Dec. 12, 1939. A. L. RICHE 2,182,856

COMPRESSION SPRING SUPPORT

Original Filed Feb. 20, 1937

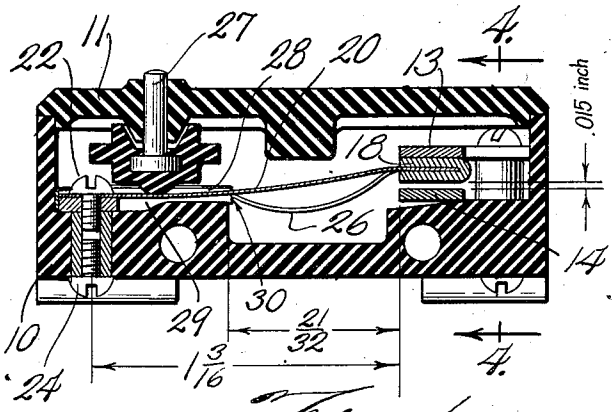


Fig. 1.

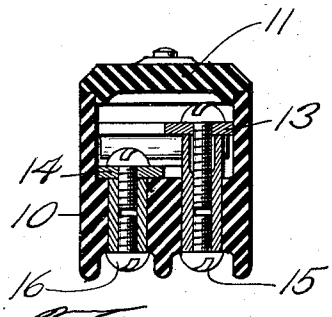


Fig. 4.

Fig. 3.

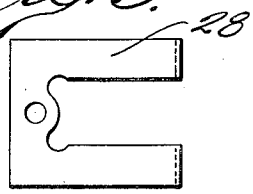
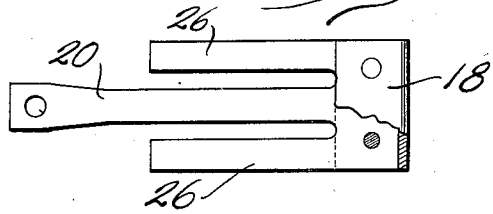


Fig. 2.



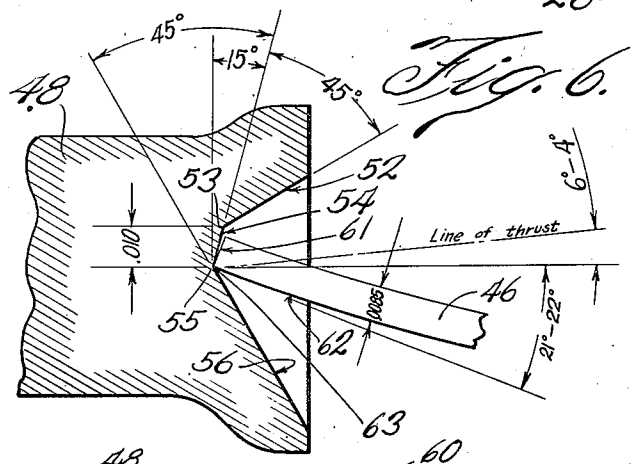


Fig. 6.

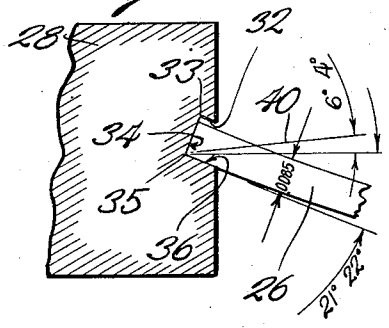


Fig. 5.

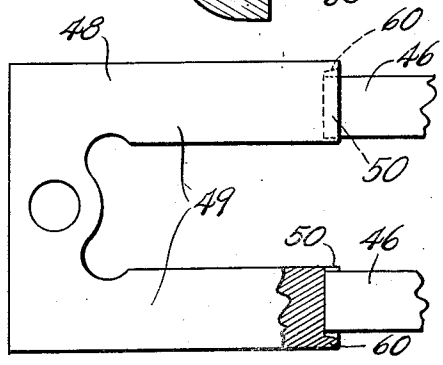


Fig. 7.

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COMPRESSION SPRING SUPPORT

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14 Claims. (Cl. 74—100)

The present invention relates generally to snap mechanisms formed of thin leaf springs for use in snap switches and the like, and relates more particularly to pivotal supports for thin leaf compression spring members thereof. This application is a continuation in part of my prior application, Ser. No. 52,778, filed December 4, 1935.

