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METHOD OF ATTACHING ELECTRICAL CONDUCTORS TO GLIDER TOW ROPES

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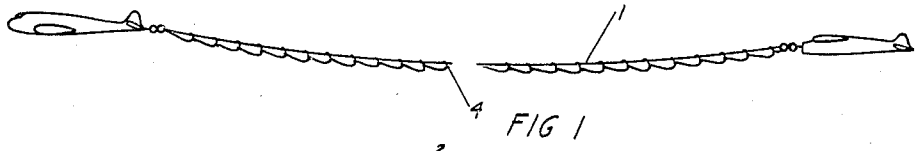



FIG 1

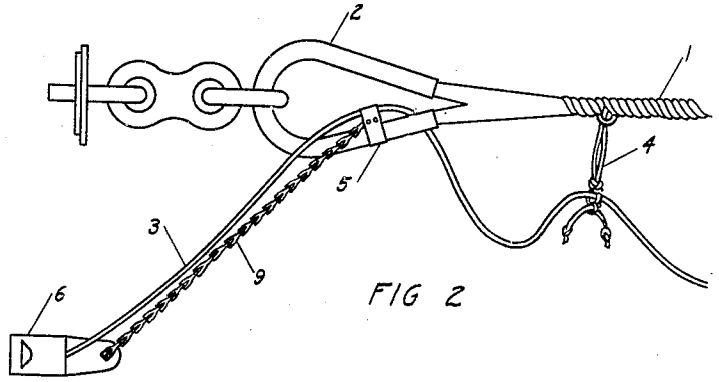



FIG 2

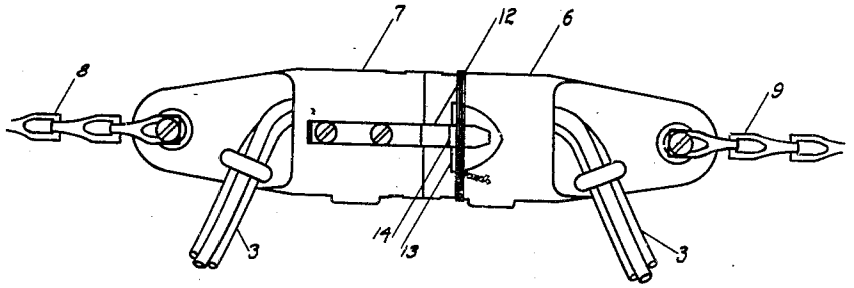



FIG 4

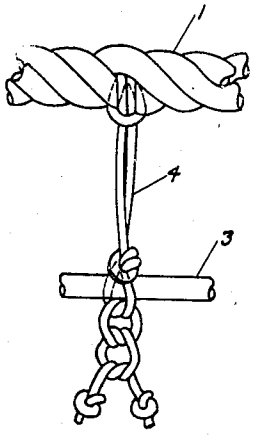



FIG 3

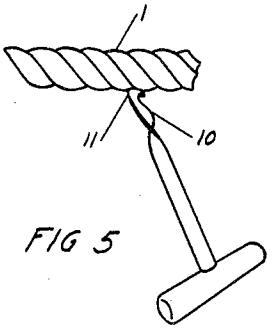



FIG 5




FIG 6

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## METHOD OF ATTACHING ELECTRICAL CONDUCTORS TO GLIDER TOW ROPES

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4 Claims. (Cl. 244—3)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

The present invention relates to a method of attaching electrical conductors to glider tow ropes.

The interphone system between tow plane and glider plane requires, of course, conductors from one to the other. These conductors are relatively inelastic or non-extensible. The tow rope between the two planes, on the other hand, is decidedly extensible. In flight, such tow ropes frequently elongate 40% or over. Since the tow rope and the conductor are substantially parallel and extend approximately from the same points in the tow plane to the same points in the glider plane, provision must be made to accommodate the conductor to this elongation of the tow rope. In operation, the conductor is suspended from and carried by the tow rope which, when the tow is completed, is finally completely dropped, by manually disconnecting it first from the glider plane and then from the tow plane. When the tow rope is disconnected from the glider, the tow plane takes up the slack in the conductor and as it does so, the conductor is pulled from its connections. As the tow rope is released from the tow plane, it pulls the conductor with it, with the same effect on the conductor connections at that end. To adequately meet this difficulty and prevent damage or destruction of the connections as well as breaking of the conductor, a particular construction of connector and its arrangement in the assembly, have been worked out as a part of the present invention.

The present invention completely eliminates the above and other objections and provides a simple, efficient and economical method and means of suspending the conductor from the tow rope and separably connecting or coupling it to the respective terminal elements carried by the tow and glider planes, respectively.

In order to more clearly disclose the method, order of performing the several steps and the arrangement and disposition of the several parts and devices used in carrying out the method, reference should be had to the accompanying drawing forming part of this application. Throughout the several figures of the drawing like reference characters designate the same parts in the different views.

