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Dec. 25, 1928.

1,696,569

H. O. HILL

TRANSMISSION TOWER

Filed Dec. 22, 1926

2 Sheets-Sheet 1

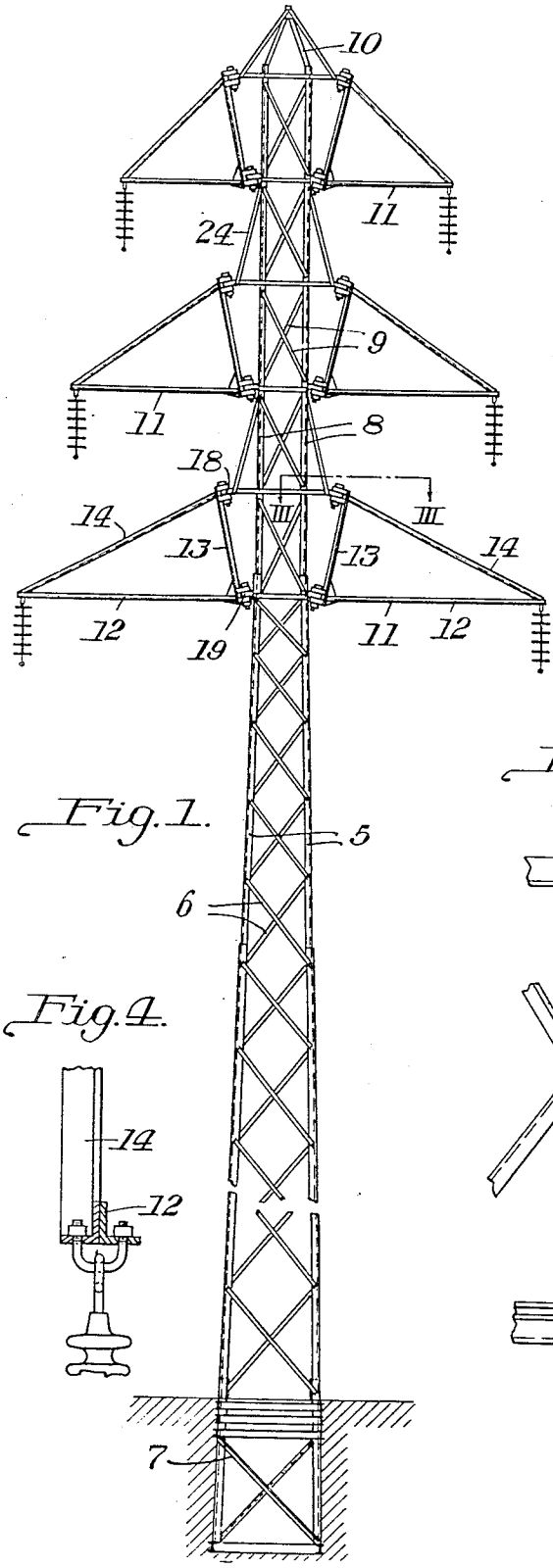


Fig. 1.

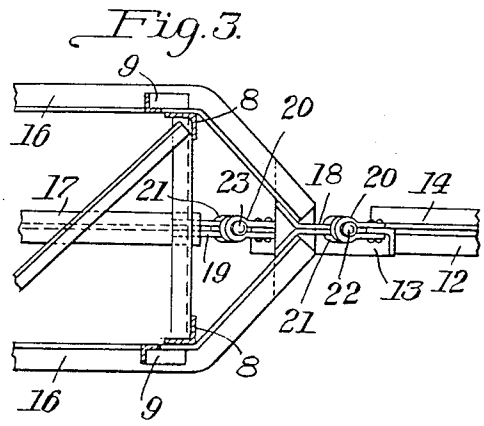


Fig. 3.

Fig. 4.