The present invention constitutes an improvement in the construction of the snap switches of the type shown in the patent of Philip K. McGall, 1,960,020, May 22, 1934. In the construction of that patent, a compression member consisting of a bowed thin leaf spring is seated in a notch. I have found that the design of both the end of the compression member and the notch affect appreciably the operating characteristics of the switch. When a V-shaped notch, such as is illustrated in Figs. 1 and 5 of the McGall patent is used, the compression spring does not pivot freely in the notch under certain circumstances so that the switch exhibits undesirable operating characteristics such as, for example, a tendency of the mobile contact of the switch to creep or move slowly away from the stationary contact instead of executing a single snap motion from one limit of travel to the other.

Objects of the present invention include the provision of an improved support for a thin leaf compression spring in a snap mechanism, the provision of an improved pivotal connection between such a spring and the member that supports it, and the provision of a snap mechanism of improved construction and operating characteristics. These and other objects will become apparent as the description proceeds.

The following description of certain specific embodiments of my invention serves by way of example to illustrate the manner in which the invention may be used. However, the invention is not limited to the particular details of construction of any such embodiment or example. In the drawing:

Fig. 1 is a sectional elevation of a complete snap switch embodying my present invention;

Fig. 2 is a plan view of the integral spring leaf which includes the thin leaf compression and tension members of the snap mechanism;

Fig. 3 is a plan view of the support member for the compression leaf spring;

Fig. 4 is a sectional elevational view of the switch of Fig. 1, taken along the line 4—4 of Fig. 1 and viewed in the direction indicated by the arrows;

Fig. 5 is an enlarged elevational view of a part of the switch of Fig. 1, illustrating in detail the construction and arrangement of the thin leaf compression spring and its support member;

Fig. 6 is a partial elevational view of an alternative arrangement and construction of the thin leaf compression spring and its support member, illustrating another embodiment of my invention; and

Fig. 7 is a plan view of the thin leaf compression spring and support member therefor shown in Fig. 6.

Referring to Figs. 1 to 4 inclusive, the snap switch therein shown is illustrative of the type of switch in which my invention may be used advantageously. It includes an insulating case comprising a base 10 and a cover 11. The switch includes upper and lower stationary contacts or stops 13 and 14 respectively which have terminals 15 and 16. The construction which provides insulated supports for the two stationary contact pieces 13 and 14 and for connecting them to their terminals 15 and 16 is best illustrated in Fig. 4.

A mobile contact 18 is carried and supported by a snap mechanism comprising a system of tension and compression leaf springs. This system of springs includes a thin leaf tension spring 20 which is supported in cantilever fashion by means of a screw 22 to provide an electrical connection between the mobile contact 18 and a terminal 24 located on the outside of the base 10 of the insulating case. The spring system also includes a pair of thin leaf compression springs 26 which are joined to the tension spring 20 at the mobile contact 18 and pivotally supported intermediate the ends of the tension member 20. The compression springs 26 are bowed in compression and bear against a support member 28. This support member 28 is cut out in the center so as to be left U-shaped to clear the tension spring 20 and has a pair of notches for receiving and pivotally supporting the compression springs 26 as described in more detail hereinafter.

The operating plunger 27 carried by the cover 11 is adapted to bear against the thin leaf tension spring 20 at a point near the cantilever support of the spring to deflect and stress the spring. The switch normally assumes the position shown in Fig. 1, with the mobile contact 18 lying against the upper stationary contact or stop 13. When the plunger 27 is depressed it deflects the tension spring 20 downward near its cantilever support 22 and causes the center line of tension of the member 20 to curve downward and move below the point or axis of the pivotal support of the compression leaf springs 26 on the support member 28. The contact 18 moves away from its rest position against the stationary contact 13 and

continues to move, propelled by the spring action of tension and compression members 20 and 26, until contact 18 comes into engagement with the lower contact or stop 14. Thus mobile contact 18 moves from one stationary contact to the other with a snap action. When the pressure is released from the plunger 27, the tension spring 20 tends to recover its former unstressed condition and in so doing bends upward near its point of cantilever support, snapping contact 18 back to its original position in abutment with the upper stationary contact or stop 13.

