March 20, 1951 S. I. LINDELL 2,546,074

TERMINAL CONSTRUCTION FOR FUSES AND THE LIKE

Filed June 2, 1949

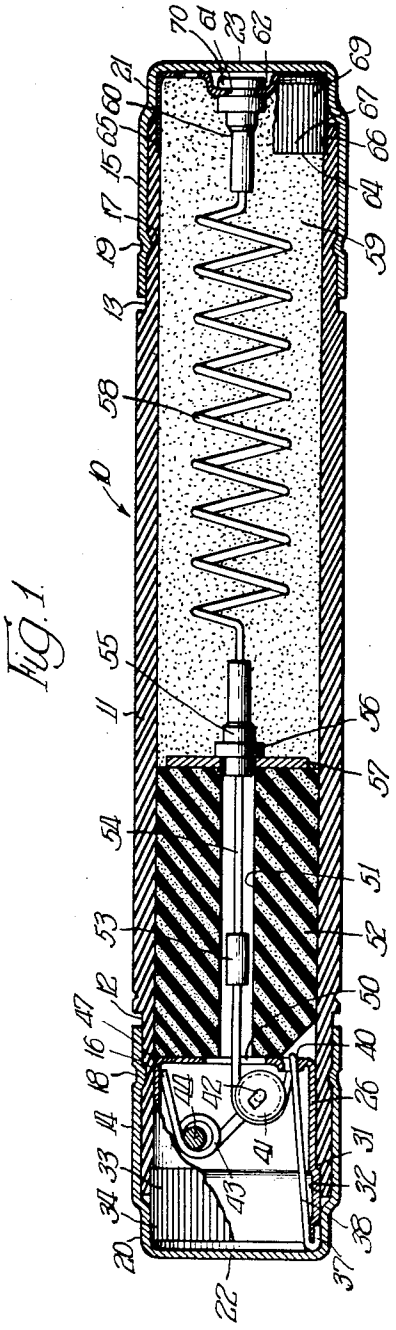

Fig. 1.

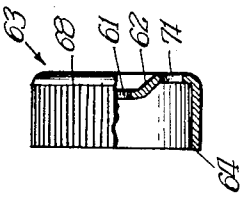

Fig. 5.

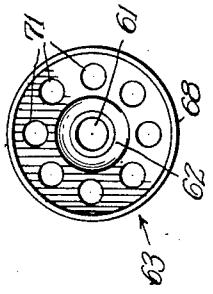

Fig. 4.

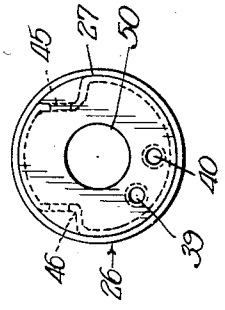

Fig. 3.

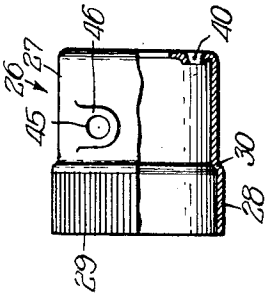

Fig. 2.

INVENTOR.
Sigurd I. Lindell,
BY
Robert R. Lockwood
Atty.

Patented Mar. 20, 1951

2,546,074

UNITED STATES PATENT OFFICE

2,546,074

TERMINAL CONSTRUCTION FOR FUSES AND THE LIKE

Sigurd I. Lindell, Chicago, Ill., assignor to S & C Electric Company, Chicago, Ill., a corporation of Delaware

Application June 2, 1949, Serial No. 96,652

15 Claims. (Cl. 200—131)

1

This invention relates generally to electric fuses, and it has particular relation to the construction and assembly of the terminals or ferrules at the ends of tubular fuse housings or the like.

