Sept. 5, 1961 R. A. YOUNG 2,999,125

CONNECTING MEANS FOR INSULATOR STRINGS

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FIG. 1

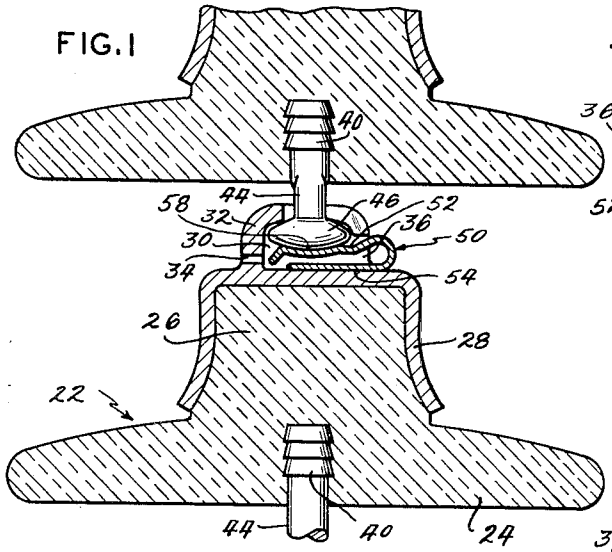


FIG. 2

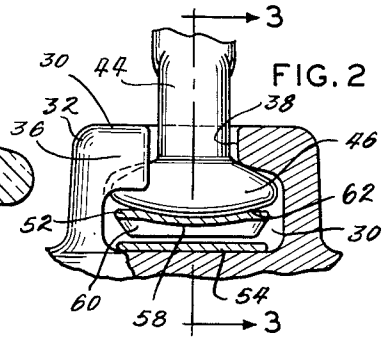


FIG. 3

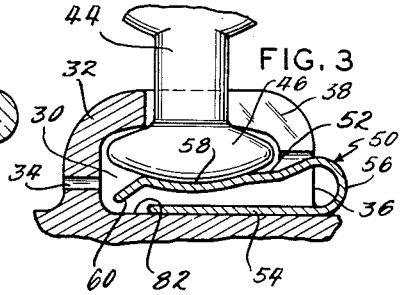


FIG. 4

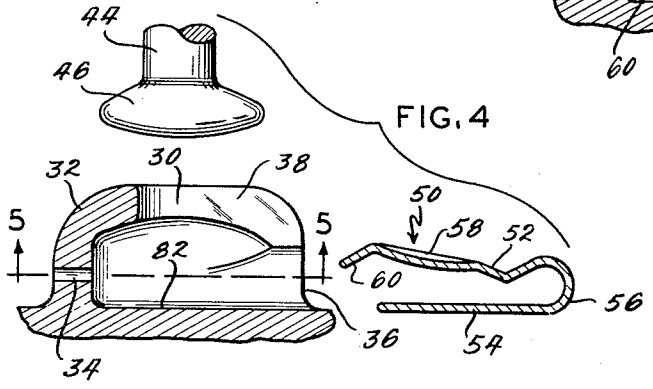


FIG. 5

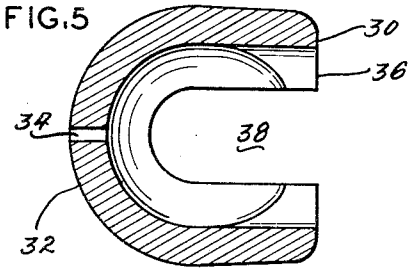
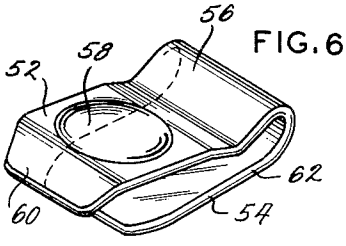


