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SUPERVISION IN GLASS FIBRE DUPLEX TRANSMISSION SYSTEMS

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(57) Claim

1. A method of monitoring a duplex transmission system in which digital signals are transmitted in both directions on the same wavelength and wherein said duplex transmission system comprises a light-guide transmission path located between a first terminal station and a second terminal station each of which being provided with an optical transmitter and an optical receiver which are connected through a branching element to the light-guide transmission path, said method comprising the steps of:

converting digital signals in the first terminal station into a redundant code before their transmission over said path by superimposing recognizable specific code errors into said signals at periodic intervals of time; and

monitoring the transmitted signal a' received by each said receiver in each terminal station, for the occurrence of said specific code errors, wherein, if said specific code errors occur in the second terminal station, the received signal is correspondingly corrected by the removal of said specific code errors and, .n addition, an undisturbed transmission route is assumed, and wherein, if said specific code errors occur in the received signal of the receiver of said first terminal station, an alarm signal is generated due to failure of the transmission route.

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COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

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Complete Specification for the invention entitled:

Supervision in Glass Fibre Duplex Transmission Systems

The following statement is a full description of this invention, including the best method of performing it known to me/us

5845/3

Abstract

Supervision in glass fibre duplex transmission systems

In glass fibre transmission in duplex operation at the same wavelength for forward direction and reverse direction, the problem occurs that, if the transmission route is interrupted, the own transmitter signal occurs in the own receive section by reflection and deceives supervision circuits provided. To safeguard the supervision, according to the invention, the digital signal to be transmitted is converted into a redundant code before transmission and specific code errors, detectable on the receive side, are thereby superimposed at periodic intervals of time. The receiver signal is monitored for the occurrence of specific code errors in both terminal stations and an alarm signal is generated if they occur in the receive section of the transmitting terminal station.

FIG 1

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Supervision in glass fibre duplex transmission systems

The invention relates to a method according to the preamble of Claim 1.

Duplex operation, in which signals are transmitted on one cable in both directions of transmission and at the same wavelength, is of particular interest with regard to the optimum utilisation of already laid fibre-optic cables. For this purpose, the transmitter signals are coupled-in and the receiver signals are coupled-out at the ends of the fibre-optic cable, for example by means of a so-called taper coupler, which acts as optical directional coupler. In this arrangement, a small component of the transmitter signal also occurs at the receiver of the same terminal station, in particular due to the Rayleigh backscatter in the glass fibre and possibly also in the coupler and at the joints. As long as the receiver signal is received with sufficient level, this comparatively small part of the backscattered transmitter signal does not disturb reception. If the transmission route is interrupted, for example due to a cable breakage, the actual receiver signal disappears, so that, with opened and thus sensitive receiver inputs, the backscattered transmitter signal can simulate a receiver signal. In this case, known supervision circuits do not respond and there is no alarm signalling in the terminal stations due to route failure.

A method of code error superimposition into digital transmission signals and a corresponding code converter are known from EP-A1-0 160 748, in which, provided there are redundant transmission codes, code errors are superimposed such that no falsification of the informational content of the digital signals occurs. Due to the superimposing of the code errors, detectable on the receive side, in this way additional information can be transmitted, for example telemetery signals or a service channel for speech signals. The code errors are

superimposed in the way that, for the transcoding of at least one word of the transmission signals an altered mode distribution, in comparison with the intended mode distribution, is used.

The object of the present invention is to create a capability for the supervision of a glass fibre duplex transmission system by which a route failure is detected with certainty.

In accordance with the present invention there is disclosed a method of monitoring a duplex transmission system in which digital signals are transmitted in both directions on the same wavelength and wherein said duplex transmission system comprises a light-guide transmission path located between a first terminal station and a second terminal station each of which being provided an optical transmitter and an optical receiver which are connected through a branching element to the light-guide transmission path, said method comprising the steps of:

converting digital signals in the first terminal station into a redundant code before their transmission over said path by superimposing recognizable specific code errors into said signals at periodic intervals of time; and

monitoring the transmitted signal as received by each said receiver in each terminal station, for the occurrence of said specific code errors, wherein, if said specific code errors occur in the second terminal station, the received signal is correspondingly corrected by the removal of said specific code errors and, in addition, an undisturbed transmission route is assumed, and wherein, if said specific code errors occur in the received signal of the receiver of said first terminal station, an alarm signal is generated due to failure of the transmission route.

