March 15, 1955

T. L. FORD ET AL

2,704,309

INSULATED ELECTRICAL CONDUCTOR AND HANGER FOR MOVING TROLLEYS

Filed Aug. 29, 1952

2 Sheets-Sheet 1

Fig. 1

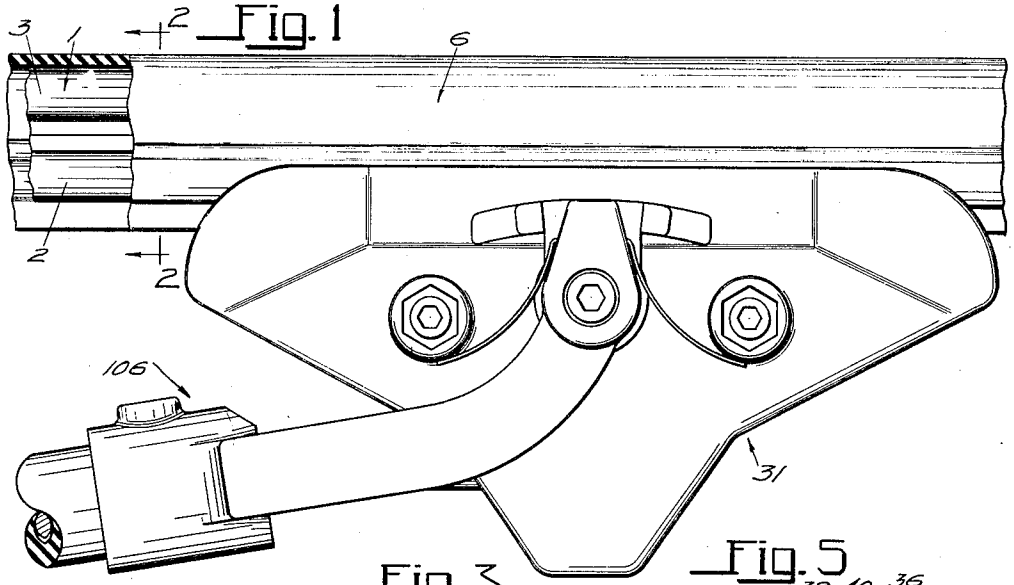


Fig. 2

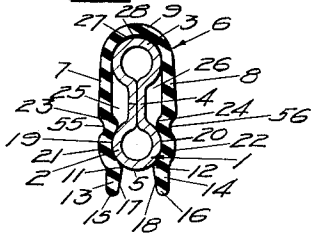


Fig. 3

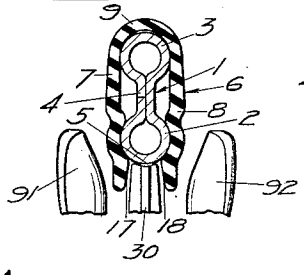


Fig. 5

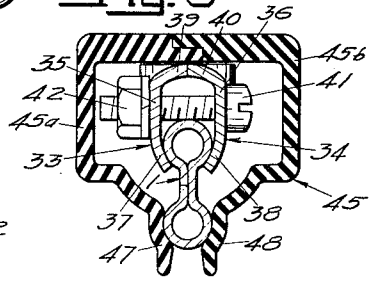


Fig. 4

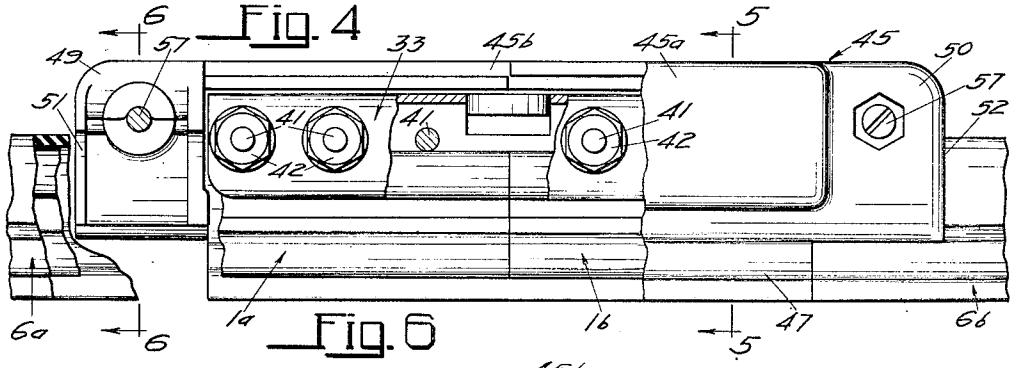
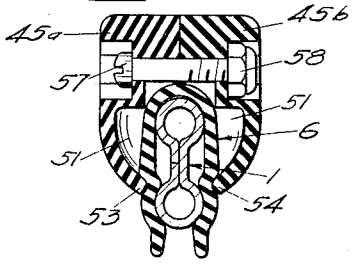


Fig. 6



INVENTORS
TIREY L. FORD
JOHN B. SHAW
BY ALLEYNE C. HOWELL JR.
JACOB E. PFAFF
DAVID R. RICE
Boyken, Modler & Beckley.
ATTORNEYS

