

July 25, 1944.

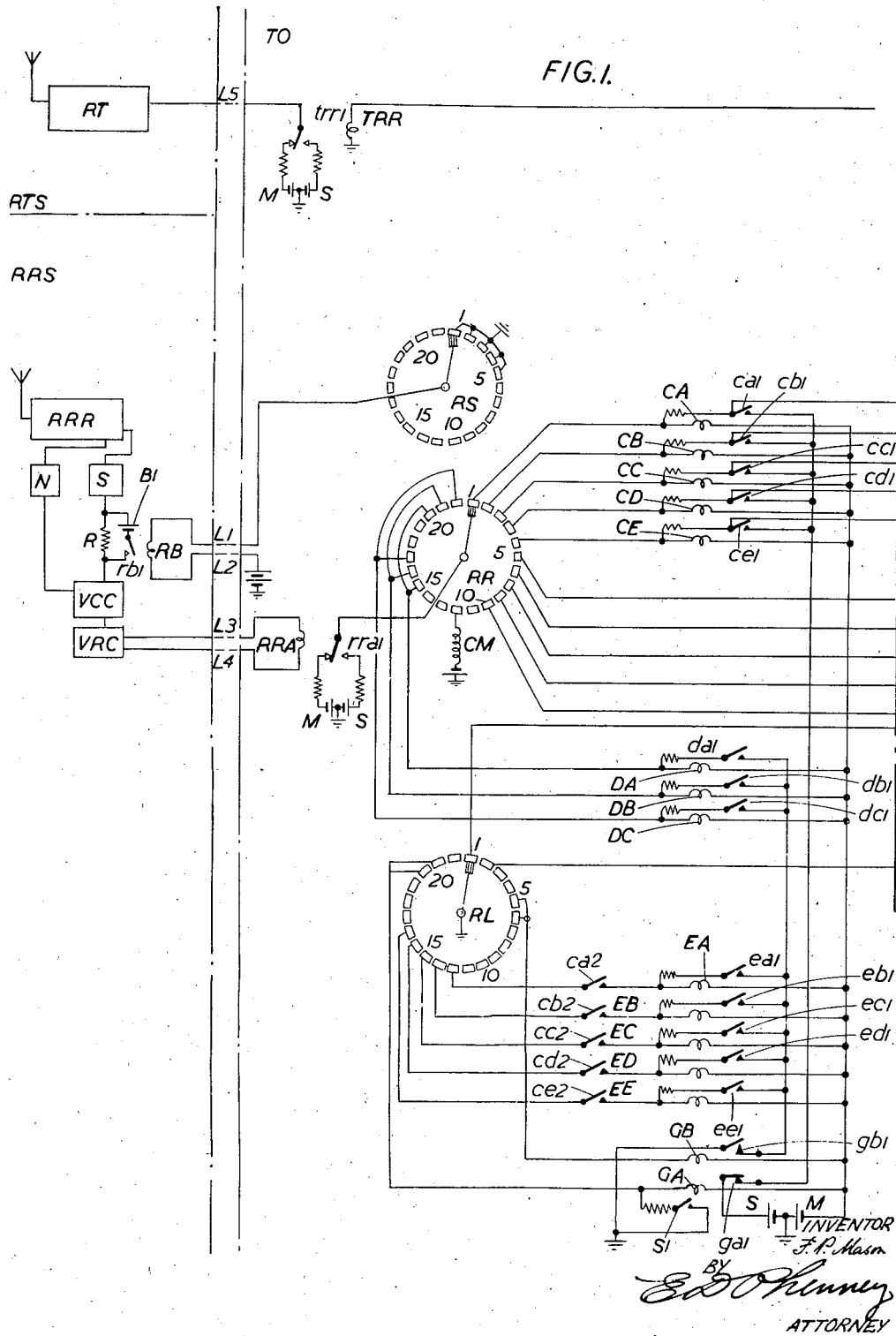
F. P. MASON

2,354,534

TELEGRAPH SYSTEM

Filed June 3, 1942

2 Sheets-Sheet 1



