March 22, 1938. J. F. WENTZ 2,111,651

HIGH FREQUENCY TRANSMISSION SYSTEM

Filed Aug. 13, 1936

FIG. 1

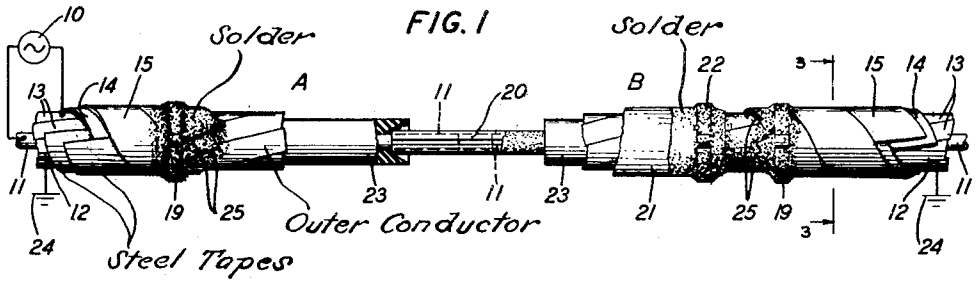


FIG. 2

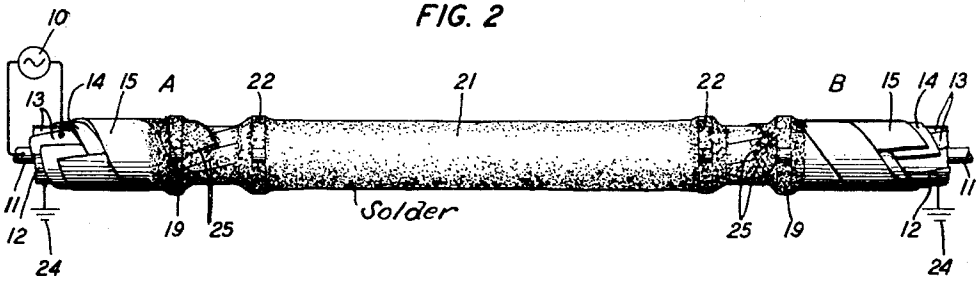
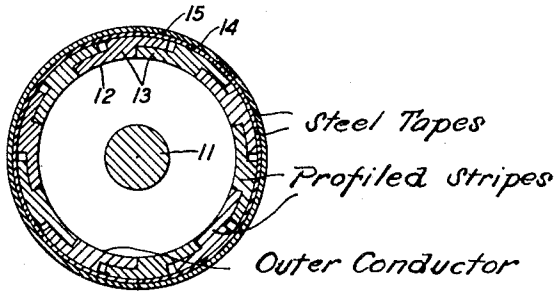


FIG. 3



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HIGH-FREQUENCY TRANSMISSION SYSTEM

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5 Claims. (Cl. 173—265)

This invention relates to a high-frequency transmission system and more particularly to a means and method of excluding extraneous voltages from such a system embodying coaxial conductors.

It is an object of the invention to provide means for and a method of reducing cross-talk in a transmission system of the concentric type to increase the efficiency thereof.

In one form of coaxial conductor to which the invention is particularly adapted, the outer conductor is built up of interengaging strips which are held in place by steel tapes wound tightly around the conductor structure. It has been found in practice that at the points of joining sections of the conductor, cross-talk currents occurred notwithstanding the fact that all known precautions were observed, in making the joint, in an effort to exclude the disturbing voltages. It was discovered in accordance with this invention that the cross-talk could be brought within tolerable limits by making a sufficiently intimate union between the steel tape and the conductor at the junction point, as will be more fully disclosed hereinafter.

In a preferred embodiment of the invention, the free ends of these steel tapes enveloping the coaxial conductor are soldered to the outer conductor on which is established an equipotential condition independent of the circuit carrying the high-frequency currents. Consequently, voltages induced in the steel tapes will be short-circuited. Thus, the efficiency of the system will be increased.

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

Fig. 1 illustrates the preferred embodiment of the invention;

Fig. 2 shows a splice joining two sections of coaxial conductors; and

Fig. 3 is a view taken along the line 3—3 of Fig. 1.

Figs. 1 and 2 show high-frequency transmission systems having suitable wide-band terminating apparatus represented by a wave source 10 which is connected across a coaxial conductor comprising an inner conductor 11 and an outer conductor 12. A transmission system of this type is disclosed and illustrated in the patent of L. Espenschied et al., No. 1,835,031 issued December 8, 1931. The outer conductor is a composite tube made up of a plurality of profiled strips 13 disposed edge to edge longitudinally so that portions of each strip are in abutting and overlapping relation, as disclosed in applicant's Patent No. 2,018,477 issued August 26, 1932.

Steel tapes 14 and 15 are spirally applied to the outer conductor to render it self-supporting and further to provide additional electromagnetic shielding for the coaxial conductor. The lay of the tapes may be substantially in the same direction as the lay of the profiled strips or be in a direction opposite thereto. Suitable insulating material, not shown, disposed at intervals on the inner conductor spaces the inner and outer conductors in a definite relation. Further details of the structure of the coaxial conductor including the lead sheathing may be had by referring to the copending application of Claude Kreisher, Serial No. 3,102 filed January 23, 1935 which has matured to Patent No. 2,080,491 dated May 18, 1937.

