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ELECTRICAL TESTING APPARATUS

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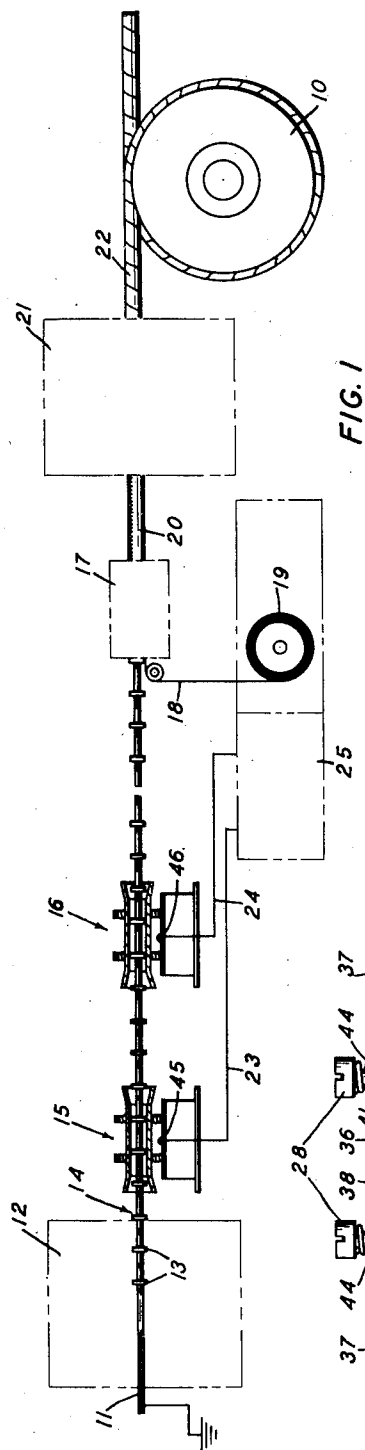


FIG. 1

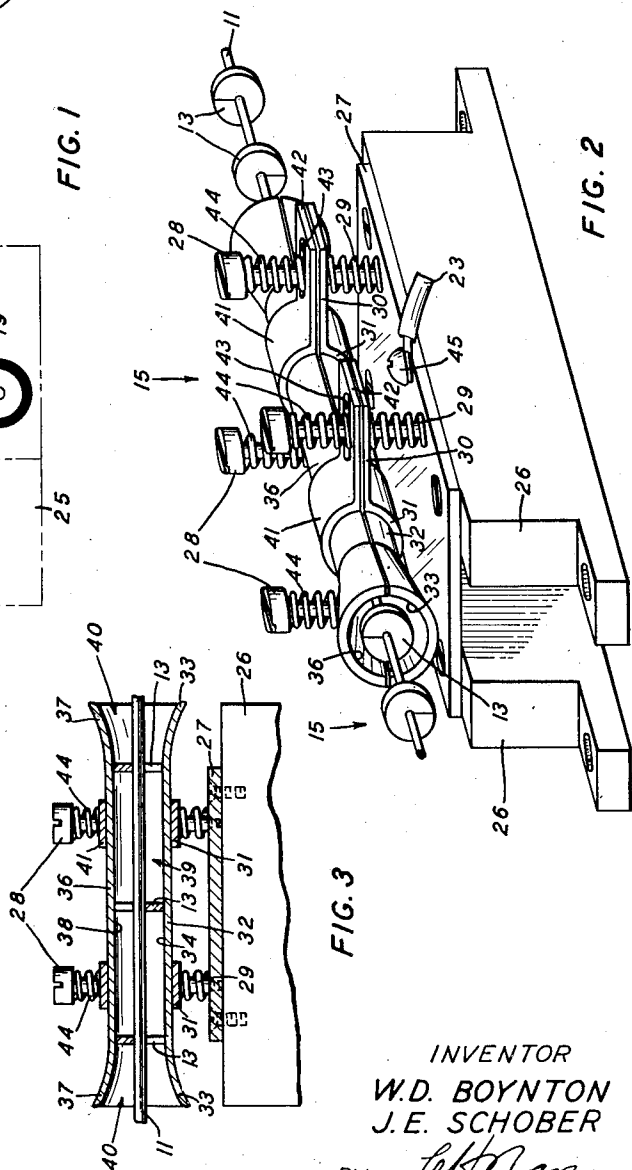


FIG. 2

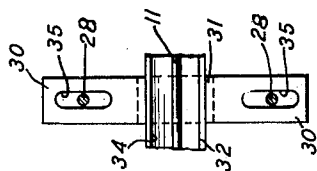


FIG. 3

FIG. 4

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ELECTRICAL TESTING APPARATUS

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This invention relates to electrical testing apparatus, and more particularly to apparatus for testing elements of coaxial cable units.