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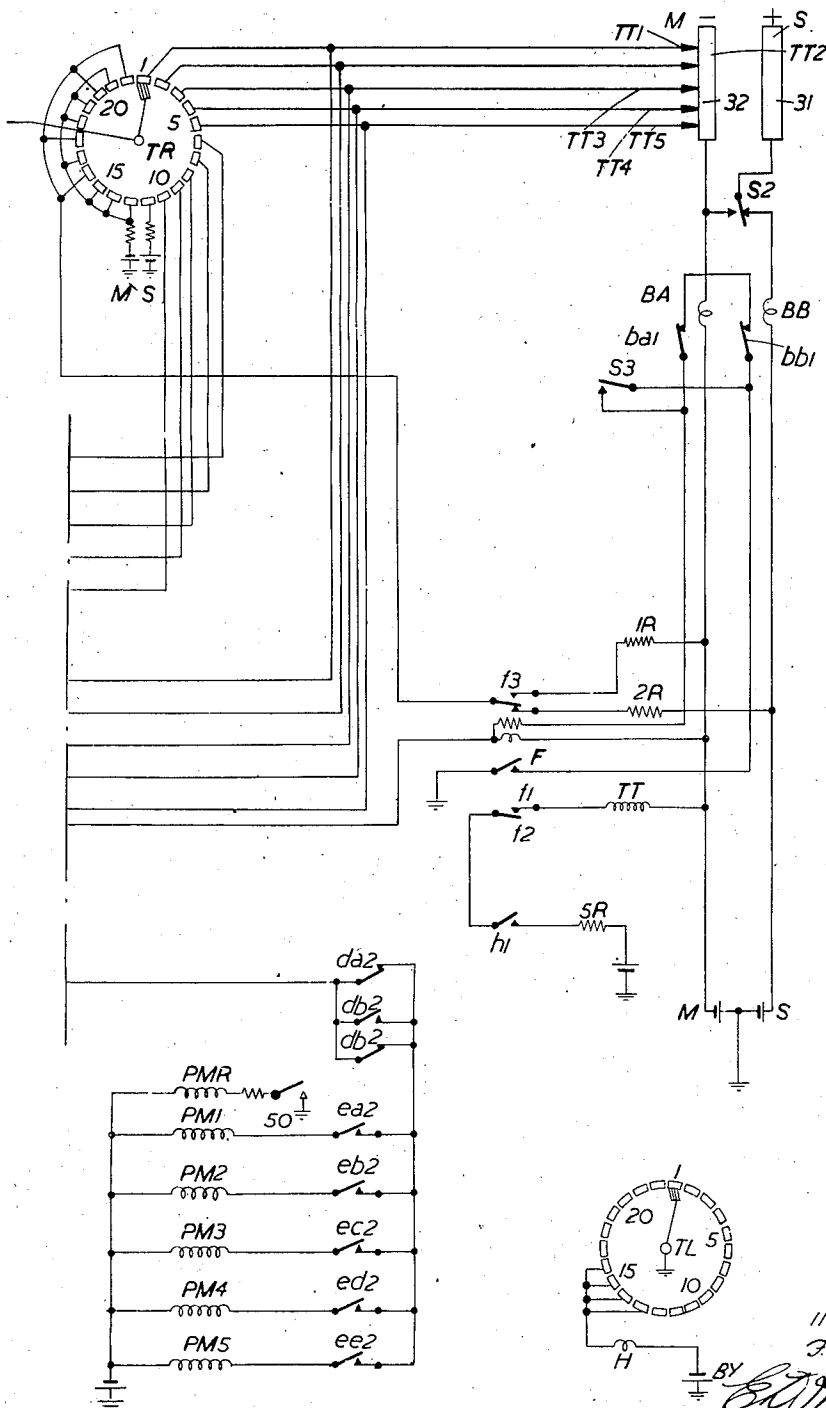
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FIG. 1.a.