In the drawing:

Fig. 1 is a side elevation of the invention, applied, the plane positions being indicated diagrammatically;

Fig. 2 is an enlarged fragmentary side elevation, showing a tow rope end and corresponding conductor attachments;

Fig. 3 is an enlarged side elevation of one sling member as assembled;

Fig. 4 is an enlarged side elevation of one of the plug assemblies; and

Figs. 5 and 6 are perspective views of the threading tool.

Referring to the drawing in detail, 1 indicates the tow rope connecting a glider plane with its tow plane. Each end is provided with the usual protecting tublular guard, shield or thimble 2, to protect it against wear at the points of connection with the respective planes. The cooperating connecting elements on the tow and glider planes and their respective manual releases are well known and it is believed that nothing would be added to an understanding of the invention by including in the application an illustration or further description of the same. The interplane communicating system comprises the usual conductors 3 from plane to plane of insulated wire and is, of course, practically inelastic and non-extensible. It is carried by the tow rope through the medium of a plurality of cord slings 4 fixed, at predetermined points, to the tow rope. Tow ropes in general usage are of nylon which has a stretch or elongation of 40% or more. If the conductor were of the same length as the tow line, in the normal condition of the tow line, and both were securely anchored at their respective ends to the respective planes, the conductor would be either severed intermediate of its ends or torn from its connections almost as soon as the tow plane started. To avoid this, the fully extended or maximum elongated length of the respective tow rope is determined and a conductor of that length is provided. According to this invention, the conductor is suspended from the tow rope by slings 4 distributed along the length of the tow rope at regular or uniform intervals or distances of 12". For each 12" of tow rope a corresponding or proportionate length of conductor is allowed. On the basis of a 41% elongation on a 350 ft. tow rope, for instance, 17" of conductor should be allowed for each 12" of the tow rope. For greater elongation corresponding allowance is made, of course. In assembling the tow rope, conductor and plug-and-socket connections involved in applying the method of this invention, the tow rope is marked off in 12" lengths beginning just beyond the rope splice at

the thimble. At each of these 12" points a cord sling is permanently inserted as will hereinafter be more fully described. Next, the conductor, assuming a maximum elongation of 41%, will be marked off in 17" lengths from one socket end. The required number of cord slings 4 are now made, one for each 12" of the tow rope. An easy way to cut the necessary lengths of these cords (20 inches) is to wrap the entire spool of cord about a board provided for this purpose and having a lateral perimeter of 20". Then, a single cut, lengthwise of the board and across the wrapped strands, will sever the whole length into a plurality of sections each of the length required. Each of these slings is permanently anchored to the tow rope by doubling the cord to form a loop the two branches of which are of equal length, separating the rope strands, threading the looped end between the strands and then passing the free ends of the sling cord through the loop and drawing it tight. The ends of the sling cord should be knotted close to the end either before or after making the tie or anchor as above. It has been found that the best location of the conductor, relative to the tow rope is about 2" below the tow rope. Accordingly, a tight overhand knot is made in the two sling cord branches at that point. Next, place the conductor 3 within the sling at the corresponding mark on the conductor and securely anchor the conductor by two square knots drawn tightly against the conductor. Every sling is applied in the same way and the conductor is similarly firmly anchored to every sling. This establishes a plurality of shallow loops equally and evenly distributed throughout the length of the tow rope, one beneath each 12" of the tow rope. At each extreme end of the tow rope the conductor should be securely anchored or fixed to the tow by a cable clamp 5 or the like, at a point about 2½" from the loop end of the thimble. Beyond this point a length of conductor equal to twice the length between the clamp and nearest sling is allowed for slack. This will provide about 36" slack at this point.

To each end of the conductor is fixed the socket end 6 of a plug-and-socket connection, the plug end 7, being carried by the respective plane. To provide a flexible connection to adequately accommodate all relative movements of the planes without damage to the conductor, the plug member is connected to the plane by a short chain 8 or any other suitable swivel connection. In order to avoid shock and resulting damage to the conductor 3 at the points where it is connected to its sockets 6, short chains 9 connect these sockets to the respective cable clamps 5 of thimbles 2. Chains 8 are shorter than the corresponding portions of conductor 3. Consequently, as the tow rope 1 leaves its respective plane, pulling with it the conductor, the slack of the respective chain 8 will be taken up before the slack of the corresponding loop of the conductor is taken up. The result is that the tow rope and chain take the strain of pulling the socket 6 so that no strain is imposed on the conductor in effecting the separation.