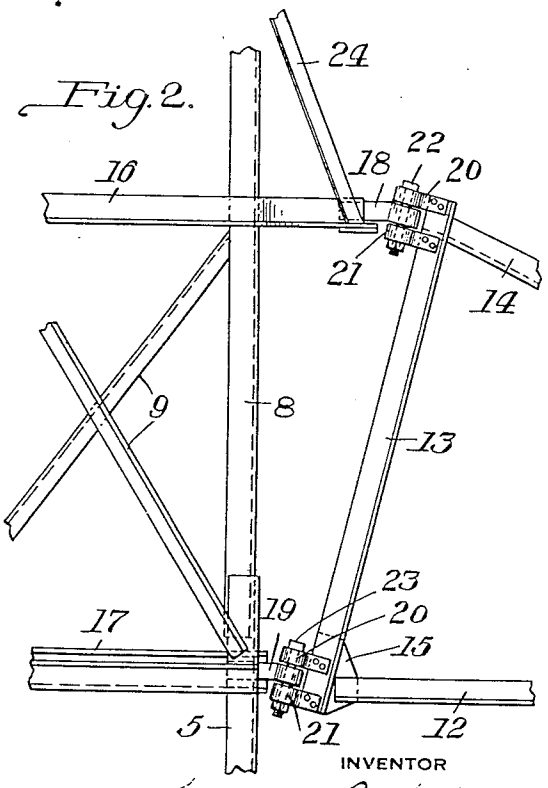


Fig. 2.

INVENTOR

Harold O. Hill

by W. G. Doolittle

Attorney

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Fig. 5.

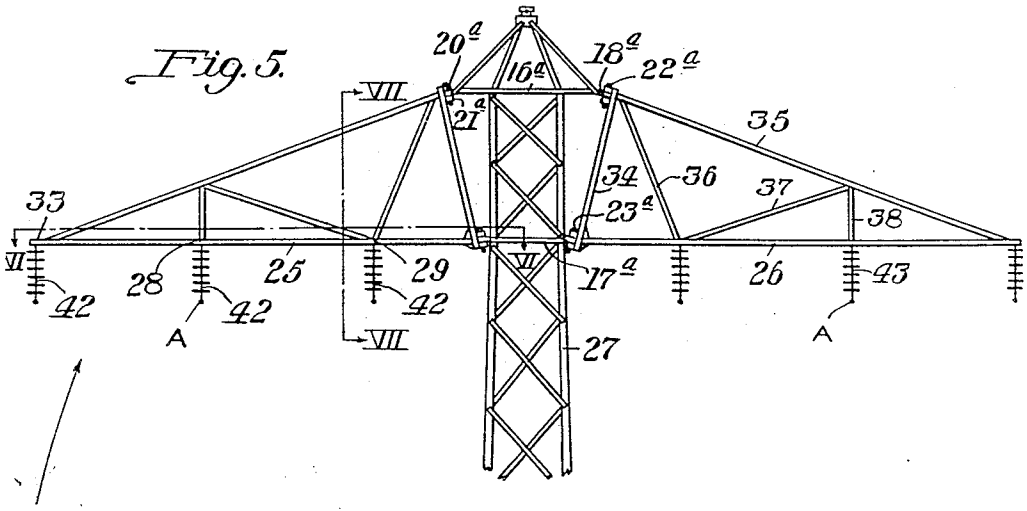


Fig. 6.

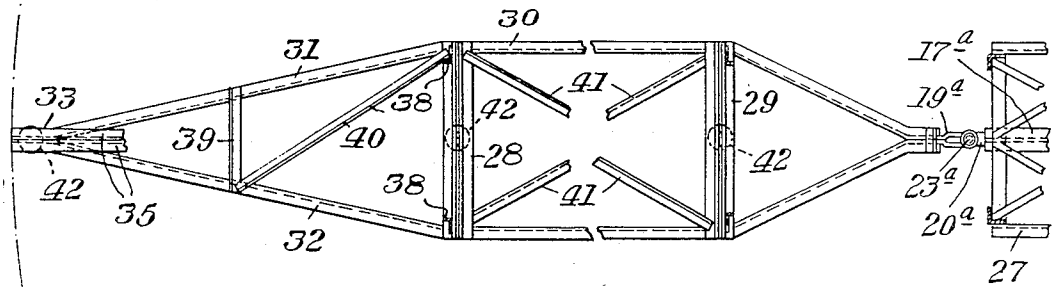


Fig. 7.

