Data transmission system with modems coupled to a common communication medium.

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Description

This invention relates to an information transmission system, which permits information transmission and reception among information processors connected to a communication medium via interfaces.

A fully distributed peer protocol transmission system or CSMA/CD (carrier sense multiple access with collision detection) system is well known in the art as a bus shaped network, which does not require any central control station and is readily capable of extension. The system effects baseband transmission via a coaxial cable as a communication line. Recently, in order to improve the efficiency of utility of the coaxial cable, broadband networks are being developed, in which a baseband signal is converted into a carrier transmission line.

When realizing a CSMA/CD system on a carrier transmission line, it is significant to ensure collision detection characteristics substantially comparable with those on the conventional baseband transmission line and also ensure compatibility with upper protocols.

To meet collision detection characteristics requirements, there are some approaches.

In a first approach, transmitted data is temporarily stored and collated bit by bit with data returned via a transmission line. If the two data are identical for all bits, it is assumed that the data has been transmitted without collision. If the two data differ even for a single bit, it is assumed that a collision has occurred. This system is referred to as bit collision system of transmitted and received data.

In this system, however, it is necessary to demodulate and decode the received signal to obtain received data and also store the transmitted data. This means that, in order to ensure the compatibility with upper protocol, part of functions of upper protocol must be effected by physical levels of lowest protocols. This will complicate the construction and increase cost of a modem as hardware which realizes the physical level. With this system, since the levels of received signals are not equal, when a modem, which transmits a relatively high level signal, receives at the same time this signal and a signal from another modem which transmits a relatively low level signal, the received low-level signal may be neglected so that a bit error or errors cannot be detected. Namely, 100% reliable collision detection cannot be attained. Further, the system cannot determine how many collisions occur while monitoring the traffic of the network. This poses a problem in connection with the control of network.

In a second approach, a modem which intends to transmit data sends out two pulses at a random time interval prior to data transmission and monitors the transmission line for a period of time two times the maximum propagation time of the transmission line from the point of time at which the first pulse is sent out. If only two pulses are received during the period of time, it is assumed that no collision has occurred so that data transmission is commenced. This system is called "random pulse monitoring system".

This system, however, requires a time of monitoring for any collision every transmission of a data packet. This reduces the transmission efficiency, i.e., effective transmission capacity, of the network. Besides, like the first system, to ensure the compatibility with upper protocols, the modem is required to store data to be transmitted from the upper protocol while monitoring two random pulses. This complicates the hardware of moderns.

In a third approach, the detection of a collision is done using a fact that a peak level of a beat signal resulting from overlapping of two signals transmitted from different modems, is double when the two signals are in phase, for instance. This system is called "signal level detection system". This approach is free from the drawbacks in the previous first and second approaches, i.e., the incapability of collision detection by a receiving modem and the reduction of the network efficiency.

In this system, however, signals transmitted from all the other modems must be received through the transmission line by any modem at an equal and stable level. If the levels of the received signals are different, it becomes difficult to decide the occurrence of a collision.

From the standpoint of the signal transmission quality and collision detection in the CSMA/CD system, it is very important to receive at an equal reception level signals transmitted from all the interfaces.

Various data transmission systems are described in the following documents:


According to one embodiment of the invention there is provided an information transmission system comprising:

- a communication line having a transmission path (1) and a reception path (2) coupled to each other at a predetermined point (3) of said line;
- a plurality of information processing devices (4a to 4n);
- a plurality of modems (5a to 5n) for coupling said information processing devices (4a to 4n) to said communication line at arbitrary points thereof and for permitting transmission and reception of information signals among said information processing devices (4a to 4n) through said communication line, each modem (5a to 5n) including a transmitting amplifier (14) to transmit an information signal from the corresponding information processing device (4a to 4n) to said transmission path (1) of said communication line.
and a receiving amplifier (15) to receive an information signal transmitted to said transmission path (1) by each of said modems (5a to 5n) through said predetermined coupling point (3) of said transmission and reception paths (1, 2) and said reception path (2);

a pilot signal providing means (6) for sending out to said communication line a pilot signal of a predetermined reference level which is capable of being received by said receiving amplifier (15) of each of said modems (5a to 5n); and

each of said modems (5a to 5n) further including:

reception level detecting means (19) coupled to said receiving amplifier (15) for detecting the reception level of a signal received through said reception path (2); and

gain adjusting means (19) characterised in that said gain adjusting means (19) are responsive to said reception level detecting means (18) for adjusting the gain of said transmitting amplifier (15) such that the reception level of a transmission signal, which is transmitted to said transmission path (1) by said transmitting amplifier (14) and received by said receiving amplifier (15) through said predetermined coupling point (3) of said transmission path and reception paths (1, 2) and said reception path (2), becomes a predetermined level which is a function of the reception level of the pilot signal received by said receiving amplifier.

Embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Fig. 1 shows a local area network using a coaxial cable according to the invention;

Fig. 2 is a block diagram of a modem used in the local network of Fig. 1;

Fig. 3 is a block diagram of a collision detector in the modem of Fig. 2;

Figs. 4 through 6 are diagrams for explaining a collision of signals occurring on the local network;

Figs. 7 through 9 are flow charts for explaining the gain control operation of a gain controller in the modem of Fig. 2 for receiving and transmitting amplifiers;

Fig. 10 shows a block diagram of a modem according to another embodiment of the invention;

Fig. 11 is a block diagram of a gain controller shown in Fig. 10;

Figs. 12 through 16 are flow charts for explaining the operation of the gain controller shown in Fig. 10;

Fig. 17 shows a local network using a single-conductor cable; and

Figs. 18 and 19 are block diagrams of a modem and a headend used in the network of Fig. 17, respectively.

Fig. 1 shows a network embodying the invention. Reference numeral 1 designates a transmission line, and 2 a reception line. These lines 1 and 2 are coupled together at a given point by a headend 3 which comprises directional couplers and an amplifier. In the headend 3, a signal on the transmission line 1 is coupled to the reception line 2 through the couplers and amplifier. A plurality of data processors 4 (4a to 4n) are connected via respective modems 5 (5a to 5n) as interfaces to the lines 1 and 2 at arbitrary points thereof. Although not shown, each modem 5 is connected to the lines 1 and 2 by directional couplers. Data transmitted from a data processor 4 is thus coupled by the associated modem 5 to the transmission line 1 and then coupled by the headend 3 to the reception line 2 to be received by each modem 5, which in turn applies the received data to the associated data processor 4. Data transmission between the data processor 4 is effected in this way. A reference level signal (i.e., pilot signal) generator 6 is connected to the headend 3.

The pilot signal generator 6 sends out a pilot signal of a reference level through the headend 3 to the receiving line 2 at a fixed time interval or a time interval depending on the traffic of the line, i.e., at proper timings. The duration of the pilot signal is set comfortably long compared to the maximum data packet length (e.g., 1.2 msec), to e.g., 5 msec. The gains of receiving and transmitting amplifiers in each modem 5 are adjusted according to the pilot signal.

The modem 5 has a construction as shown in Fig. 2. Data from the data processor 4 (which may be a baseband digital signal or code-modulated signal such as Manchester code signal) is coupled to a frequency modulator 11, to frequency modulate a carrier signal of a predetermined frequency in accordance with a frequency shift keying (FSK) system. The modulated-carrier signal is coupled through a bandpass filter 12 and an electronic switch 13 to a transmitting amplifier 14 to be amplified therein. The amplified signal is sent out to the transmission line 2.

A signal (i.e., modulated-carrier signal) transmitted from another modem is received by a receiving amplifier 15 to be amplified. The amplified received signal is coupled through a bandpass filter 16 to a frequency demodulator 17 to recover original digital data. The recovered digital data is fed to the data processor 4. The output signal of the bandpass filter 16 is also supplied to an envelope detector 18, which detects the level of the received signal. A gain controller 19 having a microcomputer adjusts the gains of transmitting and receiving amplifier 14 and 15 according to the level of the received signal detected by envelope detector 18. The output signal of envelope detector 18 is also supplied to a collision detector 20. The collision detector 20 detects a collision of signals on the line by making use of the fact that a beat signal is generated as a result of a collision of signals. It generates a collision indicative signal when it detects a collision. The collision indicative signal is fed to data processor 4, which then inhibits the issuance of data. In this way, data transmission is effected according to the CSMA/CD system.

The gain controller 19 controls the electronic
switch 13. For example, when the modem is not in a transmitting mode, the gain controller 19 disables switch 13 to prevent the carrier wave from being sent out to the transmitting line 2. Further, the gain controller 19 causes collision detector 20 to generate a collision indicative signal during a gain control operation. The detection of a collision is achieved after the gains of transmitting and receiving amplifiers 14 and 15 are adjusted to the respective optimum levels by gain controller 19.

Before describing the gain control operation, the collision detector 20 will be described with reference to Fig. 3. The output signal of envelope detector 18 is fed through a low-pass filter 21 to an amplifier 22. It is also applied to first and second comparators 23 and 24. These comparators 23 and 24 check the level of received signal with respect to reference voltages provided from respective first and second reference voltage generators 25 and 26 as threshold levels. The first reference voltage generator 25 gives a threshold level, which is slightly higher than a substantially constant received signal level detected by envelope detector 18 when only one modem transmits a signal. The comparator 23 generates an output signal when the received signal level exceeds the threshold level. The second reference voltage generator 26 provides a threshold level, which is slightly lower than the substantially constant received signal level. The second comparator 24 generates a signal when the receiving signal level is lower than the threshold level. A collision of signals transmitted simultaneously from two or more modems is thus detected by making use of the fact that the amplitude of a beat signal resulting from a collision varies from zero level to twice the level of each transmitted signal. The output signal of first and second comparators 23 and 24 are fed to a monostable multivibrator 29 through an OR gate 27 and an AND gate 28 which is enabled by an output signal of amplifier 22 only during the presence of the received signal. The monostable multivibrator 29 thus generates a collision detection signal having a predetermined duration when a collision is detected. The output signal of monostable multivibrator 29, which holds a collision detection state for a predetermined period of time, drives an oscillator 30, which generates a collision indicative signal of, for instance, 10 MHz. The gain controller 19 supplies an initial setting signal to oscillator 30 through an OR gate 31, whereby the collision indicative signal is generated during the gain control operation.

Now, a collision of signals transmitted simultaneously from different modems will be described with reference to Figs. 4 to 6.

Assuming that transmission data applied from the data processor to the modem 5 in the network described above is a baseband signal as shown in Fig. 4, the frequency modulator 11 effects frequency shifts represented as follows:

\[ f_1 = f_c + f_d \]

for transmission data of "1" (space), and

\[ f_2 = f_d - f_c \]

for transmission data of "0" (mark) where \( f_c \) is the carrier frequency and \( f_d \) is a frequency deviation.

As shown in Fig. 5, when two modems transmit data with a time (or phase) difference \( \theta \), signal difference results from the phase difference as shown by oblique line portions. They also result from the difference in bit data. As a result of the signal differences, a beat signal with a cycle period of \( f_d/2 \), as shown in Fig. 6, is generated due to the upper and lower frequency components of \( f_c \) and \( f_d \). The peak amplitude of the beat signal is substantially double the amplitude of a normal signal transmitted from each modem. The collision detector 20 can detect a collision from the amplitude-varying beat signal.

