May 3, 1932. M. DE SAIVRE 1,856,376

RADIO COMMUNICATION SYSTEM

Filed March 28, 1929

Fig. 1.

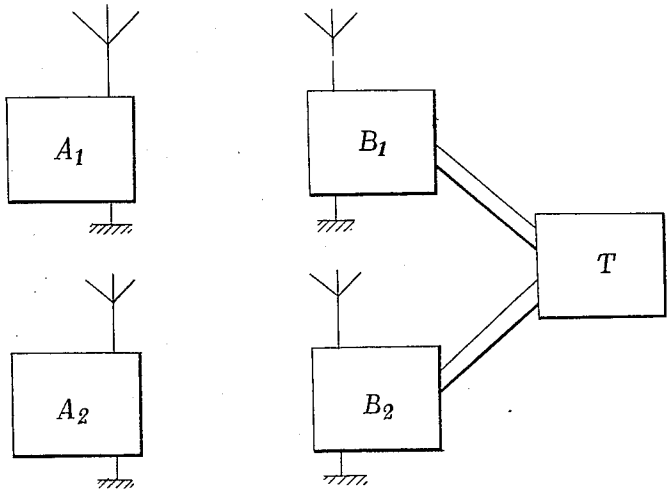
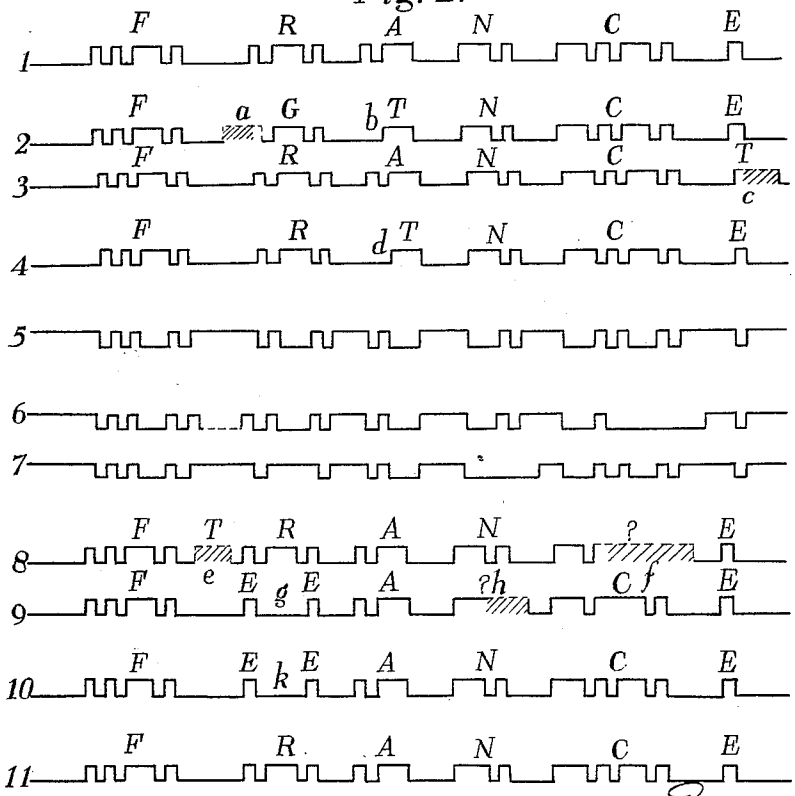


Fig. 2.



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RADIO-COMMUNICATION SYSTEM

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In known systems of radio-communication, the principle of comparing several records of the same message, which are received either simultaneously or successively, has been used. In the first case, when the records are received simultaneously, a signal must figure in every record, if it is to be considered correct, the assumption being made that all interferences are positive, and give additional signals. In the second case, the assumption is made that the only interferences are due to fading, and signals are lost, so that if a signal figures in only one record it is considered to be correct.

These two systems are defective and contradictory, since both atmospherics or parasites and fading, effect the reception, and thus it becomes necessary both to add to, and to substract from, the received records.

In accordance with the present invention, the effects of parasites and fading, in deforming the transmitted message, are both eliminated. This is done, broadly speaking, by transmitting the message upon two different systems, one eliminating errors due to parasites while possibly leaving some errors due to fading, and the other eliminating errors due to fading, while possibly leaving some errors due to parasites. A final corrected record is then made, in which these remaining errors, if any, are removed.

More particularly, the invention is practiced, as to one step thereof, by transmitting the message several times, by the normal method of sending the signals, such as dots and dashes, as impulses, separated by paces. The repeated message is received, and all positive signs or indications, which appear upon less than all of the received versions, or records, of the message, are removed. Thereby all additional signs due to parasites are removed, because an additional sign of this nature will not appear as an identical indication on all of the copies of the message. No correction is, however, made for any possible deformation of the record due to fading.

As another step of the process, the same message is also transmitted several times by the method known as counter-manipulation, or back-stroke keying, which means that the message is sent out in inverted form, impulses being sent out during the intervals between signals, so that the signals, such as dots and dashes, contitute the interval between the impulses sent. Any fading of the impulses transmitted appears in the message as received as a blank, where a positive indication should appear, and when a record of the message received is re-inverted into normal form, so that signals appear as positive indications, the deformations due to fading will appear as positive indications. Therefore, all positive indications which appear upon less than all of the received versions, or records, of this series of repeated messages, in re-inverted form, are removed, to make a corrected record. The same result would be attained by removing all blanks, which appear in less than all of the messages as received in inverted form, and re-inverting the record into normal form after this correction has been made.

The result of this correction is that all deformations due to fading are removed from the record thus made of this series of repeated messages, because they will not appear in exactly the same form on all of the copies of the message, of this series. No correction is made in this record, however, for any possible errors due to parasites. These, if present, would appear as positive indications in a record of the message, as received, in inverted form, and therefore appear as blanks in the corrected record which has been re-inverted into normal form.

