Sept. 11, 1956 K. C. JENNE 2,762,091

WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

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Fig. 1.

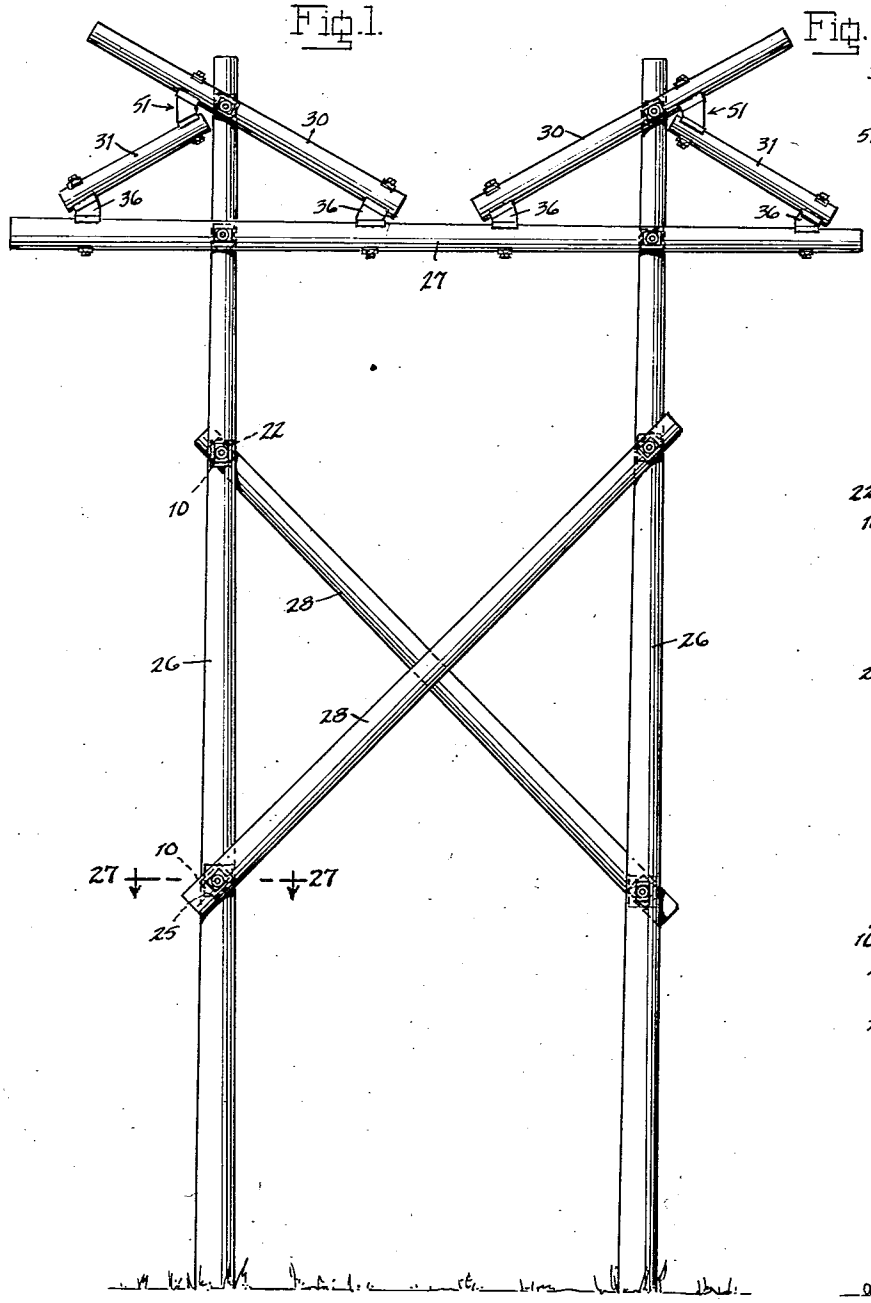
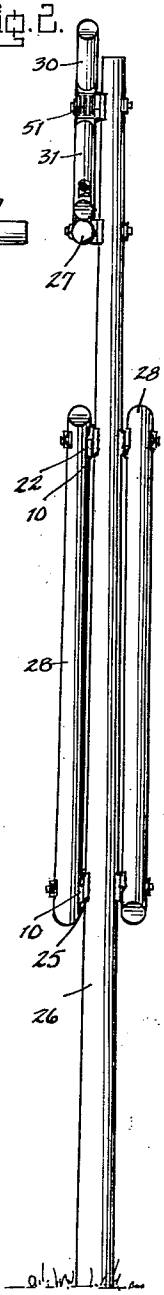


Fig. 2.



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WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

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Fig. 3.

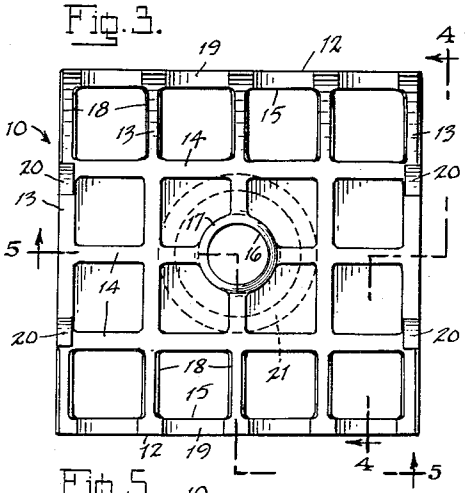


Fig. 4.

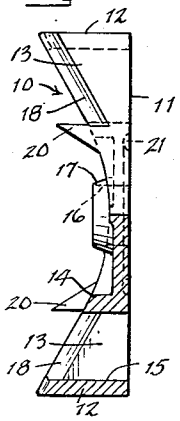


Fig. 8.

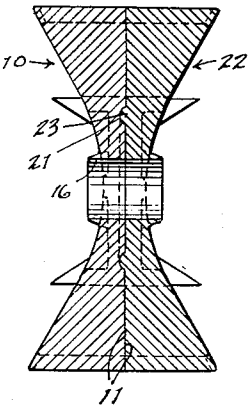


Fig. 5.

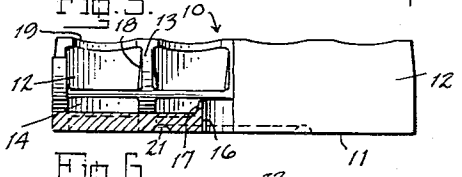


Fig. 9.

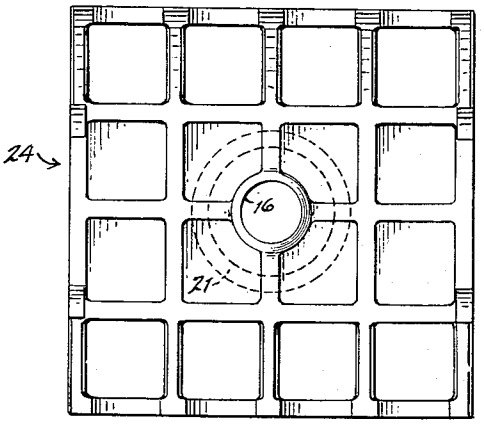


Fig. 6.

