Oct. 29, 1946. H. C. KEYSOR 2,410,290

SPRING ASSEMBLY

Filed Aug. 2, 1943 3 Sheets-Sheet 1

Fig. 2

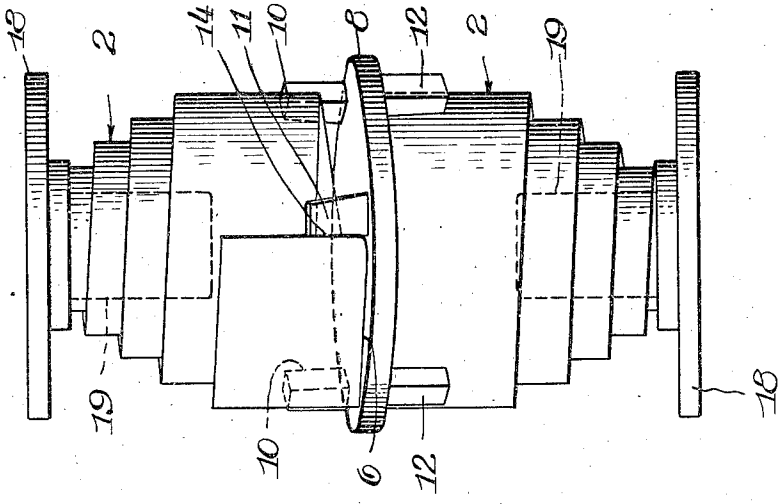


Fig. 1

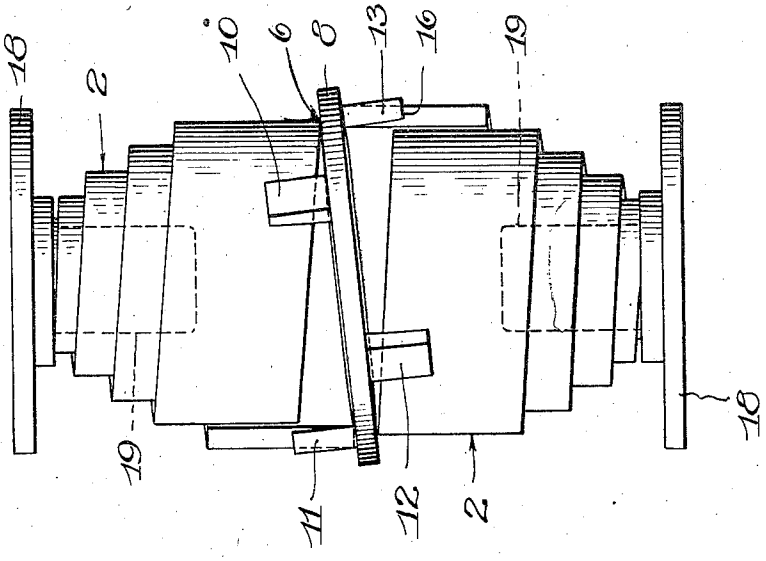
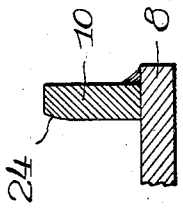