The open-loop gain control operation will now be described with reference to the flow chart of Fig. 7. The gain control operation is initiated by turning on a power source of modem 5. First, the gain controller 19 supplies an initial setting signal to collision-indicative signal generator 30, thus inhibiting data transmission from data processor 4. The electronic switch 13 is disabled to prevent the transmission of carrier signal. The pilot signal generator 6 supplies the pilot signal of a predetermined reference level \( V_{p0} \) to the headend at proper timings. Therefore, each modem 5 receives the pilot signal from headend 3 via the reception line 2. The envelope detector 18 detects a reception level \( V_{r1} \) of the pilot signal received by receiving amplifier 15. The gain controller 19 calculates an input level \( V_{i1} \) of the pilot signal to modem 5 by subtracting the gain of receiving amplifier 15 from the detected reception level \( V_{r1} \). The difference \( V_{0} - V_{i1} \) between the pilot signal level \( V_{0} \) at headend 3 and input signal level \( V_{i1} \) corresponds to the level of attenuation of signal on receiving line 2 from headend 3 to receiving modem 5. The level of attenuation of signal on transmission line 1 from the modem 5 to the headend 3 can be thought to be equal to the attenuation level \( V_{0} - V_{r1} \) of reception line. The gain controller 19 adjusts the gain of transmitting amplifier 14 according to the information mentioned above such that the output level \( V_{O} \) of transmitting amplifier 14 is obtained which satisfies the following equation,

\[ V_{O} = V_{0} - (V_{0} - V_{i1}) + G_0 \]

or

\[ V_{O} = 2V_{0} - V_{i1} - G_0 \]

where \( G_0 \) is the gain of headend 3. This means that the reception level of the transmission signal received by the receiving amplifier 15 becomes equal to the reception level \( V_{r1} \) of the pilot signal received by the amplifier 15.

In the above example, the gain of transmitting amplifier of each modem is adjusted such that the
level of a transmission signal from the modem becomes the reference level $V_R$ of the pilot signal at the headend. But, according to this invention, it is only required that a signal from each modem have a constant level at the headend. For example, the signal from each modem may be adjusted to have, at the headend, a level which is a multiple of the reference level $V_R$ of the pilot signal. Namely, the transmitting amplifier may be adjusted such that

$$V_0 = (1+\alpha)V_R - V_{L1} - G_0$$

wherein $\alpha$ is a constant.

The gain controller 19 then adjusts the gain of receiving amplifier 15 such that the reception level $V_{L1}$ of the pilot signal becomes a predetermined reception level $V_{L0}$. Thus, the adjustment of the gains of transmitting and receiving amplifiers 14 and 15 is completed so that the collision indicative signal is turned off to permit data transmission from data processor 4.

According to this system, in which the gains of transmitting and receiving amplifiers 14 and 15 of each modem are adjusted as described above, the levels of transmission signals from modems 5 may be made equal at the headend 3, regardless of the position of each modem on the transmission line. In addition, the level of a signal received through the headend 3 can be adjusted to the level $V_{L1}$ suited for the receiving process. Sufficiently high quality of transmission signal thus can be obtained, while also permitting reliable detection of a collision of signals on the line from a signal level change. Further, the gains of transmitting and receiving amplifiers 14 and 15 can be adjusted very simply as described above and the construction of modem 5 is also simple, so that it is possible to realize a network readily and at a low cost.

The gain control operation described above is based only on the pilot signal from headend 3. However, it is possible to effect gain control on the basis of a signal transmitted from another modem, in which the gain control operation has been completed, as well as the pilot signal. Such gain control operation will now be described with reference to Fig. 8. For this gain control operation, the fact that a collision has occurred must be indicated from collision detector 20 to gain controller 19 as shown by a broken line in Fig. 2. This is achieved by coupling an output signal of monostable multivibrator 29, i.e., collision detection signal, to gain controller 19. Also in this case, the collision indicative signal is issued by turning on the power source of modem 5 to inhibit data processor 4 from data transmission and set it in a signal receiving stand-by condition. In this condition, the modem receives the pilot signal or a signal from another modem 5 in which the gain adjustment has been completed to detect the output level $V_{L2}$ of receiving amplifier 15. According to the output level $V_{L2}$, the gains of transmitting and receiving amplifiers 14 and 15 are adjusted as described above. Prior to the gain control, however, decision is made as to whether the received signal is the pilot signal or not. This decision is done by checking whether the duration of the received signal is longer or shorter than the longest packet duration $T_p$ of data packets transmitted between modems 5. If the received signal is found to be a signal from another modem 5, the reception level $V_{L2}'$ of the next data packet is detected, and a similar received signal duration check is done. If the received signal is the pilot signal, the gain adjustment is executed in the manner as described above using the second detected level $V_{L2}$ as the received signal level $V_{L1}$. If the second received signal is also a signal from a modem 5, the difference $|V_{L2} - V_{L2}'|$ is obtained, and a check is done as to whether the difference is less than a permissible value. If the former is less than the latter, it is decided that the level of the transmitted signal from the modem has been adjusted to a sufficiently high precision, and thus the signal level is used in lieu of the pilot signal level for executing the gain adjustment described above. If the difference is larger than the permissible value, the routine is repeated from the detection of the reception level so that the gain adjustment of transmitting and receiving amplifiers 14 and 15 is carried out after reception of a signal whose level may be considered to have been adjusted to a high precision.

Subsequently, the modem waits for a random period to avoid a collision with a signal from any other modem before sending out a test signal at the preset level $V_O$, for instance for 3 msec. The test signal is a carrier signal used in the frequency modulator 11, which is transmitted while the electronic switch 13 is enabled by gain controller 19 for 3 msec. The modem then receives the test signal and detects the reception level $V_{L1}$ thereof. Then, a check is done as to whether the detection of signal has been done under a condition free from a collision with a signal from another modem. For this purpose, after the lapse of a random period of time, the test signal of the preset level $V_O$ is retransmitted, and its reception level $V_{L1}'$ is detected. The difference in the reception level between the first and second test signals is then obtained, and a check is done as to whether the difference is less than the permissible value. If the difference is sufficiently small, it is decided that the test has been done without collision. At this time, the gain of transmitting amplifier 14 is adjusted such that the signal transmission level of the amplifier becomes $(V_{L2} - V_{L2})$ higher than the previous level $V_O$. Upon completion of the re-adjustment of gain, the collision indicative signal is turned off to release the inhibition of data transmission, i.e., permit data transmission among modems 5.

The gain adjustment of transmitting and receiving amplifiers 14 and 15 through the closed-loop control using the test signal as described above
permits a compensation for level control errors due to manufacturing variations in characteristics of trunk amplifiers, transmitting and receiving amplifiers 14 and 15 of each modem and transmission and reception lines 1 and 2. That is, it permits the initial setting of the level of a signal received by modem 5 with very high precision. In other words, the signal reception level which has been set to \( V_{i2} \) may be actually \( V_{l2} \) due to various errors, and the test using the test signal permits more precise gain adjustment and level setting by compensating the transmission level by an amount of \( V_{l2} - V_{i2} \). This gain control operation is thus more effective and useful than the previous one.

The setting of the transmission level of the individual modems 5 of the network as described above permits a high quality signal transmission and reliable detection of a collision on the transmission line. However, the characteristics of the components of modems 5 and the transmission line may undergo changes with time so that the initially set level may no longer be suited to the network. Further, the characteristics may undergo changes with temperature during the operation of the network, thus making the preset level inadequate. Therefore, it is desirable not only to make initial level setting at the time of turning on the power source but also constantly adjust the gains of transmitting and receiving amplifiers 14 and 15 even while data transmission is in force.

The constant gain control operation will now be described with reference to the flow chart of Fig. 9. For this control operation, a data detector 32, as shown in Fig. 2, is provided to detect data from the data processor to check whether the modem is in the transmitting mode. The output of detector 32 is fed to gain controller 19 as a transmission indicative signal. The data detector 32 consists of a retriggerable multi-vibrator which is responsive to the level transitions of Manchester code data from the data processor.

In the gain control operation shown in Fig. 9, initial control operation is executed in the same way as in the case of Fig. 8 when the power source is turned on. After the initial control operation is completed, a check is always done as to whether the modem is in the transmitting or receiving mode. In the receiving mode, when a signal is received the reception level \( V_{i2} \) of the received signal is detected. A check is then done as to whether the received signal is the pilot signal or a signal transmitted from a modem on the basis of the duration of the received signal. If the received signal is the pilot signal, the gains of transmitting and receiving amplifiers 14 and 15 are adjusted in the manner as described before according to the reception level \( V_{i2} \). Further, the gain of receiving amplifier 15 is compensated for according to the difference between the detected reception level \( V_{l2} \) and the desired reception level \( V_{l2'} \). If the received signal is a signal from a modem, a collision detecting step is performed in the manner as described before. If it is decided that no collision has occurred, the gains of transmitting and receiving amplifiers 14 and 15 are increased by \( 0.1 \times (V_{i2} - V_{i2'}) \). This correction of gains is done in order to minimize adverse effects of possible maladjustment of the signal level at the other modem.

If the modem 5 is in the transmitting mode, the reception level \( V_{i2} \) of a signal transmitted by itself is detected, and the occurrence of a collision is checked from the detected level \( V_{i2} \). If it is decided that no collision has occurred, the gain of transmitting amplifier 14 is corrected according to the level difference \( V_{i2} - V_{l2} \) in the same manner as the gain adjustment using the test signal described above.

This control permits constant correction of the gains of transmitting and receiving amplifiers 14 and 15 while signal transmission among modems 5 is in force; that is, it can cope with changes in network characteristic with time and temperature change so that the signal transmission is always affected by the stable level.

In the above example, the pilot signal is used to adjust the gains of transmitting and receiving amplifiers. But, the gains of transmitting and receiving amplifiers may be adjusted using an output signal of a precisely arranged modem. Namely, if such a relation

\[ |V_{i2} - V_{l2'}| < \varepsilon \]

as described above is obtained for a signal from a predetermined modem, the signal from the modem may be used as a reference signal. In this case, an output signal from each modem is adjusted to have, at the headend, a level equal to the level of the output signal from the predetermined modem at the headend.

The gain controller 19 so far described requires an analog-to-digital converter for converting the output voltage of envelope detector 18 into a digital value and adjusts the gains of transmitting and receiving amplifiers 14 and 15 through calculation on the digital data. The calculated amplifier-gain control data is converted by a digital-to-analog converter into an analog control voltage for adjusting the transmitting and receiving amplifier gains. In this case, it is difficult to relate the calculated control voltage to the amplifier gains. In addition, the use of the analog-to-digital converter increases the modem's cost.

A preferred gain control system will be described hereinafter, which uses no analog-to-digital converter and achieves the gain control in accordance with the comparison of the envelope detector output voltage \( V_{o2} \) to a reference carrier voltage level \( V_{o2} \) representing an envelope detector output voltage which is obtained when an optimum-level output signal is obtained from the receiving amplifier.

Fig. 10 shows a construction of a modem which can perform the preferred gain control operation. In the Figure, the same parts as in the modem of Fig. 2 are designated by the same reference numerals. In this embodiment, the gain control is executed according to the pilot signal and test signal as
described above. The modem includes a data detector 32a provided on the output side of frequency modulator 17. The output of frequency modulator 17 is normally high, and goes low when data from another modem is received. The output of data detector 32a is also normally high, and goes low in response to a level transition of the output of frequency modulator 17 to a low level. In other words, the output of data detector 32a is high when the modem is receiving the non-modulated pilot signal or test signal.