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TELEGRAPH SYSTEM

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5 Claims. (Cl. 178—69)

This invention is an improvement in or modification of the invention disclosed in Patent No. 2,242,196 issued to Thompson on May 13, 1941. It relates to printing telegraph systems for operation in circumstances in which interference may be present, as for example, over radio links and has for an object to reduce the number of unwanted duplicate characters printed at the receiver.

According to the invention, transmission of a signal combination in a printing telegraph system is repeated if the signal has not been correctly received and printing in accordance with the incorrectly received signal combination is prevented by the transmission of a characteristic signal combination.

Also according to the invention, a printing telegraph transmitter system comprises means for transmitting a signal combination, means for automatically comparing a received signal combination with the transmitted signal combination, and means for thereupon transmitting a characteristic signal combination whenever the transmitted and received signal combinations are different.

Also according to the invention, a printing telegraph receiver system comprises means for receiving a signal combination, means for retransmitting the signal combination as received, and means for printing a character corresponding to the received signal combination unless prevented by the receipt of a characteristic signal combination.

An embodiment of the invention will now be described by way of example, reference being made to the accompanying drawings, in which

Figs. 1 and 1a are connecting halves of a diagram of my system, showing circuit details of apparatus at the traffic office TO;

In Figs. 1 and 1a, RTS represents a radio transmitting station, RRS represents a radio receiving station, and TO represents a traffic office provided with an impulse transmitter for transmitting telegraph impulses to RTS and a multiplex printer for receiving telegraph impulses from RRS. Similar apparatus is provided at a distant terminal to complete a two-way radio telegraph link.

The traffic office TO also includes a check back circuit and a sensitivity control circuit, the functions of which will be explained later.

Signaling over the radio link is effected by the radio transmitter RT at the radio transmitting station RTS and the radio receiver RRR at the radio receiving station RRS. Any desired

method may be employed for the radio transmission of the marking and spacing telegraph signals but it will be assumed that they are transmitted as interruptions of a continuous unmodulated carrier wave, the emission of carrier representing a spacing signal and the absence of carrier representing a marking signal.

The radio receiver RRR is provided with two output circuits. One output circuit of RRR is connected to a low-pass filter S to provide a signal path connected to a valve conversion circuit VCC the output of which is applied to a valve relay circuit VRC which repeats the marking and spacing telegraph impulses. The other output circuit of RRR is connected to a band-pass filter N the output from which is applied over an interference path to a second input to the conversion circuit VCC. Circuit details of VCC and VRC are well-known in the art and these elements may conveniently take the form shown in British Patent No. 540,839. It will be sufficient to state at this point that VRC acts as an impulse repeating arrangement of high efficiency and that VCC acts under the joint control of the signal path and the interference path to cause the impulse responding apparatus VRC to take up the same predetermined condition when the radio transmission is disturbed, whether by interference or by fading. The circuits are modified according to the invention by the inclusion of a relay RB provided with contact *rb1* connected in series with a battery B, the series combination being shunted across a resistance R1 in the signal path. The relay RB is controlled from traffic office TO over leads L1 and L2.

The arrangement used comprises five distributor rings shown diagrammatically at TR, TL, RS, RR and RL, each shown as a brush rotating over a ring of segments. Each of these distributor rings is of the well-known type in which a rotating brush connects a segmented ring with a continuous ring, the continuous rings being connected to the circuits to which the respective brushes are shown in the drawings as connected. The distributor rings TR and TL are allocated to transmission and the distributor rings RS, RR and RL to reception. The brushes of all the rings are driven together, and any well known means may be used for keeping the brushes at the two traffic offices in synchronism. One method will be described hereinafter. It will be readily understood by those skilled in the art, however, that the brushes wiping over rings RS, RR and RL are adjusted to be later in phase

than the brushes wiping over rings TR and TL to an extent dependent upon the propagation time of the signals between the two traffic offices; nevertheless, for simplicity in description it will be assumed that all the brushes are in phase.