The particular embodiment which I have selected for illustration in Figs. 1 to 4 inclusive has approximately the dimensions indicated on Fig. 1. Thus the tension member is approximately $1\frac{3}{8}$ inches long; the distance between the ends of the bowed compression leaf springs 26 is approximately $\frac{21}{32}$ of an inch; and the moving contact 18 when it snaps from one stationary contact to the other travels a distance of .015 of an inch, or approximately $\frac{1}{64}$ of an inch.

The compression leaf springs 26 and the tension leaf spring 20 are different parts of a single leaf of spring tempered beryllium copper 8½ thousandths of an inch thick (0.0085 inch), the mobile contact 18 consisting of a strip of silver folded over the connected ends of the tension and compression springs. The stationary contacts 13 and 14 also are of silver.

The U-shaped member 28 provides two lateral supports for the compression leaf springs 26 while permitting the central tension spring 20 to deflect through, and to opposite sides of, the axis of the pivotal support of the compression springs 26.

Fig. 5 provides an enlarged view of the supporting connection between the support member 28 and the compression leaf spring 26. The support member 28 has a milled slot or notch 30 in its end, said slot having three planar faces 32, 34 and 36. Faces 32 and 34 meet to form a ninety degree dihedral angle having its vertex line at the corner 33, and faces 34 and 36 meet to form another ninety degree dihedral angle having a vertex line at the corner 35. Faces 32 and 36 are parallel. This notch 30 is cut at the proper angle in the end of the support member 28 to bring face 36 substantially parallel with the bowed face of the leaf spring 26 at its left end as viewed in Figs. 1 and 5, that is at the end at which it engages the support member 28.

The left or pivot end of spring 26 has its lower left corner lying firmly and squarely in the dihedral angle between the faces 34 and 36 of the notch 30, which angle has the vertex line 35. This lower left corner of the spring 26 is the dihedral corner formed by the meeting of the end face of the spring 26 with the tension face or convex bowed face thereof. Since spring 26 is a compression member its convex bowed face is stressed in tension while its concave bowed face is stressed in compression.

For purposes of reference in the present description, the position of the switch in Fig. 1 is assumed to be horizontal. Accordingly, the position at which the curve of the bowed portion of the compression spring 26 meets the mobile contact 18 in Fig. 1 is approximately four to six degrees above the position at which the left end of the compression spring 26 engages the support member 28. The direction of the thrust exerted by the compression leaf spring 26 on the support member 28 is towards the left and approximately along the line between the two ends of the compression spring 26, that is to the left and dropping four to six degrees below the horizontal. This line of thrust is indicated approximately by the line 40 in Fig. 5.

The compression spring 26 is of such a length that when bowed and assembled in the switch as shown in Fig. 1, it makes an angle of approximately 21 to 22 degrees with the horizontal at the point at which it engages the support member 28. The exact angle depends in part upon which of the two stationary contacts 13 and 14 the mobile contact 18 is lying in engagement with. Accordingly the slot 30 is cut in the support member 28 at an angle of 22 degrees with the horizontal. The thrust of the compression spring 26 against the support member 28 is borne by the faces 34 and 36 of the notch 30, the compression spring 26 seating its dihedral angle formed by its end face 34 and tension face 36 in the dihedral angle having the vertex line 35. The height of the notch 30, or the distance between its faces 32 and 36 is only great enough to provide sufficient clearance between the concave bowed face of the spring 26 and the face 32 of the notch 30 for operation of the switch.

The left or pivot end of the compression spring 26 is accurately and sharply squared off. In constructing the complete spring leaf shown in Fig. 2 which includes both the tension spring member 20 and the two compression spring members 26, the leaf first is blanked out and then mounted in a jig where the left or pivot ends of the compression members 26 are dressed by hand with a fine file to ensure that the ends be perfectly square and smooth and that the corner between the end face and the convex or tension face of each compression spring 26 be clean and sharp.

I believe that the difficulty encountered with prior switches having compression springs or the like supported in notches, wherein those switches would fail to snap properly so that their mobile contacts could be controlled to move slowly between their stops, was due in part to a limited and only partially secure wedging of the end of the compression spring in the notch of the support member. Either a frictionless pivot connection permitting free turning of the spring in its support, or a secure grip on the spring preventing any turning at all in the support, should enable the switch to execute a reliable snap motion. But an insecure grip or a pivot with considerable friction may hold the compression spring from turning in its support only until the contact begins to move and then may permit the spring to turn so as to release the stress and thereby dissipate the energy that should have driven the contact.