In Figs. 1 and 2 is also shown an arrangement for splicing sections of coaxial conductors to provide a unitary transmission system of a concentric type disclosed in the patent of L. Espenschied et al., supra. On the end of each outer conductor is crimped a copper ring 19 to firmly hold the free ends of the steel tapes in position thereon after removing the lead sheathing.

Referring to Fig. 1 the splicing of adjoining sections A and B is accomplished by springing a split copper tube 20 onto the adjacent ends of inner conductor 11. In addition, a split copper tube 21 is secured to adjacent ends of the outer conductors 11 by crimped copper rings 22, 22. A tubular insulating member 23 serves to maintain the spacing of the inner and outer conductors. Fig. 2 shows the splice in its completed form. When desired, the splice may be contained within a lead sleeve whose opposite ends are soldered to the lead sheathings of the sections that are to be joined. Further details of the splicing arrangement may be had by referring to the copending application of J. J. Harley, Serial No. 92,122, filed July 23, 1936, and assigned to applicant's assignee.

In a coaxial type of transmission system it is well known that, due to the skin effect, high frequency currents flow on the inner surface of the outer conductor and the outer surface of the inner conductor. Moreover, transmission is unaffected by external interferences even though the outer conductor is grounded. In operation, therefore, it is one practice to connect the outer surface of the outer conductor to equipotential points 24, 24 at intervals along the system. Thus, on the outer surface of the outer con-

ductor is established an equipotential condition. A coaxial transmission system of this type is disclosed in the patent of L. Espenschied et al., supra.

In the operation of the coaxial transmission system of a type disclosed in the drawing, troublesome levels of cross-talk have been encountered. These were due to voltages induced in the steel tapes by reason of the longitudinal field set up by the copper strips.

In view of the equipotential condition established on the outer conductor, it was found that cross-talk produced as above described could be substantially reduced by soldering the free ends of the steel tapes to the outer surface of the outer conductor. Such soldering shown at 25, 25 in Fig. 1 provides a low impedance contact between the steel tapes and the outer conductor. Consequently, voltages induced in the steel tapes will be dissipated in the equipotential points 24, 24 hence cross-talk interference will be correspondingly decreased in the system.

It is obvious, of course, that the short circuit established for the dissipation of the voltage in the steel tapes is electrically independent of the circuit utilized for transmission of high frequency currents.

It will be understood that the soldering of the steel tapes may take place at the terminating ends of the coaxial conductor as well as at all ends adjoining splices similarly as shown in Figs. 1 and 2; and further, that the conductivity of the splice may be increased by thoroughly soldering the sleeve 20 to the inner conductors and the sleeve 21 to the outer conductors. This soldering is generally indicated by the dots in Figs. 1 and 2.

What is claimed is:

1. In combination in an electrical conductor structure comprising at least one section, a tubular conductor made up of copper strips disposed lengthwise of the conductor and having their edges in contact, a metallic binder strip encircling the tubular conductor and exerting pressure tending to hold the strips in contact, and means at the ends of the section of tubular conductor for increasing the conductivity comprising an autogenous union between the tubular conductor and the binder strip.

2. In combination in a coaxial conductor system for transmitting high-frequency currents, a hollow conductor made up of a plurality of profiled copper strips arranged edge to edge longitudinally so that portions of each strip are in abutting and overlapping relation, a central conductor coaxial with the hollow conductor, metallic shielding strips encircling the outer conductor, grounding means connected to the outer surface of the hollow conductor for establishing an equipotential condition thereon, and means at the opposite ends of the coaxial conductor comprising a soldered union between the outer surface of the hollow conductor and free ends of the shielding strips to establish an equipotential condition in the latter.

3. In combination in a high-frequency transmission system, a plurality of sections of coaxial conductors, each section comprising an outer conductor made up of elongated profiled strips disposed longitudinally in abutting and overlapping relation to form a substantially cylindrical inner conducting surface, an inner conductor coaxial with the outer conductor, and metallic shielding strips encircling the outer conductor, means for splicing adjoining ends of the sections to form a unitary coaxial conductor, grounding means connected to the outer surface of the outer conductor for establishing an equipotential condition thereon, and means adjacent to the splicing means comprising a soldered union between the outer surface of the outer conductor and the free ends of the shielding strips for establishing an equipotential condition in each section of the latter.

4. In a high-frequency transmission system embodying a coaxial conductor comprising a hollow outer conductor, an inner conductor coaxial therewith, and metallic shielding strips encircling the outer conductor; the method of increasing the efficiency of the system which consists in maintaining the shielding strips and the outer conductor at substantially the same potential.

5. In a high-frequency transmission system embodying a plurality of sections of coaxial conductors assembled in a unitary coaxial system, each section comprising a hollow outer conductor, an inner conductor coaxial therewith, and metallic shielding strips encircling each section; the method of increasing the effect of the shielding strips which consists in establishing an equipotential condition on the outer surface of each section of outer conductor, and maintaining the shielding strips of each section at the same potential as the outer conductor.

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