March 15, 1955

T. L. FORD ET AL

2,704,309

INSULATED ELECTRICAL CONDUCTOR AND HANGER FOR MOVING TROLLEYS

Filed Aug. 29, 1952

2 Sheets-Sheet 2

Fig. 7

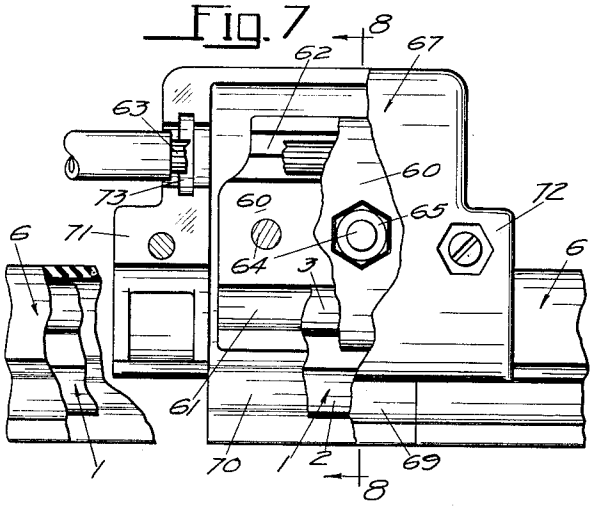


Fig. 8

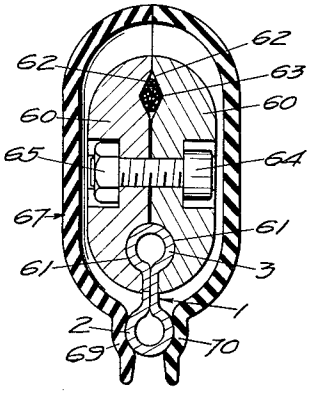


Fig. 9

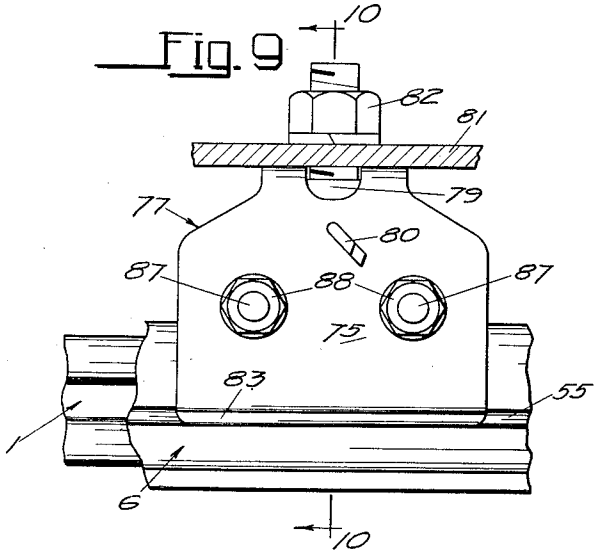


Fig. 10

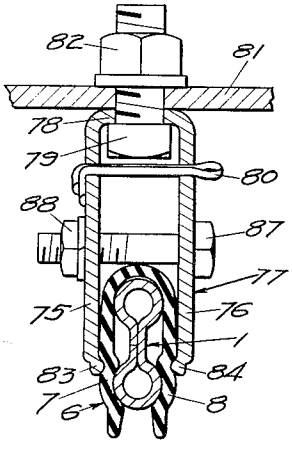


Fig. 11

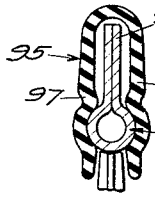


Fig. 12

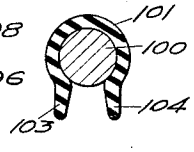


Fig. 13

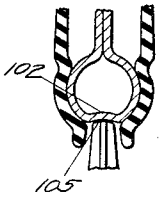
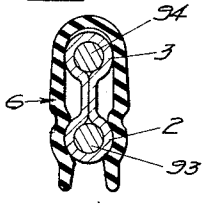


Fig. 14



INVENTORS
TIREY L. FORD
JOHN B. SHAW
ALLEYNE C. HOWELL JR.
JACOB E. PFAFF
DAVID R. RICE

BY Boyken, McAleer & Beckley
ATTORNEYS

United States Patent Office 2,704,309 Patented Mar. 15, 1955

2,704,309

INSULATED ELECTRICAL CONDUCTOR AND HANGER FOR MOVING TROLLEYS

Tirey L. Ford, Hillsborough, John B. Shaw, Redwood City, Alleyne C. Howell, Jr., San Francisco, Jacob E. Pfaff, Palo Alto, and David Russell Rice, Thornton, Calif., assignors, by mesne assignments, to Insul-8-Corp., Burlingame, Calif., a corporation of California

Application August 29, 1952, Serial No. 307,062

3 Claims. (Cl. 191—35)

This invention relates to electrical trolley apparatus for providing a continuous electrical contact between a stationary trolley track or conductor and a moving trolley. In particular the present invention relates to improved insulation for the electrical conductor.

The present invention contemplates improvements in the insulation and collector head of the "sliding shoe" type of apparatus as opposed to the type wherein the collector is provided with a plurality of teeth which successively engage the conductor.

Heretofore the problem of effectively insulating the conductor or trolley wire has been solved only at great expense. Methods formerly employed being expensive both from the stand-point of initial material cost and installation time and labor.