Certain prior attempts to prevent thin leaf compression springs of snap mechanism from wedging in V notch supports have resulted in the thin leaf compression springs exhibiting a tendency to twist or warp about their longitudinal cords out of their properly oriented positions so that the springs could not pivot easily on the support members. This restraint upon the pivoting of the compression springs of a switch tended to prevent the switch from executing a snap motion and caused the mobile contacts to creep, or move slowly, between the stationary contacts. A common result of sluggish or faulty action of a switch of this type is that the contacts separate a sufficient distance to impair good electrical contact between them but they do not separate far enough to interrupt the resulting

arc between the switch contacts and the unextinguished arc quickly destroys the switch contacts.

In my construction shown in Fig. 5, the slot 30 in the support member 28 has a width which is just enough greater than the thickness of spring 26 to afford freedom for the necessary movement of the compression spring 26 in the snap over action. The movement of the spring in the slot is slight and the required clearance is small so that the spring is substantially restrained from twisting about its longitudinal cord. In addition, the force reactions between the leaf spring 26 and the faces 34 and 36 of the notch 30 tend to seat the dihedral corner of the spring firmly in the dihedral angle formed by those faces and thereby further restrains twisting of the spring 26. The end face of the spring 26 abuts squarely against the bottom of the slot and frictionally engages the face 34 thereof over the entire end face of the compression spring 26 itself. This firm engagement between the end of the compression spring 26 and the support member 28 eliminates any tendency for the springs 26 to shift laterally out of place.

Fig. 6 illustrates another embodiment of my invention which consists in an alternative construction for the compression spring support member and the manner of its engagement with the pivot end of the compression leaf spring.

In Fig. 6, reference numeral 46 indicates a bowed compression leaf spring identical with the compression leaf spring 26 of Figs. 1 to 5 inclusive, and reference numeral 48 indicates a support member for the compression spring 46. The support member 48 differs from the support member 28 of Figs. 1 and 5 principally in the configuration of the notch for receiving the end of the bowed compression leaf spring. In all other respects the switch of which the compression spring 46 and the support member 48 are a part, is identical with the switch shown in Figs. 1 to 5 inclusive.

The support member 48 contains a groove 50 for receiving the left or pivot end of the compression leaf spring 46, which groove has three planar faces 52, 54 and 56, all of which appear as lines in the elevational view of Fig. 6. Faces 52 and 54 meet to form a concave dihedral angle of 135 degrees having a vertex line 53, and faces 54 and 56 meet to form a concave dihedral angle of 135 degrees having a vertex line 55. The central face 54 makes an angle of 15 degrees with the vertical and its normal makes an angle of 15 degrees with the horizontal. The dihedral corner of the compression leaf spring 46 which is formed by the meeting of the end face 61 thereof with the convex bowed face thereof, which corner has the vertex line 63, lies in the dihedral angle between the faces 54 and 56, so that the two vertex lines 55 and 63 substantially coincide. The line of thrust of the compression spring 46 is directed from an angle of approximately four to six degrees above the horizontal and consequently approximately bisects the dihedral angle between the faces 54 and 56 of the notch 50.

Inasmuch as the central cord of the compression leaf spring 46 lies at an angle of approximately 21 to 22 degrees with the horizontal at the end at which the spring engages the support member 48, the end face 61 of the compression leaf spring 46 lies at an angle of 6 or 7 degrees with the central face 54 of the notch in the end of the support member 48. And inasmuch as the motion of the compression leaf spring 46 when the switch operates amounts to only one or two degrees, the compression spring 46 always will engage the support member 48 only at the dihedral corner of the spring which has the vertex line 63. Inasmuch as the direction of the thrust exerted by the compression spring 46 upon the support member 48 is directed approximately along the bisector of the dihedral angle in which the corner of the compression spring rests, this thrust maintains the dihedral corner of the spring firmly seated in the apex of the angle.

Referring to Fig. 7, the notches 50 in the end of the support member 48 do not extend the full width of the piece. The notches are closed by means of projections 60 at the outer lateral ends of the notches. These projections 60 serve to prevent movements of the compression leaf springs 46 in the notches 50 longitudinally with respect to the notches, that is laterally with respect to the leaf springs themselves.