Fig. 7



INVENTOR.
Harold C. Keysor,
BY Orin O. B. Garner
Atty

Oct. 29, 1946. H. C. KEYSOR 2,410,290

SPRING ASSEMBLY

Filed Aug. 2, 1943 3 Sheets-Sheet 2

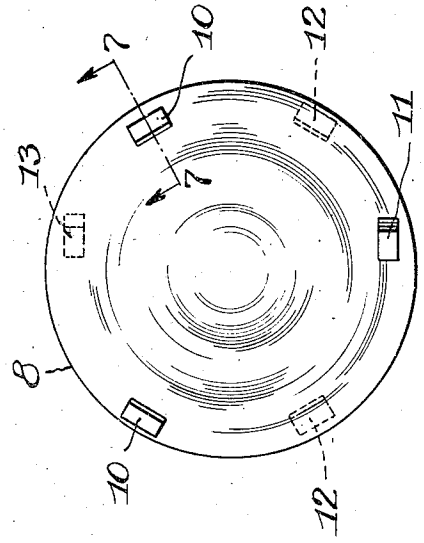


Fig. 5

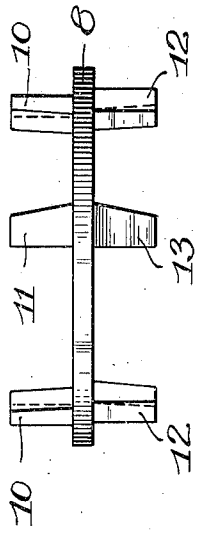


Fig. 6

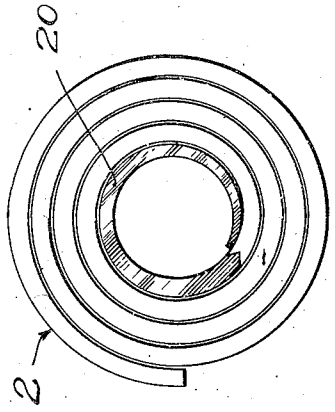


Fig. 3

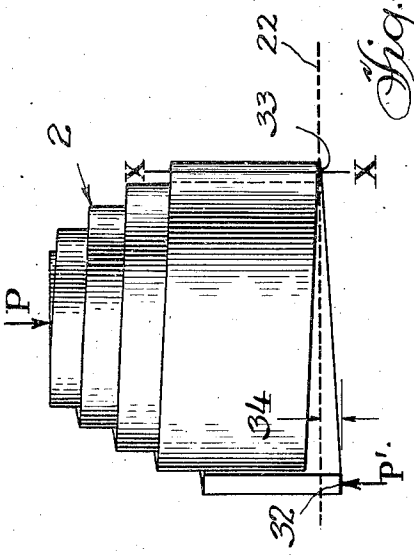


Fig. 4

INVENTOR.

Harold C. Keysor,

BY

Owen B. Garner

Atty.

