

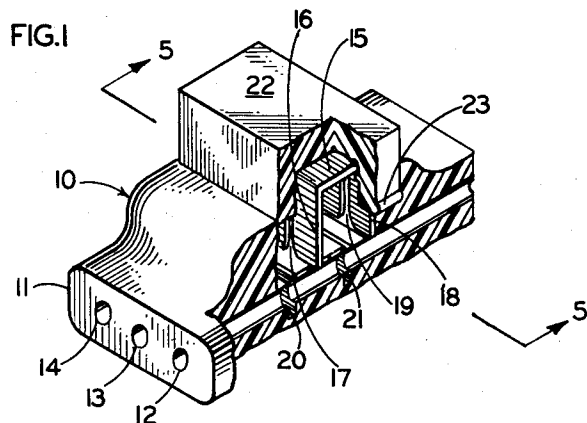
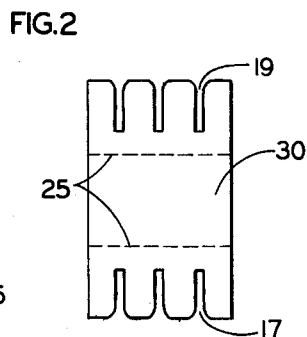
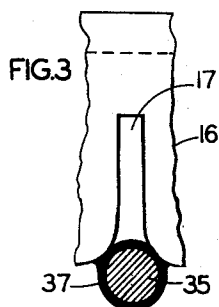
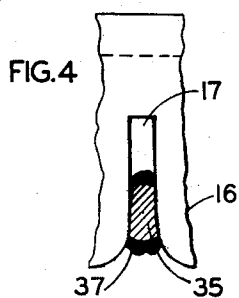
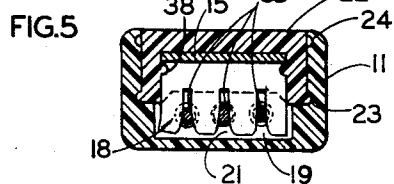
Dec. 5, 1961

E. J. LEVIN ET AL

3,012,219

SOLDERLESS CONNECTOR FOR INSULATED SMALL WIRES

Filed March 19, 1959



EVERT J. LEVIN
EDWARD E. LEACH
INVENTORS.

BY
CARPENTER, ABBOTT, COULTER & KINNEY
ATTORNEYS

1

3,012,219

SOLDERLESS CONNECTOR FOR INSULATED SMALL WIRES

Evert J. Levin, White Bear Lake, and Edward E. Leach, Minneapolis, Minn., assignors to Minnesota Mining and Manufacturing Company, St. Paul, Minn., a corporation of Delaware

Filed Mar. 19, 1959, Ser. No. 800,444

5 Claims. (Cl. 339-98)

This invention is concerned with solderless wire-connectors, such as may be used for splicing or permanently connecting together bare or insulated copper or aluminum wire conductors in telephone and other electrical circuits. One application for which the connectors of the invention are particularly well adapted is the splicing of plastic-covered copper wires of the same or different diameter in telephone cable junctions. Larger diameter wires are also conveniently and permanently connected by means of connectors constructed in accordance with the principles of the invention.

These wire-connectors are easily and rapidly applied to bare or insulated wires, forming low-resistance connections with the metallic conductor. The connection is permanent and is not loosened by repeated mechanical stresses, temperature or pressure changes, exposed to moisture, or passage of electrical current; and the initial low resistance is maintained. No preliminary stripping of insulation is required. The connector penetrates and displaces the plastic, paper or other insulating covering during application, making and maintaining a positive metal-to-metal juncture. Twisting and soldering operations are avoided. No special tools are required, the connector being applied to most wire-sizes by means of common pliers or side-cutters. In a preferred form, the connector provides its own insulating covering, and positively indicates the completion of the connection. Although the connection is permanent under all operating conditions, the connector may if necessary be removed and re-applied. The connector is further characterized by simplicity of construction and manufacture.

