

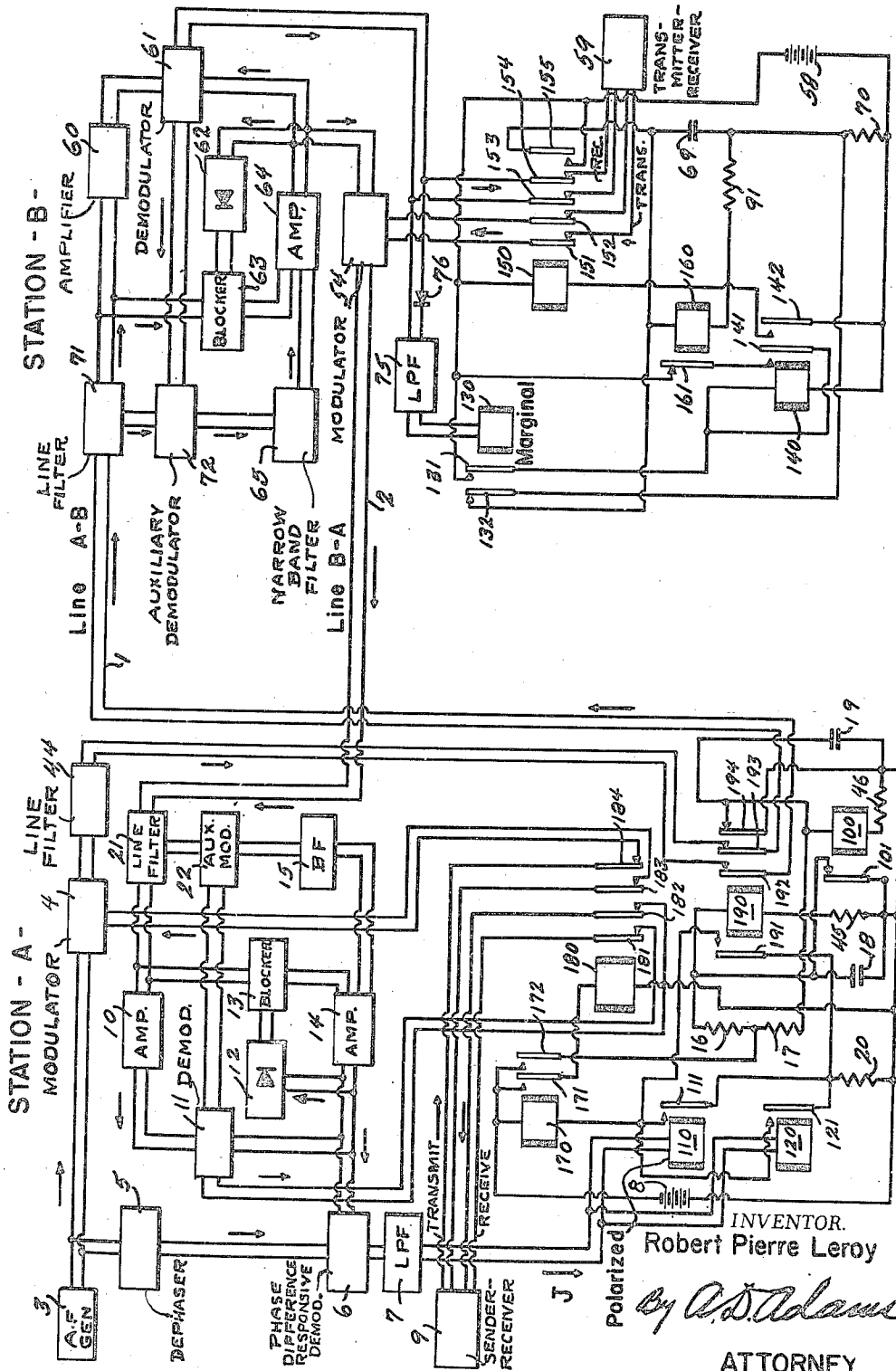
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PHASE REVERSAL TELEGRAPH SYSTEM

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PHASE REVERSAL TELEGRAPH SYSTEM

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1 Claim. (Cl. 178—66)

1

The present invention relates to systems of telegraph transmission using double current, employing a code with two signal elements, of which the first is constituted by a transmission at audio frequency, and the second is constituted by the same transmission dephased by 180 degrees.