Oct. 29, 1946. H. C. KEYSOR 2,410,290

SPRING ASSEMBLY

Filed Aug. 2, 1943 3 Sheets-Sheet 3

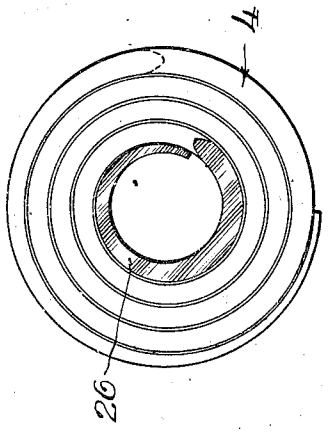


Fig. 11

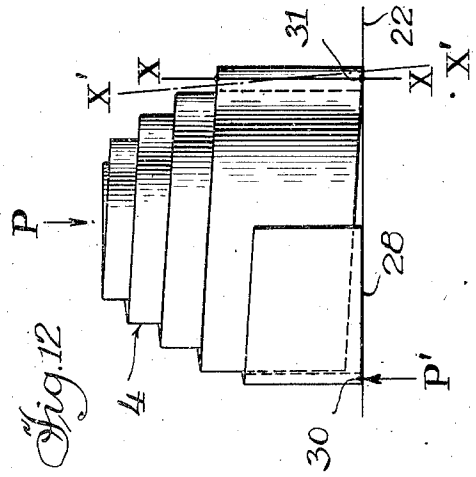


Fig. 12

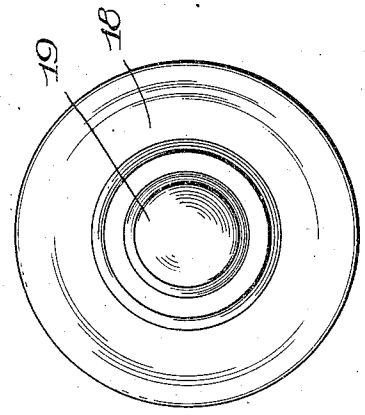


Fig. 8

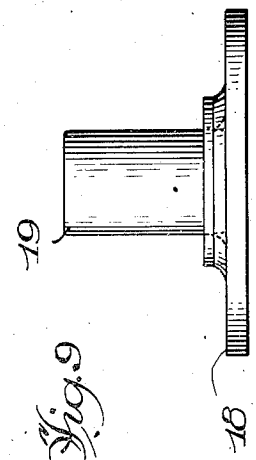


Fig. 9

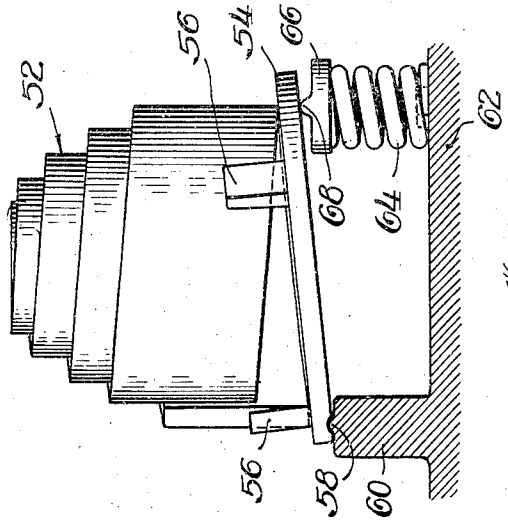


Fig. 10

INVENTOR.
Harold C. Keysor,
BY Orin O. Garner
Atty

Patented Oct. 29, 1946 2,410,290

UNITED STATES PATENT OFFICE

2,410,290

SPRING ASSEMBLY

Harold C. Keysor, Chicago, Ill., assignor to American Steel Foundries, Chicago, Ill., a corporation of New Jersey

Application August 2, 1943, Serial No. 497,031

24 Claims. (Cl. 267—62)

1

My invention relates to springs and more particularly to volute coil springs.

An object of my invention is to design a novel spring assembly comprising a pair of springs spaced by and seated against a spring plate, said plate comprising positioning means of novel form for each of said springs.

A different object of my invention is to design a volute spring assembly of such construction that resultant load on the spring coincides with the central axis thereof thereby substantially eliminating the secondary stresses which exist in a conventional volute spring and which result in its relatively short life in service.

In one illustrated embodiment of my invention, a pair of opposed top and bottom volute springs are spaced by an equalizer in the form of a spring plate, said springs being reversely arranged with the largest and outermost coils thereof being seated against said plate and being untapered so that the equalizer initially assumes a diagonal plane and shifts to a horizontal plane as load is placed upon the assembly.

In another illustrated embodiment of my invention, the equalizer supports a single volute spring and is resiliently supported from an associated member by means of a coil spring so arranged as to accommodate shifting of the equalizer from a diagonal to a horizontal plane as load is applied to the volute spring.

My invention comprehends a spring seat or plate of novel form, said seat being in the form of a disc with positioning means on the top and bottom surfaces thereof for engagement with associated coil springs, said positioning means comprising abutment faces for the ends of the coils seated against said surfaces, said abutment faces being disposed in planes perpendicular to the plane of the disc.

In the drawings,

Figure 1 is a side elevation of a volute spring assembly embodying my invention, and Figure 2 is another side elevation taken from the left as seen in Figure 1.

Figures 3 and 4 illustrate somewhat diagrammatically one of my novel volute springs and the forces acting thereon, Figure 3 being a top plan view thereof, and Figure 4 being a side elevation thereof.

Figures 5 to 7 inclusive illustrate in detail my novel equalizer plate, Figure 5 being a plan view thereof, Figure 6 being an edge elevation thereof, and Figure 7 being a sectional view taken in the plane indicated by the line 7—7 of Figure 5.

Figures 8 and 9 illustrate in detail my novel

2

end plate or spring cap, Figure 8 being a plan view thereof, and Figure 9 being a side elevation.

Figure 10 is a somewhat diagrammatic illustration of a modification of my invention.

Figures 11 and 12 are somewhat diagrammatic illustrations of the forces acting on a conventional volute spring, Figure 11 being a top plan view of the spring, and Figure 12 being a side elevation thereof.

Describing my invention in detail and referring first to Figures 1 to 9 inclusive, my novel volute spring assembly comprises substantially identical top and bottom volute springs 2, 2, one of said springs being illustrated in detail in Figures 3 and 4 from which it will be apparent that the last or outermost half-coil of the bar forming the spring is of full width rather than tapered as in the conventional spring 4 illustrated in Figures 11 and 12. The last half-coil of my novel spring is also of full thickness; however, it will be understood that this portion of the spring may, if desired, be tapered in thickness as in the conventional volute of Figures 11 and 12, provided that a full width be maintained.

