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SELF-ADJUSTING CROSS BRIDGE

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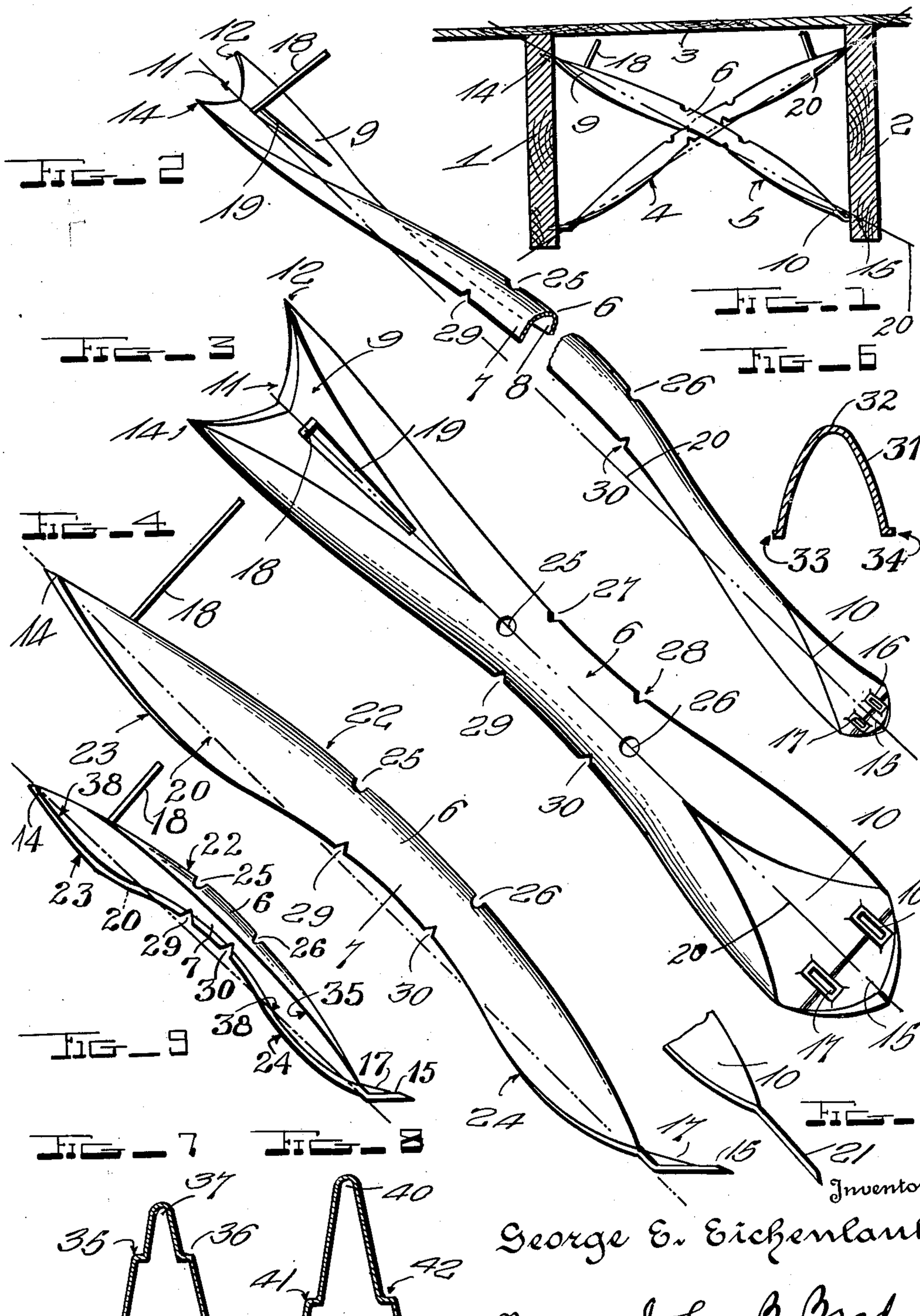

FIG. 2

FIG. 1

FIG. 3

FIG. 6

FIG. 4

FIG. 9

FIG. 7

FIG. 8

FIG. 5

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SELF-ADJUSTING CROSS BRIDGE

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My invention relates broadly to building construction and more particularly to an improved construction of prefabricated crossbridge for bracing rafters, joists or scantlings in building construction.