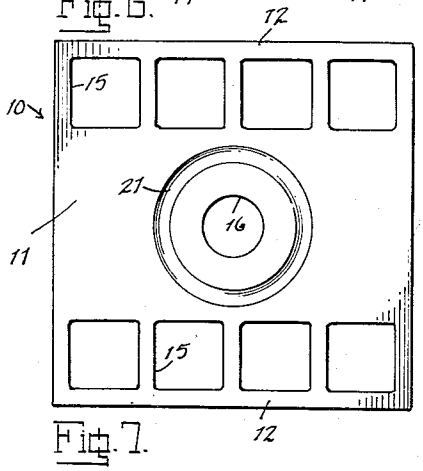


Fig. 7.

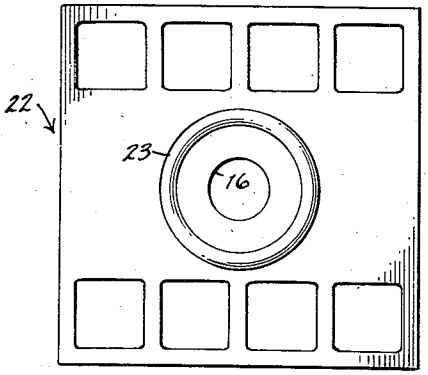


Fig. 10.

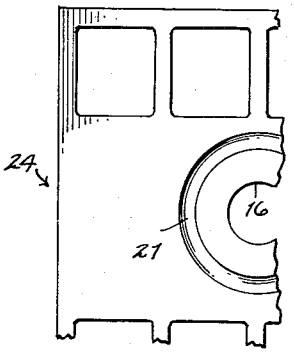
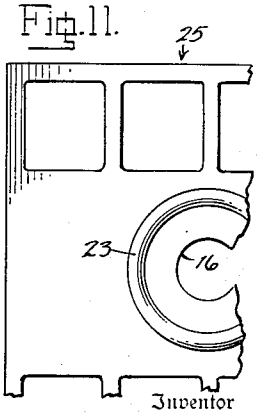


Fig. 11.



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WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

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Fig. 12.

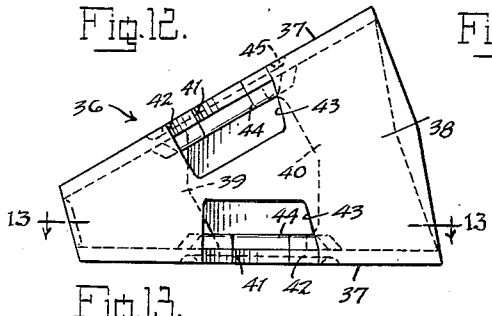


Fig. 14

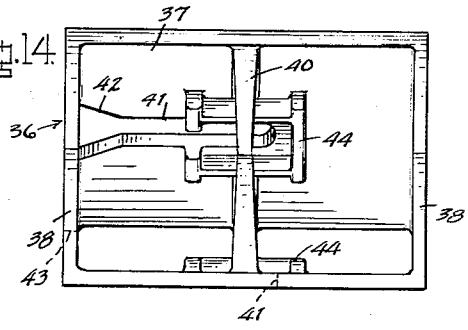


Fig. 13.

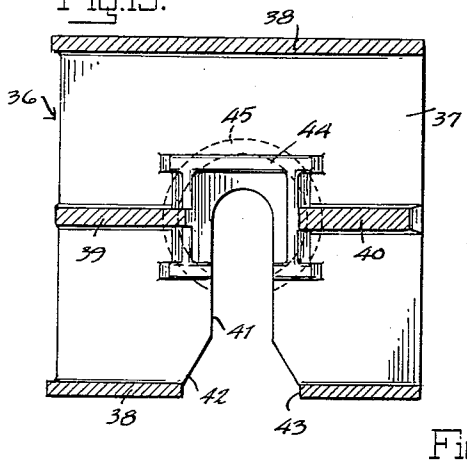


Fig. 15.

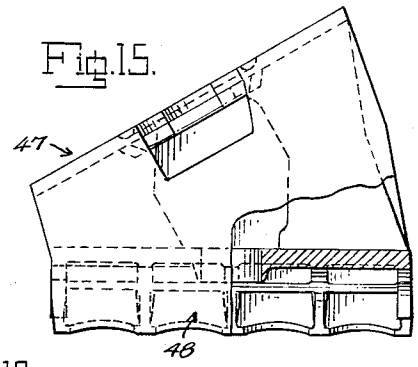


Fig. 16.

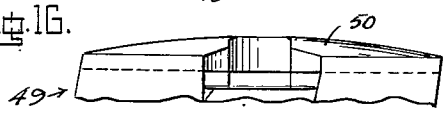


Fig. 17.

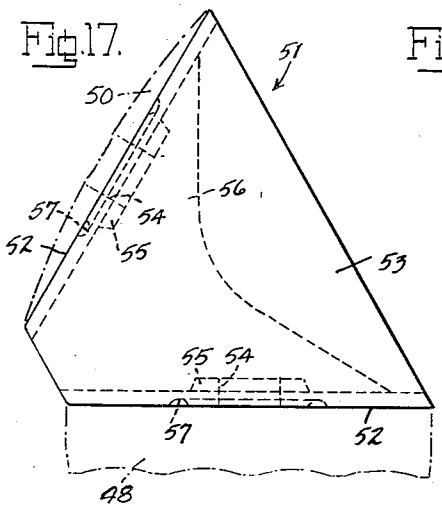
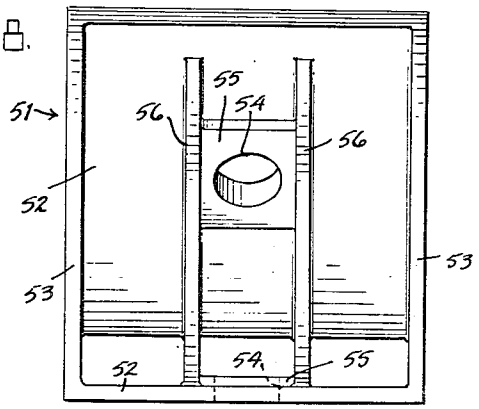


Fig. 18.



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WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

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Fig. 19.