Each spring 2 is seated as at 6 against an equalizer plate 8 illustrated in detail in Figures 5 to 7, said plate being a disc with three lugs 10, 10, and 11 on the top thereof and three lugs 12, 12, and 13 on the bottom thereof, said lugs being formed and arranged to maintain the springs 2, 2 in assembled relationship with the equalizer plate 8, as will be clearly understood from a consideration of Figures 1 and 2. The end of the portion of the bar forming the last or outermost half-coil of the top spring 2 is seated as at 14 against the lug 11 to prevent relative turning movement between the equalizer plate 8 and said top spring, and likewise, the end of the portion of the bar forming the last or outermost half-coil of the bottom spring 2 is seated at 16 (Figure 1) against the lug 13. A spring cap or end plate 18 is seated against the innermost coil of each of said springs 2, 2, said coil being sheared or tapered in width as at 20 (Figure 3) to afford a seat for the cap 18; and said cap is provided with a lug or projection 19 afforded a sliding fit within the spring.

As illustrated in Figures 1 and 2, the springs 2, 2 are reversely arranged so that the plate or equalizer 8 normally lies in a plane inclined with respect to the horizontal, but it will be apparent that as the assembly is compressed the plate will move to a horizontal plane. Thus, when the last or outermost half-coil of each spring is compressed to the closure plane thereof, as indicated at 22 (Figure 4), the plate 8 reaches a horizontal

plane, and thereafter, the respective coils of the springs close against the plate as load upon the assembly is increased. It may be noted, as best seen in Figure 7, that each of the lugs 10, 10 and 12, 12 is beveled as at 24 to accommodate the shifting movement of the equalizer without gouging the springs 2, 2.

My novel volute spring assembly is designed to obtain axial loading upon the springs, thus substantially eliminating secondary stresses existing in the conventional volute spring, and it is believed that a comparison of Figures 3 and 4 with Figures 11 and 12 will clearly illustrate the manner in which axial loading is obtained in my novel device.

In the conventional volute spring illustrated in Figures 11 and 12, the portion of the bar forming the smallest or innermost coil of the spring is sheared or tapered as at 26 to afford a seat for an associated supported member in a plane perpendicular to the axis of the spring, and likewise, the portion of the bar forming the largest or outermost coil of the spring is sheared or tapered as at 28 (Figure 12) to afford a seat for the spring upon an associated supporting member in a plane perpendicular to the axis of the spring.

The load P, as will be understood by those skilled in the art, causes a counterclockwise torque on section X—X and the reaction P' causes a reactive torque. As will be clearly seen in this figure, section X—X leans inward assuming the position X'—X' under load, inasmuch as the taper at 28 causes the outermost half-coil of the spring to be relatively flexible. For this reason, the reaction P' cannot assume its necessary magnitude until a relatively large deflection has taken place between section X—X and the point of application of P', said point of application being indicated at 30 (Figure 12). It will be understood that the leaning of section X—X is associated with a considerable warping of the various coils or, in other words, deflection thereof which is not symmetrical with respect to the central axis of the spring.

Referring now to Figures 3 and 4, it will be seen that the last or outermost coil of my novel volute spring 2 is untapered in width and in thickness. This means that in Figure 4 the relative deflection between points 32 and 33 is about twice as great as the corresponding deflection between points 30 and 31 of the spring illustrated in Figure 12, the outer coil being pressed solid against the closure plane 22 in each case. The reactive torque P' in Figure 4 tends to rotate section X—X further in a clockwise direction, and hence the inward leaning caused by the counterclockwise torque due to the load P is substantially eliminated. It will be understood that when the dimension at 34 (Figure 4) is reduced to zero by reason of the increasing load P, the equalizer plate 8, illustrated in Figures 1 and 2, will reach a horizontal position, and the coils will start at point 33 (Figure 4) to close against the plate. During this closure the load rate of the spring will be increasing as in the conventional volute spring. However, the load remains axial because of the symmetry existing in the assembly by reason of the top and bottom springs 2, 2 being substantially identical.

A modification of my invention is illustrated in Figure 10 wherein the volute spring 52 is substantially identical with that illustrated in Figures 3 and 4, said spring being seated on an equalizer plate 54 having the upstanding positioning lugs 56, 56, said lugs being substantially

identical in form and arrangement with the lugs 10, 10, and 11 on the equalizer plate 8 illustrated in Figures 5 to 7 inclusive.