The hazard of accidentally touching the charged conductor is always present and prior trolley installations have not been sufficiently foolproof to satisfy the constantly rising safety standards for personnel.

It is therefore the main object of the present invention to provide a conductor assembly which is inexpensive to make and assemble and which incorporates foolproof safety features practically eliminating any possibility of injury to personnel.

Another object of the invention is the provision of a novel form of insulation for conductors which may be removably secured to the conductor faster than heretofore possible.

Still another object of the invention is the provision of an insulated conductor and collector assembly which prevents accidental derailing of the collector from the conductor.

Other objects and advantages will be apparent from the following specification and from the drawings wherein:

Fig. 1 is a side elevational view of the insulated conductor of the present invention showing a collector head in engagement therewith.

Fig. 2 is a transverse cross-sectional view through the insulator of Fig. 1.

Fig. 3 is a transverse cross-sectional view through a conductor with the insulator in place thereon and showing a collector head in engagement with the conductor.

Fig. 4 is a side elevational view of the connector for joining two sections of the conductor together and showing the insulation for said connector.

Fig. 5 is a transverse cross-sectional view, partly broken away, through the connector and conductor track as taken along lines 5—5 of Fig. 4.

Fig. 6 is a transverse cross-sectional view through the connector and conductor track as taken along lines 6—6 of Fig. 4.

Fig. 7 is a side elevational view partly broken away of the power feed connection to the trolley wire or conductor track.

Fig. 8 is a transverse cross-sectional view through the power feed connection as taken along lines 8—8 of Fig. 7.

Fig. 9 is a side elevational view of a hanger for the insulated conductor track.