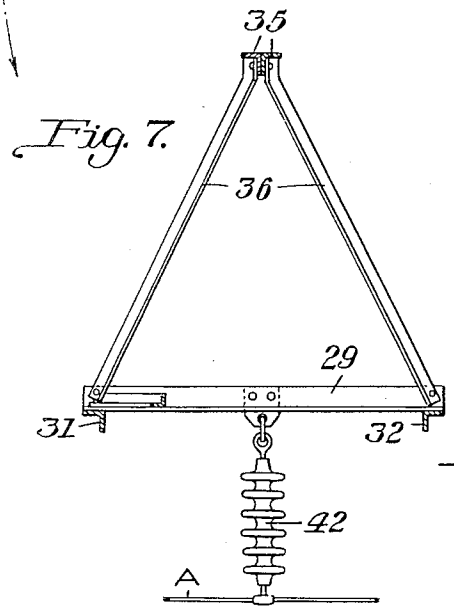
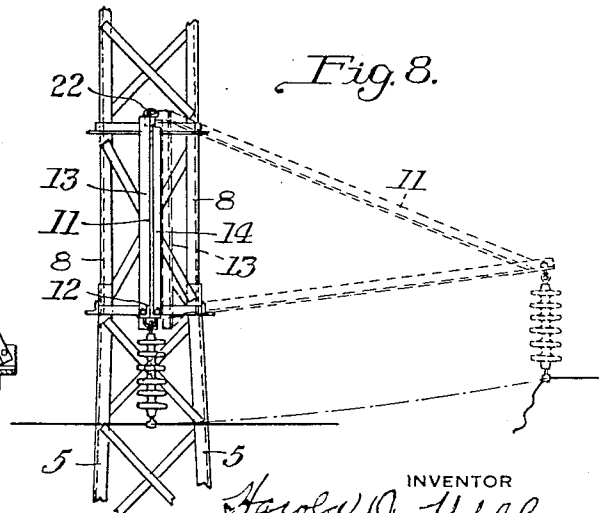


Fig. 8.



INVENTOR

Harold O. Hill

by W. F. Doolittle

Attorney.

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Patented Dec. 25, 1928. 1,696,569

UNITED STATES PATENT OFFICE.

HAROLD O HILL, OF ASPINWALL, PENNSYLVANIA, ASSIGNOR TO RITER-CONLEY MANUFACTURING COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

TRANSMISSION TOWER.

Application filed December 22, 1926. Serial No. 156,422.

This invention relates to improvements in steel transmission towers employed for supporting electric conducting wires or cables, and it relates more particularly to that class of towers having cross-arms from which suspended insulator strings for supporting the conductors are hung.

Transmission towers especially employed for supporting electric power conductors are subjected to vertical downward and horizontal loads. The vertical downward loads arise from the weight of the conductors, insulators, and the dead weight of the metal in the tower. The vertical loading, however, may be taken care of without a great deal of trouble.

The horizontal loading to which these towers are subjected presents a more difficult problem. Horizontal loading at right angles to the direction of the line is due to wind acting on the conductors and the towers, and changes in the direction of the conductors.

Another, and the most serious, horizontal loading trouble met with arises in the horizontal longitudinal loading in the direction of the line caused by broken conductors. The breaking of a conductor or conductors causes severe unbalanced conditions, and when this last mentioned longitudinal loading is applied to a transmission tower of the usual type having cross-arms extending outwardly several feet from the body of the tower, the structure is subjected to heavy shear and torsional stresses, requiring that the tower construction, in order to meet the conditions, shall be very heavy and have considerable internal bracing, as well as large and costly footings or anchors.

Among the objects of the present invention are, to provide a new and improved tower construction embodying means for eliminating or reducing to a minimum the severe shear and torsional stresses to which towers of the character of my invention are subjected, due to the horizontal longitudinal loadings caused by broken conductor wires or cables; to provide means to take care of unbalanced loading due to sleet and shock loading arising from broken wires and sleet falling from the wires; to minimize vibrations in conductors, and thereby prevent the crystallization of the conductors adjacent to their fixed supports; to provide a construction permitting the use of long spans of wire, whereby the number of towers and insulators may be greatly reduced.

Still further objects of my invention are, the provision of a tower construction that will reduce the amount of steel required over the usual type of towers, both in the tower proper and the tower foundations, and a tower construction in which all of the conductors may be located in a single horizontal plane, as well as one permitting the employment of cross-arms of different length arranged in different planes, with the conductors offset one with another.