One of the objects of my invention is to provide a construction of prefabricated bridge which can be inexpensively manufactured on a mass production scale for efficiently bracing rafters, joists or scantlings in building construction.

Another object of my invention is to provide a construction of crossbridge for bracing rafters, joists or scantlings in building construction in which the elements of the bridge are arched both longitudinally and transversely for insuring substantial rigidity in the bridged construction while allowing sufficient elasticity in the bracing to compensate for settlement and movements or normal shrinkages or warpage of floors supported by the joists or roofs supported by the rafters, or other types of surfaces supported by framing members.

Another object of my invention is to provide a construction of crossbridge for building construction which may be readily formed, pressed or struck from metal or other suitable materials, and shaped for economical packed or nested arrangement for quick removal to the installed working position of rest between the members to be braced.

Still another object of my invention is to provide a construction of crossbridge having outstruck projecting portions opposite each end thereof, serving as strengthening and attachment means for the brace and having recessed portions intermediate the ends thereof serving as means for imparting resiliency to the bridge for insuring that sufficient yieldability to the bridge throughout its installed life for compensating for changes in the position of the joists and associated floors or skin.

Other and further objects of my invention reside in the construction of crossbridge as set forth in the following specification by reference to the accompanying drawings in which:

Figure 1 is a cross sectional view showing the crossbridge of my invention installed between the joists or beams of a floor; Fig. 2 is a perspective view of one of the crossbridges illustrated in Fig. 1, the view showing the crossbridge slightly turned about the longitudinal axis thereof; Fig. 3 is a plan view of the crossbridge of my invention; Fig. 4 is a side elevational view of the crossbridge; Fig. 5 is a fragmentary view of one end of a modified form of crossbridge embodying my invention; Figs. 6, 7 and 8 are

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cross sectional views showing various sectional forms in which the crossbridge of my invention may be constructed; and Fig. 9 is a side elevation of the brace having the transverse section of Fig. 7.

As a result of long experience in building construction I have found that it is highly important to avoid any type of bracing in floor and joist construction which tends to maintain the roof or floor in a too rigidly stiff or set position. The nailing of crossbraces between joists beneath a floor has usually resulted in the bowing of the floor surface as the rafters and floor shrink by natural drying out. The bracing provided by such wood braces is often so rigid that the surfaces of the floor must bow or otherwise deform to allow for settlement or expansion and also contraction of the wood. My invention is directed to a construction of brace which may be readily pressed from sheet metal or molded from plastics and so shaped as to impart sufficient resiliency to the joists and associated floor construction to permit the yielding of the brace sufficiently to eliminate the disastrous results often encountered in a change out of level from the shift or the bowing of the floor surface and associated structural elements. I provide a crossbrace of partially curved section with the ends thereof provided with outstruck portions which serve both as strengthening and engaging means and with an intermediate arch portion having recesses cut therein at such positions that the required yieldability is imparted to the arch construction to allow the arch to yield to the limited extent required through normal alternate shrinking and swelling of the joists without impairing the effectiveness of the brace to stiffen the joists and permanently hold them in alignment so they develop their full designed strength.

Referring to the drawings in detail the crossbraces of my invention are illustrated in Fig. 1 applied between joists **1** and **2** which support the floor designated generally at **3**. The bridges are illustrated arranged crosswise or transversely of the joisted or beam floor construction at **4** and **5**. The bridging is installed the same as any common crossbridging closely adjacent each other in cross-arrangement to apply effective, continuous beam reinforcement between the joists in substantially the same plane. The crossbraces **4** and **5** are identical in construction as shown more particularly in Figs. 2, 3 and 4. In Fig. 2 it will be observed that the crossbrace is formed from thin sheet material such as sheet steel and is substantially circular

in cross section adjacent the center thereof as represented at 6, with the side walls of the central section terminating in substantially straight edges 7 and 8. The central portion of the brace is bowed outwardly in one direction while the ends of the brace are flattened out at 9 and 10 and are given a slight curve opposite to the curvature of the central portion 6. The contour of the brace along the longitudinal edges thereof simulates a substantially compound curve or a wave-like shape while the transverse section is substantially "U-shaped." The end 9 is divided with a somewhat distorted U-shaped slightly curved recess 11 in the end thereof providing a pair of rafter engaging or biting points or teeth 12 and 14. The opposite end of the brace is flattened out and tapered to a point or single biting tooth blade as represented at 15. The engaging point 15 is bent at substantially an obtuse angle with respect to the plane of the terminating end 10 of the brace. This structure enables the brace to have the pointed end 15 thereof presented to a rafter in a substantially horizontal plane when the brace is installed. The pointed end 15 is rendered substantially rigid with respect to the end 10 of the brace by means of the outstruck parallel longitudinally extending rib portions 16 and 17. The outstruck ribs 16 and 17 place the metal of the brace between the pointed end 15 and the end of the brace at 10 under condition of reinforcement for obstructing the tendency of the brace 10 to revolve about its axis or change its angularity with respect to the plane of the point 15, during the process of installation or any time thereafter.