Fig. 10 is a transverse cross-sectional view through the hanger as taken along lines 10—10 of Fig. 9.

Figs. 11, 12, 13 and 14 are transverse cross-sectional views through modified forms of insulated conductor tracks.

In detail, the invention is particularly adapted to be employed in connection with a "figure eight" type of conductor track or trolley wire generally designated 1 (Figs. 1, 3). The "figure eight" tubular conductor or trolley track is particularly popular for sliding shoe trolleys because, in cross-section it comprises a pair of generally circular vertically spaced enlarged portions formed from a unitary section of sheet metal which greatly enhances the bending resistance of the conductor track without unduly increasing its weight. Furthermore, a smooth outwardly directed convex surface is provided for engagement by the sliding shoe.

Referring to Fig. 2 the conductor track 1 is generally employed with the longitudinally extending enlarged portions 2, 3 vertically spaced with a relatively thin web 4 integrally connecting said enlarged portions.

The downwardly directed face 5 of the lower enlarged portion 2 is adapted to be slidably engaged by the sliding shoe of the trolley head as will be described subsequently in greater detail.

Insulator

The insulator of the present invention comprises a rigid sheath generally designated 6 which is formed from a plastic insulating material such as polystyrene known generally under the trade-mark "Styron." Polystyrene is particularly desirable in this connection because it may be extruded in one operation to the shape hereinafter described, and in addition it is relatively tough, has good impact strength and is not adversely affected by extremes of temperature. Of course, polystyrene has excellent insulating qualities and in addition is relatively hard and has a relatively high modulus of elasticity.

The sheath 6 is generally inverted U-shape in cross-section providing a pair of opposed sides 7, 8 rigidly connected together by an end wall 9. The thickness of sides 7, 8 and wall 9 is substantially the same but preferably the thickness of wall 9 is slightly less than the remainder of the sheath to permit sides 7, 8 to be moved slightly oppositely outwardly against the inherent resiliency of the sheath. The amount which end wall 9 is bent during such movement is, of course, inversely proportional to its thickness and the resiliency of the sheath may be adjusted by changing the thickness of end wall 9.

Inasmuch as the thickness of the sheath 6 is substantially uniform, it lends itself to manufacture by an extrusion process, a process which is less expensive and more accurate than molding. Furthermore extrusion results in the sheath being extremely uniform in cross-sectional contour and also insures uniform physical characteristics throughout its length.

Adjacent the open side of the sheath which is opposite wall 9 the sides 7, 8 are formed with oppositely inwardly extending projections 11, 12 respectively which are adapted to engage the enlarged portion 2 of conductor 1 along the downwardly directed face 5 of the same when the conductor is inserted in the sheath (Figs. 1, 2).

The marginal portions 13, 14 of sides 7, 8 which are between the projections 11, 12 and the free edges 15, 16 of said sides are provided with opposedly directed faces 17, 18 respectively which converge inwardly of the sheath from said free edges.

The amount of convergence of faces 17, 18 need not be very great but sufficient to facilitate insertion of the conductor 1 through the open side of sheath 6 to the position shown in Figs. 1 and 2.

It will be apparent that the cross-sectional contour of sheath 6 may be readily designed so that the sides 7, 8 are yieldably urged against conductor 1. It will further be apparent that when conductor 1 is pressed between converging faces 17, 18 the sides 7, 8 of the sheath will move oppositely outwardly against the resiliency of the sheath and especially the resiliency of wall 9. By making wall 9 slightly thinner than sides 7, 8, outward movement of the latter may be insured and at the same time the relatively high modulus of elasticity of the polystyrene results in sufficient resistance to such movement to urge the sides 7, 8 against the conductor after the latter has been inserted into the sheath.

At the side of projections 11, 12 opposite free edges 15, 16 of sheath 6 the sides 7, 8 are provided with opposedly opening grooves or channels 19, 20 respectively which are complementarily formed relative to the oppo-

site sides of the enlarged portion 2 of conductor 1 (Fig. 2). The outer faces of sides 7, 8 are complementarily formed relative to channels 19, 20 so as to form oppositely outwardly projecting ridges 21, 22. By this structure, the sides 7, 8 are of substantially uniform thickness between wall 9 and free edges 15, 16.