In such a system of telegraph transmission, the sending station comprises a modulator to the control terminals of which the telegraph code transmitter applies a control current which is at certain instants a "rest" current of one polarity, and at other times is a marking or operating or work current of opposite polarity. The inversion in polarity of this control current has for its effect to invert the phase of the telegraph current sent in the line, every change of polarity of the control current causing an inversion of phase of the telegraph line current.

To each character transmitted, there corresponds therefore the application to the control terminals of the modulator of a succession of pulses of current which are alternately "work" currents and "rest" currents, according to a determined code, and hence corresponds to the sending on the line of a succession of currents of phases which are alternately inverted. For example, in the International Start-Stop Code, to the letter "S" there corresponds, after the sending of a "work" or marking current pulse corresponding to the start, the transmission, during an elementary interval, of a "rest" current, then during the following interval, of a "work" current, then during a following interval of a "rest" current, then during two following successive intervals of a "work" current, and, thereafter, finally of a "rest" current corresponding to "stop."

To each one of these inversions there corresponds a change of the phase of the current which was sent on the line, there being five changes of phase in the course of the transmission of the letter S.

At the receiving station, there is applied to a demodulator, on the one hand, the received current including the inversions of phase, and on the other hand the reestablished carrier frequency current as it was set up in the line at the beginning of the transmission, keeping for it an unvarying phase. Thus, the current delivered at the output terminals of the receiving demodulator will change in sense or direction at the same time as the telegraph current will change its phase.

Hence, it can be said that every change of sense or direction of the current taken off at

2

the output terminals of the demodulator of the receiving station corresponds to a change of sense or direction of the current applied to the control terminals of the demodulator of the transmitting station. But, on first consideration, it cannot be known whether to a given received pulse of "rest" current, there corresponds, at the transmitting station, a pulse of "rest" current or a pulse of "work" current.

In order to assure agreement between the senses or directions of the current of reception and those of transmission, it is arranged so that the first current pulse delivered at the output of the demodulator of the receiving station can only be of one determined sense or direction, and the transmission will always be commenced by the transmission of a current of this same determined sense, for example, a "rest" current impulse if it has been arranged that the demodulator of the receiving station shall on its first pulse deliver a "rest" current.

If, however, there is produced on the line an accidental transient interruption, so that the carrier current disappears for an instant, it is not known, when the continuity of the circuit is re-established, whether the transmitting station is sending at this moment a "rest" signal element or a "work" signal element. Hence, there is the risk, following such an interruption, of receiving signals which are inverted.

In order to avoid this disadvantage, it is necessary in the case of the interruption of the circuit between the stations, to cause to come into operation a safety device disconnecting the terminal telegraph apparatus, putting at each station the transmitting modulator in the condition corresponding to the sending of a "rest" signal, and not putting the connection into service, after the reestablishment of the continuity of the circuit between the stations, until after determination of the fact that the received currents have again assumed their normal values and senses.

The present invention has for an object to provide devices permitting to assure the automatic performance of these operations, and is applicable to the case in which for the purpose of saving material, there is used at a station B, for the transmission from station B toward a station A, the carrier frequency reconstituted from the signals received from the station A. It is then possible to compare at the station A, the phase of the waves of the local generator at station A to that of the reconstituted carrier wave as re-sent by station B. The resultant variation

of this difference of phase is employed to control, if needed, the putting into operation of the safety device. The description of the means employed for this purpose is given hereafter, with reference to the sole figure of the annexed drawing, which shows the circuit of the assembly of a two-way connection between two stations A and B.

Referring to the drawing, the station A comprises a generator 3 of audio-frequency current whose oscillations are modulated in the sending modulator 4 by the current coming from the sender of the local telegraph sending and receiving apparatus 9, the output current of the modulator 4 at station A is sent toward the station B over the line A—B, through a line filter 44.

At station B, the received current passes through the line filter 71, from there it passes to the principal demodulator 61 through two paths, of which one comprises a first amplifier 60, and the other comprises an auxiliary demodulator 72, a narrow band filter 65, which thus has a relatively high time constant, and a second amplifier 64.

It is known that with such a circuit arrangement, there is delivered at the output of the second amplifier 64, the reconstituted carrier frequency and, hence, at the output of the principal modulator 61, the reconstituted telegraph signal current, if auxiliary demodulator 72 is controlled by a derived portion of the carrier current as reconstituted, as taken off at the output of principal demodulator 61.

