

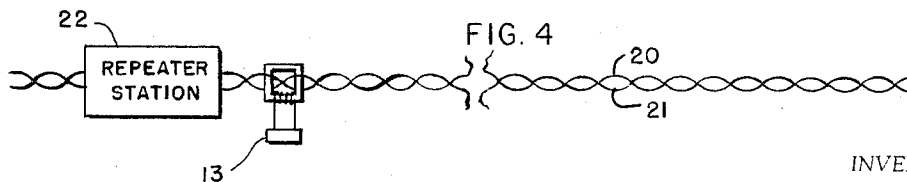
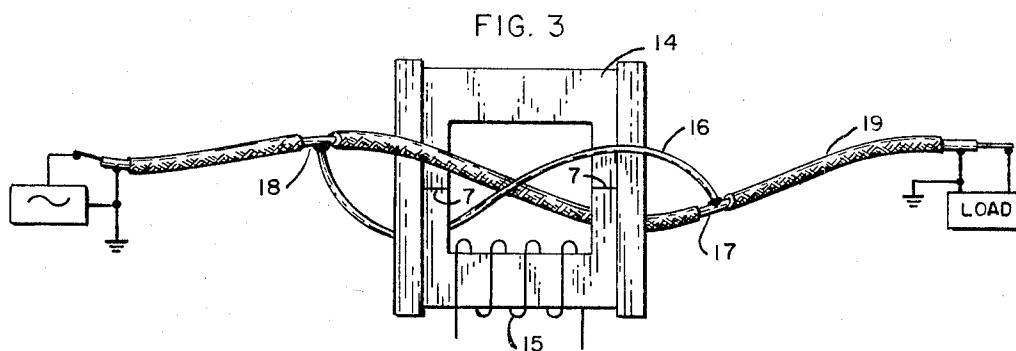
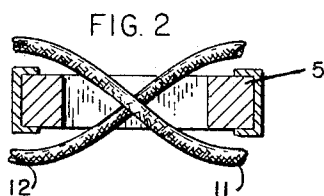
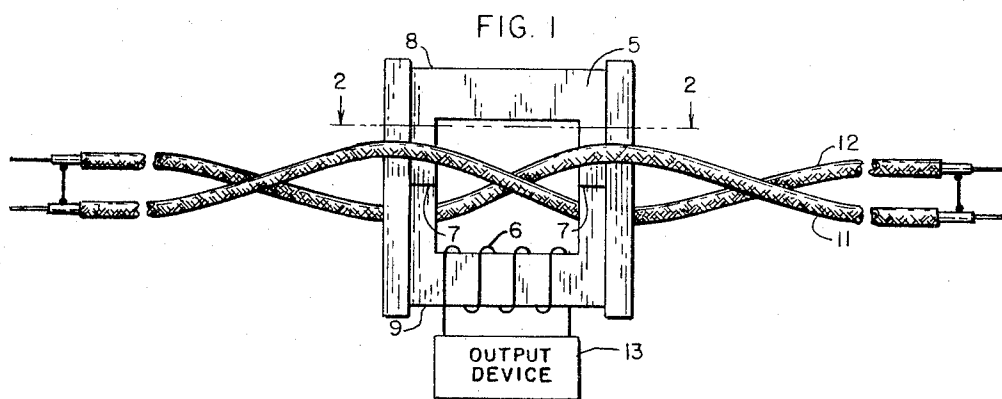
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APPARATUS FOR DETECTING AND APPRAISING SIGNALS ON CABLES

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APPARATUS FOR DETECTING AND APPRAISING SIGNALS ON CABLES

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11 Claims. (Cl. 333-6)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This application is a continuation-in-part of application Serial No. 144,801, filed October 12, 1961, now abandoned, for Apparatus for Detecting and Appraising Signals on Cables.

The invention relates to inductive pick up devices for detecting and determining the nature and intensity of intelligence signals upon a transmission line where it is not feasible to make direct contact with the message carrying elements of the cable.

The invention is designed for use with communication transmission line cables having at least two conductors, an inner conductor and an outer conductor which will be called a shield. Such cable may have a single or multiple conductor surrounded and protected from interference by the enclosing shield which is insulated from the inner conductor. This type of cable having a single inner conductor is also commonly used as a coaxial cable for transmission of high frequency signals in which case it functions as a wave guide. In either case the device of the invention is capable of externally extracting the wanted signal on the cable by induction thus to determine what if any signal is present on the transmission line without disturbing the continuity of the system or resorting to some means for obtaining direct contact with the cable conductor which may be difficult or impossible to achieve.

Heretofore inductive pick up means for use with such cables has been unsatisfactory especially when the cable or cables are subjected to outside interference picked up by the outer conductor or shield of the cable. In the operation of such transmission lines the useful signal is protected by the cable shield from spurious signals originating outside the cable.

The pick up device of the invention includes a magnetic core in the form of a loop which is caused to embrace the cable under examination and another cable the detailed form and function of which will be set forth hereinafter. The core has wound thereon an output coil which is connected to an output device which may be a visual or aural indicator or meter or any other type of device capable of responding to the intelligence signal on the cable being examined.