Along the upper sides of the opposedly opening channels 19, 20 are oppositely inwardly extending projections 23, 24 which enter the oppositely outwardly opening channels 25, 26 respectively formed by web 4 and the enlarged portions 2, 3 of conductor 1. The outer surfaces of sides 7, 8 are complementarily formed relative to projections 23, 24 providing oppositely outwardly opening grooves 55, 56.

The wall 9 which rigidly connects sides 7, 8 along the upper longitudinally extending edges of the latter is preferably formed to a circular arc and merges with the sides 7, 8 to provide a smooth juncture as best seen in Fig. 2. In this manner the arcuate upwardly directed face 27 of the enlarged portion 3 of the "figure eight" conductor 1 is adequately shielded with a minimum of material. The cross-sectional contour of the shield 6 is preferably such that there is a slight space 28 between the upwardly directed face 27 of conductor 1 and the inner surface of wall 9. In this manner the projections 11, 12 on sides 7, 8 will positively engage the downwardly directed face 5 of conductor 1 and serve to space said face a predetermined uniform distance from the free edges 15, 16. It will be understood of course when the conductor 1 is employed in the usual manner with the enlarged portions 2, 3 vertically spaced apart, that the weight of said conductor will be on the projections 11, 12.

In use, when it is desired to assemble conductor 1 and sheath 6 it is merely necessary to place said conductor alongside the open side of sheath 6 with the face 27 of the enlarged portion 3 in engagement with the opposed, inwardly converging faces 17, 18 of sides 7, 8. Upon applying pressure to urge said conductor and sheath together, the enlargement 3 will spread sides 7, 8 apart and enter the space between opposedly opening channels 19, 20. Upon further movement, the enlargement 3 will move inwardly into engagement with wall 9 at which time the enlargement 2 will be between the opposedly directed channels 19, 20. Said channels 19, 20, being formed complementarily to enlargement 2 will tend to urge the latter against projections 11, 12. In addition, when the conductor is positioned with the enlarged portions 2, 3 vertically spaced apart gravity will urge conductor 1 downwardly against said projections 11, 12 thus automatically spacing the downwardly directed face 5 a uniform distance from the free edges 15, 16 of the sides 7, 8.

It will be apparent from the above that the opposedly directed faces 17, 18 of sides 7, 8 cooperate with the face 5 of conductor 1 to form a downwardly opening channel which is adapted to receive the sliding shoe 30 of the collector (Fig. 3) in a manner which will be pointed out subsequently in greater detail.

The insulating sheath of the present invention lends itself to use with hangers, power feeds, connectors and other fittings necessary to the proper installation of trolley systems.

Track connector

Figs. 4–6 illustrate means for connecting two adjacent lengths of the conductor track and an insulating housing for shielding said means and the adjacent portions of the conductor. A pair of elongated metallic straps 33, 34 (Figs. 4, 5) are secured at their opposite ends to the adjacent end portions of conductor lengths 1*a* and 1*b* for structurally and electrically connecting said lengths. The straps 33, 34 are generally channel-shaped in opposed relationship and have vertically extending webs 35, 36 respectively and lower sides 37, 38 adapted to engage the lower portions of the upper enlargement 3 of conductor lengths 1*a* and 1*b* (Fig. 5). The upper sides 39, 40 of straps 33, 34 extend oppositely inwardly to meeting relationship at their free edges and lower sides 37, 38 are urged toward each other into tight engagement with enlarged portion 3 by bolts 41 and nuts 42 at spaced points along the length of straps 33, 34. By tightening bolts and nuts 41, 42 a rigid joint between conductor lengths 1*a* and 1*b* is readily effected, said joint serving also to electrically connect said lengths.