The initiation of the current pulse and the orientation of phase at the start are obtained by the means of a derived portion taken off at the input of first amplifier 60, and supplying second amplifier 64 through the means of a blocker 63, which offers opposition to the passage of the current under normal operating conditions, under the effect of a control current obtained by rectifying the reconstituted carrier current by means of rectifier 62. The telegraph current thus reconstituted at the output of the principal modulator 61 is sent to the telegraph receiver unit of the ordinary terminal telegraph sending and receiving apparatus 59 at station B.

On the other hand, for the transmission from station B toward station A, a portion of the reconstituted carrier frequency taken off at the output of second amplifier 64, is applied to the sending modulator 54 controlled by the current of the telegraph sender unit of the usual terminal telegraph sending and receiving apparatus 59 at station B.

At station A, the receiving apparatus proper is identical to that of station B.

The reconstituted carrier wave at the output of second amplifier 14, at station A, has a definitely determined out-of-phase relation with reference to the carrier wave produced by the generator 3 at station A. This dephasing relation has assumed a value which is definitely determined when the system starts into operation, at the moment when the sending modulators 4 and 54 being both in the "rest" position, there is produced an initiation of the reconstituted carrier oscillation. The station A comprises means to give warning of an accidental variation from this determined value of dephasing. In the assembly shown in the drawing, these means at station A comprise a phase adjuster 5 of determined characteristic for adjusting the phase by a fixed amount, compensating for a certain value of dephasing, and a phase difference responsive demodulator 6, supplied on the

one hand by the reconstituted carrier current at the output of second amplifier 14 at station A, and, on the other hand, by the current at the output of the phase adjuster 5. Hence, there will be at the output of phase difference responsive demodulator 6, a rectified current J whose pulsations can be reduced by a low-pass filter 7.

It is the variations of this rectified current J which are used for the putting into action of the phase correcting system, because if the phase of the received signal element pulse is incorrect, the value of this current will be altered.

In order to understand the operation of the system, it will be assumed at first that an accidental interruption takes place in the current in the direction BA, in the line BA. The rectified current J will decrease progressively. If the interruption is transient, the carrier wave will be rapidly re-established either with the correct phase if the modulator 54 which has not received a signal informing of the interruption, is determining a non-operative or spacing condition at the instant of the re-establishment, or with the opposite phase if the modulator is determining an operative or marking condition at that instant. In the first case, the rectified current J will return to its initial value, in the second case the value of the rectified current J will be inverted.

Two relays 110 and 120 are energized by the rectified current J, the one relay 110 responding to the inversion and the other relay 120 responding to the interruption. Relay 110 is polarized and in normal operation has its contact 111 open, when the energizing current changes direction it closes this contact. The contact of relay 120 is open when its winding is energized.

The operation of these relays 110 and 120 may be delayed in order to avoid all unnecessary operation of the device for re-establishing the correct phase. The putting into operation of these relays 110 and 120 creates by means of appropriate contacts, compensating currents, delaying their return to non-operated condition until the rectified current J has returned to its initial value.

Armatures 111 and 121 of relays 110 and 120 respectively put into circuit in parallel the current interruption protecting device or phase correcting device of the station A which is shown connected for actuation by these armatures through relay 170.

The functions of this interruption protective device at station A are the following:

1. It will cause the opening of the local circuits to sender-receiver 9 at station A, until the re-establishment of the correct phase. It will then put the output modulator 4 at station A into non-operative condition, the modulators employed being assumed to have a definite operating characteristic in the absence of control current; that is, one similar to that which would obtain with current in a non-operative condition. The operation of the receiving circuit will bring about the resumption of the non-operated condition.

2. It will transmit, in a regular rhythm, by means of a vibrating relay, for example, over the line from station A to station B, trains of waves which will have the phase which is required to be re-established, because the modulators have been put into non-operative condition. These trains of waves will have a duration T_1 and will be separated by an interval of duration T_2 . The first interruption in the train of waves will bring

5

into operation the protecting device of station B shown in the drawing in the lower part of station B. The function of this device will be first to open the local telegraph circuits of sender-receiver 59 at station B and so bring to the non-operative condition the output modulator 54 at station B, and arrangements will be provided to be sure that it remains so until normal conditions are completely restored, unless the successive trains of waves alter the situation. The protective device of station B ought, therefore, to remain blocked until the reception at station B of a train of waves of longer duration than that sent during the period of re-establishment. On the other hand, the protective device of station A will assume the non-operated position when the termination of the interruption has allowed the rectified current J from phase difference responsive demodulator 6 to return to its normal value. The compensation or adjustment can take account of the fact that this rectified current J is higher during the period of re-establishment by reason of the disconnecting of the circuit of the receiver at the station.