Among the objects of this invention are: To avoid the use of solder in interconnecting the end terminals or ferrules at the ends of a fuse housing and the conductor within the same which includes a fusible section; to interlock the ferrules and the fuse housing at each end of the latter; to close the ends of the fuse housing in such manner as to resist internal stress resulting from high pressure created on blowing of the fusible section; to employ an inner and an outer ferrule as each end of the housing with knurling to provide intimate electrical and mechanical engagement therebetween without requiring close tolerances; to locate the knurling externally on each inner ferrule for mechanically engaging the fuse housing to prevent relative turning; and to construct the various parts so that the fuse assembly can be readily and economically manufactured.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof shown in the accompanying drawing and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention, reference may be had to the following detailed description, taken together with the accompanying drawing, in which:

Figure 1 is a longitudinal sectional view of a fuse construction in which the present invention is embodied;

Figure 2 is a view, partly in side elevation and partly in section, of one of the inner ferrules;

Figure 3 is an end view of the ferrule shown in Figure 2;

Figure 4 is a view, in end elevation, of the inner ferrule for the other end of the fuse tube; and

Figure 5 is a view, partly in side elevation and partly in section of the other inner ferrule shown in Figure 4.

Referring now to the drawing, it will be observed that the reference character 10 designates, generally, a fuse device certain portions of which

2

are illustrated and described in Lindell Patent No. 2,323,229 issued June 29, 1943, and assigned to the assignee of this application. The fuse device 10 includes a tubular fuse housing 11 of suitable insulating material such as fibre. Its ends 12 and 13 are reduced in diameter for receiving outer ferrules 14 and 15, respectively, which are formed of hard drawn copper tubing. The ends 12 and 13 are cut away an extent equal to the thickness of the walls of the ferrules 14 and 15 so that their outer diameter is the same as the outer diameter of the intermediate portion of the tubular fuse housing 11. It will be noted that annular grooves 16 and 17 are provided intermediate the cut away end surfaces 12 and 13 for receiving radially inwardly extending ribs 18 and 19 which are formed after the ferrules 14 and 15 are positioned on the ends of the tubular fuse housing 11 by suitable deforming means such as rolling dies. It will be noted also that the end portions 20 and 21 of the ferrules 14 and 15 are reduced in diameter and that the ends 22 and 23 are closed. This construction together with the ribs 18 and 19 rolled into the grooves 16 and 17 provides an assembly which is capable of resisting the stresses usually set up within the housing 11 when the fuse blows.

Within the left hand end of the tubular fuse housing 11, as viewed in Figure 1, there is a cup-shaped inner ferrule 26 that is formed preferably of hard drawn copper. Its construction is illustrated in more detail in Figures 2 and 3. It has an inner small diameter portion 27 which, as shown in Figure 1, interfits with the adjacent end of the tubular fuse housing 11. Also it has an outer diameter portion 28 which is externally longitudinally knurled as indicated at 29. An annular shoulder 30 is provided between the portions 27 and 28 and it is arranged to bear against a corresponding annular shoulder 31 at the inner end of a recessed inner end surface 32 of the tubular fuse housing 11.

The externally longitudinally knurled portion 29 on the inner ferrule 26 cooperates with the tubular fuse housing 11 and the outer ferrule 14 to prevent relative turning therebetween. It will be noted that the inner portion 33 of the knurling 29 is coextensive with the recessed inner end surface 32 and that this knurled portion bites into this surface so that intimate mechanical engagement therewith is obtained. This is accomplished by having the outer diameter of the portion 28 of the ferrule 26 slightly larger than the inner diameter of the recessed inner end surface

32 and then forcing the ferrule 26 into position so that its shoulder 30 engages the shoulder 31.

Thereafter the outer ferrule 14 is forced into place and, since the inner diameter of the end portion 29 of the outer ferrule 14 is slightly less than the external diameter of the portion 28 of the inner ferrule 26, both electrical and mechanical engagement is provided therebetween. The line contact provided by the knurled portion 34 insures a low electrical resistance joint between the ferrules 26 and 14 without requiring the use of solder. At the same time intimate mechanical engagement between these parts prevents the outer ferrule 14 from turning with respect to the inner ferrule 26.

The outer ferrules 14 and 15 are interconnected by a conductor which includes a fusible section. One end 37 of this conductor which includes a flexible conductor 38 extends through openings 39 and 40, Figure 3, in the bottom of the inner ferrule 26 and is positioned, as shown in Figure 1, between the outer end of the inner ferrule 26 and the end portion 29. The construction is such that this end 37 of the flexible conductor 38 is both mechanically and electrically engaged under pressure between these parts and thus the desired electrical contact therewith is provided.