For insulating the straps 33, 34 and the adjacent portions of conductor lengths 1*a* and 1*b* a housing generally designated 45 is provided of rigid insulating material and which housing is preferably split along the longitudinally extending central place of the conductor to form two similar separable portions 45*a* and 45*b* (Figs. 4–6). The housing 45 is formed centrally of its length to shield the straps 33, 34 and is provided with downwardly projecting extensions 47, 48 which are identical in cross-sectional contour to the lower portions of sides 7, 8 of sheath 6 (Fig. 5). Said extensions 47, 48 are substantially coextensive in length with straps 33, 34 and are positioned between and in alignment with the adjacent sections 6*a*, 6*b* of the insulating sheath (Fig. 4). It will be understood of course that the sheath 6 hereinbefore described is cut into sections after the same has been extruded, said sections being assembled on the conductor in longitudinal alignment. Various lengths of the insulating sheath may be cut by a saw as required during assembly.

By the above structure, it will be apparent that a downwardly opening channel is defined by the extensions 47, 48 and the downwardly directed face 5 of the conductor track lengths 1*a* and 1*b*. Said channel is identical in cross-sectional contour to the channel formed by the sheath 6 and the conductor 1 thereby providing a continuous guideway for the sliding brushes of the collector head.

The opposite end portions of the housing 45 extend beyond the ends of straps 33, 34 and are formed to embrace the outer surface of the sheaths 6*a*, 6*b* (Figs. 4, 6). As best seen in Fig. 4 the opposite end portions 49, 50 are each formed with a pair of longitudinally spaced end walls 51, 52 which are formed complementarily to the outer surface of the sheath sections 6*a*, 6*b*. Said end portions are provided along their lower edges with oppositely inwardly projecting ridges 53, 54 (Fig. 6) which are adapted to be received in the complementary formed grooves 55, 56 formed in the opposite sides 7, 8 of sheath 6 (Fig. 2). Bolts 57 and nuts 58 serve to clamp the split end portions 49, 50 to the sections 6*a*, 6*b* respectively of sheath 6.

Power feed connection

The power feed connection (Fig. 7) by which electricity is fed to the conductor 1 comprises a pair of identical metallic clamping jaws 60 which are provided with opposedly opening grooves 61 for receiving the opposite sides of the upper enlarged portion 3 of conductor 1 (Fig. 8). Spaced from grooves 61 are another pair of opposedly opening grooves 62 between which the electrical supply line 63 is adapted to be clamped.

The clamping jaws 60 are apertured to receive bolts 64 therethrough and are formed with oppositely outwardly opening recesses for respectively receiving the heads of bolts 64 and nuts 65. By tightening bolts 64 the jaws 60 may be clamped firmly on the upper enlargement 3 of conductor 1 and at the same time the supply line 63 is clamped between jaws 60 to effect the desired electrical connection (Fig. 8).

The insulating housing 67 is somewhat similar to the connector housing 45 hereinbefore described and includes extensions 69, 70 for engaging opposite sides of the lower enlarged portion 2 of conductor 1 and which extensions are identical in cross-section to the corresponding portions of the sheath 6. In addition end portions 71, 72 are provided for embracing the sheath 6 as hereinbefore described in connection with Figs. 4, 5 and 6.

However, the housing 67 of Figs. 7 and 8 includes axially extending apertures 73 adapted to receive the power supply line 63 therethrough for connection of the same to clamping jaws 60.

Hanger for conductor track

The insulating sheathing 6 is adapted to be engaged by the jaws 75, 76 of a hanger generally designated 77 (Figs. 9, 10). The jaws 75, 76 may be stamped from sheet metal and are connected together at their upper ends by a connecting portion 78 which is provided with a central opening for receiving therethrough a headed bolt 79. A cotter pin 80 or the like may be employed extending between the jaws 75, 76 for retaining the bolt in place with its threaded shank projecting upwardly through said opening. The hanger 77 may be releasably suspended from any suitable support 81 engage-

able by nut 82 on bolt 79 for releasably clamping said support to the hanger 77.

Along the lower edges of jaws 75, 76 the same are provided with oppositely inwardly extending projections or ridges 83, 84 respectively which are adapted to be received in complementarily formed oppositely outwardly opening grooves 55, 56 in the sides 7, 8 of sheath 6.