The equalizer 54 is afforded a fulcrum at 58 against a lug 60 on a supporting member 62, said member also supporting a coil spring 64 having a spring cap 66 with a lug having arcuate bearing at 68 against the equalizer 54. In this arrangement as in that previously described, the equalizer plate 54 is disposed initially in a diagonal plane and shifts to a horizontal plane as the volute spring 52 is loaded. The coil spring 64 is designed to be compressed to a solid condition when the plate 54 has reached a horizontal plane.

It is to be understood that I do not wish to be limited by the exact embodiments of the device shown which are merely by way of illustration and not limitation as various and other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In a volute spring assembly, spaced volute springs each being formed of a flat bar comprising a plurality of telescoping coils, the portion of said bar forming the largest and outermost coil being of substantially uniform width and being of at least equal pitch to that of the other coils thereof, said springs being arranged with their large ends adjacent each other and their small ends remote from each other, and an equalizer between said springs and affording seats therefor, the adjacent end of the bar forming one of said springs being disposed at one side of said equalizer and the corresponding end of the bar forming the other of said springs being disposed at the opposite side of said equalizer, whereby said equalizer is disposed in a plane diagonal with respect to the axis of said assembly and said equalizer moves to a plane perpendicular with respect to said axis as load is applied to said assembly, and positioning means comprising a plurality of spaced lugs on said equalizer cooperating with each of said springs, certain of said lugs affording seats for the adjacent ends of respective bars to prevent relative turning movement between said springs and said equalizer.

2. In a volute spring assembly, spaced volute springs disposed with their large ends adjacent each other and their small ends remote from each other, each of said springs comprising telescoping coils having a substantially uniform width except for the smallest and innermost of said coils which is sheared to afford a seat for an associated spring cap, an equalizer between said springs and affording seats therefor, said springs being reversely arranged, and the edges of said springs bearing against said equalizer being angular with respect to the axis of said assembly, whereby said equalizer is disposed in a plane diagonal with respect to the axis of said assembly and moves to a plane perpendicular to said axis as load is applied to said assembly, and positioning means comprising a plurality of spaced lugs on said equalizer cooperating with each spring to maintain the same in assembled relationship with said equalizer, certain of said lugs being beveled to accommodate said moving of said equalizer, and other of said lugs providing abutment faces for respective springs, each of said faces lying in a plane perpendicular with respect to said equalizer.

3. In a volute spring assembly, spaced volute

springs each being formed of a flat bar comprising a plurality of telescoping coils, the portion of said bar forming the largest and outermost coil being of substantially uniform width and being of at least equal pitch to that of the other coils, said springs being arranged with their large ends adjacent each other and their small ends remote from each other, and an equalizer between said springs and affording seats therefor, the adjacent end of the bar forming one of said springs being disposed at one side of said equalizer and the corresponding end of the bar forming the other of said springs being disposed at the opposite side of said equalizer, whereby said equalizer is disposed in a plane diagonal with respect to the axis of said assembly, and said equalizer moves to a plane perpendicular with respect to said axis as load is applied to said assembly, and positioning means comprising a plurality of spaced lugs on said equalizer cooperating with each of said springs.

4. In a volute spring assembly, spaced volute springs each being formed of a flat bar comprising a plurality of telescoping coils, the portion of said bar forming the largest and outermost coil being of substantially uniform width, said springs being arranged with their large ends adjacent each other and their small ends remote from each other, and an equalizer between said springs and affording seats therefor, the adjacent end of the bar forming one of said springs being disposed at one side of said equalizer and the corresponding end of the bar forming the other of said springs being disposed at the opposite side of said equalizer, and the edges of said springs engaging said equalizer terminating at approximately equal helical angles to the longitudinal axis of said assembly, whereby said equalizer is disposed in a plane diagonal with respect to the axis of said assembly and said equalizer moves to a plane perpendicular with respect to said axis as load is applied to said assembly.

5. In a volute spring assembly, spaced volute springs each having a plurality of telescoping coils of substantially uniform width except for the innermost of said coils which is sheared, an equalizer plate between said springs and seated against the outermost coils of the respective springs, said plate being disposed in a diagonal plane with respect to the axes of said springs, the edges of respective springs engaging said equalizer terminating at approximately equal helical angles to the longitudinal axis of said assembly, and said plate being shiftable to a plane perpendicular to said axes as load is placed on said assembly, and spring caps bearing against the sheared portions of said innermost coils, said plate comprising a plurality of lugs spaced about the perimeter thereof and affording positioning means for each of said springs, certain of said lugs providing abutment surfaces in engagement with respective springs and lying substantially perpendicular to said plate.