FIG. 6



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FIG. 7

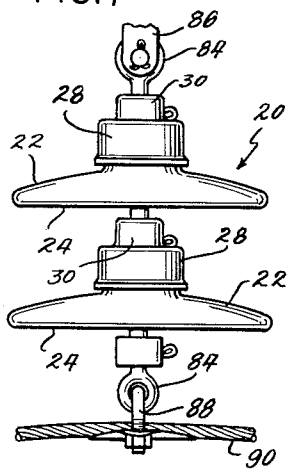


FIG. 8

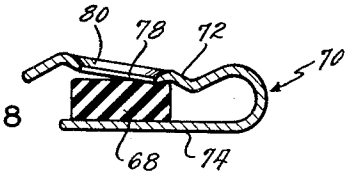


FIG. 10

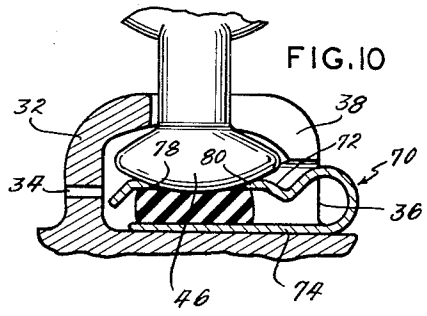


FIG. 9

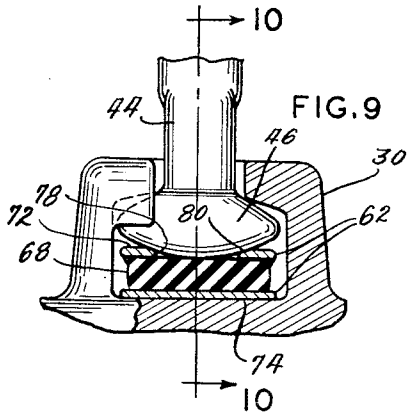
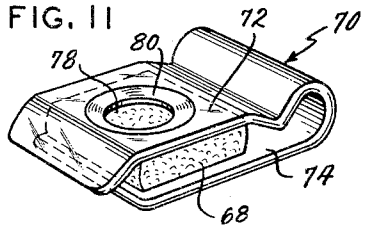


FIG. 11



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United States Patent Office 2,999,125
Patented Sept. 5, 1961

2,999,125

CONNECTING MEANS FOR INSULATOR STRINGS

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Filed Feb. 27, 1959, Ser. No. 796,135
5 Claims. (Cl. 174—141)

This application is a continuation-in-part of application Serial No. 408,893, filed February 8, 1954, by Raymond A. Young, for Connecting Means for Insulator Strings, now abandoned.

This invention relates generally to connecting means for connecting together insulators and other elements of insulator strings, and more specifically to means so constructed and arranged that spring pressure is applied to the connected parts in a manner to establish a firm and positive electrical and mechanical contact between adjoining metal portions of said connected parts which might result in the creation of radio and television interference, the predominant object of the invention being to provide a spring clip for connecting together insulators and other elements of insulator strings which is simple in construction and arrangement and is capable of performing its intended function in a highly efficient manner.

Prior to this invention insulators and other elements of insulator strings were usually connected together with the aid of cotter pins, and while these cotter pins effectively connected together said insulators and other elements, the connections produced thereby were defective in that the cotter pins allowed for looseness in the connections that permitted objectionable radio and television interference to be created on movement of the insulator strings. This interference arises out of the fact that high-voltage, high-current transmission lines, on which insulator strings are generally used, generate strong electric and magnetic fields in their vicinity. Any metallic objects located in proximity to the wires are subject to these fields, which induce electrical currents in the metallic objects. Sudden variations in the electrical resistance between two or more adjacent metallic parts of the insulator strings due to relative motion thereof as a result of "singing" or swinging of the line in the wind are therefore apt to result in minute high-frequency transient disturbances of the electromagnetic fields of the transmission line, and these disturbances manifest themselves as radio and television interference.