Bolts 87, extending between jaws 75, 76 are employed with nuts 88 to urge the jaws 75, 76 toward each other with projections 83, 84 seated in grooves 55, 56.

By the above described structure the conductor 1 may be suspended from any fixed structure as desired by any number of hangers 77 at spaced points along the length of the conductor track. It will be noted that the action of hanger 77 is to urge the sides 7, 8 of sheath 6 toward each other thus insuring that the conductor track 1 will be firmly secured within sheath 6 at all times.

The structure of the insulating sheath and its associate connections insures that the sliding shoe 30 of the trolley collector head 31 is in engagement with the downwardly directed face 5 of conductor track 1 at all times. It will be noted in this connection that the shape of sides 7, 8 of conductor track 1 is such that the trolley head is positively guided at all times. Thus with reference to Fig. 3 it will be apparent that the cheeks or side plates 91, 92 of trolley collector head 31 are prevented from undergoing undue lateral movement by the sides 7, 8 of sheath 6.

Modified forms of conductor tracks

The insulating sheath and its associated apparatus has heretofore been described in connection with a "figure eight" type of conductor track. A somewhat similar type of sheath 95 is illustrated in Fig. 11 wherein a "T type" conductor track 96 is illustrated in cross-section. The sides 97, 98 of sheath 95 are similar to sides 7, 8 of sheath 6 except that the same are spaced more closely together at the closed side of the shield so as to conform to the cross-sectional contour of the web 99 of conductor 96.

Obviously a somewhat similar construction may be employed to insulate a conventional conductor of circular cross-section such as indicated at 100 in Fig. 12. In such case the sheath 101 may engage the outer surface of the conductor 100 so that the marginal portions 103, 104 are disposed relative to the downwardly directed face of the conductor in the same manner as marginal portions 13, 14 of sheath 6 (Fig. 2) as hereinbefore described.

In some cases, it may be desirable to modify the conductor along its lower side in order to overcome any tendency of the sliding shoe to move to a position closer to one of the sides 7, 8 than the other. To this end the conductor may be formed with a slightly concavely curved downwardly directed face such as indicated at 102, Fig. 13. If the conductor structure of Fig. 13 is followed, it is preferable to form the upwardly directed face of the sliding shoe complementary as at 105 (Fig. 13).

To enhance the current carrying capacity of the conductor the same may be cast solid as has been done heretofore. However, inasmuch as the tubular type of conductor illustrated in Fig. 2 is extremely simple and inexpensive to make, it is preferable that longitudinally extending wires 93, 94 be enclosed within the enlargements 2, 3 respectively as seen in Fig. 14. This structure lends itself to a type of track connector which will be more fully described later on in detail.

It is to be understood that the particular detailed description of the invention above made is not to be taken as restrictive of the same, but merely the preferred form thereof. It is obvious that various modifications in design may be made without departing from the spirit of the invention as described in the following claims.

We claim:

1. An insulator for a longitudinally extended electrical conductor providing a downwardly directed face for engagement by the sliding shoe of a collector, said insulator being formed from a relatively tough material having a relatively high modulus of elasticity and a relatively low coefficient of friction and comprising: an elongated, highly elastic sheath of insulating material generally inverted U-shape in cross sectional contour providing a pair of opposed, vertically disposed sides, a wall connecting said sides along their upper edges, and a lower open side opposite the said wall, said sides being formed with longitudinally extending, oppositely inwardly extending projections spaced upwardly from the free edges of said sides for engaging said conductor adjacent said face for fixedly positioning said conductor in said sheath with said face spaced above and between said free edges, the inherent resiliency of said sheath being sufficient to alone yieldably urge said projections into said engagement to so retain said conductor, the spacing between said projections being sufficient to permit insertion of said conductor by only slightly spreading said sides against the inherent resiliency of said sheath, and the outer surfaces of said sides being formed with oppositely outwardly opening grooves spaced upwardly from said projections, and a hanger removably secured to said sheath for suspending the latter from a support and comprising a pair of opposed jaws having oppositely inwardly projecting ribs adapted to be received in said grooves.

