Dec. 19, 1939. L. R. SCHREINER 2,183,945

GROUNDING DEVICE FOR COAXIAL CONDUCTOR LINES

Filed Sept. 3, 1938

FIG. 1

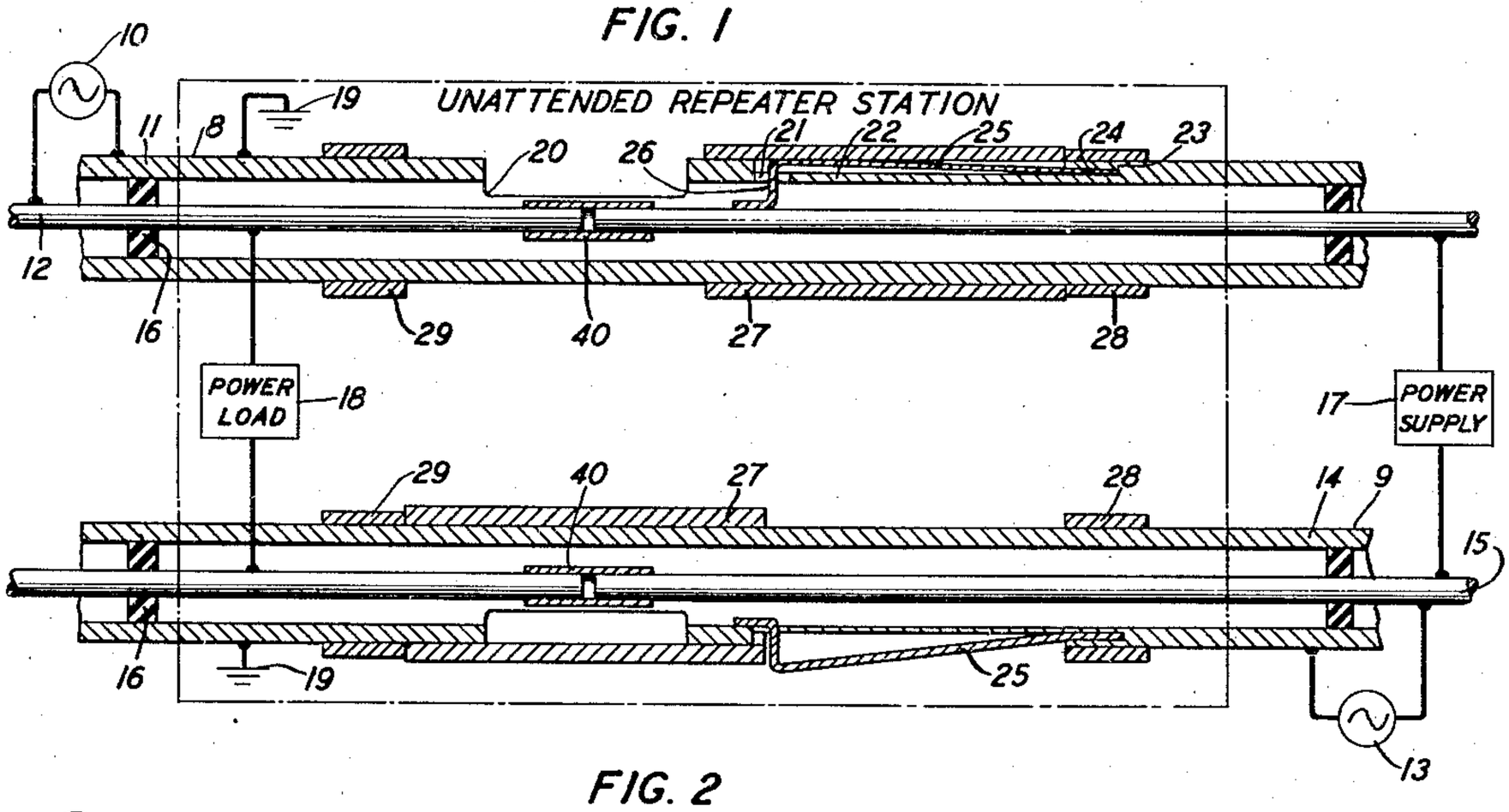


FIG. 2

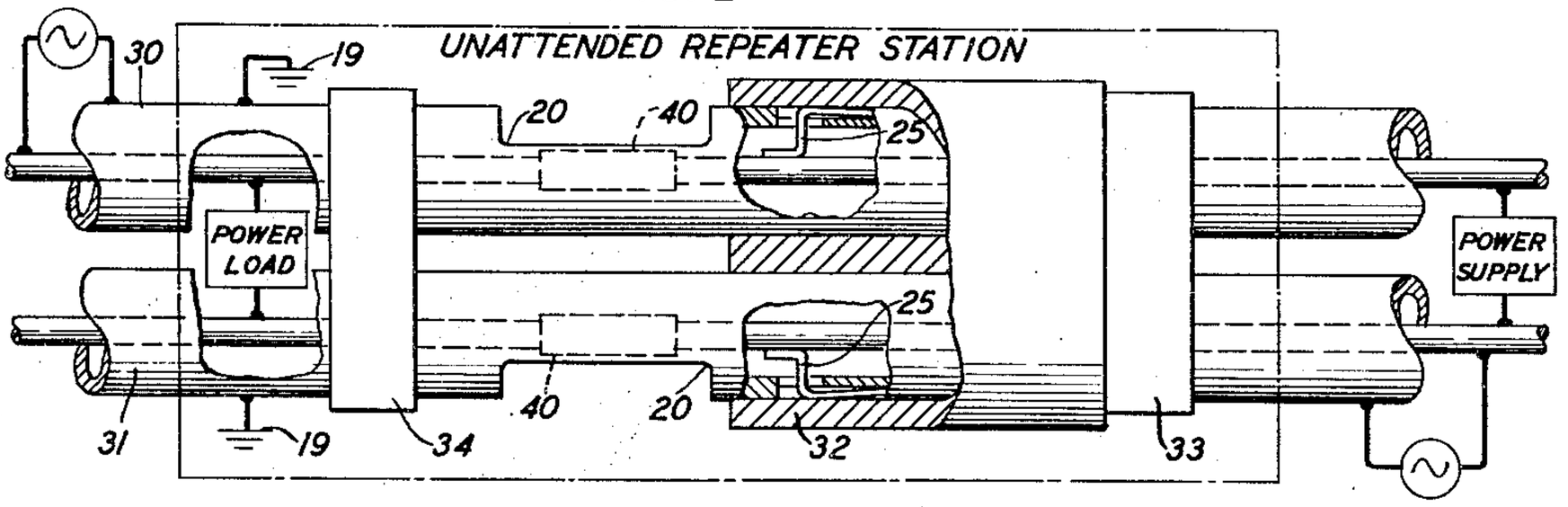
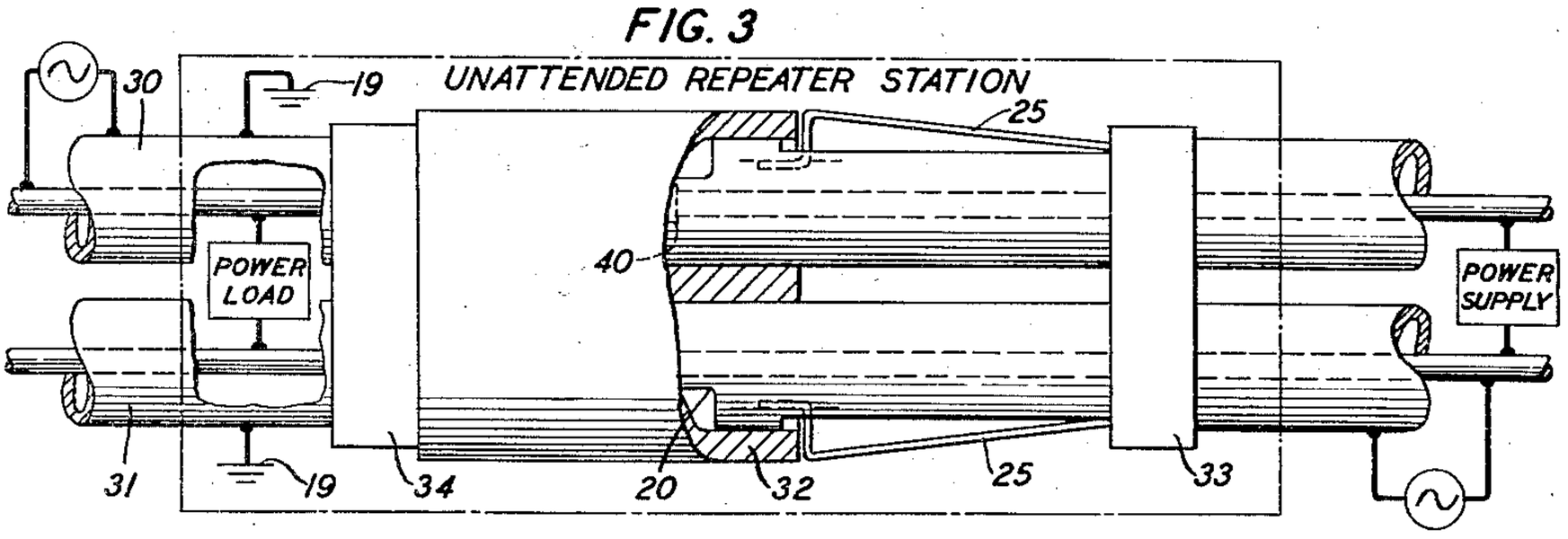