Fig. 11 shows the construction of gain controller 19a. A comparator 191 compares the output voltage Vp of envelope detector 18 to a reference carrier voltage level VCL corresponding to the envelope detector output voltage when a proper level output signal is obtained from receiving amplifier 15. It supplies a carrier level large/small indication signal to a microcircuit 190. This signal is high when Vp>VCL while it is low when Vp<VCL. A comparator 192 compares the output voltage Vp of envelope detector 18 to a threshold voltage VCS for carrier signal detection which is lower than VCL to apply a carrier sense signal to microcircuit 190. The carrier sense signal is high when Vp>VCS, i.e., when a rf signal of a relatively low level is received, and low when Vp<VCS. The output of data detector 32a, i.e., demodulator output non-transition indicative signal, and the carrier sense signal are fed to an AND gate 193. When a rf signal with no data is received, the output of AND gate 193 goes high during the duration of the rf signal. The output of AND gate 193 is fed to a signal duration measuring circuit 194. The signal duration measuring circuit 194 measures the duration of the output signal of AND gate 193, which provides a pilot indication signal which goes high after the lapse of 3 msec. (i.e., the maximum duration of the test signal) and goes low when the output of AND gate 193 goes low. The signal duration measuring circuit 194 also provides a false pilot indication signal, which is normally high and goes low during a predetermined time (32 μsec.) when the output of AND gate 193 goes low after the lapse of 5 msec. When the output signal of AND gate 193 remains high even after the lapse of 5 msec. or goes low before the lapse of this time, the false pilot indication signal remains high. When a period corresponding to each modem has been passed after the false pilot indication signal became low, a permit-to-send test signal indicative signal generator 195 supplies a permit-to-send test signal indicative signal to microcircuit 190. The microcircuit 190 supplies amplifier gain control data to a digital-to-analog converter 196, which in turn feeds gain adjust signals to transmitting and receiving amplifiers 14 and 15. The microcircuit 190 also supplies a control signal to electronic switch 13 and an initial setting signal to collision detector 20.

The gain control operation is performed following a routine as shown in the flow chart of Fig. 12. This routine includes an initial setting routine and a stationary routine. The initial setting routine is started with turning on of the power source of modem. First, a subroutine for initialization is executed. In this subroutine, an internal counter in the microcomputer is initialized, and an initial setting routine indicative flag bit is set to "1." Further, the collision indicative signal is supplied to data processor. Subsequently, subroutines for coarse adjustment of the receiving amplifier, fine adjustment thereof, coarse adjustment of the transmitting amplifier and fine adjustment thereof are executed in the mentioned order. The stationary routine includes subroutines for fine adjustments of the receiving and transmitting amplifiers. In the stationary routine, the fine adjustment of the transmitting amplifier may be executed once for, for example, 30 times of execution of the stationary routine.

The gain adjustment of the receiving amplifier is effected according to the pilot signal, while that of the transmitting amplifier is effected according to the test signal. The gain adjustments of the receiving and transmitting amplifiers will now be described with reference to the flow charts of Figs. 13 to 16.

Fig. 13 illustrates the operation of the coarse gain adjustment of the receiving amplifier. The operation is initiated by turning on the power source of the modem. First, the gain of the receiving amplifier is adjusted to a relatively large initial value, and also an initial value of the gain adjusting step size is set. Where gain control data consists of 6 bits, a gain adjusting step size corresponding to the weight of the fourth least significant bit of the control data is initially set. The microcircuit 190 now waits the generation of the pilot indication signal from signal duration measuring circuit 194, indicating the reception of the pilot signal by the modem. When the modem receives a rf carrier signal, the comparator 192 provides a high level carrier sense signal in response to the output voltage Vp of envelope detector 18 even if the amplitude of the received rf carrier signal is relatively small. As a result, the output of AND gate 193 goes high to cause signal duration measuring circuit 194 to measure the duration of the rf carrier signal. When the rf carrier signal continues for 3 msec, the signal duration measuring circuit 194 regards the rf carrier signal as the pilot signal and then generates the pilot indication signal. The output signal of comparator 192, i.e., the carrier level large/small indication signal, is high ("1") when Vp>VCL and low ("0") when Vp<VCL. When Vp>VCL, the microcircuit 190 increases the gain of receiving amplifier 15 at an interval of the initially set gain adjusting step sizes until Vp>VCL. When Vp>VCL on the other hand it decreases the receiving amplifier gain in the same steps until Vp<VCL. This gain control operation is completed by an inversion of the carrier level large/small indication signal.

The microcomputer than halves the gain adjusting step size. Then a decision is made as to whether the new gain adjusting step size is greater or less than the minimum gain adjusting step size (corresponding to the weight of the least significant bit of the gain control data). If the former step
size is greater than the latter, the operation goes back to the step of increasing or decreasing the gain according to the comparison between $V_p$ and $V_{CL}$. In this case, when the gain increasing operation is effected previously, the gain decreasing operation is effected at this time, and vice versa. When the gain adjusting step size is found to be less than the minimum gain adjusting step size, the subroutine of coarse adjustment is over, and the operation returns to the main routine.

Now, the subroutine for the fine gain adjustment of the receiving amplifier is called to carry out the operation of Fig. 14. Like the previous case of coarse adjustment, the microcomputer 190 waits the pilot indication. When the pilot indication signal goes high, the microcomputer increases the gain of the receiving amplifier in the minimum gain adjusting step size until $V_p > V_{CL}$. This operation is carried out within 2 msec, during which period the pilot indication signal is high when the pilot signal is received. Therefore, after the completion of this operation a decision is made as to whether there is any pilot indication. If there is a pilot indication, the microcomputer waits the disappearance thereof. After the pilot indication has disappeared, a decision is made as to whether there is any false pilot indication. As mentioned above, when the pilot signal is received, the false pilot indication signal goes low for 32 msec after the lapse of the pilot signal duration. This transition of signal signifies that there is no false pilot indication. If the duration of the output signal of AND gate 193 is shorter or longer than 5 msec, the false pilot indication signal remains high. This means that there is a false pilot indication.

If there is no false pilot indication, the receiving amplifier gain is adjusted such that $V_p = V_{CL}$. In the event if the pilot indication disappears due to noise or other causes during gain increasing operation or if there is no pilot indication after the gain increasing or decreasing operation, the above operation is repeated with the receiving amplifier gain set to an old gain before the fine adjustment operation. This also takes place when there is false pilot indication. When the fine adjustment of the receiving amplifier gain is completed, the operation returns to the main routine.

Now, the subroutine for the coarse gain adjustment of the transmitting amplifier is called to execute the operation of Fig. 15. First, initial values of the transmitting amplifier gain and gain adjusting step size are set. The microcomputer 190 waits a permission to send the test signal (TL). This signal is obtained when a time period corresponding to a modem number of each modem has been passed after the completion of the pilot signal reception. The microcomputer 190 then waits the disappearance of a carrier on the coaxial cable. This is detected by the output signal of comparator 192, i.e., carrier sense signal going low. When the permission to send test signal is obtained and the carrier on the coaxial cable disappears, the microcomputer 190 turns on electronic switch 13 to send out the test signal for 3 msec at most in the manner as described before. The maximum value of signal propagation times which varies with the position of each modem on the network, is set to 40 msec. The microcomputer 190 is in a stand-by condition during 40 msec after the issuance of the test signal. After 40 msec has passed, the microcomputer increases or decreases the gain of transmitting amplifier 15 in response to the carrier level large/small indication signal. More specifically, if the reception level $V_p$ of the test signal is less than the proper carrier level $V_{CL}$, the gain of the transmitting amplifier is increased in the initially set adjusting step size until $V_p > V_{CL}$. If $V_p > V_{CL}$ on the other hand, the gain is decreased in the same steps until $V_p < V_{CL}$. This adjustment of the transmitting amplifier gain is repeated while the test signal (TL) is issued. When the permission to send test signal vanishes during the gain adjustment operation, the electronic switch 13 is turned off, and the operation is repeated from the first step. The permission to send test signal usually continues for 3 msec.

When the steps of increasing or decreasing the transmitting amplifier gain at an interval of the initial gain adjusting step size is over, the initial gain adjusting step size is halved. If the new gain adjusting step size is greater than the minimum one, the step of increasing or decreasing the gain is executed in the new gain adjusting step size. When this step is over, the gain adjusting step size is further halved. When the new gain adjusting step size is less than the minimum one, the operation returns to the main routine.

Now, the subroutine for the fine gain adjustment of the receiving amplifier is called to execute the operation of Fig. 16. The internal counter in the microcomputer has been reset to zero in the initialization subroutine described above. The zero internal counter content indicates that the fine gain adjustment of the transmitting amplifier is carried out. For the fine gain adjustment of the transmitting amplifier, the microcomputer 190 causes collision detector 20 to generate the collision indicative signal to inhibit data transmission from the data processor. Then, a decision is made as to whether the operation is in the initial setting routine. In the initialization subroutine, the flag bit has been set to “1” as described above. In the initial setting routine, the coarse and fine gain adjustments of the transmitting amplifier and gain adjusting step size are set as the permission to send test signal is issued. In this routine, therefore, the operation of increasing and decreasing the transmitting amplifier gain at the interval of the minimum adjusting step size is executed continuously subsequent to the coarse gain adjustment. When the fine gain adjustment in the minimum adjusting step size is over, the microcomputer 190 turns off electronic switch 13, and sets an initial value, for instance 30, in the internal counter. Next, the microcomputer permits data transmission and resets the initial setting routine indicative flag. This brings an end to
the initial setting routine, and the operation returns to the main routine.

When the permit-to-send test signal indicative signal (T1) goes off during the step of increasing or decreasing the transmitting amplifier gain in the minimum adjusting step for the fine gain adjustment, the microcomputer 190 turns off the electronic switch 13, resets the internal counter to zero and sets the transmitting amplifier gain to the old gain obtained immediately after the end of the coarse adjustment. The operation is repeated from the step to wait the permission to send test signal.

In the stationary routine, the subroutines for the fine gain adjustments of the receiving and transmitting amplifiers are executed. The fine gain adjustment of the transmitting amplifier, however, is executed once for 30 times of that of the receiving amplifier in accordance with the initial value (30) of the internal counter. In the stationary routine whenever the fine gain adjustment subroutine for the transmitting amplifier is called from the main routine, the internal counter is decremented by 1.

The fine adjustment of transmitting amplifier in the stationary routine starts with a step of waiting the permission to send test signal. Since the initial setting routine indicative flag has been reset for the stationary routine, the fine adjustment of the transmitting amplifier in the minimum adjusting step size is started after any signal transmitted from any other modem has gone off on the coaxial cable and the electronic switch 13 has been turned on.

The invention may be applied to a single-conductor cable network as shown in Fig. 17. In this network, data are transmitted and received among modems using frequency division multiplexing. In this instance, each modem is basically the same as that shown in Fig. 2.

However, as shown in Fig. 18, the output line of transmitting amplifier 14 and input line of receiving amplifier 15 are connected together. The transmitting and receiving amplifiers 14 and 15 are connected through a directional coupler having a frequency selection property.

Further, headend 3 in this network may have a construction as shown in Fig. 13. A receiving amplifier 36 is coupled by a directional coupler 35 to transmission line 7. A signal received by receiving amplifier 36 is coupled through a band-pass filter 37 to a frequency converter 38. A frequency-converted output signal of frequency converter 38 is coupled through a band-pass filter 39 to a transmitting amplifier 40, the output of which is in turn coupled to directional coupler 35. An envelope detector 41 detects the output level of band-pass filter 37, and a gain controller 42 adjusts the gain of transmitting amplifier 40 according to the output of the envelope detector 41 to make the transmission and reception signal levels equal to each other in headend 3.

With the single-conductor cable network as described a signal transmission is carried out principally in the same manner as in the double-conductor cable network as described before. This means that the same gain control system as described above may be used.