The principles of the invention will now be more explicitly set forth in terms of the appended drawing, in which:

FIGURE 1 represents a view in perspective, with portions cut away, of a preferred form of the connector as employed in the joining of insulated copper wires in telephone circuits;

FIGURE 2 is a plan view of a conductive metal blank as used in producing the connector of FIGURE 1;

FIGURES 3 and 4 illustrate the metallic connector component in partial elevational view in two stages of application to an insulated wire shown in section; and

FIGURE 5 is a cross-sectional view taken at the position of section 5-5 of FIGURE 1 after application of the connector in the joining of wire-ends.

The connector 10 of FIGURE 1 comprises an insulating base 11 provided with longitudinal tubular passages 12, 13, 14 for insertion of wire-ends to be connected, and having a slotted, generally U-shaped, conductive member 15 supported within an insulating cap 22 movably fitted within a corresponding opening in a thickened upper portion of the base 11. The two legs 16, 18 of the member 15 enter into corresponding slots 20, 21 in the lower interior portion of base 11 when the cap 22 is pressed into the base member. Each of the legs 16, 18 is slotted directly above the corresponding tubular passage, as indicated for slot 17 in leg 16, and for slot 19 in leg 18, facing passage 12. The cap 22 is held in the open position indicated in FIGURE 1 by means of inner ridges 23 on opposing sides of the cap in cooperation with upper grooves 24 in the inner walls of the base 11, illustrated in FIGURE 5.

2

The U-shaped connector member 15 is conveniently formed from a flat slotted plate 30 as shown in FIGURE 2, wherein the opposing jaws defining the slots 17, 19 are shown to be substantially parallel over the inner closed portion of the slot and to be gradually divergent toward the open end. Inner fold lines 25 indicate the juncture between the leg portions and the central portion of the completed connector member 15.

Two stages in the formation of a permanent positive electrical connection between the connector member and an insulated copper wire are indicated in FIGURES 3 and 4.

In FIGURE 3 the insulated wire, comprising a copper conductor 35 with its insulating covering 37, is shown as it enters between the divergent end portions of the opposing jaws defining the slot 17. As pressure is applied, the conductor is forced into the slot 17, and the jaws first penetrate the insulating covering 37 and then contact and eventually partially deform the copper core 35. At the same time, the jaws are forced apart from their initially substantially parallel relationship to a relatively slightly angular position as in FIGURE 4, in which position the jaws impart continual pressure against the conductor 35 due to the resiliency of the material of which the leg 16 of the connector member is constructed.

Depending on the wire size, the thickness of insulation, and other factors, the wire may enter the slot formed by the initially parallel opposing jaw portions to a greater or lesser distance. In all cases, however, the conductor 35 should be completely within the initially parallel jaw area and should be somewhat below the closed end of the slot.

FIGURE 5 shows the configuration of the connector of FIGURE 1 at section 5-5 after it has been applied in connecting a plurality of conductors. As illustrated, the upper surface of the cap 22 is now flush with the upper surface of the thickened upper portion of the base 11, and is held in position by means of the ridges 23 fitting within corresponding lower grooves in the interior surface of the base member 11. The extended edge of the leg 18 of the connector member 15 fits within the groove 21, and the conductors 35 are shown to be forced well into the corresponding slots.

The U-shaped connector member 15 is retained within the plastic cap 22 in the specific structure here shown, by plastic ridges 38 extending from the interior side walls of the cap between the legs 16 and 18.

It will be appreciated that the width of the slots 17 is somewhat smaller, along the inner parallel portion, than the initial diameter of the copper conductor to which connection is to be made. It will also be appreciated, in view of the foregoing description, that the thickness of the connector member 16, the hardness, tensile strength and resiliency of the material of which it is constructed, and the distance between the closed end of the slot 17 and the adjacent fold line 25 of the connector member 15 must all be selected, with respect to the properties and dimensions of the wires to be connected, so as to insure that the entry of the conductor into the slot under pressure will not only force the opposing jaws through the insulating covering and into the metallic conductor but will also cause slight but significant separation of the jaw surfaces. Under these conditions, the jaw surfaces do not themselves deform; they make positive metallic contact with effective areas of the conductor surface; and they are maintained in positive permanent contact therewith.