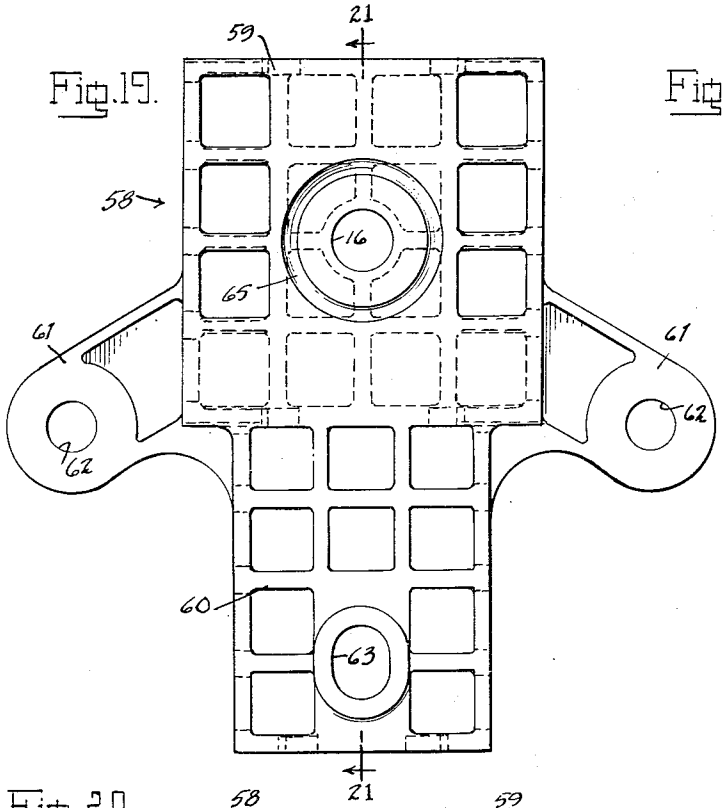


Fig. 21.

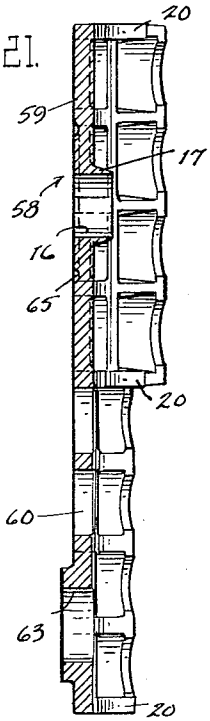


Fig. 20.

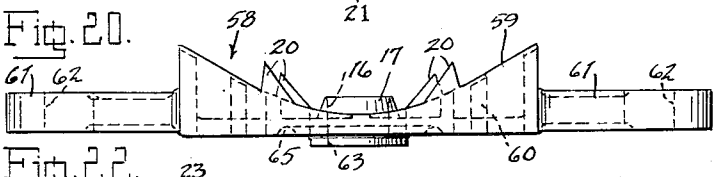


Fig. 22.

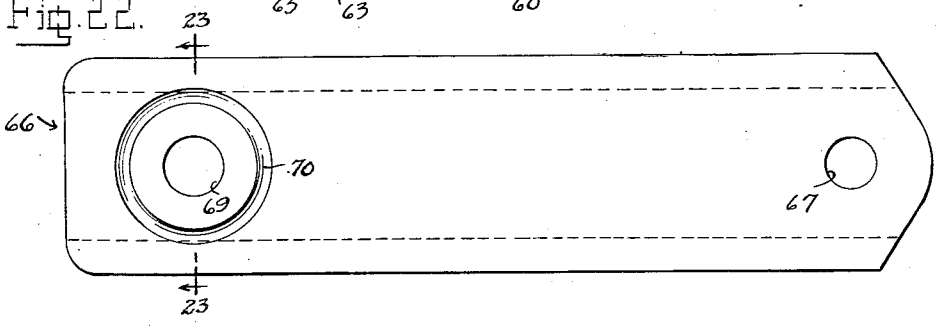
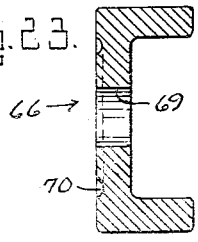


Fig. 23.



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Sept. 11, 1956 K. C. JENNE 2,762,091

WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

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Fig. 24

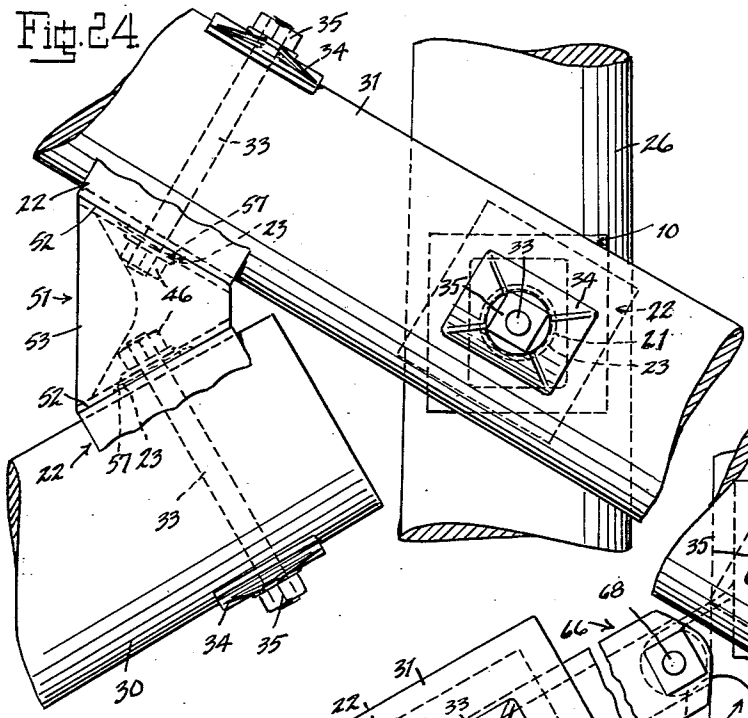


Fig. 25.

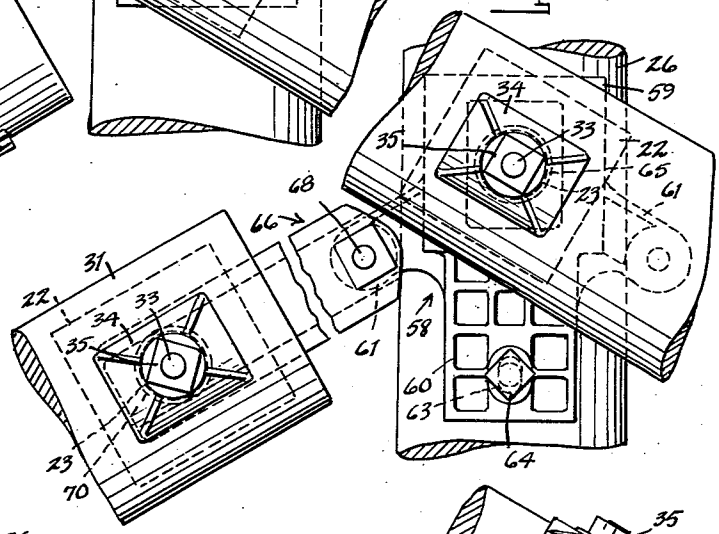


Fig. 27.