While some preferred embodiments of the invention have been described above, they are not intended to limit the scope of the invention. For example, the invention is also applicable to a network using optical fiber cables for the transmitting and receiving lines where light is the medium of data transmission. Further, a signal to be transmitted may be of any type, e.g., video and audio analog or digital signal, or it may be a baseband signal. Further, where a carrier signal is used, it may be modulated by any suitable modulation system. Further, the network may be tree-shaped or star-shaped. Namely, this invention may be applied to a network having a transmission path and a reception path which are coupled to each other at a point. Still further, one modem may be provided with the function of pilot signal generator. Moreover, the pilot signal may be discriminated from its frequency.

Attention is hereby directed to co-pending application EP—113 230 (83 307 768.8) which claims a data transmission system.

Claims

1. An information transmission system comprising:
   a communication line having a transmission path (1) and a reception path (2) coupled to each other at a predetermined point (3) of said line;
   a plurality of information processing devices (4a to 4n);
   a plurality of modems (5a to 5n) for coupling said information processing devices (4a to 4n) to said communication line at arbitrary points thereof and for permitting transmission and reception of information signals among said information processing devices (4a to 4n) through said communication line, each modem (5a to 5n) including a transmitting amplifier (14) to transmit an information signal from the corresponding information processing device (4a to 4n) to said transmission path (1) of said communication line and a receiving amplifier (15) to receive an information signal transmitted to said transmission path (1) by each of said modems (5a to 5n) through said predetermined coupling point (3) of said transmission and reception paths (1, 2) and said reception path (2);
   a pilot signal providing means (6) for sending out to said communication line a pilot signal of a predetermined reference level which is capable of being received by said receiving amplifier (15) of each of said modems (5a to 5n); and
   each of said modems (5a to 5n) further including:
   reception level detecting means (19) coupled to said receiving amplifier (15) for detecting the reception level of a signal received through said reception path (2); and
   gain adjusting means (19) characterised in that said gain adjusting means (19) are responsive to
said reception level detecting means (18) for adjusting the gain of said transmitting amplifier (14) such that the reception level of a transmission signal, which is transmitted to said transmission path (1) by said transmitting amplifier (14) and received by said receiving amplifier (15) through said predetermined coupling point (3) of said transmission path and reception paths (1, 2) and said reception path (2), becomes a predetermined level which is a function of the reception level of the pilot signal received by said receiving amplifier.

2. An information transmission system as claimed in claim 1, further characterised in that the gain of said transmitting amplifier (15) is adjusted by said gain adjusting means such that the reception level of the said transmission signal becomes substantially equal to the reception level of the pilot signal received by said receiving amplifier (15).

3. An information transmission system as claimed in claim 1, further characterised in that the pilot signal providing means (6) send the pilot signal to said coupling point (3) of said communication line and in that the gain of said transmitting amplifier (15) is adjusted by said gain adjusting means such that the said transmission signal has, at said coupling point (3) of said communication line, a predetermined level which is a function of the reference level of the pilot signal at said coupling point (3).

4. An information transmission system as claimed in claim 1, further characterised in that the pilot signal is an unmodulated signal.

5. An information transmission system as claimed in claim 4, further characterised in that each modem further comprises test signal sending means (11, 12) for sending an unmodulated test signal to said transmission path (1) through said transmitting amplifier (14); unmodulated signal detecting means (32a) for detecting that a signal received by said receiving amplifier (15) is the pilot signal or the test signal; and in that said gain adjusting means (19) are responsive to said reception level detecting means (18) and said unmodulated signal detecting means (32a) for, when the reception level of the pilot signal received by said receiving amplifier (15) is detected, causing said test signal sending means (11, 13) to send out a test signal to said transmission path (1) and adjusting the gain of said transmitting amplifier (14) such that the reception level of the test signal received by said receiving amplifier (15) through said predetermined point (3) of said communication line becomes substantially equal to the reception level of the pilot signal received by said receiving amplifier (15).

6. An information transmission system as claimed in claim 2, further characterised in that said gain adjusting means (19) is arranged to adjust the gain of said receiving amplifier (15) so that the reception level of the pilot signal becomes a predetermined level.

7. An information transmission system as claimed in claim 2, further characterised in that the transmission signal used in adjusting the gain of said transmitting amplifier (14) is a test signal.

8. An information transmission system as claimed in claim 7, further characterised in that the test signal is an unmodulated signal.

9. An information transmission system as claimed in claim 2, further characterised in that said transmission path (1) and reception path (2) of said communication line are constituted by a common transmission medium, and a frequency conversion device is provided at said coupling point (3) of said transmission and reception paths (1, 2) for effecting information transmission among said modems (5a to 5n) on a frequency division multiplexing basis.

10. An information transmission system as claimed in claim 2, further characterised in that said transmission and reception paths (1, 2) are constituted by a pair of mediums, and a headend (3) is provided at said coupling point (3) of said transmission and reception paths (1, 2).

11. An information transmission system as claimed in claim 5, further characterised in that said gain adjusting means (19) is arranged to adjust the gain of said receiving amplifier (15) so that the reception level of the pilot signal becomes a predetermined level.

12. An information transmission system as claimed in claim 5, further characterised in that said gain adjusting means (19) is arranged to perform an initial routine for gain adjustments of said transmitting and receiving amplifiers (14, 15) and a stationary routine for gain adjustments of said transmitting and receiving amplifiers (14, 15), and a stationary routine being repeatedly executed during the operation of the modem (5a to 5n) such that the gain adjustment of said transmitting amplifier (14) is effected once for plural times of that of said receiving amplifier (15).

13. An information transmission system as claimed in claim 5, further characterised in that said gain adjusting means (19) is arranged to adjust the gain of said receiving amplifier (15) so that the reception level of the pilot signal becomes a predetermined level, and to successively effect a coarse gain adjustment of said receiving amplifier (15), fine gain adjustment thereof, coarse gain adjustment of said transmitting amplifier (14) and fine gain adjustment thereof; each of the coarse gain adjustments being carried out such that the gain of the corresponding amplifier (14, 15) is adjusted by a coarse adjusting step size, the gain adjusting step size being switched to a smaller step size every time the magnitude relation between the reception level of the pilot signal or the test signal and the predetermined reception level is changed, and each of the fine gain adjustments being carried out such that the gain of the corresponding amplifier (14, 15) is adjusted by a smaller adjusting step size than those in the coarse gain adjustments.
14. An information transmission system as claimed in claim 13, further characterised in that said gain adjusting means (19) is arranged to perform an initial routine and a stationary routine, said initial routine including subroutines for a coarse gain adjustment of said receiving amplifier (15), a fine gain adjustment thereof, coarse gain adjustment of said transmitting amplifier (14) and fine gain adjustment thereof, said stationary routine including subroutines for fine gain adjustments of said receiving and transmitting amplifiers (14, 15) and being repeatedly executed during the operation of the modem (5a to 5n), and the fine gain adjustment of said receiving amplifier (14) in the stationary routine being effected once for a plurality of times of the fine gain adjustment of said receiving amplifier (15).

15. An information transmission system as claimed in claim 5, further characterised in that said transmission and reception paths (1, 2) of said communication line are constituted by a common transmission medium, and a frequency conversion device is provided at said coupling point (3) of said transmission and reception paths (1, 2) for effecting information transmission among said modems (5a to 5n) on a frequency multiplexing basis.

16. An information transmission system as claimed in claim 5, further characterised in that said transmission and reception paths (1, 2) of said communication line are constituted by a pair of transmission mediums, and a headend (3) is provided at said coupling point (3) of said transmission and reception paths (1, 2).

17. An information transmission system as claimed in claim 5, further characterised in that the pilot signal, test signal, and information signal have different durations, and said unmodulated signal detecting means (32a) is arranged to discriminate between the pilot signal and test signal on the basis of signal duration.

18. An information transmission system comprising:
   a communication line having a transmission path (1) and a reception path (2) coupled to each other at a predetermined point (3) of said line;
   a plurality of information processing devices (4a to 4n);
   a plurality of modems (5a to 5n) for coupling said information processing devices (4a to 4n) to said communication line at arbitrary points thereof and for permitting transmission and reception of information signals among said information processing devices (4a to 4n) through said communication line, each modem including a transmitting amplifier (14) to transmit an information signal from the corresponding information processing device (4a to 4n) to said transmission path (1) of said communication line and a receiving amplifier (15) to receive an information signal transmitted to said transmission path (1) by each of said modems (5a to 5n) through said predetermined coupling point (3) of said transmission and reception paths (1, 2) and said reception path (2); reception level detecting means (18) means coupled to said receiving amplifier (15) for detecting the reception level of a signal received through said reception path (2); and gain adjusting means (19) characterised in that said gain adjusting means (19) are responsive to said reception level detecting means (18) for adjusting the gain of said transmitting amplifier (14) such that the reception level of a transmission signal, which is transmitted to said transmission path (1) by said transmitting amplifier (14) and received by said receiving amplifier (15) through said predetermined coupling point (3) of said transmission and reception paths (1, 2) and said reception path (2), becomes substantially equal to the reception level of a signal transmitted from another modem (5a to 5n) and received by said receiving amplifier (15).

19. An information transmission system as claimed in claim 18, further characterised by pilot signal providing means (6) coupled to said communication line for sending out a pilot signal of a predetermined level to said communication line so that the pilot signal can be received by said receiving amplifier (15) of each of said modems (5a to 5n) through said reception path (2); and each of said modems (5a to 5n) further including means for detecting whether a signal received by said receiving amplifier (15) is the pilot signal or a signal transmitted by another modem (5a to 5n); and said gain adjusting means (19) is arranged to adjust the gain of said transmitting amplifier (14) according to the reception level of the pilot signal when the pilot signal is received by said receiving amplifier (15).

20. An information transmission system as claimed in claim 18, further characterised in that said gain adjusting means (19) is arranged to adjust the gain of said receiving amplifier (15) so that the reception level of the signal received by said receiving amplifier (15) becomes a predetermined level.

21. An information transmission system as claimed in claim 18, further characterised in that said gain adjusting means (19) is arranged to adjust the gain of said transmitting amplifier (14) when the difference between the reception levels of signals transmitted from another modem (5a to 5n) and received by said receiving amplifier (15) is smaller than a predetermined value.

22. An information transmission system as claimed in claim 18, further characterised in that each of said modems (5a to 5n) includes a test signal sending means (11, 13) for sending out a test signal to said communication line through said transmitting amplifier (14); and wherein said gain adjusting means (19) is arranged to cause said test signal sending means (11, 13) to send out the test signal to said communication line after the gain of said transmitting amplifier (14) has been adjusted, and compensate the gain of said transmitting amplifier (14) according to the reception level of the test signal received by said receiving amplifier (15).

23. An information transmission system as claimed in claim 18, further characterised in that
said transmission path (1) and said reception path (2) are constituted by a common transmission medium, and a frequency conversion device is provided at said coupling point (3) of said transmission and reception paths (1, 2) for effecting information transmission among said moderns (5a to 5n) on a frequency multiplexing basis.

24. An information transmission system as claimed in claim 18, further characterised in that said transmission path (1) and said reception path (2) of said communication line are constituted by a pair of transmission mediums, and a headend (3) is provided at said coupling point (3) of said transmission and reception paths (1, 2).