In a specific example of a connector assembly similar to that described in connection with FIGURE 1 and designed for joining plastic-insulated copper telephone wires of No. 19 to No. 26 gage, the connector member 15 is formed of 0.025 in. (No. 22 B and S gage) cartridge brass; the slots 17 are each 0.013 inch in width

between the parallel portions of the opposing jaws; the corners of the jaws at the open end of the slot are rounded on a radius of 0.020 inch; and the distance from the closed end of the slot to the adjacent fold line 25 is 0.043 inch. These dimensions, and the dimensions of the insulating base 11 and cap 22, provide that, with the connector in closed position as in FIGURE 5, each conductor 35 is completely within the initially parallel-jaw portion of the corresponding slot and between about 0.010 inch and about 0.027 inch from the closed end of said slot. With these dimensions and materials, the connector produces an eminently satisfactory permanent connection to wires and wire-sizes as indicated.

The connector of FIGURE 1 is particularly useful for connecting together a plurality of wire-ends; and for this purpose the tubular passages 12-14 need extend from the open end only slightly beyond the rearward leg portion 18 of the connector member 15. In the form illustrated, the tubular passage extending throughout the length of the base 11 permits contact with the conductor at both ends of the connector 10, or alternatively permits interconnecting of two wire-ends entering the same tubular passage from opposing ends. Thus, up to six wire-ends may be interconnected with a connector as illustrated in FIGURE 1.

The combination of sliding or wiping action and high unit pressure exerted by the connector member 15 as it is forced over an insulating conductor results in the opposing jaw surfaces entirely displacing all intervening plastic or other insulation from between the jaw surface and the metallic conductor, and also results in partial deformation of the conductor itself and the provision of fully adequate, positive and permanent electrical contact by the conductor and connector. This action also makes possible the effective encapsulation of the connection, through the inclusion within the connector of suitable soft plastic insulating materials, such as polyisobutylene or silicone greases, which completely fill all interstices within the closed connector and effectively prevent any subsequent entry of liquid water or of corrosive vapors. Plating the connector member with corrosion-resistant metal is also contemplated.

The connector 10 of FIGURE 1 will be seen to provide a completely enclosed and completely insulated permanent connection. It is, of course, possible to form connectors and to make connections in which the plastic cap 22 or equivalent is eliminated and in which the conductive connector member 15 is fully accessible. Likewise, the U-shaped member 15 may be replaced by a single slotted flat or curved plate, an outer portion of which may be designed for connection to binding posts or other connection or support members. Similarly, means other than the body member 11 may be provided for applying pressure to a wire at both sides of the slotted connector-member in forcing the wire between the opposing jaws. For example, the connector member and associated pressure-applying member may both be made of metal, the whole then preferably being enclosed in a flexible plastic open-ended insulating cover. Where subsequent removal of the connector may be desirable, the cap 22 and body 11 of the connector of FIGURE 1 are so constructed as to permit entry of a suitable blade for prying the cap and connector-member from the body-member and wires. The opposing jaws then return to, or substantially to, their original parallel positions, due to the resiliency of the connector-member, thus permitting re-application of the connector to another group of wire-ends.

As has been shown in connection with FIGURE 4, the forces providing for constant high pressure of jaw surfaces against the inserted and partially deformed conductor member are here supplied by resilient tension within the portion of the connector member 15 adjacent the closed end of the slot 17. Such a structure provides

a simple and effective means of applying the necessary stresses, and is preferred. Where additional stress is desired, the plate of which the connector member 15 is constructed may be substantially thickened, in which case it may be necessary to reduce the thickness of the jaw surface so as to provide increased unit pressure on the conductor inserted therebetween; and the jaw surfaces may in such instances be hardened to resist such increased unit pressure. Alternatively, where somewhat less stress is required, or where the base portion of the plate 30 between the fold lines 25 is significantly thicker than the leg portions 16 and 18, additional springiness or resiliency may be provided the jaw members, e.g. by additionally slotting said leg members 16 and 18 alongside the slots 17 and 19, or in other ways. However these and other modifications have not been found necessary, at least in providing fully effective permanent solderless connectors for insulated copper wires as employed in conventional telephone cables.