Coaxial cables are widely used in television lines and in long distance telephone transmission lines. Such cables usually consist of a plurality of individual coaxial units twisted together to form a composite core which is enclosed in a lead sheath. Each of the coaxial units consists of a solid central conductor, an outer tubular conductor formed therearound and spaced concentrically therewith by means of disc-shaped insulators positioned at regular intervals on the central conductor and a steel tape wrapped spirally around the outer conductor.

It has been found that the transmission characteristics of the coaxial units are affected vitally by the presence of conductive faults within the coaxial unit, which provide paths of reduced resistance between the central and outer conductors. These faults may take many forms, the more common being a microscopic conductive film of dirt on the insulating discs, bits of metal embedded in the discs, or very fine metallic slivers or splinters attached to the central conductor.

In the manufacture of such coaxial units, a solid conductor is advanced continuously through a coaxial unit forming machine, which first applies the insulator discs thereon at uniformly spaced intervals. The central conductor with the discs attached is advanced through a high potential electrode for the purpose of burning away any conductive faults that may be present, and then through a high potential testing electrode to ascertain whether or not any faults remain. If no faults are detected, the outer tubular conductor is formed over the discs by a subsequent operation of the forming machine.

In general, the burn-out and testing electrodes are usually provided with a substantially circular passage designed to slidably engage the peripheries of the discs positioned on the advancing conductor. It was discovered that the path of travel of the conductor and disc assembly varied as it advanced from the disc applying apparatus to the outer conductor forming die due to the disc applying operation on the central conductor. Obviously, this fact necessitates the use of burn-out and testing electrodes which are capable of moving freely about their mounting as required by the varying travel of the conductor, otherwise the discs positioned on the conductor might be displaced upon engagement with the walls of the contacting passage of the electrode.

An object of the invention is to provide new

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and improved electrical testing apparatus, and more particularly to provide simple and effective apparatus for testing elements of coaxial cable units.

In accordance with a specific embodiment of the invention, there is provided an electrode consisting of a pair of identically shaped members having semicircular grooves therein which co-operate to form an axially straight substantially circular passage through which a coaxial unit core to be tested may be advanced. The members are resiliently supported with respect to the advancing core unit, so that each of the members is freely movable vertically with respect to each other and freely movable as a unit transversely to the direction of travel of the advancing core.

A clear understanding of the invention will be had from the following detailed description of a specific embodiment thereof, when read in conjunction with the appended drawing, in which:

Fig. 1 is a diagrammatic, side view of a coaxial unit forming machine of known design showing a pair of testing electrodes embodying the invention;

Fig. 2 is an enlarged, perspective view of one of the testing electrodes shown in Fig. 1;

Fig. 3 is an enlarged, vertical, sectional view of the electrode shown in Fig. 1, and

Fig. 4 is an enlarged, fragmentary, plan view of a portion of the apparatus shown in Fig. 2.

Referring now to Fig. 1 of the drawing, there is shown therein a diagrammatic arrangement of a coaxial unit forming machine of known design and comprising a group of elements arranged to form coaxial units. It will be noted that a capstan 10 forming part of the coaxial unit forming machine serves to advance a central conductor 11 through a disc applying apparatus 12 of suitable design, by the action of which insulating discs 13—13 are positioned at regular intervals on the conductor 11 to form a coaxial unit core 14. The core 14 is advanced through a high potential burn-out electrode 15, a testing electrode 16 and then through a tube former 17, which serves to form a copper tape 18 drawn from a supply 19 into a tubular conductor 20 surrounding the discs 13—13 of the core 14. The partially formed coaxial unit is then advanced through a taping head indicated generally at 21 by means of which a plurality of steel tapes are served spirally around the tubular conductor 20 to form a complete coaxial unit 22, which is

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advanced by the capstan 10 to suitable takeup means (not shown).

The central conductor 11 is grounded by suitable means before it passes through the disc applying apparatus 12. The burn-out electrode 15 is connected by a conductor 23, and the testing electrode 16 is connected by a conductor 24 to one side of high potential burn-out and testing circuits, which circuits have a common side which is grounded. The burn-out and testing circuits are energized and controlled by suitable electrical apparatus mounted in the forming machine and indicated generally at 25. The purpose of the electrode 15 is to apply a very high potential across the insulating discs and the central conductor to burn out any conductive faults that may be present in the portion of the core 14 passing therethrough.