25. A method of information transmission utilising a system comprising a communication line having a transmission path (1) and a reception path (2) coupled to each other at a predetermined point (3) of said line; a plurality of information processing devices (4a to 4n); a plurality of modems (5a to 5n) for coupling said information processing devices (4a to 4n) to said communication line at arbitrary points thereof and for effecting information transmission among said information processing devices (4a to 4n) through said communication line, each modem (5a to 5n) including a transmitting amplifier (14) to transmit an information signal from the corresponding information processing device (4a to 4n) to said transmission path (1) of said communication line; and a receiving amplifier (15) to receive an information signal transmitted to said transmission path (1) by each of said moderns (5a to 5n) through said coupling point (3) of said transmission and reception paths (1, 2) and said reception path (2); said method resulting in each of said modems (5a to 5n) receiving information signals from other modems (5a to 5n) at a substantially constant level and comprising the steps of:

- providing a pilot signal of a reference level to a predetermined point (3) of said communication line;
- detecting the reception level of the pilot signal received by said receiving amplifier (15);
- sending a transmission signal to said communication line through said transmitting amplifier (14); and characterised by
- receiving the transmission signal sent out to said communication line by said receiving amplifier (15) through said coupling point (3) of said communication line and said reception path (2); and
- adjusting the gain of said transmitting amplifier (14) such that the reception level of the transmission signal received by said receiving amplifier (15) becomes substantially equal to the reception level of the pilot signal received by said receiving amplifier (15).

26. A method as claimed in claim 25, further characterised by the step of adjusting the gain of said receiving amplifier (15) to a level suitable for signal processing.

27. A method as claimed in claim 25, further characterised in that the pilot signal is provided to said coupling point (3) of said communication line.

28. A method as claimed in claim 25, further characterised in that the transmission signal is a test signal, and the pilot signal and the test signal are unmodulated signals.

29. A method as claimed in claim 28, further characterised in that the pilot signal and the test signal have different durations.

30. A method of information transmission utilising a system comprising a communication line having a transmission path (1) and a reception path (2) coupled to each other at a predetermined point (3) of said line; a plurality of information processing devices (4a to 4n); a plurality of modems (5a to 5n) for coupling said information processing devices (4a to 4n) to said communication line at arbitrary points thereof and for effecting information transmission among said information processing devices (4a to 4n) through said communication line, each modem (5a to 5n) including a transmitting amplifier (14) to transmit an information signal from the corresponding information processing device (4a to 4n) to said transmission path (1) of said communication line; and a receiving amplifier (15) to receive an information signal transmitted to said transmission path (1) by each of said moderns (5a to 5n) through said coupling point (3) of said transmission and reception paths (1, 2) and said reception path (2), said method resulting in each of said modems (5a to 5n) receiving information signals from other modems (5a to 5n) at a substantially constant level and comprising the steps of:

- receiving by said receiving amplifier (15) an information signal transmitted from a predetermined modem (5a to 5n) to said communication line through said coupling point (3) of said communication line and said reception path (2); and
- detecting the reception level of the information signal from said predetermined modem (5a to 5n) received by said receiving amplifier (15); transmitting a transmission signal to said communication line through said transmitting amplifier (14); and
- characterised by
- receiving the transmission signal by said receiving amplifier (15) through said coupling point (3) of said communication line and said reception path (2); and
- adjusting the gain of said transmitting amplifier (14) such that the reception level of the transmission signal becomes substantially equal to the reception level of the information signal transmitted from said predetermined modem (5a to 5n).

Patentansprüche

1. Informationsübertragungssystem, umfassend:
- eine Verbindungsleitung mit einer Übertragungsstrecke (1) und einer Empfangsstrecke (2), die an einer vorbestimmten Stelle (3) der Leitung miteinander gekoppelt sind,
- mehrere Informationsverarbeitungsvorrichtun-
mehrere Modems (5a—5n) zum Ankoppeln der Informationsverarbeitungsvorrangsituationen (4a—4n) an die Verbindungsleitung an beliebigen oder willkürlichen Stellen derselben und zur Ermöglichung des Übertragens und Empfangens von Informationsignalen zwischen den Informationsverarbeitungsvorrangsituationen (4a—4n) über die Verbindungsleitung, wobei jeder Modem (5a—5n) einen Übertragungsverstärker (14) zum Übertragen eines Informationssignals von der betreffenden Informationsverarbeitungsvorrangsituation (4a—4n) zur Übertragungsstrecke (1) der Verbindungsleitung und einen Empfangsverstärker (15) zum Empfangen eines Informationssignals, das durch jeden der Modems (5a—5n) zur Übertragungsstrecke (1) übertragen wird, über die vorbestimmte Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) sowie die Empfangsstrecke (2) aufweist, eine Steuersignalliefereinheit (6), um zur Verbindungsleitung ein einen vorbestimmten Bezugssignal aufweisendes Steuersignal auszusenden, das vom Empfangsverstärker (15) jedes der Modems (5a—5n) empfangbar ist, und wobei jeder der Modems (5a—5n) ferner aufweist:

eine an den Empfangsverstärker (15) ange schlossene Empfangspegeldetektor- oder -detektorseinheit (19) zum Erfassen des Empfangspegels eines über die Empfangsstrecke (2) empfangenen Signals, sowie

Verstärkereinsteilseilinhalt (19), dadurch gekennzeichnet, daß die Verstärkereinsteilseilinhalt (19) auf die Empfangspegeldetektor- einheit (18) ansprechen zwecks Einstellung der (des) Verstärkungsgrads (des) Übertragungsverstärkers (14) in der Weise, daß der Empfangspegel eines Übertragungssignals, das durch den Übertragungsverstärker (14) zur Übertragungsstrecke (1) übertragen und vom Empfangsverstärker (15) über die vorbestimmte Kopplungsstelle (3) der Übertragungsstrecke und der Empfangsstrecke (1, 2) sowie die Empfangsstrecke (2) empfangen wird, einen vorbestimmten Pegel erreicht, der eine Funktion des Empfangspegels des vom Empfangsverstärker empfangenen Steuersignals ist.

2. Informationsübertragungssystem nach Anhang 1, dadurch gekennzeichnet, daß die Verstärkung des Übertragungsverstärkers (15) durch die Verstärkereinsteilseilinhalt so einge stellt wird, daß der Empfangspegel des Übertragungssignals praktisch gleich dem Empfangspegel des vom Empfangsverstärker (15) empfangenen Steuersignals ist.

3. Informationsübertragungssystem nach Anhang 2, dadurch gekennzeichnet, daß die Steuersignalliefereinheit (6) das Steuersignal zur Kopplungsstelle (3) der Verbindungsleitung senden und daß die Verstärkung des Übertragungsverstärkers (15) durch die Verstärkereinsteilseilinhalt so eingestellt wird, daß das Übertragungssignal an der Kopplungsstelle (3) der Verbindungsleitung einen vorbestimmten Pegel aufweist, der eine Funktion des Bezugssignals des Steuersignals an der Kopplungsstelle (3) ist.

4. Informationsübertragungssystem nach Anhang 1, dadurch gekennzeichnet, daß das Steuersignal ein unmoduliertes Signal ist.

5. Informationsübertragungssystem nach Anhang 2, dadurch gekennzeichnet, daß jeder Modem ferner aufweist:
eine Test- oder Prüfsignalleitweiseeinrichtung (11, 12) zum Aussenden eines unmodulierten Test- oder Prüfsignals zur Übertragungsstrecke (1) über den Übertragungsverstärker (14),
eine Detektoreinheit (32a) für ein unmoduliertes Signal zum Erfassen, daß ein vom Empfangsverstärker (15) empfangenes Signal das Steuersignal oder das Prüfsignal ist, und
dß die Verstärkereinsteilseilinhalt (19) auf die Empfangspegeldetektor- einheit (18) und die Detektoreinheit (32a) für unmoduliertes Signal ansprechen, um dann, wenn der Empfangspegel des vom Empfangsverstärker (15) empfangenen Steuersignals erfaßt wird, die Prüfsignal de- einrichtung (11, 13) zu veranlassen, ein Prüfsignal zur Übertragungsstrecke (1) auszusenden und die Verstärkung des Übertragungsverstärkers (14) so einzustellen, daß der Empfangspegel des durch den Empfangsverstärker (15) über die vorbestimmte Stelle (3) der Verbindungsleitung empfangenen Prüfsignals praktisch gleich dem Empfangspegel des vom Empfangsverstärker (15) empfangenen Steuersignals wird.

6. Informationsübertragungssystem nach Anhang 2, dadurch gekennzeichnet, daß das für die Einstellung der Verstärkung des Übertragungsverstärkers (14) benutzte Übertragungs- signal ein Test- oder Prüfsignal ist.

7. Informationsübertragungssystem nach Anhang 2, dadurch gekennzeichnet, daß das für die Einstellung der Verstärkung des Übertragungsmedium gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Fre quenzspannervorrichtung durchführung einer Informationsübertragung zwischen den Modems (5a—5n) auf einer Fre quenzteilung-Multiplexbasis vorgesehen ist.

8. Informationsübertragungssystem nach Anhang 2, dadurch gekennzeichnet, daß die Übertragungsstrecke (1, 2) durch zwei Medien gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Kopfstelle (3) vorgesehen ist.

9. Informationsübertragungssystem nach Anhang 2, dadurch gekennzeichnet, daß die Übertragungs- und Empfangsstrecken (1, 2) durch Zwei Medien gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Kopfstelle (3) vorgesehen ist.
Einstellen der Verstärkung des Empfangsverstärkers (15) in der Weise, daß der Empfangspegel des Steuersignals zu einem vorbestimmten Pegel wird.

12. Informationsübertragungssystem nach Anspruch 5, dadurch gekennzeichnet, daß die Verstärkungseinstellheit (19) ausgelegt ist zur Durchführung einer Anfangsroute für Verstärkungseinstellungen der Übertragungs- und Empfangsverstärker (14, 15) und einer feststehenden (stationären) Routine für Verstärkungseinstellungen der Übertragungs- und Empfangsverstärker (14, 15), wobei die feststehende Routine während des Betriebs der Modems (5a—5n) wiederholt ausgeführt wird, derart, daß die Verstärkungseinstellung des Übertragungsverstärkers (14) für mehrere entsprechende Einzelfreihen des Empfangsverstärkers (15) einmal erfolgt.

13. Informationsübertragungssystem nach Anspruch 5, dadurch gekennzeichnet, daß die Verstärkungseinstellheit (19) ausgelegt ist zum Einstellen der Verstärkung des Empfangsverstärkers (15) in der Weise, daß der Empfangspegel des Steuersignals zu einem vorbestimmten Pegel wird, und zum aufeinanderfolgenden Durchführen einer Grobverstärkungseinstellung des Empfangsverstärkers (15), einer Feinverstärkungseinstellung desselben, einer Grobverstärkungseinstellung des Übertragungsverstärkers (14) und einer Feinverstärkungseinstellung desselben, jede der Grobverstärkungseinstellungen so ausgeführt wird, daß die Verstärkung des betreffenden Verstärkers (14, 15) mittels einer Grobeeinstellschrittgöße eingestellt wird, welche jedesmal auf eine kleinere Schrittgöße umgeschaltet wird, wenn die Großenbeziehung zwischen dem Empfangspegel des Steuersignals oder des Prüfsignals und dem vorbestimmten Empfangspegel geändert wird (oder sich ändert), und jede der Feinverstärkungseinstellungen so ausgeführt wird, daß die Verstärkung des betreffenden Verstärkers (14, 15) mit einer kleineren Einstellschrittgöße als bei einer Grobverstärkungseinstellung eingestellt wird.