In the accompanying drawings:

Fig. 1 is an elevational view of a tower structure embodying my invention;

Fig. 2, an enlarged detail view in side elevation, particularly showing a construction for movably connecting a cross-arm to the upper portion of the tower structure;

Fig. 3, a detail part sectional and a part plan view taken on line III—III of Fig. 1;

Fig. 4, a detail end view of an arm and a portion of an insulator secured thereto;

Fig. 5, an elevational view of a modified form;

Fig. 6, a sectional plan view taken on line VI—VI of Fig. 5;

Fig. 7, a sectional view of the arm of the form of Fig. 5, taken on line VII—VII of Fig. 5; and

Fig. 8, a view looking towards the tower from the right of Fig. 1, showing the position of a cross-arm when swung inwardly toward the tower and slightly upwardly when an unbalanced longitudinal loading has occurred.

Referring to the drawings, and first to the form of Fig. 1, the tower structure, as illustrated, includes four vertically extending corner posts 5 and the cross diagonals 6 extending across the four faces of the tower and connected with the corner posts. The lower ends of the corner posts 5 are anchored to a steel grillage unit 7 of the pole type base or anchor structure. Secured to the upper ends of the four corner posts 5, to form an upper square tower portion, are four angle members 8, the latter being connected by cross diagonals 9 entering into the construction of the upper tower portion. 10 designates oblique members extending up-

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wardly and inwardly from the upper ends of the members 8, and constitute means for carrying a ground wire, not shown, and braces for the upper cross-arm.

The cross-arms of the tower, of the form of Fig. 1, are designated generally by the numeral 11, and each includes a horizontally disposed transversely extending member 12, an inclined vertically extending member 13, and an inclined member 14, the latter joining the outer end of member 12 to the upper end of member 13. Member 13 is also connected with member 12 by a gusset plate 15.

Cross-arms 11 are each revolubly connected with the upper portion of the tower and are adapted to rotate in the direction of the transmission line when subjected to unbalanced longitudinal loading, due to various causes.

The revoluble cross-arms may be supported from the tower by any suitable means. As illustrated, I employ two upper cross-members 16 extending across two faces of the upper tower portion and projecting therefrom for a short distance and a single cross-member 17. Respectively carried by each of the supporting members 16 and 17 are hinge or pivot members 18 and 19, and 20 and 21 designate hinge members secured to the upper and lower ends of the inclined members 13 of the cross-arms. Pivot bolts 22 and 23 connect the upper and lower hinge members, see Fig. 2. 24 is a brace member for the supporting members 16.

By means of the construction just described, it will be noted that the axis of rotation of the revoluble cross-arms is in an inclined plane and transverse to the line. This manner of mounting the cross-arms makes them hang perpendicularly outwardly from the vertical axis of the tower and will greatly aid in stringing the conductors, because the cross-arms will normally hang in their correct positions. Inclining the axis of rotation of the cross-arms serves an additional and important function, namely, preventing the cross-arms from being too easily rotated. This is due to the fact that, when rotation or a partial rotation occurs, the outer end of the cross-arm will move upwardly, as indicated in the dotted position of Fig. 8, and against the weight of the conductors and insulators.

My invention contemplates the employment of revoluble cross-arms of different lengths. This is desirable under some conditions, especially where the transmission line is frequently subjected to sleet conditions. This offset arrangement is also of value to prevent contact of conductors when an upper conductor becomes broken and falls past a lower conductor.

Vibrations set up in conductors of transmission lines, and especially in conductors which have long spans between the supports, have heretofore caused considerable trouble, these vibrations causing the conductors to become crystallized adjacent to their fixed supports. The revoluble cross-arms of my invention will not only lessen the vibrations, but will greatly reduce the tendency of the conductors to crystallize at their supports, because, under my invention, the supports move with the vibrations. This will, therefore, permit the use of long spans, with a minimum number of towers and insulators, thereby effecting a great economy in the construction and maintenance of transmission lines.