The testing electrode 16 is identical in construction with the electrode 15, its purpose being to test electrically the core 14 previously passed through the electrode 15 and determine whether any faults remain in the core. The electrical apparatus indicated generally at 25 is associated with the testing electrode 16 for the purpose of deenergizing the driving means for the coaxial unit forming machine when the core 14 contains a fault which was not eliminated or burned out by the electrode 15. For a more complete understanding of the high potential burn-out, testing and control circuits associated with the electrical apparatus 23 and their relation to electrodes such as the electrodes 15 and 16, attention is directed to copending application Serial No. 566,910, filed December 6, 1944, by E. Bertalan and E. U. Rice, said application now being Patent No. 2,494,029, dated January 10, 1950.

Since the burn-out electrode 15 and the testing electrode 16 are identical in construction only the burn-out electrode 15 will be described in detail. In the particular embodiment of the invention disclosed in the accompanying drawing, and more particularly in Fig. 2, it will be noted that the burn-out electrode 15 comprises a pair of spaced supports 26—26, made of suitable insulating material, which support a rectangular metal plate 27 having a plurality of posts 28—28 secured thereto in a vertical position. A compression spring 29 is positioned over the lower portion of each of the posts 28—28 and has its lower end resting on the plate 27. The upper end of each spring 29 engages an end 30 integrally formed on saddle-shaped supports 31—31 secured to a semitubular contact member 32 adjacent to flared ends 33—33 formed on the contact member 32 and thereby support the contact member 32 in a horizontal position. The contact member 32 has a semielliptical groove 34 formed therein which is designed so that the width thereof is slightly greater than the diameter of the average insulating disc 13 positioned on the central conductor 11 while the depth of the groove 34 is slightly less than the radius of the average disc 13. Each of the ends 30—30 of the supports 31—31 is provided with an elongated aperture 35 (Fig. 4), which slidably engages the body portion of the posts 28—28.

Another semitubular contact member 36 (Fig. 2) having flared ends 37—37 and a semielliptical groove 38 therethrough which is identical in size with the semielliptical groove 34 provided on the member 32 is arranged to rest on the member 32 in an inverted fashion so as to form therewith a slightly elliptical, axially straight passage 39 having conical end portions 40—40 formed by the

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flared ends 33 and 37, respectively. A saddle-shaped support 41 is secured to the contact member 36 adjacent to each flared end 37 of the contact member 36 and is provided with ends 42—42 which are aligned with the ends 30—30 of the supports 31—31 secured on the member 32. Each of the ends 42—42 is provided with an elongated aperture 43, which is aligned with an aperture 35 provided in the associated end 30 and is also slidably engaged by the body portion of one of the posts 28—28 secured to the base plate 27. A spring 44 is positioned over the upper body portion of each of the posts 28—28 between the head thereof and the upper surface of the ends 42—42 of the supports 41—41. The conductor 23 has its bared end secured to the plate 27 by means of a screw 45 (Figs. 1 and 2) and the conductor 24 is connected to the testing electrode 16 in a similar manner by means of a screw 46 (Fig. 1).

The above-described arrangement of the contact members 32 and 36 serves to form the burn-out electrode 15 which, actually is a split electrode, having an axially straight, slightly elliptical passage 39 through which a coaxial unit core, such as the core 14, may be advanced continuously. The contact members 32 and 36 are so mounted between the springs 29—29 and the springs 44—44 that as the core 14 is advanced through the elliptical passage 39, the contact members 32 and 36 separate slightly against the action of springs 29—29 and 44—44, thereby permitting the semielliptical grooves 34 and 38 to resiliently engage substantially the entire peripheries of the insulating discs 13—13. The elongated apertures 35—35 and 43—43 provided in the ends 30—30 and 42—42 of the supports 31—31 and 41—41, respectively, permit the contact members 32 and 36 to move as a unit transversely of its longitudinal axis as the core 14 is advanced therethrough. This freedom of movement of the contact members prevents any unequal pressure to be exerted against the insulating discs 13—13 due to the varying path of travel of the core 14 between the disc applying apparatus 12 and the tube former 17.

Since the insulating discs are spaced uniformly on the central conductor 11, the contact members 32 and 36 are so designed that the elliptical passage 39, exclusive of the conical ends 40—40, will simultaneously engage only three insulating discs 13—13 (Fig. 3) at any one time. If more than three insulating discs 13—13 were simultaneously engaged by the contact members 32 and 36, it is possible that some of the discs may not be contacted by the passage 39 due to slight eccentricities which occur between the individual discs and central conductor as the discs are positioned thereon and the varying path of travel of the core 14. While this undesirable condition may occur momentarily when the contact members engage three discs, it is obvious that it is overcome by the fact that as the core 14 is advanced only two discs are engaged by the contact members for a period of time, during which the contact members align themselves with respect to irregularities of the two discs of the core 14.