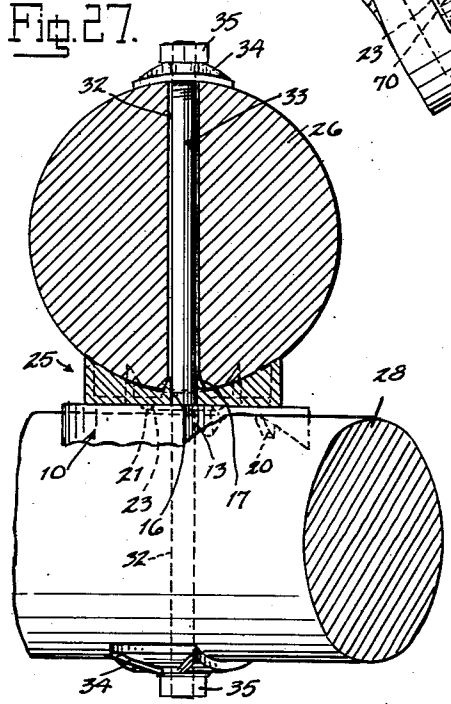
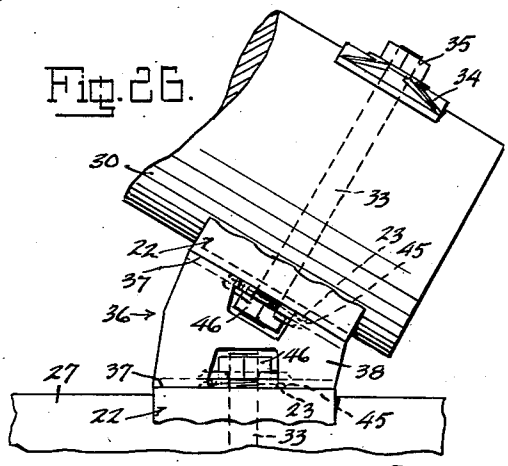


Fig. 26.



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Attorney

Sept. 11, 1956 K. C. JENNE 2,762,091

WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

Filed April 16, 1952 6 Sheets-Sheet 6

Fig. 28.

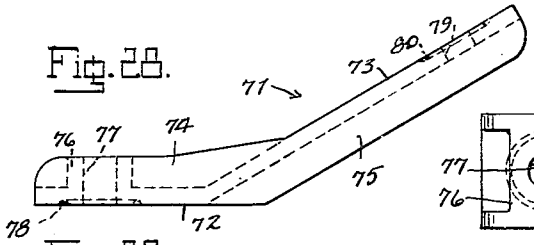


Fig. 29.

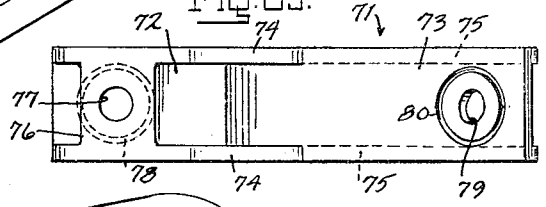


Fig. 30.

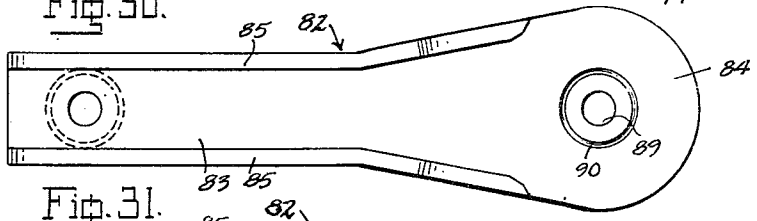


Fig. 31.

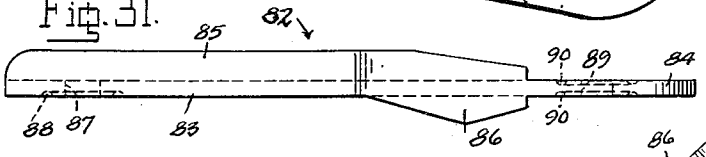
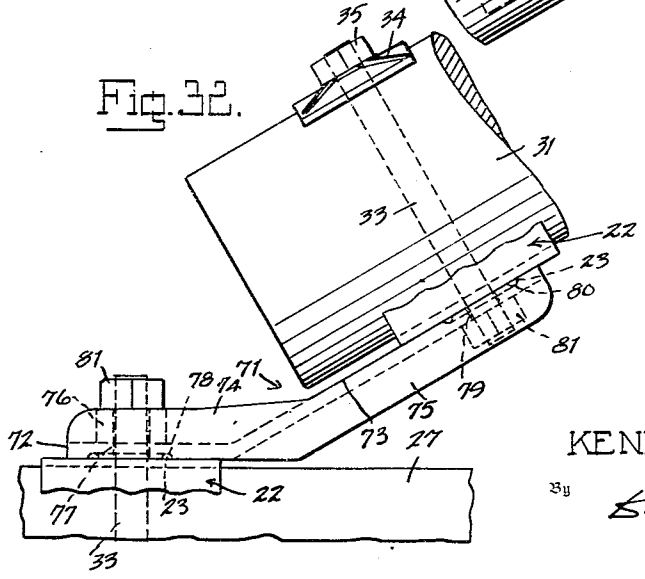


Fig. 33.

Fig. 32.



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United States Patent Office 2,762,091 Patented Sept. 11, 1956

2,762,091

WASHER GAIN FOR TIMBER STRUCTURES FORMED OF ROUND WOOD POLES

Kenneth C. Jenne, Branford, Conn., assignor to Malleable Iron Fittings Company, Branford, Conn., a corporation of Connecticut

Application April 16, 1952, Serial No. 282,618

3 Claims. (Cl. 20—92)

The present invention relates to washer gains and joint assemblies for timber structures formed of round wood poles, as distinguished from timber of rectangular cross-section. The use of round wood poles as structural members is not new, for docks, trestles, bridges, and other similar structures, have been constructed from them for years. Round poles have also been used as the cross-arms for H-frame structures, such as are used for carrying transmission lines, but this use has been limited because the methods of fastening the poles either to each other or to other structural members have not generally been such as to withstand the loads imposed on such structures over long periods.

While the present invention will find use in various timber structures, it is particularly suitable for H-frame, wish-bone frame, T-frame, and other similar line supporting structures, and the present disclosure will be particularly directed to this type of structure.