Let the two intercommunicating traffic offices be called X and Y and assume that office X is the one illustrated in the drawings and that it is transmitting a message to office Y. The signal combinations to be transmitted, according to the well known five unit code, are determined by a transmitter controlled by a perforated tape. This transmitter is of the well-known kind in which peckers controlled by perforations in the tape determine the connection of contact points TT1—TT5 to marking or spacing bus bars 32 or 31 respectively, which bus bars are connected to negative and positive battery respectively. The contact points TT1—TT5 are connected to segments 1—5 of distributor ring TR and as the brush rotates over these segments positive and negative potential is connected by the brush to a transmitting relay TRR. Contacts trr1 of relay TRR connect negative (marking) or positive (spacing) potential over the line L5 to modulate the radio transmitter RT in well-known manner and cause the transmission of radio signals to the distant terminal.

At the distant terminal the radio signals are received by a radio receiver similar to RRR, demodulated, and the resultant telegraph signals applied over lines similar to L3 and L4 to a polarised receiving relay similar to RRA at office Y. Contacts rra1 connect negative or positive potential, according to the polarities of the received telegraph signals, over segments 1—5 of distributor ring RR to relays CA—CE and to negative battery. Those relays to which marking potential is applied from contacts rra1 do not energise, those relays to which spacing potential is applied, energise and close contacts ca1—ce1, and ca2—ce2.

Contacts ca1—ce1 close a locking circuit for the relays that have been operated. Contacts ca2—ce2 connect relays EA—EE to segments 12—16 of distributor ring RL.

If any of the contacts ca1—ce1 are unoperated, negative (marking) potential is connected over the corresponding relay CA—CE to the corresponding segment of the segments 6—10 of the transmitter TR at office Y, whilst if the contacts ca1—ce1 are operated, positive (spacing) potential is connected over contacts ga1 in normal position and the operated contacts ca1—ce1 to the segments 6—10 of ring TR. Office Y will thus transmit back to office X the signals as received.

At office X the receiving brushes are passing over segments 6—10 as the signals re-transmitted from Y are received at X. The segments 6—10 of ring RR are connected to the contacts TT1—TT5 of the perforated tape transmitter. If the signal sent by contact TT1 was a marking signal, a marking signal should be received from contacts rra1 over segment 6 of ring RR. Two relays BA and BB are provided, BA being connected between negative battery and bus bar 32, and relay BB between positive battery and bus bar 31. Thus if a marking signal be received and contacts rra1 are in marking position when the brush passes over segment 6 of ring RR, both sides of relay BA are at marking potential and the circuit of BB is open so that no current flows. If a spacing signal had originally been transmitted by the tape controlled transmitter so that contacts TT1 are connected to spacing bus bar 31, and a

spacing signal is received then contacts rra1 will apply spacing potential over segment 6 of ring RR to contacts TT1 and bus bar 31. Both sides of relay BB are spacing potential and the circuit of relay BA is open, so that no current flows.

It will be seen therefore that if the received signal combination is the same as the transmitted signal combination neither relay BA nor BB energises. Should, however, any one of the elements of the combination received be different from the corresponding element as transmitted, either relay BA or BB is energised and either contact ba1 or contact bb1 is opened.

Relay F is energised when the brush passes over segment 1 of ring RL and closes a locking circuit for itself over contacts ba1, bb1 and front contacts f1. In this condition of relay F, segments 14 to 22 of distributor ring TR are all connected to marking potential, since all of these segments are directly connected to negative battery except 15, 17, 20 and 22, the latter being connected to switch f3 of relay F which in said condition is set for connection through resistance 1R to negative battery. Consequently if relay BA or relay BB is not energised, a signal consisting of nine marking elements is transmitted, and as a result the transmitted character is printed at the receiver. Relay H is energized over segments 13 to 16 of distributor ring TL, and at contacts h1 a circuit is completed from positive battery, resistance 5R, contacts h1, front contacts f2, stepping magnet TT of the perforated tape transmitter, negative battery. The tape of the transmitter is thereby stepped forward and controls contacts TT1—TT5 for the next combination.

