

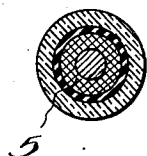
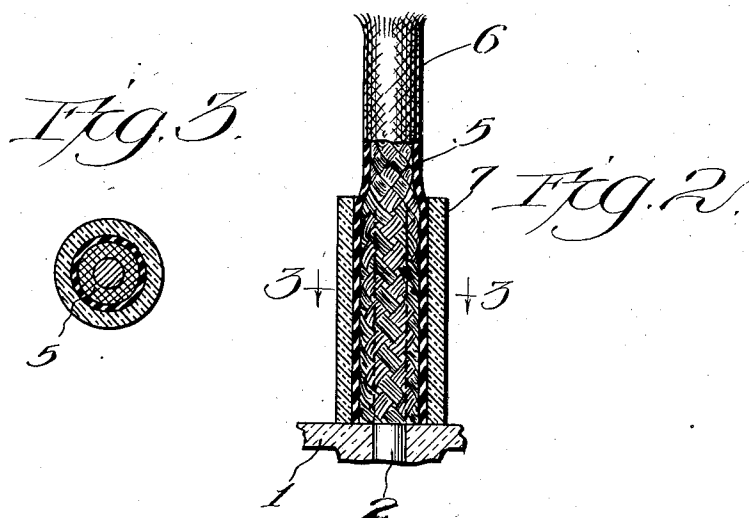
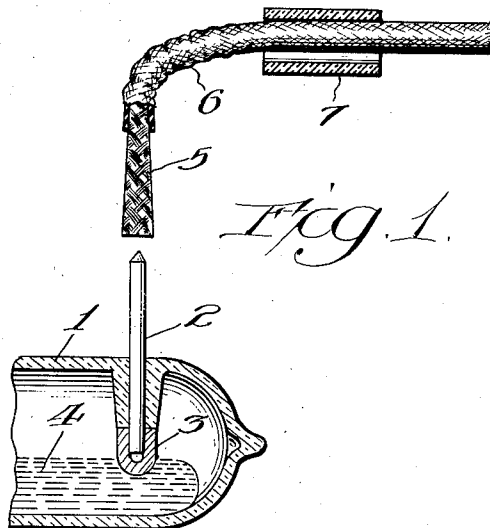
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R. W. ARMSTRONG ET AL

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JOINT BETWEEN ELECTRICAL CONDUCTORS

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Inventors:

R. W. Armstrong & Co.

J. E. Mc Cabe,

By Wm. F. Freudenreich, Atty

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UNITED STATES PATENT OFFICE.

RAYMOND W. ARMSTRONG AND IRA E. McCABE, OF CHICAGO, ILLINOIS.

JOINT BETWEEN ELECTRICAL CONDUCTORS.

Original application filed December 16, 1922, Serial No. 607,303. Divided and this application filed October 22, 1924. Serial No. 745,149.

The present application is a division of our prior application, Serial No. 607,303 filed December 16, 1922, and entitled "Mercury switch."

into such tubular conductors, a connection which is to all intents and purposes perfect can be obtained.

A flexible tubular conductor, made of a large number of fine wires and having the same current-carrying capacity as that of one of the solid leading-in wires will normally assume a condition in which the internal diameter thereof will be much smaller than the diameter of the leading-in wire. Therefore, the end of the tubular conductor which is to receive the leading-in wire must be opened to a larger diameter than that of the main body of the flexible conductor and, after the leading-in wire has been inserted and the solder applied, that portion of the flexible conductor just beyond the end of the leading-in wire will assume a bottle-neck shape, largest at the base and decreasing gradually in diameter as the distance from the leading-in wire increases. As a result, the flexible conductor will naturally bend at a point remote from the soldered joint and there will be no tendency to sharp or abrupt bends. In other words, the enlarged base of the bottle-neck stiffens and reinforces the flexible conductor adjacent to the soldered joint where ordinarily weakness occurs and, because the virgin portions of the flexible conductor at and beyond the small end of the bottle-neck are more flexible than that portion at the base, and because there is a gradual tapering of the tubular structure from the soldered joint outward, the bending will not only occur at a point remote from the joint but will be gradual and on a curve of large radius; thus avoiding such strains at any point that crystallization will occur even after the conductor has been flexed millions of times.

The various features of novelty whereby our invention or discovery is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of our invention or discovery and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawing, wherein:

Figure 1 is a view partly in elevation and partly in section illustrating the condition of the parts as the flexible conductor is about to be attached to one of the leading-in wires of a mercury switch; Fig. 2 is a longitudinal section through the completed connection be-

Switches of the kind disclosed in the aforesaid application are operated by tilting them to produce a movement of a small body of mercury and, in order that the switches may be sensitive to small forces tending to tilt the same, the conductors leading therefrom should be very flexible. Furthermore, mercury switches have been developed to such a degree that they will function almost indefinitely. Consequently the conductors connected therewith, in order to possess a length of life at all comparable to that of the switches themselves must be of such a nature that they will not only be very flexible but will also have the capacity long to withstand the stresses to which they are subjected, in flexing, without breaking or crystallizing. The flexible conductors must be soldered to the leading-in wires in order to produce a permanent connection of good electrical conductivity. If a conductor, no matter of what character, is laid against the side of one of the stiff leading-in wires and is soldered thereto, the natural point of flexing, during the operation of the switch, is close to the end of the soldered joint. During the soldering operation, however, the metal of the flexible conductor is annealed in the vicinity of the soldered joint, by the soldering heat, and the flexible conductor is therefore weakest at the point where the greatest stresses occur during flexing. Not only in the case of mercury switches, but in all kinds of electrical devices having flexible conductors leading thereto, great difficulty has always been experienced on account of frequent breakage of the flexible connections close to the soldered joints.