While transmission line supporting frames, to a great extent, have been constructed of steel, the desirability of wood for this purpose, and particularly round wood poles, has been realized with increasing interest within the past ten years or so. This interest results from a number of factors:

1. During that period, steel has been in very short supply on many occasions.

2. Modern chemical treatments have greatly extended the useful life of wood.

3. The initial cost of wood structures is considerably less than that of steel.

4. The maintenance of wood structures is considerably less than steel, for example, no painting is required.

5. Wood, having considerable insulating property, permits a reduction in the number of insulators used to support each conductor, thus resulting in considerable additional economy.

The basic problem in providing a fitting for connecting round poles is that a round pole is used in its natural tapered shape, rather than a manufactured shape, and therefore, being a product of nature, its peripheral characteristics vary widely, with the result that its actual and nominal diameter at any given point may differ by as much as fifty percent. In other words, a pole having a nominal diameter at a given point of ten inches may, in fact, be considerably out of round so that the actual circumferential surface shape at the point of connecting another pole thereto may be at substantial variance with a true ten inch diameter pole. Additional variables are present in the form of variations in fiber strength, grain structure, etc.

While considerable development has taken place in the provision of fixtures for finished timber of rectangular cross-section, there has been very little development of such fixtures for round timber, probably because of the problem of adapting such fixtures to the variables common to such round timber.

The general practise has been to fasten the round timbers together with one or more bolts, or with various

types of steel straps and bands, both of which methods are inefficient and costly. When two round timbers are bolted together, stresses are concentrated on the projected areas of the bolt holes causing a crushing of the fibers against the bolts and a deformation or bending of the bolt, and resulting in a combined shear, tension, and deformation action upon the bolt, which is aggravated as the fibers of the wood surrounding the bolt become increasingly broken and crushed.

While the inherent strength of the wood pole is great, the limitation in the past has been the inability of the fastening bolts or other connector means to provide sufficient strength to take advantage of the strength of the timber.

It is proposed in the present invention to provide an improved washer gain designed to accommodate itself to gripping engagement with a round surface of a pole of a diameter and convex form having a large range of variation from a nominal given diameter, such washer gain being, in effect, a transition piece which transmits the stresses imposed on the bolt over a large area of the round wood pole rather than through the projected area of the bolt hole alone. It is particularly proposed to provide means integral with the gain for transmitting such stresses over a large area in the form of cones, spurs and ribs.

It is a further object to provide an integral bolt hole engaging cone forming a bearing for the bolt, which cone is wedged into the end of the bolt hole so that the effective bearing area is increased while permitting of the use of a smaller diameter bolt. The economy in the smaller bolt is made possible by the fact that the cooperative gain transmits the load over a relatively large area of the pole thus eliminating the concentration of stresses which would otherwise be against the wood in line with the bolt hole. It is these stresses which tend to split the pole.

Another object is to provide a washer gain adapted to cooperate with a similar or companion washer gain in back-to-back relation so that the two gains may be engaged with crossing poles, and further to provide such companion gains capable of rotation upon each other so that they can be set at any desired angle, depending upon the crossing angle of the two poles.

It is further proposed to provide rotatable interlocking means upon the companion gains which, in addition to centering one upon the other for rotation, will minimize the shear stresses imposed on the bolt.

It is a further object to provide a washer gain for cooperation with other joint forming fittings designed to effect the butt jointing of the end of one pole to the side of another at various angles, certain of such fittings permitting any desired variation in the angle, while others are designed for specific angles such as thirty degree, sixty degree, etc. In every case, however, the cooperaitve washer gains are in such relation to such fittings that the load strain is distributed over large areas of the poles so that the tendency for the wood to split is minimized.

Other objects and advantages of the invention will become apparent from a consideration of the following detailed description taken in connection with the accompanying drawings wherein satisfactory embodiments of the invention are shown. However, it is to be understood that the invention is not limited to the details disclosed but includes all such variations and modifications as fall within the spirit of the invention and the scope of the appended claims.

In the drawings:

Fig. 1 is a front elevation of a typical H-frame structure incorporating the washer gains and certain joint assemblies of the invention;

Fig. 2 is a side elevation thereof;

Fig. 3 is a rear elevation showing the inner or hole engaging side of a washer gain according to the invention;

Fig. 4 is a view partially in side elevation and partially in vertical section, taken along the line 4—4 of Fig. 3;

Fig. 5 is a view partially in side elevation and partially in horizontal section, taken along the line 5—5 of Fig. 3;

Fig. 6 is a front elevation of the washer gain illustrated in Fig. 3 and having a circular groove provided therein;

Fig. 7 is a similar view of a washer gain constituting a companion piece to the gain as shown in Fig. 6, and having a circular rib for engaging the circular groove of the gain as shown in Fig. 6;

Fig. 8 is a vertical sectional view showing a pair of companion gains in engagement with each other;

Fig. 9 is a rear elevation, similar to Fig. 3, and showing a gain having a larger area and adapted to accommodate a range of larger diameter poles than the gain as shown in Fig. 3;

Fig. 10 is a fragmentary front elevation of the gain as shown in Fig. 9 and having a circular groove therein;

Fig. 11 is a similar view of a companion gain having a circular rib for engaging the circular groove of the gain as shown in Fig. 9;

Fig. 12 is a side elevation of a wedge shaped angle fitting for use in forming a butt connection at a 30° angle;

Fig. 13 is a horizontal sectional view taken along the line 13—13 of Fig. 12;

Fig. 14 is an end view of the angle fitting shown in Fig. 12, as seen from the right in Fig. 12;

Fig. 15 is a side elevation, partially in vertical section, of a modified form of fitting in which a member similar to that in Fig. 12 is provided upon one face with an integral washer gain structure;

Fig. 16 is a fragmentary side elevation of a modified form of angle fitting having a convex face;

Fig. 17 is a side elevation of an angle fitting for forming a butt connection at a 60° angle, the dot-and-dash lines showing modifications thereof consisting of providing an integral washer gain structure upon one face and a convex surface upon the other face;

Fig. 18 is an end elevation of the gain as seen from the right in Fig. 17;

Fig. 19 is a rear elevation of the pole engaging side of a modified washer gain, particularly intended for forming a connection between two crossing poles and a butt connection of another pole at any desired angle to the crossing poles;

Fig. 20 is a top end view of the gain as shown in Fig. 19;

Fig. 21 is a vertical sectional view taken along the line 21—21 of Fig. 19;

Fig. 22 is a front elevation of a link connector member for cooperative connection with the gain as seen in Fig. 19;

Fig. 23 is a vertical sectional view taken along the line 23—23 of Fig. 22;

Fig. 24 is a front elevation of a connected pole structure wherein an angular pole is crossed with and connected to a vertical pole and a second angular pole is butt connected to the first angular pole, the latter connection being effected by an angle fitting such as shown in Fig. 17;

Fig. 25 is a view similar to Fig. 24 in which the pole connections include a washer gain as shown in Fig. 19 in cooperation with a washer gain as shown in Fig. 7 and a link connector as shown in Fig. 22;

Fig. 26 is a side elevation of the butt connection of the end of one pole to the side of another pole, utilizing an angle fitting such as shown in Fig. 12;

Fig. 27 is a view partly in top plan and partly in horizontal section, taken along the line 27—27 of Fig. 1, and showing the cooperative use of a pair of gains of different sizes such as shown in Figs. 6 and 11;

Fig. 28 is a side elevation of a further modified form of connector fitting for effecting an angle connection of the butt end of one pole with the side of another;

Fig. 29 is a top plan view thereof;

Fig. 30 is a top plan view of a modified form of connector link for effecting the connection of a third pole to two crossing poles such as shown in Figs. 24 and 25;

Fig. 31 is a side view thereof;

Fig. 32 is a side elevation showing the connector fitting illustrated in Fig. 28 connected to two poles; and

Fig. 33 is a side elevation showing the link illustrated in Fig. 30 in its connecting relation with a third pole connected to two crossing poles.