If on the other hand, either relay BA or BB is energised, the locking circuit of relay F is broken at contacts ba1 or bb1, and at contacts f3 spacing potential is connected to segments 15, 17, 20 and 22 of ring TR so that a non-printing signal is transmitted. The circuit of the stepping magnet TT cannot be completed, being open at contacts f2 and consequently, during the next rotation of the brush over the distributor ring TR the same character combination is again transmitted over segments 1—5.

At office Y the non-printing signal, if transmitted, is received whilst the brush of the receiving ring RR is passing over segments 14 to 22. If a non-printing signal is not received, contacts rra1 are at this time in marking position and negative potential is connected over these segments to one side of relays DA, DB and DC, the other side of which is also connected to negative potential. Consequently none of these relays energises.

As the brush of distributor ring RL passes over segments 12 to 16, relays EA—EE are connected in operating circuits over contacts ca2—ce2 of the relays CA—CE that had previously operated. Thus the combination of the relays CA—CE that had been operated is transferred to the relays EA—EE and those of the latter relays that operate close locking circuits for themselves over contacts ea1—ee1 and contacts gb1 to earth. The relays CA—CE that were previously operated and had closed locking circuits for themselves are unlocked when the brush of ring RL passes over segments 20 and 21. When this happens relay GA is energised and at contacts ga1 opens the locking circuits for relays CA—CE. Contacts ea2—ee2 prepare circuits for the magnets PM1—PM5 of the multiplex printer. As none of relays DA, DB and DC has operated, the circuit for

those magnets is completed over segment 2 of ring RL, and the signal combination duly operates the printer. The multiplex printer may be a Murray multiplex printer as described on page 394 et seq. of the book by H. H. Harrison entitled "Printing Telegraph Systems and Mechanisms," but modified so that contact 50 is closed by the operation of any of the bars controlled by the magnets PM1—PM5. If any of these bars is operated, contact 50 is closed and the printer magnet PMR is operated to effect the printing of the received character.

If, however, a non-printing signal is transmitted from office X the signal sequence S, M, S, M, M, S, M, S (where M is a marking signal and S is a spacing signal) is radiated from the radio transmitter RT and in the absence of atmospheric disturbances the same combination will be received at the radio receiver RRR and repeated to the traffic office at Y so that the corresponding marking and spacing impulses are applied in turn to segments 15 to 22 of the distributor ring RR.

The first impulse of the combination S, M, S, M, M, S, M, S is a spacing impulse and is applied over segment 15 of ring RR to relay DA which thereupon operates and closes a locking circuit for itself over contacts *dal*. The second impulse is a marking impulse and is applied over segment 16 but does not operate relay DB as it is of the same polarity as the potential connected to the other side of relay DB. The third impulse is a spacing impulse and is applied over segment 17 to relay DC which thereupon operates and closes a locking circuit for itself over contacts *dcl*. Contacts *da2* and *dc2* open the printer magnet circuit and no printing can take place. The fourth and fifth impulses are marking impulses which are without effect. The sixth (M), seventh (S) and eighth (M) impulses are a repetition of the first, second and third impulses and like them constitute the characteristic combination forming the non-printing signal. The non-printing signal is thus sent twice so as to give relays DA and DC two chances of responding. Relays DA—DC and EA—EE are unlocked by energizing relay GB through engagement of the brush of ring RL with the segments 5 and 6, thereby opening switch *gb1* in the locking circuits.

It will be appreciated that the circuit is so arranged that printing will always take place unless a non-printing signal is received. This non-printing signal consists of a characteristic signal combination (S, M, S) which is unlikely to be accidentally received as a consequence of radio disturbances. It is extremely unlikely, for example, that if interfering carrier is present it will be so disposed as to cause the operation of relays DA and DC whilst leaving relay DB unoperated. It is essential that relay DB remains unoperated for the non-print to be carried out since if it operates it immediately recloses the printing circuit which relays DA and DC have opened.