14. Informationsübertragungssystem nach Anspruch 13, dadurch gekennzeichnet, daß die Verstärkungseinstellheit (19) ausgelegt ist zur Durchführung einer Anfangsroute und einer feststehenden (stationären) Routine, wobei die Anfangsroute Subroutine (oder Unterprogramme) für eine Grobverstärkungseinstellung des Empfangsverstärkers (15), eine Feinverstärkungseinstellung desselben, eine Grobverstärkungseinstellung des Übertragungsverstärkers (14) und eine Feinverstärkungseinstellung desselben umfaßt, wobei die feststehende Routine Subroutinen (oder Unterprogramme) für Feinverstärkungseinstellungen von Empfangs- und Übertragungsverstärkern (14, 15) umfaßt und während des Betriebs der Modems (5a—5n) wiederholt ausgeführt wird, und die Feinverstärkungseinstellung des Übertragungsverstärkers (14) in der feststehenden Routine jeweils einmal für mehrmalige Feinverstärkungseinstellungen des Empfangsverstärkers (15) ausgeführt wird.

15. Informationsübertragungssystem nach Anspruch 5, dadurch gekennzeichnet, daß die Übertragungs- und Empfangsstrecken (1, 2) der Verbindungsleitung durch ein gemeinsames Übertragungsmedium gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Frequenzwandlervorrichtung zur Durchführung einer Informationsübertragung zwischen den Modems (5a—5n) auf einer Frequenzmultiplexbasis vorgesehen ist.

16. Informationsübertragungssystem nach Anspruch 5, dadurch gekennzeichnet, daß die Übertragungs- und Empfangsstrecken (1, 2) der Verbindungsleitung durch zwei Übertragungsmedien gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Kopplungsstelle (3) vorgesehen ist.

17. Informationsübertragungssystem nach Anspruch 5, dadurch gekennzeichnet, daß das Steuersignal, das Prüfsignal und das Informationsignal jeweils verschiedene Dauer besitzen und die Detektoreinheit (32a) für unmoduliertes Signal angeordnet oder ausgelegt ist zum Diskriminieren zwischen dem Steuersignal und dem Prüfsignal auf der Grundlage der Signalader.

18. Informationsübertragungssystem, umfassend:

- eine Verbindungsleitung mit einer Übertragungsstrecke (1) und einer Empfangsstrecke (2), die an einer vorbestimmten Stelle (3) der Leitung miteinander gekoppelt sind,
- mehrere Informationsverarbeitungsvorrichtungen (4a—4n),
- mehrere Modems (5a—5n) zum Ankoppeln der Informationsverarbeitungsvorrichtungen (4a—4n) an die Verbindungsleitung an beliebigen oder willkürlich Stellen derselben und zur Ermöglichung des Übertragens und Empfangens von Informationssignalen zwischen den Informationsverarbeitungsvorrichtungen (4a—4n) über die Verbindungsleitung, wobei jeder Modem (5a—5n) einen Übertragungsverstärker (14) zum Übertragen eines Informationssignals von der betreffenden Informationsverarbeitungsvorrichtung (4a—4n) zur Übertragungsstrecke (1) der Verbindungsleitung und einen Empfangsverstärker (15) zum Empfangen eines Informationssignals, das durch jeden der Modems (5a—5n) zur Übertragungsstrecke (1) übertragen wird, über die vorbestimmte Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) sowie die Empfangsverstärker (15) angeschlossene Empfangspiegeldektoreinheit (18) zum Erfassen des Empfangspiegelpegels eines über die Empfangsstrecke (2) empfangenen Signals sowie Verstärkungseinheiten (19), dadurch gekennzeichnet, daß die Verstärkungseinheiten (19) auf die Empfangspiegeldektoreinheit (18) ansprechen zwecks Einstellung der (des) Verstärkungsgrads des Übertragungsverstärkers (14) in der Weise, daß der Empfangspegel eines Übertragungssignals, das durch den Übertragungsverstärker (14) zur Übertragungsstrecke (1) übertragen und vom Empfangsverstärker (15) über die vorbestimmte
Kopplungsstelle (3) der Übertragungsstrecke und der Empfangsstrecke (1, 2) sowie die Empfangsstrecke (2) empfangen wird, praktisch gleich dem Empfangspegel eines Signals wird, das von einem anderen Modem (5a—5n) übertragen und durch den Empfangsverstärker (15) empfangen wird.

19. Informationsübertragungssystem nach Anspruch 18, dadurch gekennzeichnet, daß eine Steuersignalleereinheit (6) vorgesehen ist, die mit der Verbindungsleitung gekoppelt ist, um ein Steuersignal eines vorbestimmten Pegels zur Verbindungsleitung auszusenden, so daß das Steuersignal über die Empfangsstrecke (2) vom Empfangsverstärker (15) jedes der Modems (5a—5n) empfangbar ist, und jeder der Modems (5a—5n) weiterhin Einrichtungen aufweist zum Erfassen, ob ein vom Empfangsverstärker (15) empfangenes Signal das Steuersignal oder ein durch einen anderen Modem (5a—5n) übertragenes Signal ist, und die Verstärkungseinstelleinheit (19) ausgelegt ist zum Ausstellt der Verstärkung des Übertragungsverstärkers (14) entsprechend dem Empfangspegel des Steuersignals, wenn das Steuersignal vom Empfangsverstärker (15) empfangen wird.

20. Informationsübertragungssystem nach Anspruch 18, dadurch gekennzeichnet, daß die Verstärkungseinstelleinheit (19) ausgelegt ist zum Einstellen der Verstärkung des Empfangsverstärkers (15) in der Weise, daß der Empfangspegel des vom Empfangsverstärker (15) empfangenen Signals zu einem vorbestimmten Pegel wird.

21. Informationsübertragungssystem nach Anspruch 18, dadurch gekennzeichnet, daß die Verstärkungseinstelleinheit (19) ausgelegt ist zum Einstellen der Verstärkung des Übertragungsverstärkers (14), wenn die Differenz zwischen den Empfangspegel von einem anderen Modem (5a—5n) übertragenen und vom Empfangsverstärker (15) empfangenen Signalen kleiner ist als eine vorbestimmte Größe.

22. Informationsübertragungssystem nach Anspruch 18, dadurch gekennzeichnet, daß jeder der Modems (5a—5n) eine Prüfsignalleereinrichtung (11, 13) zum Aussenden eines Test- oder Prüfsignals zur Verbindungsleitung über den Übertragungsverstärker (14) aufweist und daß die Verstärkungseinstelleinheit (19) ausgelegt ist, um die Prüfsignallieereinrichtung (11, 13) zum Aussenden des Prüfsignals zur Verbindungsleitung nach dem Einstellen der Verstärkung des Übertragungsverstärkers (14) zu veranlassen und die Verstärkung des Übertragungsverstärkers (14) nach Maßgabe des Empfangspegels des vom Empfangsverstärker (15) empfangenen Prüfsignals zu kompensieren.

23. Informationsübertragungssystem nach Anspruch 18, dadurch gekennzeichnet, daß die Übertragungsstrecke (1) und die Empfangsstrecke (2) durch ein gemeinsames Übertragungsmedium gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Frequenzwandlervorrichtung zur Durchführung einer Informationsübertragung zwischen den Modems (5a—5n) auf einer Frequenzmultiplexbasis vorgesehen ist.

24. Informationsübertragungssystem nach Anspruch 18, dadurch gekennzeichnet, daß die Übertragungsstrecke (1) und die Empfangsstrecke (2) der Verbindungsleitung durch zwei Übertragungsmedien gebildet sind und an der Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) eine Kopfstelle (3) vorgesehen ist.

25. Verfahren für Informationenübertragung unter Anwendung eines Systems, umfassend eine Verbindungsleitung mit einer Übertragungsstrecke (1) und einer Empfangsstrecke (2), die an einer vorbestimmten Stelle der Leitung miteinander gekoppelt sind, mehrere Informationsverarbeitungsvorrichtungen (4a—4n), mehrere Modems (5a—5n) zum Ankoppeln der Informationsverarbeitungsvorrichtungen (4a—4n) an die Verbindungsleitung an beliebigen oder willkürlich an Stellen derselben und zum Durchführen einer Informationsübertragung zwischen den Informationsverarbeitungsvorrichtungen (4a—4n) über die Verbindungsleitung, wobei jeder Modem (5a—5n) einen Empfangsverstärker (14) zum Übertragen eines Informationsignals von der betreffenden Informationsverarbeitungsvorrichtung (4a—4n) zur Übertragungsstrecke (1) der Verbindungsleitung und einen Empfangsverstärker (15) zum Empfangen eines Informationsignals, das zur Übertragungsstrecke (1) durch jeden der Modems (5a—5n) über die Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1, 2) sowie die Empfangsstrecke (2) übertragen wird, aufweist, wobei mit dem Verfahren erreicht wird, daß jeder der Modems (5a—5n) Informationssignale von anderen Modems (5a—5n) mit einem praktisch konstanten Pegel empfängt, und das Verfahren folgende Schritte umfaßt:

Liefert einem Steuersignal eines Bezugspegels zu einer vorbestimmten Stelle (3) der Verbindungsleitung,

Erfassen des Empfangspegels des vom Empfangsverstärker (15) empfangenen Steuersignals, (und)

Aussenden eines Übertragungssignals zur Verbindungsleitung über den Übertragungsverstärker (14),

dadurch gekennzeichnet, daß das durch den Empfangsverstärker (15) zur Verbindungsleitung ausgesandte Übertragungs- signal über die Kopplungsstelle (3) der Verbindungslleitung und die Empfangsstrecke (2) empfangen wird und
die Verstärkung des Übertragungsverstärkers (14) so eingestellt wird, daß der Empfangspegel des vom Empfangsverstärker (15) empfangenen Übertragungssignals praktisch gleich dem Empfangspegel des vom Empfangsverstärker (15) empfangenen Steuersignals wird.

27. Verfahren nach Anspruch 25, dadurch gekennzeichnet, daß das Steuersignal zur Kopplungsstelle (3) der Verbindungsleitung geliefert wird.


29. Verfahren nach Anspruch 28, dadurch gekennzeichnet, daß das Steuersignal und das Prüfsignal jeweils verschiedene Dauer aufweisen.

30. Verfahren für Informationsübertragung unter Anwendung eines Systems, umfassend eine Verbindungsleitung mit einer Übertragungsstrecke (1) und einer Empfangsstrecke (2), die an einer vorbestimmten Stelle der Leitung miteinander gekoppelt sind, mehrere Informationsverarbeitungsvorrichtungen (4a—4n), mehrere Modems (5a—5n), der Informationseinrichtungsvorrichtung (4a—4n) an die Verbindungsleitung an beliebigen oder willkürlich festgelegten Stellen derselben und zum Durchführen einer Informationsübertragung zwischen den Informationsverarbeitungsvorrichtungen (4a—4n) über die Verbindungsleitung, wobei jeder Modem (5a—5n) einen Übertragungsverstärker (14) zum Übertragen eines Informationssignals von der betreffenden Informationsverarbeitungsvorrichtung (4a—4n) zur Übertragungsstrecke (1) der Verbindungsleitung und einen Empfangsverstärker (15) zum Empfangen eines Informationssignals, das zur Übertragungsstrecke (1) durch jeden der Modems (5a—5n) über die Kopplungsstelle (3) der Übertragungs- und Empfangsstrecken (1,2) sowie der Empfangsstrecke (2) übertragen wird, aufweist, wobei mit dem Verfahren erreicht wird, daß jeder der Modems (5a—5n) Informationssignale von anderen Modems (5a—5n) mit einem praktisch konstanten Pegel empfängt, und das Verfahren folgende Schritte umfaßt:

mittels des Empfangsverstärkers (15) erfolgenden Empfang eines Informationssignals, das von einem vorbestimmten Modem (5a—5n) zur Verbindungsleitung übertragen wird, und zwar über die Kopplungsstelle (3) der Verbindungsleitung und die Empfangsstrecke (2),

Erlassen des Empfangspegels des durch den Empfangsverstärker (15) empfangenen Informationssignals vom vorbestimmten Modem (5a—5n), (und)

Übertragen eines Übertragungssignals zur Verbindungsleitung über den Übertragungsverstärker (14), dadurch gekennzeichnet, daß das Übertragungssignal durch den Empfangsverstärker (15) über die Kopplungsstelle (3) der Verbindungsleitung und die Empfangsstrecke (2) empfangen wird und die Verstärkung des Übertragungsverstärkers (14) so eingestellt wird, daß der Empfangspegel des Übertragungssignals praktisch gleich dem Empfangspegel des von vorbestimmten Modem (5a—5n) übertragenen Informationssignals wird.