As in the construction of Fig. 5, the notch 50 of Fig. 6 provides insufficient clearance to permit any considerable twisting of the compression spring members 46 about their longitudinal axes. And furthermore the tendency of the spring 46 to seat its lower corner that is, the vertex line 63, firmly in the apex of the angle between the faces 54 and 56 also restrains twisting of the spring 46 out of its proper orientation.

The support member 48 of Figs. 6 and 7 is constructed by first punching it from flat metal stock and then forming it to provide an offset at 49 corresponding to the offset 29 in support member 28 in Fig. 1. Finally the notches 50 are formed in the end by swedging. This provides a smooth surfaced and accurately shaped notch.

It will be readily apparent to those skilled in the art that the embodiments of my present invention, herein shown and described are by way of illustration and example only, and that those embodiments are capable of numerous variations and modifications. Dimensions and structural details, where given, are included only to make the description of the particular embodiment complete and explicit. The invention is not limited to such details. Therefore I do not intend to be limited to the specific form, size and construction shown in the foregoing particular embodiments but rather I wish to be limited only by the scope of the appended claims. For example my improved support for a thin leaf spring need not be employed in a switch in which a tension spring is flexed to operate the switch. The invention also may be used in switches operated differently, as by moving the member that supports either the compression spring or the tension spring or by moving the contacts between which the mobile contact snaps.

I claim:

1. In combination in a spring snap mechanism of the class described, a bowed thin leaf spring and a support therefor, the support for said thin leaf spring including means providing a notch in the form of a dihedral angle, said spring having a dihedral corner of substantially 90° formed by the meeting of the tension face of said leaf spring with a face substantially perpendicular to the longitudinal chord of the spring, said dihedral corner of said thin leaf spring being seated in said dihedral angle of said support, so that the vertices of said angles of the spring and the support coincide.

2. In combination in a snap mechanism of the class described, a compression member consisting of a bowed leaf spring having one end

thereof squared-off and having smoother faces and sharper corners than are formed by ordinary shearing tools, and a support member for said spring engaging one of said sharp corners of said squared-off end thereof.

3. In combination in a snap mechanism of the class described, a compression member consisting of a bowed leaf spring having one end thereof squared-off, and a support for said end of the bowed leaf spring, said support providing a notch in the form of a dihedral angle whose vertex line substantially coincides with the vertex line of that dihedral corner of the bowed spring which is formed by the meeting of the end face of said end of the spring with the convex bowed face of the spring.

4. In combination in a snap mechanism of the class described, a compression member consisting of a bowed leaf spring having one end thereof squared off and having smoother faces and sharper corners than are formed by ordinary shearing tools, and a support for said end of the bowed leaf spring, said support providing a notch in the form of a dihedral angle which engages only that dihedral corner of the bowed spring which is formed by the meeting of the end face of said end of the spring with the convex bowed face of said spring, the vertices of said dihedral angles of said spring and support coinciding.

5. In combination in a snap mechanism of the class described, a tension member mounted at one end and free to move at the other end, a stop for limiting the motion of the free end of the tension member, a compression member consisting of a bowed leaf spring fastened at the first end thereof to the free end of the tension member, the second end of said leaf spring being squared off and having smoother faces and sharper corners than are formed by ordinary shearing tools, a support for said second end of the bowed leaf spring intermediate the ends of said tension member, said support providing a notch in the form of a dihedral angle containing the dihedral corner of the bowed spring formed by the meeting of the end face of said second end of the spring with the convex bowed face of the spring and an obstruction for limiting displacement of said spring in said dihedral angle in the direction of the vertex line of said angle, the vertices of said dihedral angles of said spring and support coinciding.

6. In combination in a spring snap mechanism of the class described, a compression member consisting of a bowed leaf spring having one end thereof squared-off, and a support for said end of the bowed leaf spring, said support providing a dihedral angle of substantially ninety degrees, the end face of said end of the spring and the convex bowed face of the spring lying substantially flat against the two faces of said dihedral angle and the sharp corner of said spring laying in the apex of said dihedral angle.