The opposite end of the brace 9 is provided with an outstruck finger member 18 which is formed from the metal of the end 9 of the brace, leaving a substantially V-shaped aperture 19 therein. The finger 18 provides a spacing or dimensioning member for facilitating the installation of the brace as represented more particularly in Fig. 1. The builder in installing the brace first jabs a pointed end 12 or 14 into the side of the rafter 1 at a position adjacent the top thereof as gaged by the outstanding finger 18, which projects in a plane substantially perpendicular to a neutral axis through the brace which I have represented by the theoretical line 20 in Fig. 4. I have also indicated the neutral axis 20 in Figs. 1, 2 and 3. The finger 18 allows the builder to observe the approximate position at which the brace is to be jabbed into the side of the joist 1. The operative is prevented from applying the brace at too high a position on the joist 1 as the extremity of finger 18 would strike the under surface of the floor 3 or a batten or temporary member used before the flooring is put down. On the other hand, the operative by gaging the gap between the extremity of finger 18 and the under surface of floor or batten 3, will not attempt to push the pointed ends 12 and 14 of the brace into the joist 1 in a position too far below the under surface of the floor 3. When the sharp point 12 or 14 of the brace has thus been forced into the joist 1, the operative slides the sharp biting end 15 of the brace in a substantially horizontal direction "with the grain" for enabling the sharp end 15 to bite or seat itself into the side of the joist 2. This is entirely a sidewise movement, which sets both points 12 and 14 and does not disturb the relative penetration of the points 12 and 14 into joist 1.

In a modified form of my invention, as illustrated in Fig. 5, the pointed end of the brace 10 is continued in a plane which is substantially in line with the neutral axis 20 of the brace as represented at 21.

The curvature of the brace in opposite directions is more clearly represented in Fig. 4, from which it will be observed that the central portion of the brace at 6 is bowed in one direction represented by surface 22, while the end portions of the brace are bowed in the opposite directions to form two warped or arched portions as represented at 23 and 24. This substantially compound surface and curve imparts to the brace that quality of rigidity necessary to stiffen the brace as a structural element and yet to provide for sufficient flexibility of the brace to allow for natural expansion or contraction of the building structure. To further relieve the brace of excessive stiffness or rigidity, I provide perforations in the central portion of the brace as represented at 25 and 26, in spaced positions along the length of the brace. Intermediate the perforations 25 and 26 I provide recesses or notches at 27, 28, 29 and 30 which relieve rigidity of the brace as spatial conditions of the building structure units shift or change. The number of apertures and notches required may be varied as experience may require for bracing various types of structural units, or a variety of conditions normal to conditions of load or span.

The structural form of the brace illustrated in Figs. 1, 2, 3, 4 is proportioned to suit the practical functions of manufacture, shipping, warehousing, distribution and sale. The form shown has proven very effective in construction and installation. In Fig. 6 the mid-section of the piece is shown as an inverted U with flanged stiffening edges at 33 and 34, with variations thereof shown in Figs. 7 and 8. In any case, such mid-sections are developed as surfaces extending in length and flowing into other cross-sectional shapes terminating at each end in a flat-bar-section, shaped for engagement with the materials to be braced. While the stiffening flanges are not required for the shorter lengths in practice, they are indicated for the longer pieces used in wider beam or joist spacings to achieve a satisfactory L over R ratio or "radius of gyration" in a strut to obtain necessary higher strength.

In Fig. 7 I have shown a structural brace in which longitudinally extending intermediate shoulders 35 and 36 are formed on each side thereof with a substantially U-shaped intermediate rib 37 formed between the shoulders 35 and 36. The sides of the brace terminate in edge flanges represented at 38 and 39.

In Fig. 8 I have shown a further modified form of brace which is worked from sheet metal and formed with a central rib portion 40 having opposite shoulder portions 41 and 42 pressed in the sides of the brace and with the edges terminating in flanges 43 and 44 serving to impart rigidity to the brace.

