Oct. 24, 1950 H. H. WHEELER ET AL 2,526,917

LINE WIRE SPACER

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FIG. 1

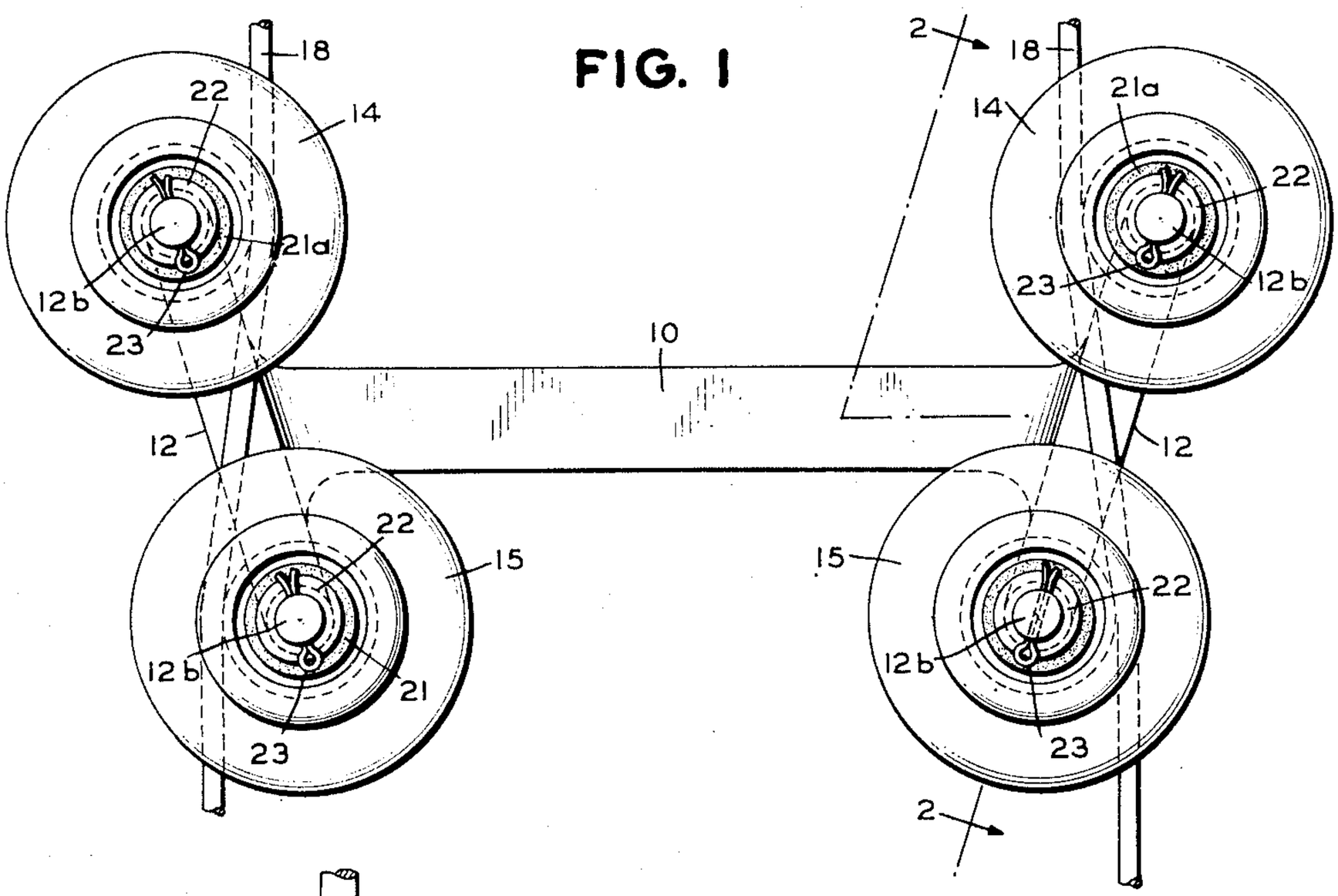
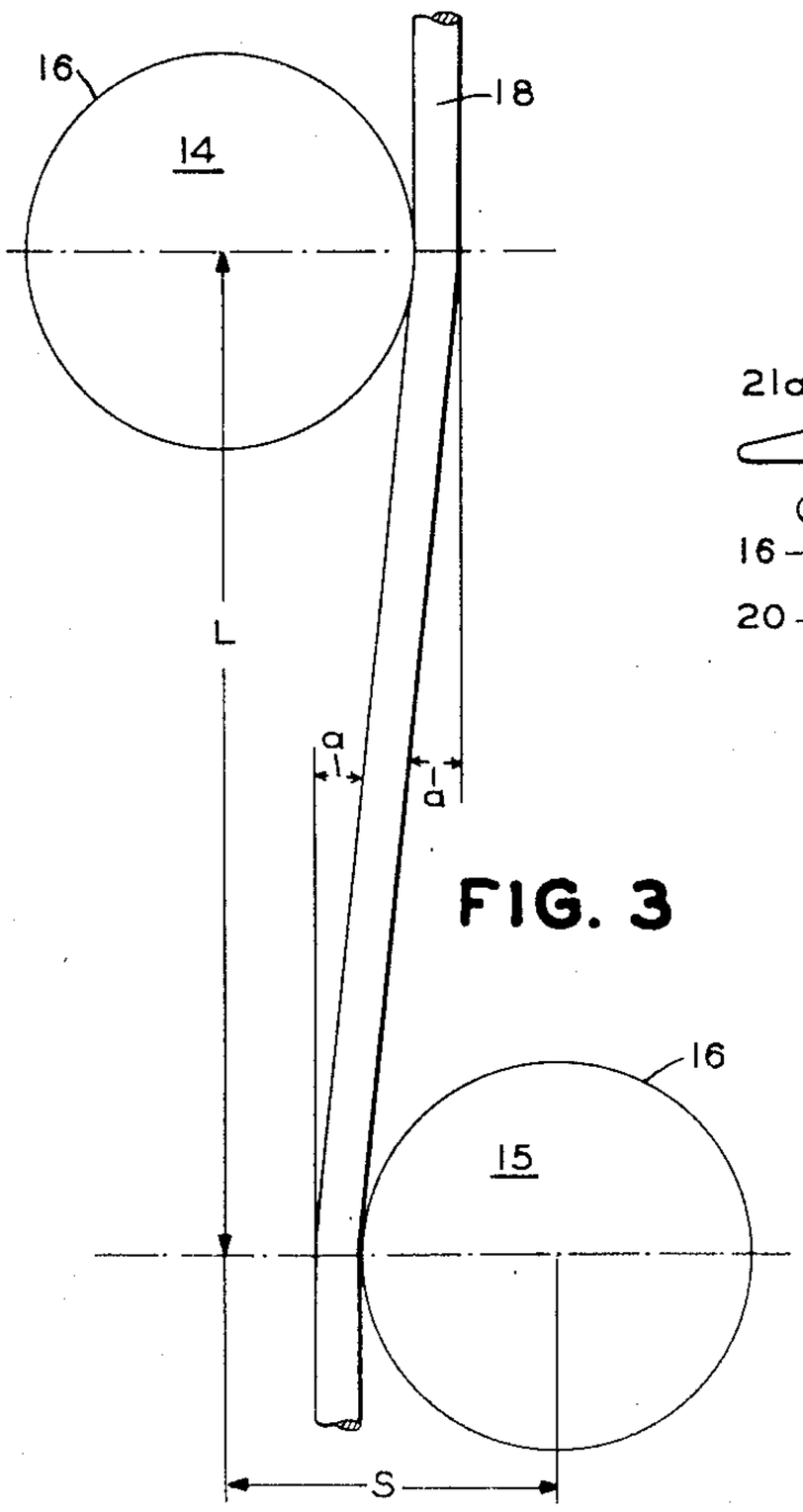


FIG. 2

FIG. 3



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LINE WIRE SPACER

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6 Claims. (Cl. 174—146)

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This invention relates to line wire spacers for maintaining a desired fixed spacing between two line wires in a span thereof between two supports, and more particularly to a spacer which is maintained in a condition of stability and in a fixed position by the line wires of the span in which the spacer is inserted.