What is claimed is as follows:

1. A wire-connector adapter for making permanent positive electrical connection to small insulated copper wires, comprising: an insulating base member having a plurality of side-by-side elongate wire-receiving channels having extended surfaces adapted to support a corresponding plurality of wires, said base member being doubly deeply grooved across said surfaces and perpendicularly to said channels; and a wide U-shaped resilient conductive connector member, the legs of the U being wide, thin, plurally deeply slotted connector plates adapted to fit within the parallel grooves in said base with their flat sides closely adjacent the corresponding side walls defining said grooves and with a slot in each plate in line with each of said channels, the narrow edges defining each said slot being generally parallel and including smoothly diverging terminal portions defining a wire-accepting opening; said connector member being further adapted for forceful entry of a wire-segment into each slot thereof under a force sufficient to cause resilient separation of said narrow edges, and said grooves being adapted to permit entry of said plates to an extent sufficient to insure said resilient separation of said edges in the formation of a permanent positive electrical connection with said wires.

2. A wire-connector adapted for making permanent positive electrical connection to small insulated copper wires, comprising: a base member having an extended surface adapted to support a wire in a fixed direction and doubly deeply grooved across said surface and perpendicularly to said fixed direction; and a conductive resilient U-shaped connector member, the legs of the U being thin deeply slotted connector plates adapted to fit within the parallel grooves in said base with their flat sides closely adjacent the corresponding side walls defining said grooves and each plate having a slot in line with said wire-supporting surface, the narrow edges defining each slot being generally parallel and including gradually diverging terminal portions defining a wire-accepting opening; said grooves being sufficient in length and depth to permit resilient separation of said slot-defining edges as said plates are forefully applied over a wire supported on said surface and into said grooves in the formation of a permanent positive electrical connection with said wire.

3. A wire-connector adapted for making permanent positive electrical connection to a metallic conductor, comprising: a base member having a plurality of side-by-side elongated wire-receiving channels having extended surfaces adapted to support a corresponding plurality of conductors, said base member being deeply grooved across and perpendicularly to said channels; and a resilient conductive connector member comprising a thin plurally deeply slotted connector plate adapted to fit within the groove in said base with its flat sides closely adjacent the corresponding side walls defining said groove and with a slot in line with each of said channels, the narrow

5

edges defining each said slot being generally parallel and including gradually diverging terminal portions defining a work-accepting opening; said wire-connector being further adapted for forceful insertion of a conductor into each said slot, by pressing said plate into said groove and over a plurality of conductors supported within said channels, under a force sufficient to insure resilient separation of said edges and formation of a permanent positive electrical connection with said conductors.

4. A wire-connector adapted for making permanent positive electrical connection to small insulated copper wires, comprising: an insulating base member having an extended surface adapted to support a wire in a fixed direction and deeply grooved across said surface intermediate the ends thereof and perpendicularly to said fixed direction; and a conductive resilient connector member comprising a thin deeply slotted connector plate adapted to fit within the groove in said base with its flat sides closely adjacent the side walls thereof and with the slot in said plate in line with a wire supported on said extended surface in said fixed direction, the narrow edges defining said slot being generally parallel and including smoothly diverging portions defining a wire-accepting opening, said plate being further adapted for receiving a said wire under pressure sufficient to cause resilient separation of said narrow edges; and said groove being adapted to permit entry of said plate to an extent sufficient to insure said resilient separation of said edges in the formation of a permanent positive electrical connection with said wire.

5

10

15

20

25

30

6

5. A wire-connector adapted for making permanent positive electrical connection to small insulated wires, comprising: a base member having an extended surface adapted to support a wire in a fixed direction and deeply grooved across said surface intermediate the ends thereof and perpendicularly to said fixed direction; and a conductive resilient connector member comprising a thin deeply slotted connector plate adapted to fit within the groove in said base with its flat sides closely adjacent the side walls thereof and with the slot in said plate in line with a wire supported on said extended surface in said fixed direction, the narrow edges defining said slot being generally parallel and including gradually diverging portions defining a wire-accepting opening, said plate being further adapted for receiving a said wire under pressure sufficient to cause resilient separation of said narrow edges; and said groove being adapted to permit entry of said plate to an extent sufficient to insure said resilient separation of said edges in the formation of a permanent positive electrical connection with said wire.

References Cited in the file of this patent

UNITED STATES PATENTS

2,587,239 Smith ----- Feb. 26, 1953

FOREIGN PATENTS

67,298 Netherlands ----- Jan. 16, 1951
615,737 Great Britain ----- Jan. 11, 1949