FIG. 3



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GROUNDING DEVICE FOR COAXIAL CONDUCTOR LINES

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Application September 3, 1938, Serial No. 228,349

7 Claims. (Cl. 178—44)

This invention relates to apparatus for grounding electrical circuits and more particularly to a device for grounding the inner conductors of coaxial conductor lines.

A concentric conductor system comprising tubular inner and outer conductors and utilized for the transmission of a wide range of frequencies is disclosed in the patent of L. Espenschied et al., No. 1,835,031, issued December 8, 1931. In that system current of the higher frequencies tends to flow at the inner surface of the outer conductor and the outer surface of the inner conductor due to the skin effect. As is well known transmission in such systems is substantially unaffected by external interferences even though the outer conductor is grounded and therefore it is the practice to connect the outer conductor to a plurality of equipotential points at intervals therealong.

A familiar type of coaxial conductor system utilizes two individual coaxial conductor lines, one for transmitting exclusively in one direction and the second in an opposite direction. One-way repeaters are connected in tandem in each conductor line at intervals of the order of ten miles. Of these approximately every sixth repeater is an attended one having an operator constantly on duty while the four intervening ones are unattended requiring an operator from time to time for routine testing and the clearing of faults. Power for energizing unattended repeaters is supplied from attended repeater stations over a circuit including the inner conductors of the two individual conductor lines. In routine testing and clearing of faults, it is necessary for a workman to gain access to portions of the inner conductors extending through the unattended repeater stations. While power is normally disconnected from the inner conductors on such occasions, it would nevertheless be a hazardous undertaking from the standpoint of safety to the workman in the event that power was inadvertently applied to the system.

Accordingly, it is an object of this invention to incorporate in the sections of coaxial conductor lines extending through unattended repeater stations an arrangement for grounding the power supply circuit to protect a workman against a power voltage arising as a result of inadvertent action at an attended repeater station.

In a preferred embodiment, this invention comprises a resilient member affixed to the grounded surface of each outer conductor at at least one point in each unattended station and adapted to connect or disconnect, as the case may be, the inner and outer conductors of each coaxial conductor line. Thus, when a workman undertakes to perform a testing operation involving the portion of a coaxial conductor line extending through an unattended station, he first actuates the resilient member to connect the grounded outer conductor to the inner conductor thereby establishing an equipotential condition on the inner conductor. When the workman completes the testing operation, the resilient member is actuated to remove the ground from the inner conductor so that thereafter the coaxial conductor line is conditioned for signaling and power transmission. The workman is therefore protected against shock from power voltages applied inadvertently to the system at an attended station during the interval of the connection between the inner and outer conductors.