In a system as above briefly outlined the useful signal on the transmission line is inductively transferred to the output coil which in turn is connected to the output device. However in addition to the useful signal, interference originating externally to the cable is picked up by the cable shields and if not nullified is also transferred to the output coil. These interference signals, when severe, render proper reception of the useful signal difficult or impossible.

The invention provides means for nullifying the adverse effect of these interference signals. To accomplish this the invention includes the use of another cable, in addition to the one under examination, which will be termed the auxiliary cable. This latter cable must have electrical characteristics such that external interference signals picked up thereby will have the same intensity and phase as those picked up by the other cable. This implies also that the auxiliary cable be located reasonably close to the transmission line. During the testing operation the

auxiliary cable carries no intelligence signal or at least no signal that cannot be disregarded or separated from the wanted intelligence by other means.

The two cables are coupled to the pick up core of the device of the invention in such manner that the flux induced in the core by external interference signals on one cable is opposed by the flux induced in the core by the interference signals on the other cable. Thus the adverse effect of external interference is nullified and the useful signal is received clearly.

It is a primary object of the invention to provide an inductive signal detecting means for use with transmission lines which is capable of nullifying the adverse effects of interference signals originating outside the line cables and receiving the desired signal free from the adverse effects of external interference.

A further object of the invention is to provide a pick up device capable of receiving a wanted signal on a transmission line without disturbing the continuity of the line or resorting to means for obtaining direct contact with the cable conductors which may be undesirable or impossible to do.

Other objects and features of the invention will more fully appear from the following description and will be particularly pointed out in the claims.

To provide a better understanding of the invention specific embodiments thereof will be described and illustrated in the accompanying drawings wherein:

FIGURE 1 is a partially diagrammatic view of the device of the invention.

FIGURE 2 is a cross section taken on line 2-2 FIGURE 1.

FIGURE 3 is a partially diagrammatic view of a different embodiment of the invention.

FIGURE 4 illustrates a specific cable system and the manner in which the invention is applied thereto.

A practical form for the device may desirably include a suitable casing, not shown, within which may be received the means for indicating the received intelligence signal. The pick up device consists of loop 5 of soft ferromagnetic material upon which is wound an output coil 6. The pick up device may desirably be mounted upon the casing to provide a compact and convenient unit. The core may be of any shape which provides a closed flux path such as a loop thru which the cables involved may be threaded and means may be provided to open the loop to facilitate positioning the cables with respect to the core. To provide for opening the loop the core is divided into two separate sections presenting abutting faces indicated at 7. The sections may be clamped in registered position by clamping means of any suitable construction such as clips fitting closely over the ends of the core sections. Other means for opening the core loop may be provided.

To prepare the device for operation the sections 8 and 9 of the core 5 are separated and the cable 11 to be examined is so placed that it enters the core at one side of the core window and an auxiliary cable 12, connected at its ends to the outer conductor of cable 11, is passed thru the core window from the other side of the core as illustrated in FIGURES 1, 2 and 4 of the drawings. The arrangement of the cables with respect to the core may be executed in any suitable manner so long as the resulting coupling of the cables with the core will be such that flux induced in the core by external interference signals on one cable is substantially equal to and opposed by the flux induced in the core by external interference signals in the other cable. Such coupling may consist of a plurality of turns of each cable about the core. In this latter case the turns of the cable would be wound in opposite directions. With the device properly coupled

to the cables the wanted signal will be transferred to the output coil and thence to the output device while the adverse effects of interference signals are substantially nullified.

It is assumed that the large majority of the interference will produce currents in the cables in the same direction as viewed in the drawings, i.e., in a push-push manner. It is possible, of course, to set up some interference currents in opposite directions, i.e., in push-pull, as a result of any external fields which may pass between the cables. If the cables are a twisted pair or are mounted close together the push-pull interference currents will be very small and negligible.

It is also pointed out that the signal being transmitted in cable 11 will produce a current on the center conductor which, after passing through the utilization device (not shown) will return on the outer conductors of both cables 11 and 12 since the ends of these outer conductors are connected together. Since the signal currents on the outer conductors are equal, they will induce no flux in core 5 for the same reason that the interference currents induce no flux. The signal currents on the center conductor of cable 11 will therefore be the only substantial source of induced flux in core 5. It is assumed here that there is no signal present on the center conductor of cable 12.

The core member 5 may be made in various conformations, for example, it may be in the shape of a figure of eight with its cross over points slightly separated the core forming a continuous flux path with the flux in the two loops moving in opposite directions. In this case the two cables are threaded straight thru the loops.

A somewhat different form of the invention is shown in FIGURE 3 wherein a core 14 of the same general structure as that described in connection with FIGURE 1 is provided. The core has an output coil 15 wound thereon which is connected to an output device not shown.