Referring to the drawings, and more particularly to Figs. 3–6, the washer gain illustrated therein and indicated generally as 10 is dimensioned so as to accommodate a range of pole diameters of approximately 6"–10", it being understood that the invention contemplates both smaller and larger size gains to accommodate smaller and larger diameter ranges. In each case, however, certain features are of corresponding size and structure so that a gain of one size will cooperate with a gain of the same or of another size, or with certain fittings, as will hereinafter more fully appear.

The gain 10 is of substantially square outline and the particular gain illustrated has a dimension along its sides of approximately 5⅝", although it will be understood that this dimension may be varied under different circumstances and is cited simply to indicate the comparative size of the gain to the pole. The outer face 11 of the gain is flat while its inner face is concavely formed to substantially embrace the convex curved surface of a pole.

To this end, the gain is provided with longitudinal side walls 12—12 between which extend a series of spaced ribs 13, the end ribs of which constitute the end walls of the gain. The edges of these ribs are shaped by forming their intermediate portions on a radius corresponding to the radius of the smallest diameter pole to be engaged, for instance 3", and extending the end portions of the edges in straight lines tangential to the curved intermediate portion so that increasing diameter poles will contact these end portions between their ends and the curved intermediate portion.

A series of longitudinal ribs 14 extends across the ribs 13 to form a grid-like structure with the upper edges of the ribs 14 flush with the upper edges of the ribs 13. Adjacent the side walls 12, the spaces between the ribs are open, as at 15, for the purpose of reducing weight, while the intermediate spaces are solid for added strength. A central bolt-receiving hole 16 extends through the gain with its axis normal to the flat outer face 11 and at its inner side is carried through an annulus 17 having an outer conical surface which, as shown in Fig. 4, projects to a considerable extent from the convexly curved surfaces of the ribs 13. At each side of the holes 15, the ribs 13 are beveled, as at 18, so that the end portions of the ribs may dig into the wood structure of the pole with a wedging action, and between the ribs 13 the edges of the end walls 12 are recessed, as at 19, so as to allow for the better penetration of the ends of the ribs into the wood surface.

Upon each of the end ribs 13 constituting the end walls of the gain, there is provided a pair of spurs 20 which serve to dig into the wood pole at points substantially widely spaced, both longitudinally and laterally, from the central opening 16 and thus firmly fix the position of the gain upon the pole and resist turning of the gain upon the bolt. These spurs provide a positive anchoring of the gain upon the pole, but the stresses that are imposed upon the gain are not entirely concentrated upon the spurs but are distributed through the additional widely distributed digging engagement of the ribs with the pole.

The flat face of the gain 10 is provided in concentric relation with the hole 16 with a circular groove 21 for the purpose of providing a rotatable interlocking connec-

tion with a companion gain 22, illustrated in Fig. 7, which has a circular rib 23 formed upon its flat face for engagement with the groove 21. The gain 22 is otherwise identical with the gain 10. The grooves 21 and the ribs 23 also provide for rotary interlocking engagement with other fittings, as will hereinafter more fully appear.

As shown in Fig. 8, the rib 23 is engaged with the recess 21 so that the companion gains are centered and may be rotated relative to each other about the axis of the bolt engaged through the holes 16. Thus, the pole on which one gain is mounted may be disposed at any desired angle to the pole upon which the other gain is mounted. In addition to centralizing the gains for relative rotary movement, the rib and groove connection serves to distribute stresses to both the poles and to minimize shear stresses on the bolt.

In Figs. 9 and 10 there is shown a modified form of gain 24 of a larger size to accommodate a larger range of pole sizes. In this case, the radius of the intermediate curved edge portions of the ribs 13 is larger than the radius of the ribs of the gain 10, for instance 4" as compared to 3", and the side dimensions are correspondingly increased. However, the gain 24 is provided with a similar size bolt hole 16 and with the same size locking groove 21, so that it may be used as a companion gain with the smaller gain 22 shown in Fig. 7. Similarly, a gain 25, Fig. 11, corresponding in size to the gain 24 is provided with a rib 23 so that this gain may be used as a companion gain with either the gain 24, or the smaller gain 10 shown in Fig. 6.

The washer gains illustrated in Figs. 3–11 are employed as companion pairs in face-to-face relation in the connection of two poles in crossing relation with each other, the particular size of the gains for the respective poles being determined by the approximate diameters or by the actual peripheral curvature of the particular part of the pole where the connection is to be made. A typical application of the gains is shown in Figs. 1 and 2, illustrating an H-frame for transmission lines. Such frames are of substantial size being, for instance, 60' from the ground to the top and 40' in width, and the poles employed may range in diameters from approximately 15" to 6".

In practise, the frame is assembled flat on the ground and then erected into its vertical position. The frame illustrated comprises two upright poles 26—26 supporting a horizontal spar pole 27 and having a pair of crossed brace poles 28—28 connected between them at suitable points between the ground and the spar pole. The spar pole, which projects at each end, normally supports the weight of insulators and the transmission lines, and is, therefore, suitably trussed against bending strains by truss poles 30—30 and 31—31.

In this illustration, the points where the various poles cross each other are connected in a similar manner through bolts and companion pairs of washer gains. The arrangement permits the connected poles to be disposed at any desired angle to each other or, if occasion demands, in parallel relation.

A typical connection is shown in Fig. 27, wherein the part of the upright pole 26 at which the connection is made, is of relatively large diameter and has a large size gain 25, such as illustrated in Fig. 11, engaged therewith, while the bracing pole 28, being of smaller diameter, has the smaller size gain 10 as illustrated in Fig. 6 engaged therewith, these gains being selected so that one has a rib 23 and the other has an interlocking groove 21.