6. In a volute spring assembly, spaced volute springs disposed with their large ends adjacent each other and their small ends remote from each other, each of said springs comprising telescoping coils having a substantially uniform width except for the smallest and innermost of said coils which is sheared to afford a seat for an associated spring cap, and an equalizer between said springs and affording seats therefor, the outermost coils of respective springs being reversely arranged and having their equalizer engaging edges disposed at helical angles to the longitudinal axis of said

assembly, whereby said equalizer is disposed in a plane diagonal with respect to the axis of said assembly and moves to a plane perpendicular to said axis as load is applied to said assembly, said equalizer comprising positioning means for each of said springs.

7. In a spring assembly, a volute spring comprising a flat bar formed into a plurality of telescoping coils, said bar being of uniform width except for the portion forming the smallest and innermost of said coils, which portion is tapered in width to afford a seat for an associated load transmitting member, a resiliently mounted equalizer lying in a plane diagonal with respect to the axis of said spring and affording a seat for the outermost coil thereof, the edge of said outermost coil engaging said equalizer terminating at a substantially uninterrupted helical angle, said equalizer being shiftable to a plane perpendicular to said axis as load is applied to said spring, and positioning means on said equalizer comprising a plurality of lugs spaced around said spring, the end of the outermost of said coils being seated against one of said lugs.

8. In a volute spring assembly, spaced volute springs each having a plurality of telescoping coils of substantially uniform width except for the innermost of said coils which is sheared, an equalizer plate between said springs and seated against the outermost coils of the respective springs, said outermost coils being reversely arranged and terminating at helical angles to the axis of respective springs whereby said plate is disposed in a diagonal plane with respect to the axes of said springs, said plate being shiftable to a plane perpendicular to said axes as load is placed on said assembly, and spring caps bearing against the sheared portions of said innermost coils, said plate comprising a plurality of lugs spaced about the perimeter thereof and affording positioning means for each of said springs.

9. In a volute spring assembly, spaced volute springs disposed with their large ends adjacent each other and their small ends remote from each other, each of said springs comprising telescoping coils having a substantially uniform width except for the smallest and innermost of said coils which is sheared to afford a seat for an associated load transmitting member, and an equalizer between said springs and affording seats therefor, the edges of respective springs engaging said equalizer being disposed at approximately equal helical angles to the axis of said assembly, said springs being reversely arranged whereby said equalizer is disposed in a plane diagonal with respect to the axis of said assembly and moves to a plane perpendicular to said axis as load is applied to said assembly.

10. In a volute spring assembly, substantially identical top and bottom volute springs each having its outermost half-turn of full width and of at least equal pitch to the other turns thereof, and an equalizer between said springs affording seats for the outermost half-turns of the respective springs, said springs being reversely arranged, whereby said equalizer is initially disposed in a plane diagonal with respect to the axis of said assembly, said equalizer comprising positioning means characterized by a plurality of lugs on the top and bottom of said equalizer, the end of the outermost half-turn of each spring being seated against one of said lugs.

11. In a spring assembly, a volute spring comprising a flat bar formed into a plurality of telescoping coils, said bar being of uniform width ex-

cept for the portion forming the smallest and innermost of said coils, which portion is tapered in width to afford a seat for an associated load transmitting member, and a resiliently mounted equalizer lying in a plane diagonal with respect to the axis of said spring and affording a seat for the outermost coil thereof, the edge of said outermost coil engaging said equalizer being disposed at a helical angle to said axis, said equalizer being shiftable to a plane perpendicular to said axis as load is applied to said spring.

12. In a volute spring assembly, spaced volute springs each having a plurality of telescoping coils of substantially uniform width except for the innermost of said coils which is sheared, an equalizer plate between said springs and seated against the outermost coils of the respective springs, said outermost coils being reversely arranged and having the plate engaging edges thereof disposed at helical angles to the axis of respective springs, said plate being disposed in a diagonal plane with respect to the axes of said springs, and said plate being shiftable to a plane perpendicular to said axes as load is placed on said assembly, and spring caps bearing against the sheared portions of said innermost coils.