Since the contact members are designed to engage no more than three discs at any one time, it is impossible for the contact members to engage less than two discs at any one time. It is believed to be apparent that two discs will always keep the contact members substantially well aligned with the advancing core 14, thereby causing the electrode to adjust itself to the eccentricities of the discs and to the varying path of travel of

the central conductor. If it were possible for the contact members to engage only one disc at any one time, this self adjusting action of the contact members would not take place, thus making it possible for the oncoming discs to strike the ends of the contact members and to be displaced on the central conductor. Since the contact members 32 and 36 are designed to engage only three discs at any one time and since they are free to move vertically with respect to each other and are arranged to move as a unit transversely of its longitudinal axis, there is no tendency for the contact members to displace the insulating discs 13—13 positioned on the central conductor 11 as the coaxial unit core 14 is advanced therethrough by the capstan 10.

The testing electrode 16 is constructed in the same manner as described above for the burn-out electrode 15 and its mechanical operation with respect to the core 14 being advanced there-through is the same as that described for the electrode 15.

The electrodes 15 and 16 perform the following electrical tests on the core 14, consisting of a central conductor 11 having 0.375 inch O. D. polyethylene insulating discs 13—13 uniformly spaced thereon, which core is advanced through the electrodes by the capstan 10. The burn-out electrode 15 may be assumed to represent the high side of a high potential burn-out circuit energized and controlled by the electrical apparatus indicated generally at 25. When the burn-out circuit is energized, the burn-out electrode serves to apply a very high potential (of the order of about 4000 volts) around the peripheries of the insulating discs 13—13, and, therefore, between the discs and the central conductor 11 forming the portion of the core 14 being engaged and enclosed by the semielliptical passage 39. Since the conductor 11 is grounded, and since the burn-out and testing circuits have a grounded common side, it can be considered to be connected to the grounded side of the high potential burn-out circuit, which places the high potential directly across the peripheries of the insulating discs and the central conductor. Should the portion of the core 14 engaged by the electrode 15 contain a conductive fault, which produces a path of reduced dielectric strength between the walls of the passage 39 and the central conductor 11, the high potential breaks down the fault and causes a high current to flow therethrough. In most instances this high current flowing through the fault will burn out the fault and vaporize it, thus removing it from that portion of the core 14.

The portion of the core 14 so treated by the burn-out electrode 15 is then advanced through the testing electrode 16. The electrode 16 is connected to the high side of a high potential testing circuit, being also energized and controlled by the electrical apparatus indicated generally at 25. When the testing circuit is energized, the electrode 16 serves to apply a high potential (of the order of about 3500 volts) around the peripheries of the discs 13—13 positioned on that portion of the core 14 now engaged by a similar elliptical passage provided in the testing electrode 16. If any conductive fault remains in the portion of the core 14 being so tested by the electrode 16, a breakdown will again occur at the fault and a current will flow in the testing circuit. The testing circuit is arranged so that when such a breakdown occurs the electrical apparatus 25 associated therewith will operate to deenergize the driving means of the coaxial forming machine

which arrests the movement of the core 14 and thereby prevents the copper tube 20 from being applied over a faulty section of the core 14. The amount of potential applied around the advancing core 14 by the burn-out electrode 15 and the testing electrode 16 is regulated so that it will break down conductive faults in a core unit having 0.375 inch O. D. insulating discs, but will not cause current to flow through satisfactory portions of the core. In other words, the burn-out and testing electrodes operate together to prevent the coaxial machine from forming a defective coaxial unit 22. After any fault that is located by the testing electrode 16 has been corrected, the coaxial machine is restarted and continues to form the coaxial unit 22 until another fault is present in the core 14 after it has passed the burn-out electrode 15.

While the above-described apparatus is particularly well adapted as a testing electrode for coaxial unit cores, it may be modified in various ways to test different types of conductors without departing from the spirit and scope of the invention, as defined in the annexed claims.