In order to guard against loss or distortion of the non-printing signal due to fading, the characteristic signal combination is sent twice. The number of extra characters printed is thereby greatly reduced whilst at the same time the chances of two stray radio impulses occurring at exactly the right times to operate the receiving relays in the correct combination are still very small. Also, the two non-printing signals are separated by two marking signals so as to disturb what would otherwise be a regular alter-

nation of marking and spacing signals and thus make it unlikely for reversals transmitted on an adjacent carrier wave to produce the effect of non-printing signal.

5. Synchronisation of the distributors is shown as being achieved by means of the well known system described with reference to Fig. 313 on p. 312 of the book by H. H. Harrison entitled "Printing Telegraph Systems and Mechanisms," the correcting magnet CM being shown connected to segment 12 of distributor ring RR. From segments 11 and 12 of the distributor ring TR two impulses of opposite character are sent. If the impulse sent out over segment 11 arrives at the other station over segment 12, the correcting magnet CM is operated to set back the phase of the receiving distributor. It will be noted that this impulse is of the opposite character to that of the printing impulses and this ensures that disturbances will not insert a false correcting impulse.

Switches S1, S2 and S3 are provided in order to permit of definite conditions being applied to all the segments of the distributors to ensure rapid initial synchronisation. Switch S1 when operated short circuits relay GA and so prevents locking of the relays CA—CE and ensures that marking potential is applied to segments 6 to 10 of ring TR. Switch S2 short circuits the bus bars 31 and 32 and maintains segments 1 to 5 at marking potential. Switch S3 ensures that relay F remains operated and this applies marking potential to segments 14 to 22.

Whenever the check back circuit (C BC in Fig. 1) at X determines that the transmitted character has been correctly received at Y, relay F at X remains operated and a succession of nine marking impulses is transmitted whilst the brush passes over segments 14—22 of ring TR. These impulses, which are transmitted as a long period of no-carrier, produce no effect on relays DA, DB, DC at Y and printing takes place.

In the system described in Patent 2,242,196 the non-printing signal is transmitted by causing relay F on releasing to connect all the segments 15—22 of ring TR to spacing potential, so that a long spacing signal is transmitted to effect the operation of a relay D which opens the operating circuit of the printer. In these circumstances the non-printing signal is transmitted as a long period of carrier energy.

Moreover, in order to deal more effectively with radio disturbances, the effects of atmospherics and similar interference were converted into that of fading so that the only disturbance requiring further consideration was that of fading. This feature is retained in the present modified systems.

During disturbed atmospheric conditions, therefore, fading effects will be present in the receiving circuits with the result that character signals will be incorrectly received and many non-printing signals will be transmitted (as long periods of carrier energy). Many of these non-printing signals, however, will be wholly or partially faded out; the resultant tendency being to convert them into printing signals and so to cause the printing of a large number of unwanted extra characters. In order to reduce the number of such extra characters the circuit of Patent No. 2,214,196 was so arranged that any carrier arriving during the printing signal period would act as a non-printing signal by effecting the operation of relay D. This, however, had the drawback that any stray carrier energy

on, or sufficiently close to, the working carrier frequency would cause a printing signal (absence of carrier) to be converted into a non-printing signal (presence of carrier) with the resultant loss of a desired character.

This drawback is overcome, according to the present invention, by arranging to print in all cases where a non-printing signal is not received, the non-printing signal being of such a character as to offer the minimum chance of its being simulated by stray carrier energy, as already explained.

In order to reduce still further the number of extra characters printed during the existence of disturbances, the sensitivity control circuit is provided. The object of this circuit is to decrease the sensitivity of the receiver during the reception of the code elements as compared with its sensitivity during the reception of the non-printing signal.

For this purpose the apparatus at the traffic office TO is provided with an additional receiving ring RS having its segments 1—5 connected to earth. The battery is thereby connected to lines L1 and L2 respectively to effect the operation of a relay RB at the radio receiving station RRS whilst the brushes at the traffic office TO are passing over segments 1—5, i. e. while the code signals are being received by the receiver RRR. Relay RB upon operating connects a battery B across a resistance R in the signal path. Battery B is connected in such a direction as to reduce the sensitivity of valve V3, and therefore to reduce the amplitude of the code signals fed to the valve relay circuit VRC.