In the form of my invention illustrated by Fig. 5, I have shown an embodiment in which the conductors are disposed in a single horizontal plane. In this form of my invention, I preferably employ two revoluble cross-arms 25 and 26 arranged to project from two opposite faces of the tower structure 27. Each of the said arms is made of structural elements consisting preferably of angles cut to the desired length and include insulator supporting members 28 and 29 extending across the expanded portion 30 of the arm, oblique members 31 and 32 extending outwardly from member 28 and meeting at 33, an inclined vertically extending member 34; and an inclined member 35 leading from the upper end of member 34 to the outer ends of members 31 and 32. In addition to these members, the arms include suitable brace members 36, 37, 38, 39, 40, and 41. Insulator strings 42 and 43 carrying conductors A are suspended from members 28 and 29 and from the point 33.

The revoluble cross-arms 25 and 26 are supported from the tower structure in substantially the same manner as the cross-arms of the form of Fig. 1; that is to say, by two cross-members 16^a and a single cross-member 17^a, together with the hinge connection, including members 18^a, 19^a, 20^a, 21^a and pivot bolts 22^a and 23^a.

In both illustrated forms of my invention, I have shown movable or revoluble conductor supporting means designed to be moved in the direction of the line, when subjected to unbalanced longitudinal loading. This movement, it will be understood, will so greatly reduce the conductor tension and the moment arm of the revolving force, as to practically eliminate the torque stresses heretofore received by the cross-arms and the tower proper.

It is well known that a slight increase in the length of a wire cable, or conductor, between two supports will greatly reduce the tension thereon. In my invention, a movement of a cross-arm or conductor supporting means in the direction of the line, as described, will serve to increase the length of the conductor in the span affected, and immediately reduce the tension on the con-

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ductor in that span, which amounts to a corresponding reduction in the parallel line loading on the tower. Further, it will be noted that the movement of the cross-arm will bring the point of attachment of the conductor to the tower closer to the center axis of the tower, and thereby reduce the torque stresses in the tower, both by the reduction in the line tension and the reduction in the eccentricity of the point of attachment from the center axis of the tower.

It will, of course, be understood that in the event a single wire or cable only is broken in the form of Fig. 5, the movement of the cross-arm, which also carries other wires towards the tower, will not be as great as the movement of the arm of the form of Fig. 1. In other words, the cross-arm will move and reduce the tension in the remaining conductors on one side of the cross-arm and increase the tension in the remaining conductors on the other side, until equilibrium is re-established.

The movement of the cross-arm of the form of Fig. 1 is particularly illustrated by Fig 8. In this view, the full lines show the arm in its normal position and the dotted lines show the position of the arm when it is swung inwardly towards the tower when a break occurs.

What I claim is:

1. A transmission tower having a revoluble cross-arm pivotally mounted on the tower for movement in the direction of the line when subjected to unbalanced longitudinal loading, said cross-arm having its axis of rotation inclined with respect to the vertical axis of the tower.

2. A transmission tower having a revoluble cross-arm, adapted to move to a position perpendicular to the line when unloaded and to swing in the direction of the line and upwardly when subjected to an unbalanced longitudinal loading.

3. A transmission tower having a revoluble cross-arm mounted on the tower and having its axis of rotation inclined with respect to the vertical axis of the tower.

4. A transmission tower having a revoluble conductor supporting portion mounted on the tower for movement in the direction of the line and having its axis of rotation inclined with respect to the vertical axis of the tower to reduce the eccentricity of the conductor loading from the center axis of the tower when subjected to unbalanced longitudinal loading.

5. A transmission tower having a revoluble conductor supporting member having its axis of rotation inclined with respect to the vertical axis of the tower and pivotally mounted thereon for movement in the direction of the line when subjected to unbalanced longitudinal loading, said member and tower proper having co-acting hinge members.

6. A transmission tower having a revoluble cross-arm including a member inclined with respect to the vertical axis of the tower, hinge members carried by the inclined member, co-acting hinge members on the tower proper, said cross-arm arranged for movement in the direction of the line when subjected to unbalanced longitudinal loading.

7. The combination with a transmission wire, of a supporting structure comprising an upright member, a revoluble wire supporting member mounted on the upright and having its axis of rotation inclined with respect to the vertical axis of the upright.

In testimony whereof I affix my signature.

HAROLD O. HILL.