If, however, the interruption is produced in the direction A—B on the line A—B, it will be necessary that this interruption should produce the same effects at station B as those which have been described above at station A. In this case, as in the preceding case, the function of the protecting device of station B will consist of cutting off the local telegraph circuits from transmitter-receiver 59 as soon as an interruption in the direction A—B will have been registered, and to put the modulator 54 in the non-operative condition before an inversion of the carrier wave can result. Since, at station B, no local generator of alternating current is provided, of which the phase can be compared with that of the reconstituted carrier wave, it is necessary to find a different criterion from that used at station A to show the interruption.

A preventive measure is also required in this case, by means of which the station A may ascertain whether inversion has been produced or not.

The criterion used which will effect the operation of the protective or phase correcting device of station B, is the reduction of the amplitude of the reconstituted telegraph signals. To understand this operation, it is necessary to notice that if the carrier wave has disappeared for a certain considerable interval of time, or if it has momentarily disappeared and reappears immediately afterwards with inversion of its phase, a transitory phenomenon has necessarily taken place in the reconstituted telegraph signal, the duration of which phenomenon is substantially equal to that of the elementary signal element or pulse. If, at the output demodulator 61 at station B, a circuit is arranged in parallel with the circuit carrying telegraph current to the usual receiver and including a rectifier 76 and a low-pass filter 75 whose time constant is less than the time constant of the telegraph filters but is more than one-half of the latter, in order to avoid the action of the variations which bring about the succession of signals, a circuit will be provided adapted to energize a relay 130 whose contacts are open in normal position when fully energized, which will have come to the non-operated or closed position when the current which it receives, which is normally substantially constant owing to the automatic gain control associated with the amplifiers, ceases or is sufficiently reduced. Relay 130 may have a definite spring bias. The exact value of

6

current required for the release of relay 130 into non-operated position can be regulated by a compensating current.

The armature 131 of relay 130 at station B, when so deenergized, will close the energizing circuit of relay 140, which will then be energized independently of contact 131 through contact 141 and through a contact 161 which remains closed until the end of the operation. Relay 140 will, at the same time, close through contact 142 the circuit of relay 150 of which the contacts 151 and 152 open the local circuits to the local transmitter-receiver 59, a fifth contact 155 closing a branch circuit comprising relay 160 and condenser 69 which, in turn, short-circuits the armature 132 of relay 130 in the absence of telegraph current, as well as the resistances 70 and 91.

If current is again applied to the telegraph circuit, the contact 132 removes the short-circuit of condenser 69 which will charge slowly so that relay 160 can operate only after a certain interval of delay T_2 which is greater than the duration T_1 of the trains of waves sent from station A. When, upon the disappearance of this current, the contact 132 short-circuits the condenser 69, and also during the whole duration of the attempts at re-establishment of the previous condition, the armature 161 of relay 160 closes a contact in series with contact 141. The device will be able to return to the non-operated condition only when at the moment of re-establishment, a current of greater duration will have been able to manifest itself.

In order to be sure that an accidental re-establishment of the circuit does not interfere with the re-establishing operations, the delay interval T_2 should be greater than the time which separates the ascertainment of a break and that of the first interruption caused by station A.

The operation of the interruption protecting unit at station A is as follows. Relay 170 is connected in circuit and energized through contacts 111 and 121, and the relay 170, when energized, closes at contact 171 the energizing circuit of relay 180 whose contacts 181, 182, 183, 184, open the local circuits to local transmitter-receiver 9, and at contact 172 closes the energizing circuits of relays 190 and 100 which are arranged to operate as an inverter.