The predominant purpose of this invention is to eliminate this situation and this is accomplished by providing spring clips for connecting the insulators and other elements of insulator strings. These spring clips are designed to not only hold the pin and socket of two connected elements in firm mechanical contact so as to maintain a uniform contact area therebetween, but to also establish between the pin and socket an independent conducting path having a low substantially constant electrical resistance. At the same time, unlike the old cotter pin, our spring clip is itself in constant firm electrical contact with the other metallic parts of the connection regardless of any motion or vibration thereof.

It is therefore the object of this invention to provide a simple, rugged, and effective method and apparatus for providing and maintaining a firm mechanical and electrical connection between all the metallic parts of a ball-and-socket joint on electrical insulator strings.

We shall now describe our invention in connection with the attached drawings in which:

FIG. 1 is a vertical section of parts of an insulator string connected together with the aid of spring clips in accordance with this invention;

FIG. 2 is a fragmentary view partly in front elevation and partly in vertical section of a portion of the structure shown in FIG. 1;

FIG. 3 is a fragmentary section taken on line 3—3 of FIG. 2;

FIG. 4 is an exploded, fragmentary view, partly in elevation and partly in section, showing parts of an insulator string to be connected and one of the improved string clips of this invention for connecting said parts;

FIG. 5 is a section taken on line 5—5 of FIG. 4;

FIG. 6 is a perspective view of one of the improved spring clips of this invention;

FIG. 7 is an elevational view of an insulator string showing a plurality of insulators and fittings connected together in accordance with this invention;

FIG. 8 is a vertical section of an alternative embodiment of the clip of my invention;

FIG. 9 is a view partly in side elevation and partly in vertical section of a portion of the structure shown in FIG. 1, but using the clip of FIG. 8;

FIG. 10 is a view partly in elevation and partly in vertical section taken along line 10—10 of FIG. 9; and

FIG. 11 is a detail perspective view showing the embodiment of FIG. 8 in its compressed condition.

In order to permit assembly of insulator strings of any desired length and in order to permit replacement of broken elemens, the individual insulators making up an insulator string must be releasably connected together. The connection must be firm enough to withstand the mechanical strain of the weight of the lines moving back and forth under the influence of the wind, and yet the insulator string must be flexible enough to be able to "give" in all directions to compensate for wind and thermal expansion effects. The type of connection normally used is a ball-and-socket type connection in which the upper portion of each individual insulator is provided with a metallic cap at the top of which is formed a socket having a cavity with metallic bottom, sides and top. The ball member of the joint is the head of a metal pin firmly attached to the underside of the adjacent insulator. This pin head is shaped like a flattened sphere. The socket has a slot in its side so that the pin head can be slid into the socket. When the pin head is in position within the socket, the slot is blocked by the spring clip of my invention (previously, the blocking was done by means of a cotter pin inserted in the space between the bottom of the pin head and the bottom of the socket).

Electrical contact between the pin head and the socket is achieved by the pressure of the upper curved surface of the pin head against the inside of the upper surface of the socket. Under normal conditions, the weight of the wire hanging from the insulator string will assure a sufficiently good contact between the pin head and the socket so that no interference problems will arise. Under many circumstances, however, the position of the insulator string (as for example on a hillside) may be such that the weight of the wire is insufficient to pull the pin head and the socket into engagement with sufficient force to assure proper electrical contact therebetween when the line is vibrating in the wind. In this situation, the necessary force is exerted on the pin head by my spring clip, either by the resiliency of the spring clip material itself or by the resiliency of a plug of Neoprene or similar material interposed between the upper and lower legs of the clip. It will be seen that the pressure exerted by my clip (on the order of about three hundred pounds in my preferred embodiment) will be sufficient to maintain the pin head and the socket in firm electrical contact, even if the movement of the wire attempts to lift the insulator string up rather than pull it down.