Reivendications

1. Un système de transmission d’information comprenant:

une ligne de communication ayant une voie d’émission (1) et une voie de réception (2) qui sont mutuellement couplées à un point prédéterminé (3) de la ligne;

un ensemble de dispositifs informatiques (4a à 4n);

un ensemble de modems (5a à 5n) destinés à connecter les dispositifs informatiques (4a à 4n) à la ligne de communication, à des points arbitraires de celles-ci, et à permettre l’émission et la réception de signaux d’information entre les dispositifs informatiques (4a à 4n), par l’intermédiaire de la ligne de communication, chaque modem (5a à 5n) comprenant un amplificateur d’émission (14) destiné à émettre vers la voie d’émission (1) de la ligne de communication un signal d’information provenant du dispositif informatique correspondant (4a à 4n), et un amplificateur de réception (15) destiné à recevoir un signal d’information qui est émis sur la voie d’émission (1) par chacun des modems (5a à 5n), par l’intermédiaire du point de couplage prédéterminé (3) des voies d’émission et de réception (1,2) de la voie de réception (2);

des moyens de génération de signal pilote (6) destinés à émettre sur la ligne de communication un signal pilote d’un niveau de référence prédéterminé qui peut être reçu par l’amplificateur de réception (15) de chacun des modems (5a à 5n); et

chacun des modems (5a à 5n) comprenant en outre:

des moyens de détection de niveau de réception (19), connectés à l’amplificateur de réception (15) pour détecter le niveau de réception d’un signal qui est reçu par la voie de réception (2); et

des moyens de réglage de gain (19), caractérisé en ce que ces moyens de réglage de gain (19) fonctionnent sous la dépendance des moyens de détection de niveau de réception (18), de façon à régler le gain de l’amplificateur d’émission (14) de telle manière que le niveau de réception d’un signal transmis, qui est émis sur la voie d’émission (1) par l’amplificateur d’émission (14) et qui est reçu par l’amplificateur de réception (15) par l’intermédiaire du point de couplage prédéterminé (3) de la voie d’émission et de la voie de réception (1,2), et par l’intermédiaire de la voie de réception (2), devienne un niveau prédéterminé qui est fonction du niveau de réception du signal pilote reçu par l’amplificateur de réception.

2. Un système de transmission d’information selon la revendication 1, caractérisé en outre en ce que les moyens de réglage de gain réglement le gain de l’amplificateur d’émission (15) de manière que le niveau de réception du signal transmis devienne pratiquement égal au niveau de réception du signal pilote reçu par l’amplificateur de réception (15).

3. Un système de transmission d’information selon la revendication 1, caractérisé en outre en
ce que les moyens de génération de signal pilote (6) émettent le signal pilote vers le point de couplage (3) de la ligne de communication, et en ce que les moyens de réglage de gain règlent le gain de l'ämpificateur d'émission (15) de façon que le signal transmis ait, au point de couplage (3) de la ligne de communication, un niveau prédéterminé qui est fonction du niveau de référence du signal pilote à ce point de couplage (3).

4. Un système de transmission d'information selon la revendication 1, caractérisé en outre en ce que le signal pilote est un signal non modulé.

5. Un système de transmission d'information selon la revendication 4, caractérisé en outre en ce que chaque modem comprend en outre:
   - des moyens d'émission de signal de test (11, 12) destinés à émettre un signal de test non modulé sur la voie d'émission (1), par l'intermédiaire de l'ämpificateur d'émission (14);
   - des moyens de détection de signal non modulé (32a) destinés à détecter qu'un signal reçu par l'ämpificateur de réception (15) est le signal pilote ou le signal de test; et
   - en ce que les moyens de réglage de gain (19) fonctionnent sous la dépendance des moyens de détection de niveau de réception (18) et des moyens de détection de signal non modulé (32a) pour faire en sorte que, lorsque le niveau de réception du signal pilote reçu par l'ämpificateur de réception (15) est détecté, les moyens d'émission de signal de test (11, 13) émettent un signal de test sur la voie d'émission (1), et les moyens de réglage de gain règlent le gain de l'ämpificateur d'émission (14) pour que le niveau de réception du signal de test que l'ämpificateur de réception (15) reçoit par l'intermédiaire du point prédéterminé (3) de la ligne de communication, devienne pratiquement égal au niveau de réception du signal pilote que reçoit l'ämpificateur de réception (15).

6. Un système de transmission d'information selon la revendication 2, caractérisé en outre en ce que les moyens de réglage de gain (19) sont conçus de façon à régler le gain de l'ämpificateur de réception (15) pour que le niveau de réception du signal pilote devienne un niveau prédéterminé.

7. Un système de transmission d'information selon la revendication 2, caractérisé en outre en ce que le signal transmis qui est utilisé pour régler le gain de l'ämpificateur d'émission (14) est un signal de test.

8. Un système de transmission d'information selon la revendication 7, caractérisé en outre en ce que le signal de test est un signal non modulé.

9. Un système de transmission d'information selon la revendication 2, caractérisé en outre en ce que la voie d'émission (1) et la voie de réception (2) de la ligne de communication sont constituées par un support de transmission commun, et un dispositif de conversion de fréquence est placé au point de couplage (3) des voies d'émission et de réception (1, 2), pour effectuer la transmission d'information entre les modes (5a à 5n) en un mode de multiplexage en fréquence.

10. Un système de transmission d'information selon la revendication 2, caractérisé en outre en ce que les voies d'émission et de réception (1, 2) sont constituées par une paire de supports de transmission, et une tète de réseau (3) est établie au point de couplage (3) des voies d'émission et de réception (1, 2).

11. Un système de transmission d'information selon la revendication 5, caractérisé en ce que les moyens de réglage de gain (19) sont conçus de façon à régler le gain de l'ämpificateur de réception (15) pour que le niveau de réception du signal pilote devienne un niveau prédéterminé.

12. Un système de transmission d'information selon la revendication 5, caractérisé en outre en ce que les moyens de réglage de gain (19) sont conçus de façon à exécuter un programme initial pour effectuer des réglages de gain des amplificateurs d'émission et de réception (14, 15), et un programme constant pour effectuer des réglages de gain des amplificateurs d'émission et de réception (14, 15), ce programme constant étant exécuté de façon répétée pendant le fonctionnement du modem (5a à 5n), de façon que le réglage de gain de l'ämpificateur d'émission (14) soit effectué une fois pendant que celui de l'ämpificateur de réception (15) est effectué plusieurs fois.

13. Un système de transmission d'information selon la revendication 5, caractérisé en outre en ce que les moyens de réglage de gain (19) sont conçus de façon à régler le gain de l'ämpificateur de réception (15) pour que le niveau de réception du signal pilote devienne un niveau prédéterminé, et de façon à effectuer successivement un réglage de gain grossier de l'ämpificateur de réception (15), un réglage de gain fin de ce dernier, un réglage de gain grossier de l'amplificateur d'émission (14) et un réglage de gain fin de ce dernier;
   - chacun des réglages de gain grossiers étant accompli de manière que le gain de l'amplificateur correspondant (14, 15) soit réglé avec un pas de réglage grossier, le pas de réglage de gain étant remplacé par un pas plus petit chaque fois que la relation de grandeur entre le niveau de réception du signal pilote ou du signal de test, et le niveau de réception prédéterminé est changée, et chacun de réglages de gain fin est accompli de façon que le gain de l'amplificateur correspondant (14, 15) soit réglé avec un pas de réglage plus petit que ceux des réglages de gain grossiers.

14. Un système de transmission d'information selon la revendication 13, caractérisé en outre en ce que les moyens de réglage de gain (19) sont conçus de façon à exécuter un programme initial et un programme constant, le programme initial comprenant des sous-programmes pour un réglage de gain grossier de l'ämpificateur de réception (15), un réglage de gain fin de ce dernier, un réglage de gain grossier de l'amplificateur d'émission (14) et un réglage de gain fin de ce dernier, le programme constant comprenant des sous-programmes pour des réglages...
de gain fins des amplificateurs de réception et
d’émis(sion (14, 15) et étant exécuté de façon
répétée pendant le fonctionnement du modem
(5a à 5n), et le réglage de gain fin de l’ampli-
ficateur d’émis(sion (14) dans le programme
constant étant effectué une seule fois pendant
que le réglage de gain fin de l’amplificateur de
réception (15) est effectué plusieurs fois.

15. Un système de transmission d’informa-
tion selon la revendication 5, caractérisé en outre en
ce que les voies d’émis(sion et de réception (1, 2)
de la ligne de communication sont constituées
par un support de transmission commun, et un
dispositif de conversion de fréquence est placé
au point de couplage (3) des voies d’émis(sion et de
réception (1, 2), pour effectuer une transmission d’informa-
tion entre les modems (5a à 5n) en un
mod(e) de multiplexage en fréquence.

16. Un système de transmission d’informa-
tion selon la revendication 5, caractérisé en outre en
c(e) que les voies d’émis(sion et de réception (1, 2)
de la ligne de communication sont constituées
par une paire de supports de transmission, et une
tête de réseau (3) est placée au point de couplage
(3) des voies d’émis(sion et de réception (1, 2).

17. Un système de transmission d’informa-
tion selon la revendication 5, caractérisé en outre en
c(e) que le signal pilote, le signal de test et le signal
da nformation ont des durées différentes, et les
moyens de détection de signal non modulé (32a)
sont conçus de façon à discriminer entre le signal
pilote et le signal de test sur la base de la durée du
signal.

18. Un système de transmission d’informa-
tion, comprenant:
une ligne de communication ayant une voie
d’émis(sion (1) et une voie de réception (2)
couplées l’une à l’autre en un point prédéterminé
(3) de cette ligne;
un ensemble de dispositifs informatiques (4a à
4n);
un ensemble de modems (5a à 5n) pour coupler
des dispositifs informatiques (4a à 4n) à la ligne de
communication, en des points arbitraires de celle-
ci, et pour permettre l’émis(sion et la réception de
signaux d’information entre les dispositifs informa-
tiques (4a à 4n), par l’intermédiaire de la ligne de
communication, chaque modem comprenant
un amplificateur d’émis(sion (14) pour émettre
un signal d’information sur la voie d’émis(sion (1)
de la ligne de communication, à partir du dispositif
informatique correspondant (4a à 4n), et un
amplificateur de réception (15) pour recevoir un
signal d’information qui est émis sur la voie
d’émis(sion (1) par chacun des modems (5a à 5n),
par l’intermédiaire du point de couplage prédéter-
miné (3) des voies d’émis(sion et de réception (1,
2), et par l’intermédiaire de la voie de réception
(2); des moyens de détection de niveau de récep-
tion (18) connectés à l’amplificateur de réception
(15) pour détecter le niveau de réception d’un
signal reçu par l’intermédiaire de la voie de réception
(2); et des moyens de réglage de gain
(19), caractérisé en ce que les moyens de réglage
de gain (19) fonctionnent sous la dépendance des
moyens de détection de niveau de réception (18)
de façon à régler le gain de l’amplificateur d’émis-
sion (14) d’une manière telle que le niveau de
réception d’un signal transmis, qui est émis sur la
voie d’émis(sion (1) par l’amplificateur d’émis-
sion (14) et qui est reçu par l’amplificateur de réception
(15), par l’intermédiaire du point de couplage prédéterminé (3) des voies d’émis(sion et de
réception (1, 2) et par l’intermédiaire de la voie de
réception (2), devienne pratiquement égal au
niveau de réception d’un signal qui est émis par
un autre modem (5a à 5n) et qui est reçu par
l’amplificateur de réception (15).

