-piece hanger leaf.

8. In a multiple leaf spring adapted for attachment to fixed points, said spring normally having a camber therein, a hanger leaf longitudinally slidable with respect to an adjacent leaf, and means for increasing the frictional resistance to sliding of said hanger leaf when said spring is loaded so as to decrease the camber therein.

9. In a multiple leaf spring adapted for attachment to fixed points, said spring normally having a camber therein, a hanger leaf longitudinally slidable with respect to an adjacent leaf, and means for increasing the frictional resistance to sliding of said hanger leaf in proportion to its loading when said spring is loaded so as to decrease the camber therein.

10. In a multiple leaf spring adapted for attachment to fixed points, said spring normally having a camber therein, a hanger leaf longitudinally slidable with respect to an adjacent leaf, said slidable leaf having a tapered portion for coacting with a similarly tapered member for increasing the frictional resistance to sliding of said hanger leaf when said spring is loaded so as to decrease the camber therein.

11. In a multiple leaf spring adapted for attachment to fixed points, said spring normally having a camber therein, a two-piece hanger leaf having complementary tapered overlapping ends, one of said pieces being longitudinally slidable with respect to the other, and other leaves embracing opposite sides of said overlapping ends.

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