Flexible conductor 38 extends over a pulley 41 which is rotatably mounted on an arm 42 at one end of a tension spring 43 which is carried by a shaft 44 that extends transversely of the ferrule 26 through bearing openings 45 in recessed portions 46 therein. The other end 47 of the tension spring 43 bears against the inner end of the inner ferrule 26 as shown more clearly in Figure 1. The pulley 41 and tension spring 43 are provided for tensioning the conductor 38 in the manner described in the aforesaid Lindell patent.

It will be observed that the flexible conductor 38 extends from the inner ferrule 26 through a central opening 50 in the bottom thereof into a bore 51 of a block 52 of arc extinguishing material such as boric acid. The flexible conductor 38 is connected by a terminal sleeve 53 to one end of a fusible section 54 in the form of a strain wire. It will be understood that the fusible section 54 is calibrated to blow under certain time and current conditions which need not be described in detail here. The other end of the fusible section 54 extends into a terminal 55 which has an intermediate flange 56 that bears against a washer 57 which is located at the inner end of the block 52 of arc extinguishing material. It will be understood that the tension spring 43 is restrained by the flange 56 bearing against the washer 57 through the connection thereto by the flexible conductor 38 and the fusible section 54. In this manner the block 52 of arc extinguishing material is placed in compression.

Within the tubular fuse housing 11 and beyond the block 52 of arc extinguishing material there is a resistor 58 which is in the form of a coil of hard drawn tungsten wire. One end of the resistor 58 is connected to the terminal 55. The resistor 58 is embedded in a filling 59 of marble dust and its other end is connected to a terminal 60. The functioning of the resistor 58 formed of a coil of tungsten wire with the marble dust filling 59 and the interaction thereof with the fusible section 54 are described in detail in the aforesaid Lindell patent and will not be repeated here.

It will be observed that the terminal 60, which is identical in construction with the terminal 55, extends through an opening 61 in a central recessed portion 62 of an inner ferrule 63 which is shown more clearly in Figures 4 and 5 of the drawings. The inner ferrule 63 preferably is formed of hard drawn copper and its inner edge 64 bears against an annular shoulder 65 of the tubular fuse housing 11. The annular shoulder 65 is located at the inner end of a recessed inner end surface 66 of the tubular fuse housing 11 which is coextensive with the inner portion 67 of external longitudinal knurling 68 on the inner ferrule 63. Like the inner ferrule 26 described above, the outer diameter of the inner ferrule 63 is somewhat larger than the diameter of the inner end surface 66 so that, when the inner ferrule 63 is forced into the end of the tubular fuse housing 11, the knurled portion 67 bites into the surface 66 and is thereby held against turning. The outer portion 69 of the longitudinal knurling 68 has intimate electrical and mechanical engagement with the inner surface of the reduced diameter end portion 21 of the outer ferrule 15. This not only provides electrical connection between these parts without requiring the use of solder but also it provides intimate mechanical engagement so as to prevent relative turning.

The outer end of the terminal 60 is headed over as indicated at 70 so as to hold it in position on the inner ferrule 63 and to provide good mechanical and electrical connection thereto. Openings 71 are provided in the inner ferrule 63 to permit the entrance of the marble dust filling 59 after assembly and prior to application of the outer ferrule 15.

In assembling the fuse device 10, the fusible section 54 is first joined to one end of the flexible conductor 38 by the terminal sleeve 53. The latter is deformed onto the ends of these elements. Thereafter, the resistor 58 with the terminals 55 and 60 deformed onto its ends is aligned with the fusible section 54 and one end of the terminal 55 is deformed onto its free end. Next the tension spring 43 and the pulley 41 are assembled within the inner ferrule 26, the spring 43 being carried by the shaft 44. The previously assembled flexible conductor 38 and the fusible section 54 are threaded through the washer 11 and the block 52 of arc extinguishing material which is located adjacent the inner ferrule 26. The flexible conductor 38 is threaded through the opening 50 in the bottom of the ferrule 26, around the pulley 41, which may be held in the position shown in Figure 1 by a special tool, through the openings 40 and 39, and the end 37 then is hooked over the outer end of the inner ferrule 26. When the special tool is removed the spring 43 places the fusible section 54 in tension and the block 52 of arc extinguishing material in compression.

The parts assembled as just described are positioned in the tubular fuse housing 11 through the left hand end and the inner ferrule 26 is forced inwardly until its annular shoulder 30 engages the annular shoulder 31. Thereafter the terminal 60 is pulled out of the other end of the tubular fuse housing 11 and the other inner ferrule 63 is secured thereto by the headed over portion 70. After this has been done the inner ferrule 63 is forced into the right hand end of the tubular fuse housing 11 until its inner edge 64 engages the shoulder 65.