The invention is to be explained in more detail below with reference to an exemplary embodiment, represented in the drawing.

The FIG represented in the drawing shows in diagrammatic representation a glass fibre duplex transmission system with a first and a second terminal station LE1, LE2, between which there is a transmission route ÜS, which may include regenerative repeaters and makes do with a single optical waveguide. The first terminal station has, following an input for the first digital signals to be transmitted, DS1, a first

transcoder COD1, which is coupled to a first mode memory M1. Via a first control input ST1, the mode memory M1 receives, in time with the code errors generated, control signals by which the state of the mode memory M1 is changed. The first transcoder COD1 is designed as a 5B6B transcoder, which selects in dependence on the preceding input signal one of two possible mode distributions for the following digital signal. This selection is changed by the control signal ST1 at the mode memory

M1. As a result, the codeword corresponding to the incorrect mode distribution is generated and emitted to the first transmitter S1, which includes a driver amplifier and a laser diode with control circuit and generates an optical signal corresponding to the transcoded signal. This optical signal is emitted to the first tap AZ1, which is designed as an SM coupler of taper type and couples the optical transmitter signal into the optical waveguide in the transmission route ÜS.

The first tap AZ1 serves at the same time for coupling-out of the receiver signal from the optical waveguide of the transmission route ÜS. The receiver signal is fed to the first receiver E1, which is designed in a known way as a PIN diode receiver and emits an electric signal to the first decoder Dec1, in which on the one hand a 6B5B conversion takes place and on the other hand a monitoring for codewords which have not been formed according to the mode arising from the prehistory but according to the incorrect mode and occur in this case at a certain time period. These codewords are likewise decoded, a unique assignment to the correct primary value being possible, at the same time a selector signal is emitted to a first alarm signalling circuit AL1, which includes a memory. In this arrangement, the memory includes not only a resonance amplifier but also a memory capacitor with connected threshold detector. Upon periodic occurrence of the error signal, the threshold detector responds and emits a first alarm signal ALS1 to a corresponding output, which can be connected to further alarm signalling devices and, if appropriate, also to a device for route switching.

Following the transmission route ÜS, there is provided in the second terminal station a second tap AZ2, which emits the receiver signals to a second receiver E2. From the second receiver E2, which is likewise designed as a PIN diode receiver, the generated electric signals are emitted to a second decoder Dec2, which likewise performs a 6B5B conversion and, in addition, the signals are monitored for the occurrence of the specific code errors

and these are correspondingly corrected in the conversion. From the second decoder Dec2, the first digital signal DS1 is emitted to an output for further processing. At the same time, corresponding error pulses are emitted to a second alarm signalling circuit AL2, which has an inverse output with respect to the first alarm signalling circuit AL1, so that a second alarm signal ALS2 is emitted by the second alarm signalling circuit only if the potential at the memory in the second alarm signalling circuit drops below a predetermined value.

The transmit side of the second terminal station LE2 is designed differently to the first terminal station LE1. Connected to a input for the digital signals to be transmitted in the opposite direction, DS2, is a second transcoder COD2, which performs a 5B6B conversion and emits the converted signals to a second laser diode transmitter S2 with driver amplifier and control circuit. The second terminal station LE2 thus does not include any input for control signals for code error superimposition.

The two terminal stations LE1, LE2 may also be designed completely identically, so that the possibility of code error superimposition exists in each of the two terminal stations. The alarm signalling circuits AL1, AL2 then have in each case a non-inverting and an inverting output, which are wired depending on in which of the two terminal stations the code error superimposition takes place, but this can only ever be performed in one of the two terminal stations.

In practice, a superimposition of the code errors at a rate of 1×10^{-6} is expedient, provided that the digital signals intended for transmission, DS1, DS2, have bit rates between 10 and several 100 Mbits/sec.

To safeguard the monitoring against unintended code errors, an alarm signal cannot be generated until occurrence of the special code errors. The described use of a resonance amplifier, which is adjusted to the period of the code error superimposition and consequently only passes on to the alarm signalling circuits error pulses which occur with the intended period of code error

superimposition is particularly advantageous.