In the operation of metallic telegraph and telephone communication circuits, and particularly where carrier frequencies are employed, reduction in carrier frequency cross talk may be effected by increasing the separation between the adjacent pairs of line conductors and decreasing the spacing between the wires constituting each pair of conductors. Thus, with present line construction practices the normal wire separation for high frequency carrier circuits is usually either eight inches or nine and one-fourth inches between the wires of each pair, although with carrier frequencies of the order of 150 kilocycles the spacing in some cases has been reduced to six inches. This means that in the longer spans of the line, there is increased danger of swinging contacts between these closely spaced wires. With line wire spans of less than 150 feet in length, wire spacers are usually not required, but with the above mentioned reduced wire spacing spans exceeding 150 feet in length usually require one or more spacers to provide adequate protection against crosses or swinging contacts.

Among the objects of the invention are to provide a line wire spacer which is capable of quick and easy installation at any desired point without the necessity of cutting the line wires and without injury to the wires; the spacer is light in weight so as not to unduly increase the sag of the line wires; the spacer remains fixed in service in its installed location; the normal spacing of the conductors is not appreciably altered by the presence of the spacer; and the insulation of the wires is not reduced due to the presence of the spacer but is maintained equivalent to the insulation on the poles or other supporting structure of the line.

Other objects and advantages of the invention will be apparent from the following detailed description of an illustrative embodiment thereof, taken in connection with the accompanying drawings, in which:

Fig. 1 is a top plan view of a line wire spacer constructed in accordance with the invention, and inserted between two line wires in a span thereof;

Fig. 2 is a view, in elevation, of one of the pairs of insulators and mounting means therefor, looking along the line 2—2 of Fig. 1, the line wire being omitted for the sake of clarity; and

Fig. 3 diagrammatically indicates the extent of deflection of each line wire due to its engagement with the insulators of the spacer, and also shows the relative positions and spacing of the insulators of each pair.

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As shown in Figs. 1 and 2, the spacer may comprise a bracket composed of a metallic web or body portion 10 having at each end thereof upstanding metallic U-shaped members 12. The two legs 12*a*, Fig. 2, of each member 12 have reduced portions 12*b* at their ends which form insulator supporting pins for carrying the line wire insulators 14 and 15. The insulators may be composed of a dielectric vitreous material, such as a high quality glass, or they may be composed of a vulcanized rubber having a wax-like compound incorporated therein and which has non-wetting surface characteristics and non-breakable features, such as disclosed in Smith and Wheeler Patents Nos. 2,218,497 and 2,304,483. Preferably, although not necessarily, the U-shaped members 12 are made integral with the elongated body portion 10, and these members including the body portion may be composed of a light weight metal or alloy, for example, aluminum, magnesium, and alloys thereof.

If vitreous insulators are employed, in order to minimize line leakage from the insulators to the metal pins, and to cause a high insulation value of the line to be maintained notwithstanding the presence of one or more spacers in a span and the occurrence of adverse weather conditions, the insulators in addition to have the usual skirts 20 are mounted on cylindrical insulating sleeves or bushings 21 which in turn are mounted on the pins formed by the reduced portions 12*b* of the legs. The bushings are composed of a material having good dielectric characteristics; preferably the composition of the bushings is the same as that of the rubber insulators disclosed in the aforesaid Smith and Wheeler patents. The upper end of each bushing comprises a circular flange or collar portion 21*a* which seats on the upper surface of the associated insulator. A washer 22 surrounds the upper end of each pin 12*b* and a cotter pin 23 passes through a small hole in the insulator pin so that the legs 12*a* of the spacer are supported within the insulators by means of the members 21*a*, 22, and 23. It is desirable to provide sufficient clearance between the insulators 14 and 15 and the sleeve members 21, or to pro-