Now the external ferrule 14 is forced over the left hand end 12 of the tubular fuse housing 11 with which it has a press fit until it is stopped by the reduced diameter end portion 20 engaging the end of the fuse housing 11. This completely

closes the left hand end of the tubular fuse housing 11.

The space around the resistor 58 within the tubular fuse housing 11 now is filled with marble dust 59 through the openings 71 in the inner ferrule 63. Thereafter the outer ferrule 15 is forced over the right hand end 13 of the tubular fuse housing 11 with which it has a press fit until its reduced diameter end portion 21 engages the end of the fuse housing 11. Finally both of the outer ferrules 14 and 15 are deformed by rolling to provide the radially inwardly extending ribs 18 and 19 which project into the annular grooves 16 and 17, respectively, so as to hold the ferrule assemblies at the ends of the tubular fuse housing 11 from endwise movement.

It will be noted that the ends of the fibre fuse housing 11 are positioned between the inner portions 33 and 67 of the inner ferrules 26 and 63 and the outer ferrules 14 and 15. This construction insures that the ends of the housing 11 cannot expand on absorbing moisture and move away from the inner ferrules 26 and 63 since these portions thereof are held in compression.

When the knurled construction is employed for the inner ferrules 26 and 63, as described, it is unnecessary to hold the tolerances of these ferrules and the outer ferrules 14 and 15 as close as would otherwise be required if the knurling were omitted and reliance were placed on merely a press fit therebetween. This materially reduces the cost of manufacture and, at the same time, increases the speed of assembly. The longitudinal knurling bites into the end surfaces 32 and 66 and also into the inner surfaces of the end portions 20 and 21 of the outer ferrules 14 and 15.

Multiple line contact under pressure is established by the knurled surfaces 29 and 68 of the inner ferrules 26 and 63 with the smooth inner surfaces of the outer ferrules 14 and 15 with which they have a press fit. If desired, the outer cylindrical surfaces of the inner ferrules 26 and 63 can be smooth and the inner cylindrical surfaces of the outer ferrules 14 and 15 can be knurled to provide the intimate mechanical and electrical engagement therebetween and the mechanical engagement with the ends of the housing 11.

Since certain changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawing and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. In a fuse construction, in combination, a tubular insulating housing, an externally longitudinally knurled inner ferrule extending into each end of said housing with the longitudinal knurling biting into the inner end surface of said housing and extending beyond the ends thereof, a conductor including a fusible section extending through said housing and electrically interconnecting said inner ferrules, and an outer ferrule telescoped over each end of said housing, the outer end portion of each outer ferrule being reduced in diameter so that the longitudinal knurling on each inner ferrule bites into the inner surface of the outer ferrule, the longitudinally knurled portions of said inner ferrules providing intimate electrical and mechanical engagement between them and the outer ferrules and intimate mechanical engagement between them and said housing whereby the electrical resistance at the joint between each inner and outer ferrule is reduced and both ferrules at each end are prevented from turning relative to each other and to said housing.

2. The invention, as set forth in claim 1, wherein one end of the conductor is positioned between one inner ferrule and the corresponding outer ferrule and is mechanically gripped thereby to provide a low electrical resistance therebetween.

3. The invention, as set forth in claim 2, wherein a terminal is provided on the other end of the conductor and it is secured by deformation to the other inner ferrule.

4. In a fuse construction, in combination, a tubular insulating housing, an externally longitudinally knurled inner ferrule extending into each end of said housing with the longitudinal knurling biting into the inner end surface of said housing and extending beyond the ends thereof, a conductor including a fusible section extending through said housing and electrically interconnecting said inner ferrules, and an outer ferrule closed at one end and telescoped over each end of said housing, the closed end portion of each outer ferrule being reduced in diameter so that the longitudinal knurling on each inner ferrule bites into the inner surface of the outer ferrule, the longitudinally knurled portions of said inner ferrules providing intimate electrical and mechanical engagement between them and the outer ferrules and intimate mechanical engagement between them and said housing whereby the electrical resistance at the joint between each inner and outer ferrule is reduced and both ferrules at each end are prevented from turning relative to each other and to said housing.