In this form of the invention a section of insulated cable or wire 16 is directly connected to points 17 and 18 of the cable 19 under test. Two points 17 and 18 have been stripped of insulation and connections from the ends of the wire 16 are made to the cable 19 by soldering or by the use of removable clips. The cables 16 and 19 are threaded thru the core 14 in the same manner as the cables 11 and 12 are threaded in the core 5.

The wire 16 should have the same electrical characteristics as the shield of the cable 19 thus they constitute two parallel metallic paths which divide both the interference signal and the intelligence signal on the outer conductor into two equal parts. These signals, as in the other form of the invention, create equal opposing fluxes in the core. Thus the adverse effects of the interfering external signals and the intelligence signal are nullified. The desired signal from the center conductor of cable 19 is transferred to the output coil 15.

A valuable application of the invention is shown in FIGURE 4 of the drawings wherein 20 and 21 are a twisted pair of coaxial cables constituting a portion of a long transmission line including a plurality of widely spaced repeater stations such as the station 22. In such a system the cables have the same length, the same electrical characteristics and may contain transmitted and received signals. The ends of the outer conductors of cables 20 and 21 are normally grounded and, therefore, connected in common at the repeater stations 22. When transmission is taking place a strong signal will be present in the center conductor of one of the cables while a relatively low attenuated energy signal or no signal at all will be present in the center conductor of the other cable adjacent the repeater stations 22. This condition permits signals in the transmitting cable to be checked with the induction pick up embodying the invention. Signals may be detected and checked at any point along the line and in the specific case of a suspected defect at a repeater station the pick up is applied to the cables at

a point adjacent the output of the repeater as shown in FIGURE 4. To apply the device the pick up core 5 is opened and the two cables arranged therein as shown in FIGURES 1, 2, and 4, after which the core is closed.

In this application of the invention the pick up device detects the useful signal in the cable which is transmitting. The second cable which has a low energy signal or none at all acts in the same capacity as the cable 12 in FIGURE 1. The shields of the two cables embraced by the core 5 will pick up external interference signals of equal intensity from outside spurious fields. The effect of these signals due to the arrangement of the cables in the core is to set up equal and opposing fluxes in the core which cancel out. Of course, the intelligence signals on the outer conductors will be equal as in the previous case. The desired signal which is transferred to the output coil 5 and indicated by the sensing device 13 is free of the adverse effects of external signals.

What is claimed is:

1. An inductive signal pick-up device comprising a coaxial transmission cable having an inner and outer conductor, an auxiliary cable having a conductor connected at at least two spaced locations to said outer conductor, a ferromagnetic core of loop configuration, said cables having signal pick up characteristics and coupled to said core intermediate said spaced locations such that current due to external interference signals received by said cables will induce equal and opposing fluxes in said core whereby the adverse effects of said interference signals are nullified and the useful signal on said center cable is transferred to said core, an output coil coupled to said core, and an output device connected to said coil.

2. The device according to claim 1 and further including means to temporarily open and close said loop shaped core to receive said cables.

3. The device according to claim 1 and wherein said cables are twisted together throughout their length.

4. An inductive signal pick-up device comprising a coaxial transmission cable, a ferromagnetic core of loop configuration, said cable passing through said core, means coupled to said cable and said core for inducing fluxes in said core which are equal and opposite to the fluxes induced in said core by signals on the outer conductor of said coaxial cable, an output coil coupled to said core, and an output device connected to said coil.

5. The device according to claim 4 and wherein said means comprises a conductor connected to said outer conductor on opposite sides of said core.

6. The device according to claim 4 and wherein said means comprises a coaxial transmission cable the outer conductor of which is connected in parallel to the outer conductor of said first-mentioned transmission cable.

7. The device according to claim 6 and wherein said coaxial cables are twisted together throughout their length.

8. An inductive signal pick-up device comprising a pair of electrically similar coaxial transmission cables for transmitting signals between two stations in opposite directions, each said cable having an inner and outer conductor, said outer conductors being connected to each other at at least two spaced locations, a ferromagnetic core of loop configuration, said cables passing through said core in opposite directions intermediate said locations, a coil coupled to said core, and an output device connected to said coil.

9. The device according to claim 8 and further including means to temporarily open and close said loop shaped core to receive said cables.

10. The device according to claim 8 and wherein said cables are twisted together through their length.

11. An inductive signal pick up device in combination with a coaxial transmission cable, having an outer conductive shield comprising a ferromagnetic core of loop configuration having an output coil wound thereon, an auxiliary wire adjacent to said coaxial cable having its ends directly connected to the shield of said coaxial cable at points spaced apart lengthwise along the cable, said

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auxiliary wire having electrical characteristics such that currents present on the cable shield and wire induced by external interference signals will be divided equally therebetween, said cable and wire being inductively coupled to said core in such manner that equal opposing fluxes are induced in said core by the said interference induced currents whereby the adverse effects of said interference are nullified and the useful signal on said transmission cable

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is transferred to said output coil, an output device connected to said coil and means for temporarily opening the core loop and reclosing it thereby to facilitate placement of the cable and wire with respect to the core.

No references cited.

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