Nylon ropes are pretty closely and tightly made and relatively difficult to separate for insertion of these slings. Furthermore, nylon, as a material, is more easily damaged than other rope materials. To meet these objections, a sling-threading tool or implement has been devised as shown in Figures 5 and 6. It is a gimlet type implement having a bar or blade 10 of cork-screw formation terminating in a hooked point 11. In use, the point and blade are inserted between the rope strands as indicated in Fig. 5 and passed through to position shown in Fig. 6. There it receives the loop of sling 4 and is drawn back in the reverse direction, pulling the sling loop through between the rope strands, without injury to the rope.

The plug-and-socket assembly coupling the respective ends of the conductor to the tow plane and glider, in addition to the usual frictional hold of the plug elements in the cooperating socket elements, is provided with friction grips in the form of leaf springs 12 carried by one element of the coupling and cooperating with shoulders 13 formed in the other element of the coupling. Springs 12, of course, are stepped, provided with offsets or have other engaging surfaces or parts 14 adapted to cooperate with the shoulders. By inclining the cooperating surfaces 13 and 14 to a greater or less degree, the amount of friction or corresponding resistance to separation or lease may be predetermined. It is essential, of course, on the other hand, that this resistance shall amply exceed that which would cause any ordinary accidental separation in regular operation. Various other means may be used for separably connecting the plug-and-socket elements to be pulled apart when a given resistance has been exceeded.

In the operation of the invention, assuming tow and glider planes to be in flight, the glider plane releases its tow connection, then, as the tow plane pulls away, the slack of chain 9 is taken up and socket 6 is pulled, disconnecting 3 from the glider plane. Then, as the tow plane continues, the conductor is simply idly suspended from the tow rope. Next, the tow rope is released from the tow plane. As it drops behind, its weight and that of the attached conductor take up the slack in chain 9 on that end which, as it tightens, pulls socket 6 at that end so that the whole assembly of tow rope, conductor and sockets, as a unit, drops.

It will be clear that there is no shock or other destructive wear on any part of the conductor involved in disconnecting the conductor from either plane as the tow plane drops or releases its glider.

It is thought that the method constituting the present invention, the several steps involved in carrying out that invention and the constructions and arrangement of the several parts of the equipment required in the invention will be clear from the preceding detailed description. Many changes may be made in the details and order of the several steps of the method disclosed and in the constructions, arrangement, and disposition of the various parts and devices used in carrying out the method, within the appended claims, without departing from the field of the invention, and it is meant to include all such within the application wherein only a preferred form of the invention has been set forth by way of illustration.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. In combination an elongatable tow rope, a conductor separate from and exterior of said tow rope and of a length approximately equal to that of said tow rope at maximum elongation, a plurality of slings immovably fixed to said tow rope equi-distantly throughout its length and positive anchoring connections between said slings and said conductor, said conductor being permanently disposed and permanently maintained in a plurality of shallow loops below said tow rope and between said slings, each loop having a length ap-

proximately equal to that of the corresponding tow rope section at maximum elongation.

2. In combination an elongatable tow rope, a conductor separate from and exterior of said tow rope and of a length approximately equal to that of said tow rope at maximum elongation, a plurality of slings all of the same predetermined length permanently fixed to said tow rope equidistantly throughout its length, positive anchoring connection between said slings and said conductor flexibly suspending said conductor from said tow rope, said conductor being permanently disposed and permanently maintained in a plurality of shallow loops below said tow rope and between said slings, each loop having a length approximately equal to that of the corresponding tow rope section at maximum elongation, socket members carried by said conductor ends for separable connection with cooperating members carried by respective planes and connections between said tow rope and socket members whereby said sockets are separated by pull of the tow rope before strain is imposed on the conductor.

3. In combination an elongatable tow rope, a conductor separate from and exterior of said tow rope and of a length approximately equal to that of said tow rope at maximum elongation, a plurality of slings all of the same predetermined length permanently fixed to said tow rope equidistantly throughout its length, positive anchoring connections between said slings and said conductor flexibly suspending said conductor from said tow rope, said conductor being permanently disposed and permanently maintained in a plurality of shallow loops below said tow rope and between said slings, each loop having a length approximately equal to that of the corresponding tow rope section at maximum elongation, socket members carried by said conductor ends for separable connection with cooperating members carried by respective planes, means for yieldingly maintaining connection between the respective sockets and cooperating members and connections between said tow rope and socket members whereby said sockets are separated by pull of the tow rope before strain is imposed on the conductor.

4. In combination, an elongatable tow rope, a conductor separate from and exterior of said tow rope and of a substantially invariable length approximately equal to that of said tow rope at maximum elongation, a plurality of slings immovably fixed to said tow rope in approximate parallel relation one to the other equi-distantly spaced throughout the tow rope length, and permanent immovable anchoring connections between every sling and the aforesaid conductor, the length of all slings between tow rope and conductor being approximately the same, said conductor being permanently disposed and permanently maintained in a plurality of shallow loops below said tow rope and between said slings, each loop having a length approximately equal to that of the corresponding tow rope section at maximum elongation and extending between adjacent slings.

ELMER H. BORGELT.