Under most conditions of movement, the motion of the pin head with respect to the socket will be sufficient

to cause substantial variations in the electrical resistance therebetween, with the result that radio interference is created. For this reason, my spring clip is preferably made of a material which is a good conductor of electricity, and its lower leg is preferably flat so as to offer the greatest possible contact area with the bottom of the socket. In its upper leg, the clip has a circular depression which is shaped to fit the bottom surface of the pin head so that the pin head will have a substantial area of contact with the spring clip regardless of any movement of the pin head relative to the spring clip. In the embodiment using a resilient plug between the legs of the spring clip, the clip may be made of a non-resilient conducting material such as aluminum. In this case it is desirable to form a hole in the upper leg of the spring clip in place of the depression in the clip of the self-resilient embodiment. The purpose of this hole is to prevent the Neoprene or other resilient plug from being so squeezed by the depression that it will exert an undesirably large resilient force against the pin head, thereby making the insulator string too stiff. In the case of an aperture in the clip, the edges of the aperture may be beveled so as to present a maximum amount of contact area to the underside of the pin head.

Although flatness of the entire lower leg of the spring clip is not essential in the self-resilient embodiment, such flatness is essential in the embodiment comprising a resilient plug because it is necessary to provide the maximum amount of space between the legs of the clip so as to be able to use a resilient plug of sufficient thickness to reliably produce the desired result. The resilient plug embodiment has the further advantage that if the clip were to break, the resilient plug would still force the pin against the socket with sufficient force to maintain a reasonably good electrical contact therebetween, and the resilient plug would at the same time hold the broken pieces of the clip in firm contact with the metallic socket and pin so that no loose metal can be lying around in the socket to create radio interference.

In the drawings, wherein are shown for purposes of illustration merely, two embodiments of the invention, 20 designates in FIG. 7 an insulator string which is comprised of a plurality of suspension insulators 22. The insulators 22 are of the usual and well known construction having a lower disk portion 24 (FIG. 1) and a head portion 26 which projects from said disk portions and is received within a cap 28 that is suitably cemented to said head portion 26. The cap 28 of each insulator 22 is provided with a socket 30 in its upper portion which is closed at its rear end and at its sides by wall portions 32 of the upper portion of the cap in which said socket is formed, except for an opening 34 in the rear wall for a purpose hereinafter described. The socket is open at its forward end 36 and opens at the top into a slot 38 (FIG. 5) which is formed in the top wall of the upper portion of the cap in which the socket is formed. Also, the insulator body has formed therein a cavity in which is suitably cemented the upper portion 40 of a pin 44, said pin being provided with an enlarged head portion 46 at its lower end which serves a purpose to be hereinafter explained.

The spring clip of this invention, which is designated generally by the reference numeral 50, comprises a strip of round-edge metal, or other suitable material, which is resiliently biased sufficiently to perform its intended function, either by its inherent springiness or by a plug of resilient material cooperating therewith. This strip of material is bent double to provide two substantially parallel legs 52 and 54, said two legs being joined by a loop-shaped bridge portion 56, which serves as an eye that is useful in inserting the clip in place for use, and in withdrawing said clip. Also, the leg 52 of the clip 50 is provided with a depression 58 shaped to match the curvature of pin head 46 for optimum electrical contact therewith. The depression 58 serves as a seat, as will presently appear, and the extreme outer end 60 of said leg 52 is curved downwardly to facilitate insertion of said clip in place for use, and to prevent longitudinal displacement of the resilient plug in the embodiment of FIGS. 9 through 11. As is shown most clearly in FIGS. 2 and 9, the clip must be made from stock having rounded edges 62. This is particularly true in the self-resilient embodiment of FIGS. 1–4 and 6, because the sharp bend 56 of the clip material will give rise to cracks at the edges of the material if the clip is made from ordinary sharp-edged strip. These cracks would spread rapidly across the stressed metal at the bend and would cause breakage of the clip after a very short time.