The contacts 192, 193 of relay 190 open the connection from the generator 3 to the circuit of line A—B when relay 190 is in the energized condition. If relay 170 returns to its non-energized condition, which will evidently be when relay 190 is in the non-energized condition, the contact 172 is opened and opens the energizing circuit of the inverter unit including relays 190 and 100, the contact 191 remains closed, and, at the same time, the contacts 181, 182, 183, 184, close the local circuits to local transmitter-receiver 9. In order to prevent the correcting devices from operating again under the effect of a subsequent interruption which may not have been registered yet, on account of the transmission time, $2T_0$ corresponding to the time required to traverse the double going and coming path from A to B and then from B to A, it is sufficient to arrange in parallel with contacts 111 and 121, a contact 191 controlled by the relay 190 which closes a circuit to energize relay 170 when relay 190 is in the operated condition. The disconnection of the generator can, therefore, only be effected at a definite instant by a control signal transmission traversing the entire circuit and whose reception has already commenced, which is possible if the time intervals T_1

and T_2 are greater than $2T_0$. Hence, no failure of current can occur.

The operation of the inverter group including relays 190 and 100 is as follows: Starting with the non-operated condition, the relay 190 being traversed by no energizing current and being then in the non-operated condition, the winding of relay 100 is then de-energized because its winding is short-circuited by closed contact 194, which also short-circuits the condenser 19. Then, upon the closing of contact 172, the winding of relay 190 is energized and relay 190 assumes the energized condition, but relay 100 remains in de-energized condition. When relay 190 assumes the energized condition, its contacts 192, 193, open the connecting circuit from generator 3 to line A—B. At the same time that contact 194 opens when relay 190 becomes energized, the short circuit on condenser 19 is removed and condenser 19 starts to charge. The winding of relay 100 then starts to become energized. When relay 100 becomes energized, its contact 101 is closed and short-circuits condenser 19 and the winding of relay 190, which causes relay 190 to assume the de-energized condition. This will close contacts 192, 193, again completing the circuit connecting generator 3 to the line A—B. When relay 190 thus assumes the de-energized condition, through contact 194, it again short-circuits condenser 19 and the winding of relay 100, and the cycle is repeated. The time periods of operation are determined by the magnitudes of the several condensers and resistances involved.

It will be apparent to those skilled in the art that my invention is susceptible of modifications to adapt the same to particular conditions, and all such modifications which are within the scope of the appended claim I consider to be comprehended within the spirit of my invention.

I claim:

In a system of carrier frequency telegraphy transmitting on the line signals comprising carrier frequency, signal elements of opposite phase, a first station, a second station, two uni-directional lines connecting said stations, said first station comprising an audio carrier frequency generator, each of said stations comprising transmitting keying means, transmitting modulating means controlled by said keying means adapted to change keying impulses of opposite polarity into carrier frequency pulses of opposite phases, and receiving demodulating means adapted to change received carrier frequency pulses of opposite phases into continuous current impulses of opposite polarity, each said receiving demodulating means comprising means for deriving a portion of the received modified

carrier frequency current and converting the same into unmodified original carrier frequency current, said transmitting modulating means at said first station being connected to said generator, said transmitting means at said second station being connected for energization by the carrier frequency output of said deriving and converting means at said second station for converting into unmodified carrier frequency current, each of said lines connecting said transmitting modulating means of one said station to said receiving demodulating means of the other said station, a phase adjuster at said first station having its input connected to said generator, phase difference responsive demodulating means at said first station having one input connected to the output of said phase adjuster and having its other input connected to the output of said deriving and converting means at said first station for converting into unmodified carrier frequency current, and being adapted to deliver output direct current which is a function of the difference of phase of its two inputs, telegraph receiving means at each said station connected to the output of said receiving demodulating means at said station, control relay means at said first station connected for actuation by the output of said phase difference responsive means, pulsing relay means at said first station having a controlled contact connected in series in the output line of said transmitting demodulating means at said first station, first interlocking relay means connected for actuation by said control relay means and adapted when actuated to open the circuits of said transmitting keying means to said modulating means and of said telegraph receiving means at said first station and also to actuate said pulsing relay means, master relay means at said second station, a rectifier and a low-pass filter at said second station connected between the output of said receiving demodulator at said second station and the actuating winding of said master relay means, and second interlocking relay means connected for actuation by said master relay means when in deenergized condition and adapted to open the circuits of said transmitting keying means and said telegraph receiving means at said second station, whereby a momentary opening and immediately subsequent reclosing of either of said lines maintains the original correspondence of polarity of keyed signals from a keying means at one said station and the telegraph receiving means at the other said station.

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No references cited.