vide sufficient clearance between the sleeve members 21 and the pins 12*b*, to cause the insulators to be freely rotatable about the pins, thereby to facilitate pulling the spacer along the pair of line wires until it reaches a desired position in the wire span in which it is inserted. If rubber insulators are employed it is desirable to provide sufficient clearance between these insulators and the mounting pins to enable the rubber insulators to revolve freely for the same reason.

The insulators have wire grooves 16 which receive the line wires 18 and cause the spacer to be supported in a desired fixed position in a span by the tension of the line wires on the insulators. As shown in Fig. 1, each of the U-shaped bracket members 12, together with the pair of insulators mounted thereon, is positioned on the bracket at an angle to the direction of the line wire in the span in which the spacer is inserted. This is diagrammatically illustrated in Fig. 3 in which the wire grooves of the insulators 14 and 15 are indicated by the circles 16. The lateral distance S between projections of the centers of the insulators of each pair to a line perpendicular to the direction of the span is such that at each of the insulators the angle of departure a of the line wire 18 from a straight line which represents the normal direction of the line wire in the span, will produce a resultant pressure on the insulators, which pressure is just sufficient to maintain the spacer in a condition of stability, and in a fixed position in service.

If the angle of departure a should be too great, this would detrimentally affect the electrical balance of the circuit and also would make it difficult to insert the spacer in the line wires. Moreover, it would result in the introduction of sharp bends or kinks which would reduce the tensile strength of the wires and tend to cause breakage of the wires at the kinked places, and would undesirably increase the force required to pull the spacer along the wires from the place where it is inserted, as at a pole or other suporting structure, to its desired fixed position in the span. The nature of the line wire material, the diameter and weight of the line wire, as well as the percentage of the ultimate stress at which the line wire is normally maintained, all affect the magnitude of the resultant pressure exerted. Thus, an aluminum conductor will normally require a larger angle of deflection than a steel wire having the same diameter due to the higher tension at which the latter wire must be strung in order to avoid an objectionably large sag in the span. On the other hand, a high-strength steel wire such as that commonly designated as "135" steel will require a smaller angle to provide adequate stability than will a conductor of the same diameter but of ordinary grade of steel since the former conductor is stiffer and normally worked at a higher tension.

We have found that for small conductors, such as 102 mil or 114 mil copper, if the angle a is 6°, which produces a resultant pressure that is approximately one-tenth of the wire tension, this is entirely adequate. For larger conductors having higher ultimate stresses, such as 162 mil Copperweld, the angle of departure a may be reduced to 3° which produces a resultant pressure that is approximately equal to one-twentieth of the conductor tension. Angles of these magnitudes will have no appreciable effect on the electrical balance and operating efficiency of the conductors of the metallic circuit.

The distance L between the projections of the centers of the insulators 14 and 15 to a line parallel to the direction of the span is largely governed by the stiffness of the conductors and is therefore a funtcion of the conductor material, the stringing tension and the diameter. In the installation of this spacer the wires 18 are inserted in the wire grooves on the inner surfaces of the two upper insulators 14, as viewed in Fig. 1, and are placed in the wire grooves on the outer surfaces of the two lower insulators 15; this may be done from a pole or other support at one end of the line wire span. The spacer then is customarily pulled along the wires 18 by a releasable pull wire or hand line until its desired location is reached, which results in the wires being slightly bent in one direction at insulators 14 and in the opposite direction at insulators 15. It has been found that, with angles of departure as specified above, a value of L equal to thirty times the conductor diameter gives excellent results, although for small conductors the effort required to pull the spacer along the span is not excessive even if the distance L is reduced to twenty times the diameter of the wire; while in the case of large gauge conductors, even with an angle of departure in the neighborhood of 3° it is preferable to increase the distance L to a value of approximately thirty-five times the diameter of the wire.