The self-resilient type of clip shown in FIGS. 1–4 and 6 is simple and sturdy, but it has the following drawbacks: It requires close quality control and high-grade steel; it has to be cadmium-plated to improve its electrical properties, then heat-treated to prevent hydrogen embrittlement as a result of the cadmium plating, and finally given an iridite anti-corrosion finish; and if it does fail, the failure is dangerous because the pieces of the clip can readily fall out of the socket and leave the slot unblocked, so that the pin can slip out, causing the line to fall.

In applications where failure of the clip can be critical, it is therefore preferable to use the resilient plug type of clip shown in FIGS. 9 through 11. In this embodiment, the clip 70 itself is made of aluminum or other highly conductive but not necessarily springy material, and the resiliency is provided by a plug 68 of resilient material, such as Neoprene, which is inserted between the legs 72 and 74 of the clip 70 so as to be compressed when the legs 72 and 74 are squeezed together. Although it is possible to form a depression in the Neoprene plug to match the depression 58 of the leg 52 of the clip 50 (FIG. 6), it is better to provide a hole 78 in the leg 72 of clip 70 (FIG. 11) so as to allow a sufficient thickness of Neoprene to be placed beneath the pin head 46 to obtain the desired compression characteristics. The upper rim 80 of hole 78 is beveled so as to assure maximum electrical contact between the clip 70 and the pin head 46 regardless of any relative motion thereof.

The lower leg 54 or 74 of clip 50 or 70, respectively, is flat and rests against the flat bottom 82 of socket 30, thus assuring both optimum mechanical support and optimum electrical contact between the clip and the socket. It will therefore be seen that the clip establishes a reliable, constant, low-resistance electrical path between the pin head and the socket, while at the same time securely locking the pin head in the socket.

In assembling a plurality of insulators to produce a string of insulators, the head portion 46 of the pin 44 of each insulator 22, which has another insulator 22 disposed immediately beneath it, is inserted into the socket 30 of said lower insulator, the shank portion of said pin 44 moving rearwardly in the slot 38 and the top face of the head portion 46 of the pin 44 being arranged in close contact with the bottom face of the top wall 32 of the socket 30. The clip is then inserted into the socket 30, by means of the tool described in application Serial No. 672,653, filed July 18, 1957, now Patent Number 2,921,367 or by any other means. The tool of said application hooks onto the socket 30 by means of a pin insertable into opening 34. The leg 54 or 74 of the clip 50 or 70, respectively, contacts with the bottom face 82 of the socket 30, and the leg 52 or 72 of the clip 50 or 70, respectively, contacts with the head portion 46 of the pin 44 of the insulator 22 immediately above the insulator 22 in whose socket 30 the clip is located, the rounded lower portion of the head portion 46 of said pin being seated in the seat provided by the depression 58 or hole 78 in the leg 52 or 72 of the clip. With the clip so disposed, spring pressure is applied by the leg 52 or 72 of the clip which tends to move the head portion 46 of the pin 44 into tight contact with the

lower face of the top wall 32 of the socket 30. Thus, all looseness between the metallic parts of a connection between a pair of adjacent insulators is eliminated and a firm electrical connection is established between the parts, whereby the opportunity for creation of radio and television interference because of variations of the electrical resistance between said parts is done away with.

In addition to connecting together insulators 22 in accordance with this invention as shown in FIG. 7, fittings providing ball eyes 84 for suspension from a support 86, or for supporting a cable harness 88 carrying the line wire 90, and other elements of insulator strings may be connected to insulators of the insulator strings in the same manner, the fittings either having pin portions similar to the pins 44 previously described herein or sockets adapted to receive the pins 44 of insulators 22, the fittings and insulators being connected together with the aid of the spring clips 50 or 70 as has been previously explained herein.