13. In a volute spring assembly, a support member having an upstanding lug, a coil spring spaced from said lug and seated on said member, an equalizer fulcrumed on said lug and supported from said spring, and a volute spring seated on said equalizer, the edge of said spring engaging said equalizer being disposed at a helical angle relative to the axis of said spring, said equalizer being initially disposed in a diagonal plane and being shiftable to a horizontal plane as load is applied to said volute spring, said coil spring being formed and arranged to be solid when said equalizer assumes said horizontal plane.

14. In a volute spring assembly, spaced volute springs each being formed of a flat bar having a plurality of telescoping coils, said springs being disposed with their largest coils adjacent each other, a plate member between said springs and affording seats therefor, and positioning means on said plate for said springs, said positioning means including means in abutment with the adjacent end of the bar forming each spring, the edges of respective springs which engage said plate member being diagonally disposed with respect to the longitudinal axis of said assembly and terminating at approximately opposite sides of said plate member.

15. In a volute spring assembly, spaced volute springs disposed with their large ends adjacent each other, and a plate between said springs and affording seats for said large ends, said springs being so formed and arranged that their plate engaging edges are diagonally arranged with respect to the longitudinal axis of said assembly and terminate at approximately opposite sides of said plate, whereby the plate is initially disposed in a plane diagonal with respect to the axes of said springs and shifts to a plane perpendicular to said axes as load is applied to said assembly.

16. In a volute spring assembly, substantially identical top and bottom volute springs each having its outermost half-turn or full width, and an equalizer between said springs affording substantially parallel seats for the outermost half-turns of the respective springs, the equalizer engaging

surfaces of said springs being disposed at helical angles to the axis of said assembly and said springs being reversely arranged, whereby said equalizer is initially disposed in a plane diagonal with respect to the axis of said assembly.

17. In a volute spring unit, a pair of opposed volute springs and an equalizer in engagement with respective springs along substantially parallel surfaces, the portions of said springs engaging said equalizer terminating at opposite sides thereof and being diagonally disposed with respect to the longitudinal axis of said unit.

18. In a volute spring unit, a pair of opposed volute springs and an interposed equalizer having substantially parallel surfaces in engagement with the large ends of respective springs, the portions of said springs engaging said equalizer terminating at substantially opposite sides thereof and being diagonally disposed with respect to the longitudinal axis of said unit and being at approximately equal helical angles with respect to said axis.

19. In a volute spring assembly, a pair of volute springs and an intermediate equalizer plate in engagement therewith, the adjacent end portions of said springs being of full width and pitch and terminating at substantially opposite sides of said plate.

20. In a volute spring assembly, a pair of volute springs and an intermediate equalizer plate in engagement with the large ends thereof, the plate engaging edges of said ends being of full width and pitch and terminating at substantially opposite sides of said plate.

21. In a spring unit, spaced aligned coil springs and an interposed equalizer engaging respective springs along substantially parallel surfaces, the equalizer engaging portions of said springs terminating at substantially opposite sides of said equalizer and being diagonally disposed at approximately equal helical angles with respect to the longitudinal axis of said unit.

22. In a spring unit, spaced aligned coil springs and an interposed equalizer engaging respective springs along substantially parallel surfaces, the equalizer engaging portions of said springs terminating at substantially opposite sides of said equalizer and being diagonally disposed at approximately equal helical angles with respect to the longitudinal axis of said unit, and positioning means on said equalizer engaging each spring to prevent relative torsional movement with respect thereto.

23. In a spring unit, a pair of aligned coil springs and a plate therebetween engaging respective springs along substantially parallel surfaces, the end portions of said springs which engage said plate being terminated at substantially opposite sides thereof and being diagonally disposed with respect to the longitudinal axis of said unit, whereby said plate is disposed in a plane diagonal to said axis.

24. In a spring unit, a volute coil spring, a resiliently mounted equalizer affording a support for said spring, the engaging surfaces of said spring and equalizer being diagonally disposed with respect to the longitudinal axis of said spring, whereby said equalizer is initially disposed in a plane diagonal with respect to said axis and is shiftable to a plane perpendicular to said axis as load is applied to said spring.

HAROLD C. KEYSOR.