7. In combination in a spring snap mechanism of the class described, a tension member mounted at one end and free to move at the other end, a stop for limiting the motion of the free end of the tension member, a compression member consisting of a bowed leaf spring fastened at one end thereof to the free end of the tension member, the other end of said leaf spring constituting a pivot end, said pivot end being squared off, and a support for the pivot end of the bowed leaf spring intermediate the ends of said tension member, said support having a notch including a concave dihedral angle of approximately 135 degrees so oriented that its bisecting plane extends therefrom approximately in the direction of said stop, said concave dihedral angle containing that dihedral corner of the bowed spring which is formed by the meeting of the end face of the pivot end of the spring with the convex bowed face of said spring, said leaf spring being bowed to such an extent that said concave dihedral angle engages substantially only said dihedral corner.

8. The combination of claim 7 wherein there is included an obstruction ending said notch at a position flanking said spring to limit lateral displacement of said spring in said notch.

9. In combination in a spring snap mechanism of the class described, a compression member consisting of a bowed leaf spring having one end thereof squared off, a support for said end of the bowed leaf spring, said support having a notch having three planar faces forming first and second dihedral angles, said first dihedral angle being approximately two radians, the corner between the end face and the convex bowed face of said leaf spring at said end thereof lying in the first dihedral angle of said support, the corner between the end face and the concave bowed face of the leaf spring at said end thereof being adjacent to the vertex of the second dihedral angle, the end face of the leaf spring lying at an angle of approximately one-tenth radian to that face of the notch which contains the vertices of both said first and second dihedral angles, said second dihedral angle being at least approximately one and one half radians and sufficiently great that its faces avoid engagement with said corner of the leaf spring between the end face thereof and the concave bowed face thereof, the reaction of said leaf spring against said support consisting of a thrust directed toward the vertex of the first dihedral angle and in a direction that approximately bisects said first dihedral angle.

10. The combination of claim 9 wherein there is included an obstruction ending said notch at a position flanking said leaf spring for preventing displacement of said spring in said notch laterally of said spring.

11. In combination in an apparatus of the class described, a tension member operatively mounted at one end thereof with the other end free to move, a stop for limiting the motion of said free end, a pair of parallel compression members adjacent and on opposite sides of said tension member consisting of bowed leaf springs each having one end connected to the free end of said tension member with its other end constituting a pivot end, each of said leaf springs having the end face at its pivot end forming a dihedral corner of substantially ninety degrees with the convex bowed face of the spring, each of said leaf springs having the vertex line of said dihedral corner substantially coinciding with the corresponding vertex line of the other leaf spring, means for supporting the pivot end of each of said leaf springs intermediate the ends of said tension member, said means including a member having a notch with two planar faces forming a concave dihedral angle of approximately two radians and having a vertex line substantially parallel to the corresponding vertex line of the support of the other leaf spring, and substantially parallel to the vertex lines of the dihedral corners of said leaf springs, said dihedral corner of each spring lying in said di-

hedral angle of its support, the pivot end face of the leaf spring lying at an angle of approximately one-tenth radian to the face of the notch adjacent it, the reaction of said spring against said support consisting of a thrust directed towards the vertex line of the dihedral angle of said support in a direction that approximately bisects said dihedral angle, and means for manipulating the foregoing elements to cause the line of tension of said tension member to cross the extended vertex lines of said dihedral angles.

12. In combination in a snap mechanism of the class described, a compression member consisting of a bowed leaf spring having one end thereof squared off, a support for said end of said bowed leaf spring, said support providing a concave dihedral angle containing the dihedral corner of the bowed spring formed by the meeting of the end face of said end of the spring with the convex bowed face of the spring, and an obstruction in said dihedral angle for limiting the displacement of said spring in said dihedral angle in the direction of the vertex line of said angle.

13. In combination in a spring snap mechanism of the class described, a thin leaf compression member and a support therefor, the support for said compression member including means for providing a notch in the form of a dihedral angle; said compression member having a dihedral corner having an angle less than the angle of the notch so that it cannot fill the notch, the vertex lines of said dihedral angles of said notch and compression member coinciding, said corner of said compression member having a sharper edge and being flanked by smoother faces than are formed by ordinary shearing tools, said compression member being so oriented that it engages said support only at its vertex line.

14. The combination of the immediately preceding claim wherein the end of said compression member is squared off so that said dihedral corner of said compression member engaging said support is substantially 90°.

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