The invention will be more readily understood from the following description taken together with the accompanying drawing in which:

Fig. 1 illustrates one form of the invention, and Figs. 2 and 3 show an alternate form of the invention.

In the drawing, the same reference numerals are employed to identify the same members appearing in the several figures thereof.

Fig. 1, which illustrates a coaxial conductor system to which the present invention is applicable, shows portions of two coaxial conductor lines 8 and 9 extending through an unattended repeater station. A wave source 10 connected across outer conductor 11 and inner conductor 12 of the line 8 represents terminal circuits for carrier currents of high frequency being transmitted in one direction while a wave source 13 connected across outer conductor 14 and inner conductor 15 of the line 9 represents terminal circuits for carrier currents of similar frequencies being transmitted in an opposite direction. Suitable insulators 16 disposed at intervals along both inner conductors serve to maintain the outer conductor and inner conductor in a predetermined spaced relation. Each outer conductor is also connected to equipotential points 19, 19.

A coaxial conductor system utilizing separate coaxial conductor lines for the transmission of high-frequency currents in opposite directions is shown in Fig. 11 of the patent of L. Espenschied et al., supra. While that patent discloses lines comprising tubular inner and outer conductors the individual lines may also consist of a hollow outer conductor built up of a plurality of interengaging strips and a solid inner conductor as illustrated in the patent of J. F. Wentz, No. 2,018,477, issued October 22, 1935.

Power for energizing a load 18 located at each unattended repeater station is obtained from a remote commercial supply 17, which is located in associated stations, over a circuit comprising the inner conductors 12 and 15 of the respective lines 8 and 9. Each load 18 may preferably comprise one or more one-way repeaters and include suitable apparatus to insure that the proper value of power is applied to each unattended load or re-

peater to maintain an efficient transmission of signals at a substantially constant level. Details concerning the distribution of power between an attended station and the unattended stations associated therewith are shown in the patent of M. E. Strieby No. 2,037,183, issued April 14, 1936.

In accordance with the form of invention shown in Fig. 1, each outer conductor is provided with an opening 20 of adequate configuration to expose the inner conductor for the making of appropriate electrical connections to testing apparatus (not shown), as will be hereinafter explained. An aperture 21 disposed to the right of the opening 20 is also formed in each outer conductor. Commencing at the aperture 21, the periphery of each outer conductor is provided with a flat surface 22 extending longitudinally thereof and terminating in a slot 23. In the latter is suitably anchored an end 24 of a resilient member 25 of effective electrical conductivity and disposed on the flat surface 22. The opposite end of the resilient member 25 is formed with a reversed L-shaped portion 26 which projects through and is freely movable in the aperture 21. The horizontal leg of the portion 26 is shaped to provide an effective electrical contact with the inner conductor for a purpose that will be hereinafter explained.

Positioned on the outer conductors 11 and 14 are sleeves 27, 27 slidable thereon in a manner that movement to the right is limited by rigidly affixed collars 28, 28 and to the left by similar collars 29, 29. When one of the sleeves 27, 27 is in the right-hand position shown in connection with the line 8, the opening 20 therein is completely uncovered to expose the inner conductor 12 and at the same time the resilient member 25 is depressed to cause the horizontal leg of the portion 26 to contact the inner conductor 12.

Since the outer conductor 11 of the line 8 is connected to the equipotential point 19, the inner conductor associated therewith is also electrically connected to this equipotential point. Hence the equipotential condition established permanently on both outer conductors is extended to the inner conductor 12. This condition serves to remove power from the line and, in case of testing, to protect a workman against a power voltage applied inadvertently to the line 8 from an attended station while he is engaged in the performance of routine testing and fault-removing operations. As the line 9 is also permanently connected to an equipotential point 19, the same protective condition may be provided therein by disposing the sleeve 27 associated therewith in the position shown in connection with the similar sleeve 27 on the line 8.