Prior to assembly of the gains, the poles are provided with diametric bolt-receiving holes 32 which are of a size to loosely receive the through bolt 33. The face-to-face gains are placed upon the respective poles with the cone projection 17 of each gain wedgingly fitted into the respective bolt hole and thereupon the bolt 33 is engaged through the two poles and has fitted upon its threaded ends curved washers 34—34, which are retained thereon by nuts 35.

Upon tightening the nuts, the gains are drawn tightly into engagement with the surfaces of the poles causing the spurs to become embedded therein and the rib surfaces of the gains to either firmly press against the surface of the pole or to become embedded therein, depending upon the particular curvature of the pole surface. It should be pointed out in this respect that due to the natural shape of the pole, the curvature may vary at either side of the bolt hole, and due to the natural longitudinal taper of the pole, the diameter at one end of the gain may be slightly less than at the other end of the gain. The widely distributed digging-in points of the spurs and ribs of the gain insure a positive interlocking engagement with the pole at sufficiently widely spaced points as to provide maximum resistance to turning and slippage, as well as to provide for the transmission of load stresses over a wide area of the pole.

It will be noted that the cone projection or annulus 17 is, in effect, a bearing thimble engaged in the end of the bolt receiving hole, and has the advantageous effect of a large diameter bolt, thus increasing the effective diameter of the bolt at the point of shear represented by the interface between the gain and the pole. It also supports the bolt directly upon the gain rather than against the surface of the hole, so that various forces applied to the bolt, which would otherwise tend to crush the wood fibers and to split the pole, as well as to bend the bolt, will be transmitted through the gain to a large area of the pole. It is further pointed out that any tendency to split the pole is minimized by the fact that the body of the gain at each side of the annulus is in the shape of a wedge formation for disposition between the surface of the pole and a load engaged with the bearing face of the gain and connected to the pole by the bolt extending through the annulus and the pole.

It will also be noted that the stresses on both the poles are so directed that the tendency to split or otherwise deteriorate the pole is minimized.

In the case of forming a butt connection of one pole with the side of another pole, several types of fittings may be employed in cooperation with the washer gain. In the usual frame structure, the butt connections are at a definite angle, as, for instance 30° and 60°, and for this type of installation, it is preferred to provide a cooperative fitting having a predetermined angle for use with the specific angle of the butt connection.

In Figs. 12–14 there is illustrated a 30° angle fitting, indicated generally as 36, which comprises flat face walls 37—37, disposed at a 30° angle to each other and connected by side walls 38—38, the face walls being braced intermediate their ends by connecting web portions 39 and 40. The member 36 is symmetrical at each face side, and each face wall is provided with a slot 41 extending inwardly from one side edge to the center, the outer end of the slot being flared outwardly, as at 42, and the side wall 38 having an opening 43 of sufficient size to enable a nut carried upon a bolt to be laterally moved into the slot from one side. In surrounding relation to the inner end of the slot, the inner side of the face wall is provided with a rectangular rib formation 44 which serves to receive the nut and hold it against turning, it being pointed out that the nut is backed off the thread of the bolt sufficiently to clear the rib formation as it is laterally moved into place, and thereupon it is drawn into the rib formation by pulling outwardly upon or tightening the bolt.

This arrangement enables an angle fitting to be assembled between a pair of poles after the bolts and washer gains have been connected thereto simply by sliding the angle fitting sideways in between the poles. This fitting is employed in the illustration shown in Figs. 1 and 2, for connecting the lower ends of the truss poles 30 and 31 to the spar pole 27. The connection is illustrated in detail in Fig. 26, wherein it will be seen that the

spar pole 27 has a gain 22 connected thereto by a through bolt 33, and similarly the truss pole 30 has a gain 22 secured thereto by a bolt 33, each of the bolts being provided at its outer end with a curved washer 34 and a securing nut 35, and having secured upon its inner end a nut 46 disposed within the angle fitting.

Each of the face walls 37 is provided with a circular groove 45 in concentric relation to the inner end of the slot 41 and interlockingly receiving the rib 23 of a cooperating washer gain. For convenience in manufacture, grooves are provided in the angle fitting, so that for cooperative engagement therewith, either a grooved gain 10 or 24, such as shown in Figs. 6 and 10, may be engaged therewith, in which case there will be no rotary interlocking, or a ribbed gain 22 or 25, such as shown in Figs. 7 and 11, may be interlockingly engaged therewith.

In Fig. 15 there is illustrated a modified form of angle fitting, generally indicated at 47, and which consists in providing one face of an angle fitting with an integral washer gain structure 48 substantially similar to the washer gain 10 shown in Figs. 3–6. The angle fitting is otherwise similar to the fitting 36 shown in Fig. 12.

In Fig. 16 there is illustrated a further modification in which one face of the angle fitting, indicated generally at 49, and which is otherwise similar to either the angle fitting 36 illustrated in Fig. 12, or the fitting 47 illustrated in Fig. 15, is provided with a convexly formed face 50. This type of fitting may be used in cases where a pole has such a bend or twist that its ends are misaligned, so that while one end may be connected at a definite angle, the other end is at an indeterminate angle. The convex surface 50, therefore, allows the flat face of the gain secured upon the truss pole to rock in any direction upon the spherical convex surface to find its proper position.

As shown in Fig. 1, the butt connection of the truss pole 31 with the side of the truss pole 30 is at a 60° angle, and an angle fitting, as illustrated in Figs. 17 and 18, is employed at this point, its connection with the poles being illustrated in detail in Fig. 24. This angle fitting, generally indicated as 51, comprises face walls 52—52 disposed at an angle of 60° to each other, and side walls 53—53 extending between them. Each of the face walls is provided with a bolt receiving hole 54 and a bearing portion 55 at the inner side. A pair of bracing ribs 56—56 extends between the intermediate portions of the face walls and are so spaced as to provide retainers for preventing the turning of the nuts engaged upon the bolts inserted through the holes 54 and bearing upon the bearing portions 55. It will be noted in this angle fitting that the extended axial line of the bolt hole 54 of one face wall will clear the end of the other face wall, so that it is possible to engage the bolt straight through the holes from either side.

Each of the face walls 52 is provided with a circular groove 57 concentric to the hole 54 for interlocking engagement of the circular ribs of the washer gains. As shown in Fig. 24, the angle fitting 51 is connected between the poles 30 and 31 in a substantially similar manner to the securing of the fitting 36 as shown in Fig. 26, each of the poles being provided with washer gains 22, and the poles and gains being connected to the angle fitting by bolts 33 provided upon their outer ends with curved washers 34 and nuts 35 and upon their inner ends with nuts 46 disposed against the inner sides of the face walls of the angle fitting.