19. Un système de transmission d’informa-
tion selon la revendication 18, caractérisé en outre en
ce que les moyens de génération de signal pilote (6)
sont connectés à la ligne de communication pour
émeter sur la ligne de communication un signal
pilote d’un niveau prédéterminé, de façon que le
signal pilote puisse être reçu par l’amplificateur de
réception (15) de chacun des modems (5a à
5n), par l’intermédiaire de la voie de réception (2);
er chacun des modems (5a à 5n) comprenant en
outr(e) des moyens destinés à détecter si un signal
reçu par l’amplificateur de réception (15) est le
signal pilote ou un signal émis par un autre
modem (5a à 5n); et les moyens de réglage de
gain (19) sont conçus de façon à régler le gain de
l’amplificateur d’émis(sion (14) conformément au
niveau de réception du signal pilote, lorsque
l’amplificateur de réception (15) reçoit le signal
pilote.

20. Un système de transmission d’informa-
tion selon la revendication 18, caractérisé en outre en
ce que les moyens de réglage de gain (19) sont
conçus de façon à régler le gain de l’amplificateur
de réception (15), de façon que le niveau de
réception du signal reçu par l’amplificateur de
réception (15) devienne un niveau prédéterminé.

21. Un système de transmission d’informa-
tion selon la revendication 18, caractérisé en outre en
c(e) que les moyens de réglage de gain (19) sont
conçus de façon à régler le gain de l’amplificateur
de réception (14) lorsque la différence entre les
niveaux de réception de signaux qui sont émis
par un autre modem (5a à 5n) et qui sont reçus
par l’amplificateur de réception (15) est inférieure
t(e) à une valeur prédéterminée.

22. Un système de transmission d’informa-
tion selon la revendication 18, caractérisé en outre en
c(e) que chacun des modems (5a à 5n) comprend
des moyens d’émis(sion de signal de test (11, 13)
destinés à émettre un signal de test vers la ligne
de communication, par l’intermédiaire de l’ampli-
ficateur d’émis(sion (14); et
dans lequel les moyens de réglage de gain (19)
son conçus pour faire en sorte que les moyens
de rémission de signal de test (11, 13) émettent le
signal de test vers la ligne de communication
après que le gain de l’amplificateur d’émis-
sion (14) a été réglé, et de façon à compenser le gain
de l’amplificateur d’émis(sion (14) conformément
au niveau de réception du signal de test que reçoit
l’amplificateur de réception (15).

23. Un système de transmission d’informa-

selon la revendication 18, caractérisée en outre en ce que la voie d’émission (1) et la voie de réception (2) sont constituées par un support de transmission commun, et en ce qu’un dispositif de conversion de fréquence est placé au point de couplage (3) des voies d’émission et de réception (1, 2), pour effectuer une transmission d’information entre les modems (5a à 5n) en un mode de multiplexage en fréquence.

24. Un système de transmission d’information selon la revendication 18, caractérisé en outre en ce que la voie d’émission (1) et la voie de réception (2) de la ligne de communication sont constituées par une paire de supports de transmission, et une tête de réseau (3) est placée au point de couplage (3) des voies d’émission et de réception (1, 2).

25. Un procédé de transmission d’information utilisant un système qui comprend une ligne de communication ayant une voie d’émission (1) et une voie de réception (2) couplées l’une à l’autre en un point prédéterminé (3) de la ligne; un ensemble de dispositifs informatiques (4a à 4n); un ensemble de modems (5a à 5n) pour coupler les dispositifs informatiques (4a à 4n) à la ligne de communication, en des points arbitraires de celle-ci, et pour effectuer une transmission d’information entre les dispositifs informatiques (4a à 4n) par l’intermédiaire de la ligne de communication, chaque modem (5a à 5n) comprenant un amplificateur d’émission (14) pour émettre sur la voie d’émission (1) de la ligne de communication un signal d’information provenant du dispositif informatique correspondant (4a à 4n); et un amplificateur de réception (15) pour recevoir un signal d’information émis sur la voie d’émission (1) par chacun des modems (5a à 5n), par l’intermédiaire du point de couplage (3) des voies d’émission et de réception (1, 2) et par l’intermédiaire de la voie de réception (2); ce procédé conduisant à ce que chacun des modems (5a à 5n) reçoive des signaux d’information provenant d’autres modems (5a à 5n) à un niveau pratiquement constant, et comprenant les opérations suivantes:

- on applique à un point prédéterminé (3) de la ligne de communication un signal pilote ayant un niveau de référence;
- on détecte le niveau de réception du signal pilote que reçoit l’amplificateur de réception (15);
- on émet un signal de transmission sur la ligne de communication, par l’intermédiaire de l’amplificateur d’émission (14); et caractérisé en ce que on reçoit le signal d’émission qui est émis sur la ligne de communication, au moyen de l’amplificateur de réception (15), par l’intermédiaire du point de couplage (3) de la ligne de communication et par l’intermédiaire de la voie de réception (2); et on règle le gain de l’amplificateur d’émission (14) de façon que le niveau de réception du signal de transmission que reçoit l’amplificateur de réception (15) devienne pratiquement égal au niveau de réception du signal pilote que reçoit l’amplificateur de réception (15).

26. Un procédé selon la revendication 25, caractérisé en outre par l’opération qui consiste à régler le gain de l’amplificateur de réception (15) à un niveau approprié pour le traitement du signal.

27. Un procédé selon la revendication 25, caractérisé en outre en ce que le signal pilote est appliqué au point de couplage (3) de la ligne de communication.

28. Un procédé selon la revendication 25, caractérisé en outre en ce que le signal de transmission est un signal de test, et le signal pilote et le signal de test sont des signaux non modulés.

29. Un procédé selon la revendication 28, caractérisé en outre en ce que le signal pilote et le signal de test ont des durées différentes.

30. Un procédé de transmission d’information utilisant un système qui comprend une ligne de communication ayant une voie d’émission (1) et une voie de réception (2) couplées l’une à l’autre en un point prédéterminé (3) de la ligne; un ensemble de dispositifs informatiques (4a à 4n); un ensemble de modems (5a à 5n) pour coupler les dispositifs informatiques (4a à 4n) à la ligne de communication, en des points arbitraires de celle-ci, et pour effectuer une transmission d’information entre les dispositifs informatiques (4a à 4n) par l’intermédiaire de la ligne de communication, chaque modem (5a à 5n) comprenant un amplificateur d’émission (14) pour émettre sur la voie d’émission (1) de la ligne de communication un signal d’information provenant du dispositif informatique correspondant (4a à 4n); et un amplificateur de réception (15) pour recevoir un signal d’information émis sur la voie d’émission (1) par chacun des modems (5a à 5n), par l’intermédiaire du point de couplage (3) des voies d’émission et de réception (1, 2) et par l’intermédiaire de la voie de réception (2), ce procédé conduisant à ce que chacun des modems (5a à 5n) reçoive des signaux d’information provenant d’autres modems (5a à 5n) à un niveau pratiquement constant, et comprenant les opérations suivantes:

- on reçoit au moyen de l’amplificateur de réception (15) un signal d’information qu’un modem prédéterminé (5a à 5n) émet vers la ligne de communication par l’intermédiaire du point de couplage (3) de la ligne de communication et par l’intermédiaire de la voie de réception (2);
- on détecte le niveau de réception du signal d’information provenant du modem prédéterminé (5a à 5n) qui est reçu par l’amplificateur de réception (15);
- on émet un signal de transmission sur la ligne de communication, par l’intermédiaire de l’amplificateur d’émission (14); caractérisé en ce que on reçoit le signal de transmission au moyen de l’amplificateur de réception (15), par l’intermédiaire du point de couplage (3) de la ligne de communication et par l’intermédiaire de la voie de réception (2); et on règle le gain de l’amplificateur d’émission (14) de façon que le niveau de réception du signal de transmission que reçoit l’amplificateur de réception (15) devienne pratiquement égal au niveau de réception du signal pilote que reçoit l’amplificateur de réception (15).
START

GENERATE COLLISION INDICATIVE SIGNAL

DETECT \( V_{I2} \)

CALCULATE \( V_{I1} \) FROM \( V_{I2} \)

ADJUST GAIN OF TRANSMITTING AMP SUCH THAT \( V_O = 2V_O - V_{I1} - G_0 \)

ADJUST GAIN OF RECEIVING AMP SUCH THAT \( V_{I2} = V_{I0} \)

OFF COLLISION INDICATIVE SIGNAL

END
START

SET INITIAL VALUES OF RECEIVING AMP GAIN AND GAIN-ADJUSTING STEP

WAIT PILOT INDICATION

IF $V_D : V_{CL} < 1$ THEN INCREASE RECEIVING AMP GAIN

IF $V_D : V_{CL} > 1$ THEN DECREASE RECEIVING AMP GAIN

ADJUSTING STEP $= x^{1/2}$

IF ADJUSTING STEP $< $ MINIMUM STEP THEN RETURN

IF ADJUSTING STEP $> $ MINIMUM STEP THEN RETURN
START

WAIT PILOT INDICATION

INCREASE RECEIVING AMP GAIN AT MINIMUM STEP UNTIL $V_D > V_{CL}$

DECREASE RECEIVING AMP GAIN AT MINIMUM STEP UNTIL $V_D < V_{CL}$

PILOT INDICATION?

AMP GAIN—OLD GAIN

WAIT PILOT INDICATION GOING OFF

FALSE PILOT INDICATION?

YES

OLD GAIN—RECEIVING AMP GAIN

RETURN
FIG. 15

START

TURN OFF SW.

SET INITIAL VALUES OF RECEIVING AMP GAIN AND GAIN-ADJUSTING STEP

WAIT PERMIT-TO-SEND TEST SIGNAL(TL)

WAIT CARRIER ON CABLE GOING OFF

TURN ON SW. WAIT FOR 40μSEC

< Vd : VCL >

INCREASE GAIN, WAIT FOR 40μSEC

DECREASE GAIN, WAIT FOR 40μSEC

< Vd : VCL >

ADJUSTING STEP — $x^{1/2}$

ADJUSTING STEP: MINIMUM ADJUSTING STEP

RETURN
FIG. 16

START

WAIT PERMIT-TO-SEND TEST SIGNAL(TL)

COUNTER

\( n = 0 \)

INHIBIT DATA TRANSMISSION

INITIAL ROUTINE

NO

TURN OFF SW. COUNTER--0 AMP GAIN=OLD GAIN

WAIT CARRIER GOING OFF

YES

TURN ON SW. WAIT FOR 40\mu SEC

DECREMENT COUNTER

INCREASE TRANSMITTING AMP GAIN AT MINIMUM STEP UNTIL \( V_D > V_{CL} \) WHILE WAITING FOR 40\mu SEC

DECREASE TRANSMITTING AMP GAIN AT MINIMUM STEP UNTIL \( V_D < V_{CL} \) WHILE WAITING FOR 40\mu SEC

TURN OFF SW.

SET COUNTER TO INITIAL VALUE

PERMIT DATA TRANSMISSION

INITIAL ROUTINE INDICATIVE FLAG--0

RETURN