What is claimed is:

1. In an apparatus for electrically testing a continuously advancing coaxial unit core having a central conductor with insulating discs spacedly positioned thereon, the improvement which comprises an elongated semitubular bottom contact member, means for resiliently supporting the bottom contact member at the ends thereof in a horizontal position, an elongated semitubular upper contact member arranged to rest on the bottom contact member so as to form therewith a substantially cylindrical, axially straight passage through which a coaxial unit core may be advanced, and resilient means aligned with the resilient supporting means for urging the upper contact member downwardly against the bottom contact member, said resilient supporting means and urging means permitting independent vertical movement of each contact member thereby forming a vertically expansible passage for the advancing core, whereby the contact members are permitted to separate vertically so that the peripheries of the insulating discs of the advancing core are resiliently engaged as the coaxial unit core advances through the said expansible passage formed by the contact members.

2. In an apparatus for testing a continuously advancing coaxial unit core having a central conductor with insulating discs spacedly positioned thereon, the improvement which comprises an elongated semitubular lower contact member, a base plate, means for resiliently supporting the lower contact member at the opposite ends thereof horizontally above the base plate, an elongated semitubular upper contact member arranged to rest on the lower contact member so as to form therewith a substantially cylindrical, axially straight passage through which the coaxial unit may be advanced, resilient means aligned with the resilient supporting means for urging the upper contact member downwardly against the lower contact member, said resilient supporting means and urging means serves to permit independent vertical movement of the contact members and thereby make the axially straight passage vertically expansible to receive the advancing coaxial unit core, means provided on the base plate to slidably engage the resilient supporting means and the resilient urging means for holding the contact members in position, said resilient support being so arranged on the holding means

that the contact members are free to move transversely to the path of travel of the coaxial unit core, whereby the contact members are free to move horizontally and vertically with the advancing core so that the peripheries of the insulating discs will be resiliently engaged but not displaced on the central conductor as the core unit advances through the passage.

3. In an apparatus for electrically testing a continuously advancing coaxial unit core having a central conductor with insulating discs spacedly positioned thereon, the improvement which comprises an elongated semitubular lower contact member having its ends flared outwardly, a pair of support lugs having an elongated hole in each end thereof and secured transversely on the lower member so that one lug is adjacent to each flared end thereof, a rectangular base plate, a resilient member positioned on the base plate for engaging the end of each lug and so as to support the lower contact member parallel with the base plate, an elongated semitubular upper contact member having its ends flared outwardly and arranged to rest on the lower contact member so as to form therewith a substantially cylindrical, axially straight passage therethrough, said flared ends of the contact members cooperating to form conically shaped extremities on said passage, a pair of lugs transversely secured to the upper contact member so as to be aligned with the lugs on the lower contact member and provided with an elongated hole in each end which is aligned with the elongated hole provided in the adjacent end of the lug secured on the lower contact member, resilient means positioned on each of the lugs of the upper member for urging the upper member against the lower member, and a plurality of posts positioned on the base plate and passing through the elongated holes provided on the lugs secured on said members to hold the members in alignment, said posts also serving to secure the resilient means in place on the lugs, whereby the members are free to move vertically and horizontally as the core is advanced therethrough thereby permitting the peripheries of the insulating discs of the core to be resiliently engaged but not displaced on the central conductor as the core is advanced therethrough.

4. In an apparatus for electrically testing a continuously advancing coaxial unit core having a central conductor with insulating discs spacedly positioned thereon, the improvement which comprises an elongated semitubular contact member having its opposite ends flared outwardly, a pair of supports having an elongated hole in each end thereof and secured transversely on

the contact member so that one support is adjacent to each flared end, a base, a plurality of resilient members positioned on the base plate for engaging the ends of the supports so as to spacedly position the contact member from the base, a second elongated semitubular contact member having its ends flared outwardly and arranged to rest against the first-mentioned contact member so as to form a substantially cylindrical axially straight passage through which a coaxial unit may be advanced, said flared ends of the contact members cooperating to form conically shaped extremities on the said passage, a pair of supports transversely secured to the second-mentioned contact member so as to be aligned with the supports on the first-mentioned contact member, said supports secured on the last mentioned contact member having an elongated hole at each end which is aligned with the elongated hole provided in the corresponding ends of the supports secured on the first-mentioned contact member, resilient means positioned on the ends of the supports secured on the second-mentioned contact member for urging the member against the first-mentioned contact member, a plurality of posts positioned on the base plate and passing through the elongated holes provided on the lugs secured on said members to hold the contact members in alignment, said posts also serving to secure the resilient means in place on the lugs, said elongated holes in the supports permit the contact members to move transversely of the coaxial unit core as it is advanced through the passage formed by the members while the resilient supporting means permit the contact members to separate so that the discs are resiliently engaged but not displaced on the central conductor as the core is advanced through the said passage.

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