It will be seen that I have provided a simple, efficient method of eliminating static in insulator strings while at the same time giving the insulator string mechanical strength. Many embodiments of my invention are possible, and I therefore do not desire to be limited by the embodiments shown, but only by the scope of the following claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In an electrical insulator string having a plurality of elements connected by pin-and-socket type connections, an anti-static locking clip comprising an electrically conductive generally U-shaped member, the legs of said U-shaped member being resiliently biased apart, one of said legs having a circular depression forming a clip retaining seat for receiving a round pin head end in firm electrical contact, and the other of said legs being adapted to rest against a portion of said socket opposite the pin head end in firm electrical contact therewith, whereby the legs of said clip are compressed between the end of said pin head and the socket, said clip when compressed acting to hold the pin and socket engaged but permitting universal movement therebetween and between said seat and pin end and engagement of said seat with said pin end retaining said clip within the socket.

2. In a pin-and-socket connector for electrical insulators, an anti-static clip for locking said connector comprising a generally U-shaped electrically conductive member having a pair of legs resiliently biased apart by a piece of resilient material inserted therebetween, said member being inserted between said pin and said socket for providing an electrical path therebetween.

3. An anti-static clip for flexibly retaining a round pin-like head of a metal pin connector of one electric insulator within the round slotted metal socket connector of a second electric insulator wherein the pin connector is engaged with the socket connector through the slot and the connectors can be flexibly held together thereafter by preventing axial relative movement by insertion of a clip through the slot, said clip comprising a pair of superimposed legs of similar length formed of flat metal strip with free ends no wider than the slots in the slotted metal socket, means resiliently connecting said legs and acting to space said legs apart, and a seat adjacent the end of the upper leg of said pair of legs formed by a circular depression contoured for surface contact with the exposed end surface of the metal pin connector, the lower leg of said pair of legs being spaced from the upper leg a distance sufficient to firmly retain said seat on the pin end surface and prevent axial relative movement of the pin end connector in the socket connector after said legs are inserted through the slot in the slotted socket connector so that said seat receives the pin end to hold said clip within the socket.

4. An anti-static clip for flexibly retaining a round pin-like head of a metal pin connector of one electric insulator within a round slotted metal socket connector of a second electric insulator wherein the pin connector is engaged with the socket connector through the slot and the connectors can be flexibly held together thereafter by preventing axial relative movement by insertion of a clip through the slot, said clip comprising a pair of superimposed legs of similar length formed of flat metal strips with free ends no wider than the slots in the slotted metal socket, a bridge connecting the opposite ends of said legs and acting to space said legs apart, and a seat adjacent the end of the upper leg of said pair of legs formed by a circular depression contoured for surface contact with the exposed end surface of the metal pin connector, the lower leg of said pair of legs being spaced from the upper leg a distance sufficient to firmly retain said seat on the pin end surface and prevent axial relative movement of the pin end connector in the socket connector after said legs are inserted through the slot in the slotted socket connector to engage said seat and pin end surface to hold said clip within the socket.

5. An anti-static clip for flexibly retaining a round pin-like head of a metal connector of one electric insulator within a round slotted metal socket connector of a second electric insulator wherein the pin connector is engaged with the socket connector through the slot and the connectors can be flexibly held together by thereafter preventing axial relative movement by insertion of a clip through the slot, said clip comprising a pair of superimposed legs of similar length formed from flat metal strips with free ends no wider than the slots in the slotted metal socket, a bridge connecting the opposite ends of said legs and acting to space said legs apart, and a seat adjacent the end of the upper leg of said pair of legs formed by a circular depression contoured for surface contact with the exposed end surface of the metal pin connector, a piece of resilient material inserted between said legs for resiliently urging the lower leg of said pair of legs away from the upper leg a distance sufficient to firmly retain said seat on the pin end surface and prevent axial relative movement of the pin end connector in the socket connector after said legs are inserted through the slot in the slotted socket connector to engage said seat and pin end surface and hold said clip within the socket.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,999,125 September 5, 1961

Raymond A. Young

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 26, for "elemens" read -- elements --; column 6, line 30, after "metal" insert -- pin --.

Signed and sealed this 13th day of February 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

UNITED STATES PATENT OFFICE

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