2. An insulator for a longitudinally extended electrical conductor providing a downwardly directed face for engagement by the sliding shoe of a collector, said insulator being formed from a relatively tough material having a relatively high modulus of elasticity and a relatively low coefficient of friction and comprising: an elongated highly elastic sheath of insulating material generally inverted U-shape in cross sectional contour, providing a pair of opposed, vertically disposed sides, a wall connecting said sides along their upper edges, and a lower open side opposite the said wall, said sides being formed with longitudinally extending, oppositely inwardly opening, channels for embracing and retaining said conductor therein with said face spaced above and between the free edges of said sides, the inherent resiliency of said sheath being sufficient to alone so retain said conductor, said channels being sufficiently shallow to permit insertion of said conductor by only slightly spreading said sides against the resiliency of said sheath, said sheath being sufficiently hard and smooth to permit longitudinal shifting between said conductor and said sheath without substantial frictional resistance, the outer surfaces of said sides being formed with oppositely outwardly opening grooves spaced upwardly from the lower edges of said channels, and a hanger removably secured to said sheath for suspending the latter from a support and comprising a pair of opposed jaws having oppositely inwardly projecting ribs adapted to be received in said grooves.

3. An insulator for a horizontally extended electrical conductor having an enlarged portion extending longitudinally thereof along its lower edge and providing a downwardly directed face for engagement by the sliding shoe of a collector, said insulator being formed from a relatively tough material having a relatively high modulus of elasticity and a relatively low coefficient of friction and comprising: an elongated, highly elastic sheath of insulating material generally inverted U-shape in cross sectional contour providing a pair of opposed, vertically disposed sides, a wall connecting said sides along their upper edges, and a lower open side opposite the said wall, said sides being formed with longitudinally extending, oppositely inwardly extending projections spaced upwardly from the free edges of said sides for engaging said enlarged portion of said conductor adjacent said face for fixedly positioning said enlarged portion in said sheath with said face spaced above and between said free edges, the inherent resiliency of said sheath being sufficient to alone yieldably urge said projections into said engagement to so retain said enlarged portion, the spacing between said projections being sufficient to permit insertion of said enlarged portion by only slightly spreading said sides against the inherent resiliency of said sheath, the marginal portions of said sides between said projections and said free edges being formed to provide opposedly directed surfaces converging inwardly from said free edges to assure said sliding shoe retaining contact with said conductor through said open side, and the outer surfaces of said sides being formed with oppositely outwardly opening grooves spaced upwardly from said projections, a hanger removably secured to said sheath for suspending the latter from a fixed support and comprising a pair of resiliently connected, opposed jaws having oppositely inwardly projecting ribs thereon adapted to be received in said grooves, said grooves being sufficiently shallow to permit insertion of said ribs in said grooves by only slightly spreading said jaws apart against the resil-

iency thereof, the resiliency of said hanger being sufficient to alone so suspend said sheath and said conductor, and a tightening member for rigidly securing said hanger to said sheath.

References Cited in the file of this patent

UNITED STATES PATENTS

427,221	Boynton	May 6, 1890
440,789	Cushing	Nov. 18, 1890
445,103	Vogler	Jan. 20, 1891
457,105	Boynton	Aug. 4, 1891
457,377	Short	Aug. 11, 1891
463,760	Sargent	Nov. 24, 1891
490,297	Miner	Jan. 24, 1893
532,796	Lewis	Jan. 22, 1895
1,181,477	Ozanich	May 2, 1916
1,357,454	Hellyer	Nov. 2, 1920
1,398,005	Colabrese	Nov. 22, 1921
2,155,242	Ryan	Apr. 18, 1939
2,304,720	Wehr	Dec. 2, 1942
2,324,993	Kubaugh	July 20, 1943
2,413,061	McKee et al.	Dec. 24, 1946
2,422,132	Saiter	June 10, 1947
2,428,957	Benbow	Oct. 14, 1947
2,668,199	Connell	Feb. 2, 1954