5. In a fuse construction, in combination, a tubular insulating housing with the inner portion of each end recessed to provide an annular shoulder, an externally longitudinally knurled inner ferrule extending into each end of said housing and bearing against the shoulder thereat with the longitudinal knurling biting into the inner end surface of said housing and extending beyond the ends thereof, a conductor including a fusible section extending through said housing and electrically interconnecting said inner ferrules, and an outer ferrule closed at one end and telescoped over each end of said housing, the closed end portion of each outer ferrule being reduced in diameter so that the longitudinal knurling on each inner ferrule bites into the inner surface of the outer ferrule, the longitudinally knurled portions of said inner ferrules providing intimate electrical and mechanical engagement between them and the outer ferrules and intimate mechanical engagement between them and said housing whereby the electrical resistance at the joint between each inner and outer ferrule is reduced and both ferrules at each end are prevented from turning relative to each other and to said housing.

6. In a fuse construction, in combination, a tubular insulating housing with the inner portion of each end recessed to provide an annular shoulder and having an external annular groove near each end, an externally knurled inner ferrule extending into each end of said housing and bearing against the shoulder thereat with the knurling biting into the inner end surface of said housing and extending beyond the ends thereof, a conductor including a fusible section extending through said housing and electrically interconnecting said inner ferrules, and an outer ferrule closed at one end and telescoped over each end

of said housing and having a radially inwardly extending rib interfitting with said annular groove thereat, the closed end portion of each outer ferrule being reduced in diameter so that the knurling on each inner ferrule bites into the inner surface of the outer ferrule, the knurled portions of said inner ferrules providing intimate electrical and mechanical engagement between them and the outer ferrules and intimate mechanical engagement between them and said housing whereby the electrical resistance at the joint between each inner end and outer ferrule is reduced and both ferrules at each end are prevented from turning relative to each other and to said housing.

7. In a fuse construction, in combination, a tubular insulating housing with the inner portion of each end recessed to provide an annular shoulder and having an external annular groove near each end, an externally knurled inner ferrule extending into each end of said housing and bearing against the shoulder thereat with the knurling biting into the inner end surface of said housing and extending beyond the ends thereof, a conductor including a fusible section extending through said housing and electrically interconnecting said inner ferrules, and an outer ferrule closed at one end and telescoped over each end of said housing and having a radially inwardly extending rib interfitting with said annular groove thereat, the closed end portion of each outer ferrule being reduced in diameter so that the knurling on each inner ferrule bites into the inner surface of the outer ferrule, the knurled portions of said inner ferrules providing intimate electrical and mechanical engagement between them and the outer ferrules and intimate mechanical engagement between them and said housing whereby the electrical resistance at the joint between each inner and outer ferrule is reduced and both ferrules at each end are prevented from turning relative to each other and to said housing, the end portions of said housing being reduced an amount corresponding to the thickness of each outer ferrule whereby the external diameter thereof is the same as that of the intermediate portion of said housing.

8. In a fuse construction, in combination, a tubular insulating housing, an externally longitudinally knurled inner ferrule extending into one end of said housing with the longitudinal knurling biting into the inner end surface and extending beyond said end thereof, a conductor including a fusible section extending through said housing and electrically connected to said inner ferrule, and an outer ferrule telescoped over said end of said housing, the outer end portion of said outer ferrule being reduced in diameter so that the longitudinal knurling on said inner ferrule bites into the inner surface thereof, the longitudinal knurled portion of said inner ferrule providing intimate electrical and mechanical engagement between it and said outer ferrule and intimate mechanical engagement between it and said housing whereby the electrical resistance at the joint between said inner and outer ferrules is reduced and both ferrules are prevented from turning relative to each other and to said housing.

9. The invention, as set forth in claim 8, wherein one end of the conductor is positioned between the ferrules and is mechanically gripped thereby to provide a low electrical resistance therebetween.

10. The invention, as set forth in claim 8, wherein a terminal is provided on one end of the conductor and it is secured by deformation to the inner ferrule.