The object of the present invention is to produce a simple and novel flexible connection to a lead-in wire, or other wire, which will insure perfect conductive continuity and high capacity for carrying current, a maximum degree of flexibility, and great durability.

We have discovered that by making a conductor in the form of a tube of fine wire braided together, or a plurality of such tubes arranged one within the other, and properly fitting the outer end of the leading-in wire

tween the leading-in wire and the flexible conductor and Fig. 3 is a section taken approximately on line 3—3 of Fig. 2.

Referring to the drawing, 1 represents the glass tube of a mercury switch through one wall of which extends a comparatively stiff lead-in wire 2 having at the inner end an enlarged head 3 adapted at times to engage with a body of mercury 4; the member 1 being preferably made of glass. The flexible conductor 5 is tubular in form and is made of fine wires braided together so that when the conductor is stretched, in the course of manufacture, the internal bore becomes small and practically disappears. This tubular member may be made of any desired number of individual tubes arranged one within the other and it is covered with a suitable sheathing 6 of insulating material of any usual or suitable type that will not interfere with the flexibility of the conductor. By making the conductor out of many fine wires braided together, it will be extremely flexible, while the stresses to which the individual fine wires are subjected are small as the fine wires braided together permit a flexing through an adjustment of the wires in the tubular conductor, instead of through a sharp bending of any single wire.

When the connection is to be made to the leading-in wire, the sheathing is first pushed back as indicated in Fig. 1 so as to expose a portion of one end of the metallic core. A pin or other device is then inserted into the end of the tubular core or conductor so as to spread or expand the same to a diameter large enough to permit the leading-in wire to be inserted. The tubular conductor is pushed down over the leading-in wire, preferably until it engages with the wall of the switch tube or housing. Solder is then applied to the exterior of that portion of the tubular conductor that surrounds the protruding end of the leading-in wire. Because of the nature of the tubular conductor, the solder finds ready entrance through the interstices in the same to the surface of the leading-in wire and therefore a perfect joint can readily be made. As heretofore stated, the normal internal diameter of the flexible conductor is small and therefore this member tends to contract to its natural size immediately beyond the end of the leading-in wire and consequently assumes the shape of a bottle-neck, the larger end of which is at the outer end of the leading-in wire. After the solder has been applied, the insulating covering is drawn back into place, concealing the soldered joint. A sleeve 7 of insulating material is then sealed along the sheathed conductor until one end engages with the wall of the switch tube. This sleeve is preferably of about the same length as the joint that is, of about the same length as the projecting portion of the leading-in

wire, and it preferably has an internal diameter such that the sleeve will fit tightly upon the enlarged sheathed end of the tubular conductor. The sleeve thus conceals the frayed end of the sheathing and, if it is made somewhat stiff, it compels any flexing of the conductor to take place beyond the joint.

It will thus be seen that our improved terminal connection permits a perfect joint to be quickly and conveniently made, conceals the frayed end of the sheathing and permits the insulation to be carried completely to the outer surface of the glass or other insulating substance from which the leading-in wire projects, so that no metal is exposed and there is no possibility of a short circuit by accidental bridging across from one terminal to another on the outside of a switch. These are advantages in addition to the main advantage resulting from the easy curve on which the flexible tubular conductor is expanded as the rigid joint is approached, whereby a high degree of flexibility is retained without subjecting any of the many fine wires to objectionable stresses.

While we have illustrated and described with particularity only a single preferred form of our invention, as applied to a terminal of a mercury switch, we do not desire to be limited to the exact structural details thus illustrated and described, or to the field of mercury switches; but intend to cover all forms and arrangements coming within the definitions of our invention constituting the appended claims.

We claim:

1. A flexible connection to lead in wires of hermetically sealed glass containers such as mercury switches comprising an electrical conductor composed of a plurality of fine wires braided together to form a flexible tube with one end expanded and telescoped over the protruding lead in wire and soldered thereto.

2. A flexible connection to lead in wires of mercury tube switches comprising an electrical conductor composed of a plurality of fine wires braided together to form a flexible tube expanded and telescoped over the protruding lead in wire and soldered thereto, and a flexible insulating sheathing about said conductor.

3. A flexible connection to lead in wires of mercury tube switches comprising an electrical conductor composed of a plurality of fine wires braided together to form a flexible tube expanded and telescoped over the protruding lead in wire and soldered thereto, a flexible insulating sheathing about said conductor, and a short tight fitting sleeve holding said sheathing against said conductor throughout its joint to the lead in wire.

4. A flexible connection between a fixed

electrical conductor and a movable mercury tube switch having a short rigid lead in wire sealed in the glass wall thereof comprising an electrical conductor composed of
5 a plurality of fine wires braided together to form a tube of less diameter than the lead in wire telescoped over the end thereof to engage the glass and soldered to the lead in wire, a flexible insulating sheathing about said conductor, and a fabric sleeve snugly engaging throughout its joint to the switch, whereby the connection may be continuously flexed without disruption.

In testimony whereof, we sign this specification.

RAYMOND W. ARMSTRONG.
IRA E. McCABE.