During disturbed atmospheric conditions, a large number of transmitted signal elements will be lost, and, as already explained, this leads to the transmission of non-printing signals and retransmission of characters. Due to elements of the non-printing signals being lost, a large number of unwanted extra characters tend to be printed. The sensitivity of the circuit VCC during code signals, however, is reduced to such an extent that upon incidence of a fade the reception passes through the following stages:

Stage	Code signals	Non-printing signal
1.-----	Correct.-----	Absent (not transmitted).
2.-----	Failing.-----	Correct.-----
3.-----	Absent.-----	Failing.-----
4.-----	do.-----	Absent (faded out).

It will be seen that as soon as the non-printing signal begins to fade out, the code signals are completely faded out. This absence of code signals conditions the printer for a non-print, non-feed function so that even though the loss of the non-printing signal may result in the printing function being performed no character will actually be printed.

What is claimed is:

1. A printing telegraph system including signal transmitting means at a transmitting station, signal receiving means at a receiving station including printing apparatus, means for retransmitting a received signal combination from the receiving station to the transmitting station, means at the transmitting station for receiving and comparing the re-transmitted signal combination with the original signal combination, and means for controlling the operation of the printing apparatus in accordance with the results of said comparison, comprising means at

the transmitting station for sending a non-print signal combination when the compared signals differ, said non-print signal combination comprising a transmitted carrier wave element and a signal element consisting of a period of non-transmission in sequence, said control means including a first relay operative by said transmitted signal element so as to open the printing circuit and a second relay operative by said signal element comprising a non-transmission period and also operative by interference waves so as to close the printing circuit, the arrangement being such that interference waves received during the reception period for said carrier wave element and also during said non-transmission period will be ineffective to actuate the preventing means.

2. A printing telegraph system including signal transmitting means at a transmitting station, signal receiving means at a receiving station including printing apparatus, means for retransmitting a received signal combination from the receiving station the transmitting station, means at the transmitting station for receiving and comparing the retransmitted signal combination with the original signal combination, and means for controlling the operating of the printing apparatus in accordance with the results of said comparison comprising means at the transmitting station operative when the compared signals differ to send a non-print signal combination comprising a carrier wave element and an element consisting of a period of non-transmission in sequence, and means at the receiving station selectively responsive to said non-print signal combination for preventing the operation of the printing apparatus, said preventing means comprising an operating circuit for the printing mechanism, including a normally closed switch and a normally open switch in parallel, a relay for opening the closed switch, means for energizing the relay during the period of reception of the carrier wave signal element, a relay arranged to close the normally open switch and means for energizing said relay when an interference wave is received during the period of reception of said non-transmission element, the arrangement being such that said circuit will remain closed when interference waves are received during both of said signal element reception periods.

3. A printing telegraph system as set forth in claim 2, in which the non-print signal sending means includes means for repeating said signal and the selectively responsive means at the receiving station includes means for energizing said first mentioned relay successively upon receipt of said successive signals.

4. A printing telegraph system as set forth in claim 2, in which the non-print signal includes a second carrier wave signal element in sequence with the non-transmission element, a third relay, means for energizing the third relay upon receipt of said second carrier wave element, and a second normally closed switch opened by said third relay and located in said circuit in parallel with said switches.

5. A printing telegraph system comprising signal transmitting means at a transmitting station, signal receiving means at a receiving station including printing apparatus, and means for controlling the operation and non-operation of the printing apparatus by signals from the transmitting station, including means for sending a carrier wave signal element and providing a period of non-transmission forming a second signal element in sequence, a printing apparatus

operating circuit at the receiving station, a first relay operative by said transmitted signal element so as to open the printing circuit and a second relay operative by said signal element comprising a non-transmission period and also operative by interference waves so as to close the

printing circuit, thereby maintaining the operation of the printing apparatus, even upon receipt of an interference wave of similar frequency during the period of said non-transmitted signal element.

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