In Figs. 19–23 there is illustrated a modified form of washer gain having a connecting link member for cooperation therewith, particularly intended for connecting the butt end of one pole to two crossing poles in substantially the same arrangement as shown in Fig. 24. The washer gain, indicated generally at 58, consists of an upper part 59, generally similar to the washer gain 10 as illustrated in Figs. 3–6, a lower integrally formed part 60 of grid formation and somewhat narrower than the upper part 59, and angularly extending side arms 61—61 each having a bolt receiving bearing end provided with a bolt hole 62. The inner side of the lower portion 60 is curved in conformity to the curvature of the inner side of the upper portion 59 and constitutes, in effect, an extension thereof having ribs, recessed edges and spurs substantially corresponding in structure and arrangement to the corresponding parts of the upper part 59.

Because this fitting is intended to take heavy side strain along either one of the arms 61, the downward extension 60 provides auxiliary holding means against relative turning upon the pole, and, additionally, this extension is provided with a bolt hole 63 in which a bolt 64 is engaged as shown in Fig. 25. The upper part 59 is provided with a circular groove 65 for cooperative engagement of the circular rib 23 of either of the washer gains 22 or 25 used for effecting the connection of the truss pole 30 to the upright pole 26.

The connection of the butt end of the pole 31 is made by means of a channel form connector link 66, shown in Figs. 22 and 23, provided at one end with a bolt hole 67 for connection with the arm 61 by means of a bolt 68 as shown in Fig. 25, and provided at its other end with a bolt hole 69 for connection with the through bolt 33 connecting the washer gain 22 to the truss pole 31. The link is provided in concentric relation to the hole 69 with a circular groove 70 for interlocking engagement by the circular rib 23 of the washer gain 22. By providing the arms 61 at each side of the gain 58, a connection may be made at either or both sides, as desired.

In Figs. 28, 29 and 32 there is illustrated a modified form of link for effecting the connection and angular relation of the butt end of a truss pole with the side of a spar pole or other similarly arranged pole. This connection comprises a link 71 having a horizontal arm part 72 and an angular arm part 73 disposed at a desired angle to the part 72, as for instance 30°. Both arms are of channel form for reinforcement, the arm 72 having the channel forming side walls 74 at its upper side and the arm 73 having the channel forming walls 75 at its lower side.

The arm 72 is provided between the walls 74 with a thickened bearing portion 76 having a bolt receiving hole 77 therethrough and, in concentric relation to this hole, the underside of the arm 72 is provided with a circular groove 78 for interlocking engagement of the circular rib 23 of the washer gain 22 or 25, as shown in Figs. 7 and 11. The arm 73 is provided near its outer end with a bolt receiving hole 79 and at its upper side, and in concentric relation to the hole 79, there is provided a circular groove 80 for receiving the circular rib 23 of a washer gain.

As shown in Fig. 32, the spar pole 27 and the truss pole 31 are provided with washer gains 22 secured thereto by bolts 33 engaged through holes 32 and having curved washers 34 and nuts 35 upon their outer ends. The inner ends of the bolts are respectively engaged in the bolt holes 77 and 79 of the link and the assembly is secured by nuts 81—81 engaged upon the inner ends of the bolts and bearing respectively upon the bearing portion 76 and upon the underside of the arm 73.

In Figs. 30, 31 and 33 there is illustrated a modified form of link for connecting the butt end of a truss pole or the like in angular relation to a pair of crossed poles, for instance one of the vertical poles 26 of the H-frame and one of the truss poles 30. This connection consists of a link 82 having a parallel sided arm portion 83 and a widened plate portion 84 extending from one end of the arm 83. The link is of generally channel form for reinforcement, being provided with side walls 85 extending along the sides of the arm 83 and partially along the sides of the plate portion 84. Additional reinforce-

ment ribs 86 are provided partially along the side edges of the plate portion 84 at the opposite side from the walls 85.

The arm 83 is provided near its outer end with a bolt receiving hole 87, and in concentric relation to this hole there is provided on the forward surface a circular groove 88 for receiving the rib 23 of a washer gain. The plate portion 84 is of generally circular outline and is provided centrally with a bolt receiving hole 89, and in each of its flat surfaces there is provided, in concentric relation to the hole, a circular groove 90 for receiving the rib of a washer gain.

As shown in Fig. 33, the poles 26 and 30 are connected by a through bolt 33 having washers 34 and nuts 35 engaged upon its ends, washer gains 22 being respectively provided upon the opposed sides of the poles. Instead of being in face-to-face contact with each other, however, these gains have the plate ends 84 of the link member 82 disposed between them, the bolt 33 extending through the bolt hole 89 thereof and the ribs 23 of the gains engaging the grooves 90. Thus, the link extends from the connection of the poles 26 and 30 and may be disposed at any desired angle, depending upon the angularity of the truss pole 31. This truss pole is provided with a washer gain 22 connected thereto by a through bolt 33 having a curved washer 34 and a nut 35 engaged upon its outer end, the inner end of the bolt being engaged through the bolt hole 87 and secured by a nut 91 screwed upon its end and bearing upon the rearward side of the arm 83.

What is claimed is:

1. A washer gain for disposition between a round wood pole and a load supported by said pole, comprising a body having a forward side including a load engaging forward bearing face of rectangular outline, said forward side having transverse end edges for disposition transverse to the pole axis and substantially parallel side edges for disposition substantially parallel to the pole axis, a rearward side including a pole conforming and engaging substantially cylindrical curved concave rearward surface, having its axis of curvature parallel to the plane of said bearing face and coincident to the central vertical plane perpendicular to said bearing face and midway between said side edges of said forward side, said rearward side having transverse end edges for disposition transverse to the pole axis and substantially parallel side edges for disposition substantially parallel to the pole axis, end walls extending between the respective end edges of said forward and rearward sides, and side walls extending between the respective side edges of said forward and rearward sides, and means to effect an increase in the effective diameter of the bolt at the point of shear represented by the interface between the gain and the pole comprising an annulus disposed substantially centrally between said side edges of said rearward side and projecting rearwardly therefrom and having an outer peripheral wall in the form of a truncated cone, said body having a bolt receiving cylindrical passage having its axis coincident to said central plane and perpendicular to said bearing face and extending therefrom coaxially through said annulus, the junction of the cylindrical wall of said passage with the rearward end of said peripheral wall of said annulus forming a relatively sharp circular edge for wedging engagement of said annulus in a bolt hole of said pole coaxial with and of substantially the diameter of said bolt receiving passage, said forward and rearward sides and said end and side walls defining at each side of said central vertical plane wedge formations for disposition between the round surface of a pole engaged by said concave rearward surface and a load engaged with said bearing face and connected to said pole by a bolt engaged through said respective bolt holes of said body and said pole.

2. A washer gain according to claim 1, further characterized by pairs of pole engaging spurs projecting rearwardly from said rearward side, one pair being disposed adjacent each of said transverse end edges of said rearward side, and the spurs of each pair being transversely spaced at each side of said central vertical plane.

3. A washer gain according to claim 1, further characterized by a pair of link attaching arms respectively extending outwardly from each of said side walls.

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