When one of the sleeves 27, 27 is in the left-hand position shown in connection with the line 9, the opening 20 is covered to entirely enclose the inner conductor 15. At the same time this particular sleeve 27 is also disengaged from the associated resilient member 25 thereby enabling the latter to retract through the aperture 21 from contact with the inner conductor to interrupt the equipotential condition that may be established thereon in the manner described above relative to line 8. With the opening 20 closed and the resilient member 25 in the retracted position, the line 9 is conditioned for the transmission of power and signaling currents. The line 8 is of course similarly conditioned when the sleeve 27 associated therewith is also disposed in the left-hand position. It is understood that the horizontal leg of the portion 26 is of sufficient length to prevent the complete withdrawal thereof through the aperture 21.

In moving one of the sleeves 27 from the left-hand position shown on line 9 to the right-hand position shown on line 8, the resilient member 25 associated therewith is momentarily depressed with a finger until the sleeve 27 rides partially thereover. Thereafter the sleeve 27 maintains the resilient member 25 in the depressed state shown in connection with line 8. The arrangement shown in Fig. 1 provides that the inner conductors of the individual coaxial conductor lines 8 and 9 may be independently or simultaneously exposed and grounded as desired and is particularly suited to the case where a single coaxial conductor line is used for either one-way transmission exclusively or for two-way transmission. It is understood that the apertures 21, 21 could be eliminated and the resilient members 25, 25 arranged so that the reversed L-shaped portions 26, 26 project into the openings 20, 20. It is understood that the resilient members 25 can be mounted in a position opposite to that shown in the several figures so that the former are actuated exclusively by the sleeves 27 thereby obviating the finger operation mentioned above.

Figs. 2 and 3 illustrate an alternate form of the invention wherein the inner conductors of a pair of coaxial conductor lines are exposed or covered at the same time. Figs. 2 and 3 are substantially the same as Fig. 1 except both lines 30 and 31 are embraced by a single sleeve 32 that is slidable between respective left-hand and right-hand limiting collars 34 and 33, each of which also embraces both lines 30 and 31. Fig. 2 shows the sleeve 32 in a right-hand position engaging the limiting collar 33 and wherein the resilient members 25, 25 are simultaneously depressed in contact with both inner conductors of the lines 30 and 31. The equipotential condition established in the outer conductors due to the equipotential points 19, 19 is therefore extended to both inner conductors. As previously mentioned this serves to remove power from the inner conductors. Inasmuch as the openings 20, 20 are now uncovered, a workman is protected from power voltages to perform whatever testing operations are necessary at the particular time. Fig. 2 therefore shows an arrangement for simultaneously grounding both inner conductors for testing purposes.

When the sleeve 32 is in the left-hand position engaging the collar 34 shown in Fig. 3, the openings 20, 20 are covered thereby enclosing the inner conductors of the lines 30 and 31. Also, in this position the sleeve 32 is disengaged from the resilient members 25, 25 so that the latter are free to retract from contact with the inner conductors to interrupt the equipotential condition that may be extended thereto from the outer conductors in the manner mentioned previously in connection with Fig. 2. Fig. 3 therefore illustrates an arrangement for simultaneously conditioning both lines for signaling transmission after these lines had been previously grounded for testing purposes as shown in Fig. 2.

To facilitate testing each inner conductor may be sectionalized such that each section is individual to a particular unattended load 18. This is accomplished by applying at each opening 20 a sleeve 40 over the contiguous ends of the inner conductors located thereat. Sliding both sleeves 40 to the right in Figs. 1, 2 and 3 and out of con-

tact with the sections to which the load 18 is connected serves to sectionalize the inner conductors in a manner such that the power supply is removed therefrom. Sectionalizing may be desirable when tests of the apparatus included in the load 18 are to be made.

What is claimed is:

1. In a coaxial transmission system including a coaxial conductor having an opening comprising an inner conductor and an outer conductor having an opening and both conductors being arranged to transmit high-frequency signaling currents, a circuit including ground for establishing an equipotential condition on the outer conductor; a cover for the opening, means actuated by movement of the cover such as to expose the opening for extending the equipotential condition from the outer conductor to the inner conductor.