11. In a fuse construction, in combination, a tubular insulating housing, an externally longitudinally knurled inner ferrule extending into one end of said housing with the longitudinal knurling biting into the inner end surface and extending beyond said end thereof, a conductor including a fusible section extending through said housing and electrically connected to said inner ferrule, and an outer ferrule closed at one end and telescoped over said end of said housing, the closed end portion of said outer ferrule being reduced in diameter so that the longitudinal knurling on said inner ferrule bites into the inner surface thereof, the longitudinally knurled portion of said inner ferrule providing intimate electrical and mechanical engagement between it and said outer ferrule and intimate mechanical engagemen between it and said housing whereby the electrical resistance at the joint between said inner and outer ferrules is reduced and both ferrules are prevented from turning relative to each other and to said housing.

12. In a fuse construction, in combination, a tubular insulating housing with the inner portion of one end recessed to provide an annular shoulder, an externally longitudinally knurled inner ferrule extending into said end of said housing and bearing against said shoulder with the longitudinal knurling biting into the inner end surface and extending beyond said end thereof, a conductor including a fusible section extending through said housing and electrically connected to said inner ferrule, and an outer ferrule closed at one end and telescoped over said end of said housing, the closed end portion of said outer ferrule being reduced in diameter so that the longitudinal knurling on said inner ferrule bites into the inner surface thereof, the longitudinally knurled portion of said inner ferrule providing intimate electrical and mechanical engagement between it and said outer ferrule and intimate mechanical engagement between it and said housing whereby the electrical resistance at the joint between said inner and outer ferrules is reduced and both ferrules are prevented from turning relative to each other and to said housing.

13. In a fuse construction, in combination, a tubular insulating housing with the inner portion of one end recessed to provide an annular shoulder and having an external annular groove near said end, an externally knurled inner ferrule extending into said end of said housing and bearing against said shoulder with the knurling biting into the inner end surface and extending beyond said end thereof, a conductor including a fusible section extending through said housing and electrically connected to said inner ferrule, and an outer ferrule closed at one end and telescoped over said end of said housing and having a radially inwardly extending rib interfitting with said annular groove, the closed end portion of said outer ferrule being reduced in diameter so that the knurling on said inner ferrule bites into the inner surface thereof, the knurled portion of said inner ferrule providing intimate electrical and mechanical engagement between it and said outer ferrule and intimate mechanical engagement between it and said housing whereby the electrical resistance at the joint between said inner and outer ferrules is reduced and both ferrules are prevented from turning relative to each other and to said housing.

14. In a fuse construction, in combination, a

tubular insulating housing with the inner portion of one end recessed to provide an annular shoulder and having an external annular groove near said end, an externally knurled inner ferrule extending into said end of said housing and bearing against said shoulder with the knurling biting into the inner end surface and extending beyond said end thereof, a conductor including a fusible section extending through said housing and electrically connected to said inner ferrule, and an outer ferrule closed at one end and telescoped over said end of said housing and having a radially inwardly extending rib interfitting with said annular groove, the closed end portion of said outer ferrule being reduced in diameter so that the knurling on said inner ferrule bites into the inner surface thereof, the knurled portion of said inner ferrule providing intimate electrical and mechanical engagement between it and said outer ferrule and intimate mechanical engagement between it and said housing whereby the electrical resistance at the joint between said inner and outer ferrules is reduced and both ferrules are prevented from turning relative to each other and to said housing, the end portion of said housing being reduced an amount corresponding to the thickness of said outer ferrule whereby the external diameter thereof is the same as that of the intermediate portion of said housing.

15. In a fuse construction, in combination, a tubular insulating housing, an inner ferrule extending into each end of said housing with a

portion extending beyond the ends thereof, a conductor including a fusible section extending through said housing and electrically interconnecting said inner ferrules, and an outer ferrule telescoped over and having a press fit with each end of said housing and the inner ferrule thereat, the outer end portion of each outer ferrule being reduced in diameter, one of the juxtaposed surfaces of the ferrules at each end of said housing being longitudinally knurled thereby providing intimate electrical and mechanical engagement between them and intimate mechanical engagement with said housing whereby the electrical resistance at the joint between each inner and outer ferrule is reduced and both ferrules at each end are prevented from turning relative to each other and to said housing.

SIGURD I. LINDELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,502,883	Sandin	July 20, 1924
1,517,981	Grieve	Dec. 2, 1924
1,540,000	Glowacki	June 2, 1925
1,907,740	Clark	May 9, 1933
2,108,550	Rawlins	Feb. 15, 1938
2,416,428	Boothe	Feb. 25, 1947