Various other structural forms may be imparted to the brace for imparting that composite degree of flexibility and stiffness to permit self-adjustment to the building after the brace is placed in position. Sufficient springiness is provided in the several structures shown to allow for the yielding of the brace both vertically and longitudinally in a restricted degree while maintaining the bracing properties afforded by the structural unit.

The arc-shaped ends of the brace, reentrant arc for the head and extended-arc for the toe

(foot or heel) enable easy penetration (of the wood) at the pointed head-end and also, by lateral (horizontal pushing) action at the opposite or toe-end (with the grain or into the grain of the wood), both such penetrations are easily attained merely by manual pressures and without the employment of tools. The unique-arc shapes of my construction and the construction of the two ends are such however that after initial penetration of the wood or other like material having grain and hardness, the resistance is progressively and rapidly built up against excessive penetration in order to set the ends of the brace in solid bearing at each end and equalized each to the other, when the shaft of the piece takes over further mechanical work as a strut or brace in compression. Both ends together and with the shaft interact to effect the perfect set desired to develop the ultimate self-adjusting purposes of the brace. The shaft and both ends are so formed in combination that, when critical resistance to penetration is offered by the varying density or hardness of the wood or other material, the unique mid-section of the brace coupled with its camber away from a straight axial line further coupled with the warped shape near the ends, will cause the shaft to spring upward and bow longitudinally without failure or undue loss of strength. Excessive bow to the brace is readily seen or felt by the hand of the installer wherefor it becomes impossible to apply this brace in such manner that excessive stiffness or rigidity is imparted to the structure so braced.

With time, the joists shrink and the brace is imbedded more firmly due to fatigue in the wood and the brace is sprung slightly more in its designed direction and later, when the wood swells due to natural causes of temperature and humidity or both, the spring in the brace recovers or relaxes and so continuously adjusts itself to the ever-and-always changing dimensions of the structure. The brace thus is said to breathe concurrently with the structure, which may be said to pant.

It will be observed that the arrangement of one end of one brace is contra-opposed to the other end of the coacting brace. One end of each brace is an exact inverse duplicate of the other end. This identity in structure facilitates manufacture in that the brace, if struck from a strip-sheet is made complete without any waste of material whatsoever.

The shape of the structural unit is such that the units may be nested compactly for shipment and removed directly from the shipping carton and installed without nailing or the use of tools. The engaging points or teeth **12** and **14** serve in lieu of nails with respect to the side of one joist while the knife-edged flat heel **15** serves as the engaging means for the adjacent joist for applying the continuous diagonal bracing force between the joists.

While I have described the brace of my invention in certain of its preferred embodiments, I realize that modifications in the construction may be made and I intend no limitations upon my invention other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A bridge for bracing and staying a plurality of spaced joists comprising a brace member having an arch-shaped portion intermediate the ends thereof and terminating at one end in a pair of spaced piercing teeth and terminating at the other end in a cutting member, said piercing teeth constituting spaced shiftable centers about which said cutting member is adjustable, and a spacing finger outstruck from said brace member adjacent said teeth for measuring the position of application of said piercing teeth to the side of a joist.

2. A bridge for bracing and staying a plurality of spaced joists comprising a brace member having an arch-shaped portion intermediate the ends thereof and terminating at one end in a pair of spaced piercing teeth and terminating at the other end in a cutting member, said teeth constituting spaced shiftable centers about which said cutting member is adjustable and an outstruck finger projecting substantially normal to the axis of said brace member intermediate the piercing teeth thereof and operating to measure the position of application of the piercing teeth to the side of a joist.

3. A bridge for bracing and staying a plurality of spaced joists comprising a resilient member arched intermediate the ends thereof and having a transverse section throughout the major length measured intermediately of the ends that presents a convex external surface and a concave internal surface, said member terminating at one end in a pair of spaced piercing teeth, and terminating at the opposite end in a centrally disposed cutting toe, said spaced teeth forming centers about which said cutting toe is operative to swing with said teeth as shiftable centers, and a spacing finger projecting from the convex external surface of said member adjacent the spaced piercing teeth for providing a measuring guide for setting said teeth with respect to the side of a joist.