A further possibility of generating the special code errors arises if a redundant code with at least one "prohibited" codeword is provided as transmission code. In this case, instead of a comparatively frequently occurring codeword, the codeword not intended for the transmission, that is prohibited, can be generated in the conversion on the transmit side, the occurrence of the said prohibited codeword then being monitored by the decoders. Consequently, there is also the possibility of supervising glass fibre duplex transmission systems in which no alphabetic code with several possible mode distributions is used.

4 Patent Claims

1 FIG

The claims defining the invention are as follows:

1. A method of monitoring a duplex transmission system in which digital signals are transmitted in both directions on the same wavelength and wherein said duplex transmission system comprises a light-guide transmission path located between a first terminal station and a second terminal station each of which being provided with an optical transmitter and an optical receiver which are connected through a branching element to the light-guide transmission path, said method comprising the steps of:

converting digital signals in the first terminal station into a redundant code before their transmission over said path by superimposing recognizable specific code errors into said signals at periodic intervals of time; and

monitoring the transmitted signal as received by each said receiver in each terminal station, for the occurrence of said specific code errors, wherein, if said specific code errors occur in the second terminal station, the received signal is correspondingly corrected by the removal of said specific code errors and, in addition, an undisturbed transmission route is assumed, and wherein, if said specific code errors occur in the received signal of the receiver of said first terminal station, an alarm signal is generated due to failure of the transmission route.

2. A method according to claim 1, wherein the alarm signal is not generated until after repeated periodic occurrence of the specific code errors.

3. A method according to claim 1 or 2, wherein the digital signals are converted into a redundant alphabetic code with several possible modes before transmission and the specific code errors are generated by a different mode distribution being used instead of the intended mode distribution during the transcoding of the digital signals.

4. A method according to claim 1 or 2, wherein the digital signals are converted into a redundant code including at least one prohibited codeword before transmission, with the specific code errors being generated by the prohibited codeword, not intended for transmission.

5. A method of monitoring a duplex transmission system substantially as described herein with reference to the drawing.

DATED this TWENTY-FOURTH day of APRIL 1991

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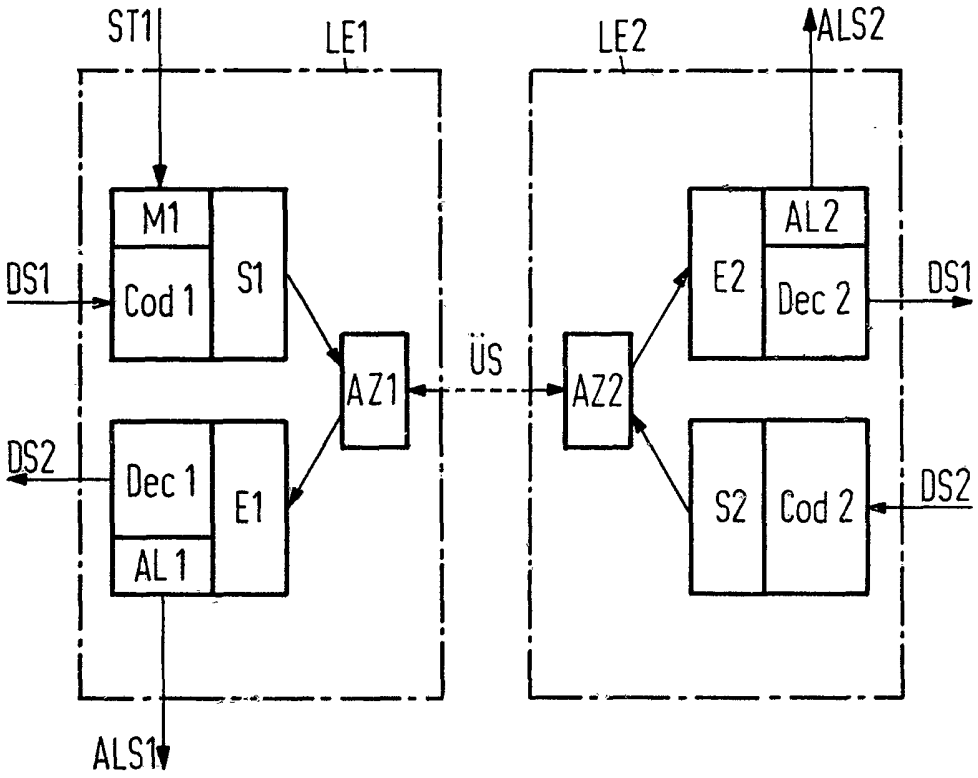
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