2. In a coaxial transmission system including a coaxial conductor line arranged to transmit high-frequency signaling currents, said line comprising an inner conductor and a hollow outer conductor having a portion cut away to expose the inner conductor, and a circuit including ground for establishing an equipotential condition on the outer conductor; means for extending the equipotential condition from the outer conductor to the inner conductor comprising conductive means mounted on the outer conductor and engageable with the inner conductor through the cut-away portion, and means disposable on the outer conductor for controlling the engagements of the conductive means with the inner conductor.

3. In a coaxial transmission system including a coaxial conductor line arranged to transmit high-frequency signaling currents, said line comprising an inner conductor and a hollow outer conductor having a portion cut away to expose the inner conductor, and a circuit including ground for establishing an equipotential condition on the outer conductor; means for extending the equipotential condition from the outer conductor to the inner conductor comprising resilient conductive means having a portion anchored to the outer conductor and another portion movable in the cut-away portion, and means engageable with the resilient means to actuate the movable portion thereof to contact the inner conductor.

4. In a coaxial transmission system including a coaxial conductor line arranged to transmit high-frequency signaling currents, said line comprising an inner conductor and a hollow outer conductor having a portion cut away to expose the inner conductor and a circuit including ground for establishing an equipotential condition on the outer conductor; means for extending the equipotential condition to the inner conductor and interrupting the same as the cut-away portion is respectively uncovered and covered comprising a resilient conductive member having one end rigidly secured to the outer conductor and a bent portion formed on the opposite end and engageable with the inner conductor, and means slidably mounted on the outer conductor to uncover and cover the cut-away portion so that when the cut-away portion is uncovered the resilient member is actuated to cause the bent portion to contact the inner conductor and when the cut-away portion is covered the resilient member is retracted to move the bent portion out of contact with the inner conductor.

5. In a coaxial transmission system comprising at least one outlying unattended repeater station, a pair of coaxial conductor lines arranged to transmit high-frequency signaling currents, each line including an inner conductor and a hollow outer conductor having a portion cut away to expose the inner conductor, a power circuit including the inner conductors of both lines for supplying power to each outlying unattended repeater station, and a ground circuit connected to the outer conductors; means for rendering the power circuit ineffective and effective as the cut-away portions are respectively uncovered and covered comprising conductive means mounted on the outer conductors and engageable with the inner conductors, and means for actuating the conductive means into engagement with the inner conductors to connect the ground circuit thereto as the cut-away portions are uncovered and releasing the conductive means from engagement with the inner conductors to disconnect the ground circuit therefrom as the cut-away portions are covered.

6. In a coaxial transmission system comprising at least one outlying unattended repeater station, a pair of coaxial conductor lines arranged to transmit high-frequency signaling currents, each line including an inner conductor and a hollow outer conductor having a portion cut away to expose the inner conductor, a power circuit including the inner conductors of both lines for supplying power to each outlying unattended repeater station, and a circuit including ground for establishing an equipotential condition on the outer conductors; means for extending said equipotential condition to the inner conductors and interrupting the same as the cut-away portions are respectively uncovered and covered comprising conductive means mounted on the outer conductors and engageable with the inner conductors, and means disposable on the outer conductors in one position to uncover the cut-away portions and simultaneously therewith to actuate the conductive means into engagement with the inner conductors and in another position to cover the cut-away portions and simultaneously therewith to release the conductive means from engagement with the inner conductors.

7. In a coaxial transmission system including a coaxial conductor line arranged to transmit high-frequency signaling currents, said line comprising an inner conductor and a hollow outer conductor having a portion cut away to expose the inner conductor, and a circuit including ground for establishing an equipotential condition on the outer conductor; means for extending said equipotential condition to the inner conductor and interrupting the same as the cut-away portion is respectively uncovered and covered comprising conductive means mounted on the outer conductor and engageable with the inner conductor, and means slidably disposable on the outer conductor to uncover and cover the cut-away portion such that when the cut-away portion is uncovered the conductive means is actuated into engagement with the inner conductor and when the cut-away portion is covered the conductive means is released from engagement with the inner conductor.

LOUIS R. SCHREINER.

CERTIFICATE OF CORRECTION.

Patent No. 2,183,945. December 19, 1939.

LOUIS R. SCHREINER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 9, claim 1, strike out "having an opening"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of December, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.