In order to avoid possible injury to the line conductors during the installation of the spacer, the insulators should not have too small a diameter at their wire grooves 16. The ratio of the diameter of the insulator at its wire groove to the diameter of the wire should preferably be not less than eight so as not to introduce unduly severe bending stresses in the conductors, and may advantageously be increased to twelve or thirteen, but should not be greatly in excess of the latter figure because of the increased size and weight as well as the greater electrical losses which would result from the use of insulators that were too large.

Preferably, and as shown, the bracket structure of the spacer is depending from the insulators and thus in service the bracket is below the pair of line wires, although obviously the bracket could be positioned above the pair of wires if the insulators and bushings were reversed on the pins and the washers and cotter keys disposed accordingly.

Instead of having the insulator mounting brackets 12 integral with the ends of the elongated body portion 10, it will be appreciated that these may be separable parts secured to the body 10 by means of bolts or other suitable fastening means, in which case the angle of the bracket members may be adjusted to vary the angle of departure of the line wire thereby to adapt a spacer for various sizes and kinds of line wire conductors.

While there is shown and described herein a particular embodiment of the invention for the purpose of illustration, many other and varied forms and uses will present themselves to those versed in the art without departing from the invention, and the invention is therefore not limited except as indicated by the scope of the appended claims.

What we claim is:

1. A line wire spacer for maintaining a predetermined fixed spacing between two line wires in the span thereof between two supports and adapt-

ed to be carried by said line wires, comprising a bracket having a body portion with two pairs of insulator-mounting members secured thereto, said pairs of mounting members being spaced from each other a distance to provide a desired spacing between the wires, line wire insulator rotatably mounted on each pair of said mounting members, each pair of insulators being individual to one of the line wires and having wire grooves for receiving said one of the line wires, the insulator-mounting members of each pair being positioned on the bracket at a small angle to the direction of the line wire in the span when the spacer is inserted therein, said angle having a value which produces only a slight deflection in the wire by the wire grooves on opposite sides respectively of the insulators of the pair and produces a small angle of departure of the line wire from a straight line at each of the insulators, said angle of departure having a sufficient value, however, to cause a resultant pressure to be exerted on the insulators sufficient to support the weight of the spacer and maintain the spacer in a condition of stability and in a fixed position in the wire span without the use of tie wires on the insulators of the spacer.

2. A line wire spacer for maintaining a predetermined fixed spacing between two line wires in the span thereof between two supports and adapted to be carried by said line wires, comprising a bracket having a body portion with two pairs of insulator-mounting members secured thereto, said pairs of mounting members being spaced from each other a distance to provide a desired spacing between the wires, line wire insulators rotatably mounted on each pair of said mounting members, each pair of insulators being individual to one of the the line wires and having wire grooves for receiving said one of the line wires, said pairs of insulator-mounting members being positioned on the bracket along divergent lines relative to each other and each pair positioned thereon at a small angle to the direction of the line wire in the span when the spacer is inserted therein, said angle having a value which produces only a slight deflection in the line wires by the wire grooves on opposite sides respectively of the insulators of the pairs and produce a small angle of departure of each line wire from a straight line at each of its pair of insulators, said angle of departure having a sufficient value, however, to cause a resultant pressure to be exerted on the insulators sufficient to support the weight of the spacer and maintain the spacer in a condition of stability and in a fixed position in the wire span without the use of tie wires on the insulators of the spacer.