4. A bridge for bracing and staying a plurality of joists comprising a brace member having a preformed arch-shaped portion extending longitudinally intermediate the ends thereof, with one of said ends provided with a substantially U-shaped recess terminating in spaced penetrating teeth at opposite extremities thereof, said brace member terminating at the opposite end thereof in a substantially U-shaped centrally disposed cutting toe, said teeth and said toe being operative to effect diagonally opposite engagement with the sides of spaced joists, and a pair of longitudinally extending spaced ribs disposed between said cutting toe and said brace member in symmetrical positions on opposite sides of the central axis of said brace member for strengthening said cutting toe with respect to said brace member, said brace member being resilient throughout the arch-shaped portion thereof.

5. A bridge for bracing and staying a plurality of joists comprising a resilient brace member of curved transverse section having a preformed arch-shaped portion intermediate the ends thereof and terminating at one end in a substantially U-shaped recess having spaced penetrating teeth at opposite sides thereof and terminating at the opposite end in a substantially U-shaped centrally disposed toe, said teeth and said toe being operative to effect diagonally opposite engagement with the sides of spaced joists with said teeth constituting shiftable centers about which said toe is adjustable, and a pair of longitudinally extending spaced ribs disposed within the curved transverse section of said brace member for strengthening the arch-shaped portion of said brace member.

6. A bridge for bracing and staying a plurality of spaced joists comprising a brace member formed from resilient material having a pre-

formed arch-shaped portion intermediate the ends thereof and terminating at one end in a pair of spaced piercing teeth, and terminating at the other end in a transversely disposed tapered central cutting member, said piercing teeth constituting spaced shiftable centers about which said cutting member is adjustable and a plurality of spaced notches formed in the central part of the arch-shaped portion of said brace member.

7. A bridge for bracing and staying a plurality of spaced joists comprising a brace member formed from a resilient material having a preformed arch-shaped portion intermediate the ends thereof formed in a substantially U-shaped transverse section and terminating at one end in a pair of spaced piercing teeth and terminating at the other end in a centrally disposed cutting member, said piercing teeth constituting spaced shiftable centers about which said cutting member is adjustable, and a pair of symmetrically arranged shoulders extending longitudinally of the arch-shaped portion of said bridge within the sides of the U-shaped transverse section, said transverse section extending beyond the said shoulders and terminating in peripheral flanges.

8. A bridge for bracing and staying a plurality of spaced joists comprising a preformed arch-shaped brace member having a substantially U-shaped transverse section and terminating at one end in a pair of spaced piercing teeth and at the other end in a central cutting member, and means in the substantially U-shaped transverse section of said brace member for predetermining the rigidity of the brace.

9. A bridge for bracing and staying a plurality of spaced members and a surface supported thereby comprising a substantially resilient preformed arch shaped brace member formed from thin sheet material having a curved transverse section terminating in side portions extending in substantially arcuate contours on a longitudinal axis through the brace member, said arcuate contours being formed on radii located on opposite sides of the longitudinal axis of said brace member and being contiguous end-to-end with alternate arcuate contours curved in one direction and the intermediate arcuate contour curved in the opposite direction and penetrating portions at opposite ends of said brace member for establishing connection with the spaced members to be braced.

10. A bridge for bracing and staying a plurality of joists with respect to a surface supported thereby comprising a longitudinally extending

substantially resilient preformed arch-shaped brace member formed from thin sheet material having a curved transverse section terminating in side portions extending in substantially arcuate contours in successive alternate end-to-end contiguous positions on a longitudinal axis through the brace member, said arcuate contours being formed on radii located on opposite sides of the brace member whereby said arcuate contours follow curves that are successively concave and convex with respect to each other along the longitudinal axis of the brace member with penetrating portions at opposite ends thereof for engagement with joists to be braced, said brace member having the alternate contours arcuate thereof substantially enveloping the longitudinal axis through said brace member while the intermediate arcuate contour extends beyond the said longitudinal axis through the brace member.

11. A bridge for bracing and staying a plurality of joists comprising a resilient member having a substantially arcuate transverse section intermediate the ends thereof and extending in a longitudinally disposed preformed arch terminating at one end in a pair of spaced transversely arranged piercing teeth and terminating at the opposite end in a centrally arranged cutting toe disposed in a transverse plane, said spaced teeth operating as shiftable centers embedded alternately in the side of a joist about which the cutting toe is shiftable in the plane of said cutting toe in a radii with either of said spaced piercing points as a center, from either of two directions with said cutting toe entering the coacting surface of an adjacent joist with a shearing action from either of two directions.

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