3. A line wire spacer for maintaining a predetermined fixed spacing between two line wires in the span thereof between two supports and adapted to be carried by said line wires, comprising a bracket having a body portion with two pairs of insulator-mounting members secured thereto, said pairs of mounting members being spaced from each other a distance to provide a desired spacing between the wires, line wire insulators mounted on each pair of said mounting members, each pair of insulators being individual to one of the line wires and having wire grooves for receiving said one of the line wires, the insulator-mounting members of each pair being positioned on the bracket at an angle to the direction of the line wire in the span when the spacer is inserted therein, said angle having a value which produces only a slight deflection in the wire by the wire grooves on opposite sides respectively of the insulators of the pair and produces a small angle of departure of the line wire from said straight line at each of the insulators, said angle of departure having a sufficient value, however, to cause a resultant pressure to be exerted on the insulators sufficient to support the weight of the spacer and maintain the spacer in a condition of stability and in a fixed position in the wire span without the use of tie wires on the insulators of the spacers, said angle of departure having a value which produces a resultant pressure within the range of approximately one-tenth to one-twentieth of the wire tension in the span.

4. A line wire spacer for maintaining a predetermined fixing spacing between two line wires in the span thereof between two supports and adapted to be carried by said line wires, comprising a bracket having a body portion with two pairs of insulator-mounting members secured thereto, said pairs of mounting members being spaced from each other a distance to provide a desired spacing between the wires, line wire insulators mounted on each pair of said mounting members, each pair of insulators being individual to one of the line wires and having wire grooves for receiving said one of the line wires, the insulator-mounting members of each pair being positioned on the bracket at an angle to the direction of the line wire in the span when the spacer is inserted therein, said angle having a value which produces only a slight deflection in the wire by the wire grooves on opposite sides respectively of the insulators of the pair and produces an angle of departure of the line wire within the range of approximately three to six degrees from a straight line at each of the insulators, said angle of departure having a sufficient value, however to cause a resultant pressure to be exerted on the insulators sufficient to support the weight of the spacer and maintain the spacer in a condition of stability and in a fixed position in the wire span without the use of tie wires on the insulators of the spacer.

5. A line wire spacer for maintaining a predetermined fixed spacing between two line wires in the span thereof between two supports and adapted to be carried by said line wires, comprising a bracket having a body portion with two pairs of insulator-mounting members secured thereto, said pairs of mounting members being spaced from each other a distance to provide a desired spacing between the wires, line wire insulators mounted on each pair of said mounting members, each pair of insulators being individual to one of the line wires and having wire grooves for receiving said one of the line wires, the insulator-mounting members of each pair being positioned on the bracket at a small angle to the direction of the line wire in the span when the spacer is inserted therein, said angle having a value which produces only a slight deflection in the wire by the wire grooves on opposite sides respectively of the insulators of the pair and produces a small angle of departure of the line wire from a straight line at each of the insulators, said angle of departure having a sufficient value, however, to cause a resultant pressure to be exerted on the insulators sufficient to support the weight of the spacer and maintain the spacer in a condition of stability and in a fixed position in the wire span without the use of tie wires on the insulators of the spacers, the insulators of each pair being spaced from each other in a direction along the

span a distance such that the distance between projections of the centers of the insulators to a line parallel to the direction of the span lies within the range of approximately twenty to thirty-five times the diameter of the wire.

6. A line wire spacer for maintaining a predetermined fixed spacing between two line wires in the span thereof between two supports and adapted to be carried by said line wires, comprising a bracket having a body portion with two pairs of insulator-mounting members secured thereto, said pairs of mounting members being spaced from each other a distance to provide a desired spacing between the wires, line wire insulators mounted on each pair of said mounting members, each pair of insulators being individual to one of the line wires and having wire grooves for receiving said one of the line wires, the insulator-mounting members of each pair being positioned on the bracket at a small angle to the direction of the line wire in the span when the spacer is inserted therein, said angle having a value which produces only a slight deflection in the wire by the wire grooves on opposite sides respectively of the insulators of the pair and produces a small angle of departure of the line wire

from a straight line at each of the insulators to cause a resultant pressure to be exerted on the insulators sufficient to support the weight of the spacer and maintain the spacer in a condition of stability and in a fixed position in the wire span without the use of tie wires on the insulators of the spacer, the ratio of the diameter of each insulator at its wire groove to the diameter of the wire being not less than approximately eight nor greater than approximately thirteen.

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