We have, then two corrected records, from both of which all positive signs, which appear in less than all of the copies of the message in the series, have been eliminated. In the first, from which parasites have been removed as additional positive indications, the only errors can be blanks, due to fading, where plus values should appear. Similarly, in the second record, from which fading deformations have been removed as additional positive indications, the only errors can be blanks, due to parasites, where plus values should appear. It is therefore a simple matter to perform the final step of the

method, which consists in making a final corrected record from the two corrected records, above described, by inserting in this final record all positive indications, in the one which correspond with blanks in the other. Therefore, in the final record, all positive indications are inserted which appear on either of the two corrected records first made.

It is advantageous to transmit the first mentioned series of messages, the normal series, by a long-wave transmission, since such transmissions are likely to be affected by atmospheric discharges, that is, parasites, but not very much by fading. The second series, sent in inverted form, is advantageously sent by short-wave transmission, since that is likely to be affected chiefly by fading, atmospheric discharges interfering less in this form of transmission.

The object of the invention is the provision of an improved method of the character above described.

Without limiting the scope of the invention in any way, the accompanying drawings show diagrammatically one way in which the invention may be carried into effect.

Fig. 1 shows diagrammatically an arrangement of transmitting and receiving stations.

Fig. 2 shows diagrammatically the various stages in the reception of a word, according to one method of applying the invention.

With reference to Fig. 1, according to the invention, two transmitting stations A_1 and A_2 and two receiving stations B_1 and B_2 may be employed. A message is transmitted on a short wave-length by "counter manipulation" methods between A_1 and B_1, two or three times in succession. The successive messages are recorded at the receiving station and the additional signs, due to fading, are automatically eliminated by combining the records obtained by the delayed repetitions of the signals.

The message is also transmitted on a long wave-length between the stations A_2 and B_2 by ordinary methods, the message again being repeated two or three times. The successive messages are recorded at the receiving station and the additional signs, due to parasites, are again automatically eliminated. The transmissions between A_1 and B_1 and A_2 and B_2 may be made either simultaneously or one after the other.

After the record obtained at B_1 has been reversed, it is compared with the non-reversed record obtained at B_2. The former record presents a certain number of "blanks" due to parasites, whilst the latter has a number of "blanks" due to fading. These blanks may be eliminated by a local retransmission of the two messages or by impressing the two messages in parallel on a receiving apparatus T. Under these conditions a sign need only figure in one of the messages to be correctly recorded.

The method of comparing records obtained in the manner described, is illustrated in Fig. 2. In this figure, 1 shows the original message transmitted by the system of direct manipulation. Two records obtained on this system are shown at 2 and 3. In record 2, a parasite occurred at *a* and a signal was lost at *b* owing to fading. In record 3 a parasite occurred at *c* and thus transformed the E into T. Comparing these two records in the manner usual to systems of direct manipulation, the signals *a* and *c* since they do not occur in both records, are ignored and the correct version is obtained for the letters F R N C E. The fading at *b* in record 2, however, removes this signal from one of the records and the corresponding signal in record 3 is ignored although it is a correct one. Hence the record 4 is obtained from a combination of records 2 and 3 and the resulting word is F R T N C E.

At 5, the signal transmitted by counter manipulation methods is shown, and two records obtained are shown at 6 and 7. These two records are reversed and then appear as shown at 8 and 9. In record 8 there is an additional signal *e* due to fading in the original record 6, and also at *f* there is an extra signal. In record 9 there is a signal lost at *g* and one gained at *h*.

Now comparing these two records in the same manner as the records 2 and 3 were compared, the record 10 is obtained in which there is a blank *k*. Records 4 and 10 are now compared knowing that in both records the only errors that are present are blanks and therefore considering a signal occurring in only one of the records as being correct. Thus the blank at *k* in record 10 is filled by the corresponding signal which was correctly received on record 4 and the blank *d* on record 4 is filled by the corresponding signal correctly shown on record 10. Hence the final record 11 is correctly obtained.

It is evident that a combination of two methods is used. The system of delayed repetitions is used in each communication to eliminate additional signs from the received messages which are then combined in the manner indicated above, the system of "counter-manipulation" being used to facilitate the process.

The counter-manipulation need not necessarily involve an additional operation. It may be operated on the same lines as the direct manipulation. In this case the latter would be effected by a normal current during intervals with an additional working current during the signalling periods, as is usual in rapid line telegraphy. The two currents would then start from the same relay, the working current being directed towards the

station A_1 and the normal current towards the station A_2.

This arrangement has the advantage of avoiding any interference between the two frequencies, as they are not emitted simultaneously.

Another modification of the invention consists in using a single station functioning on a single wave-length only. In this case the initial transmission, followed by a repetition, is effected by ordinary manipulation, and two further repetitions are made by "counter-manipulation".

The two messages transmitted by ordinary manipulation are received by the different sectors of a telegraphic apparatus which eliminates the additional signs due to parasites, by means of recording relays fed in series, and the two other messages transmitted in "counter-manipulation" are received by the sectors of second telegraphic apparatus which, after the messages have been reversed, eliminates in a similar way the additional signs due to fading. Both the resulting messages are free from additional signs, but there may be additional blanks which are eliminated, as previously described, during their simultaneous translation, the corresponding relays being fed in parallel instead of in series as when the messages are originally recorded.

During the transmission, the number and nature of the repetitions may be modified according to the atmospheric conditions. If, for example, there are no parasites but a very pronounced fading, which is of a frequent occurrence in short-wave transmissions, the transmission in normal manipulation may be entirely suppressed, but the number of counter-manipulation repetitions, on the contrary, increased.

If on the other hand the fading is not very pronounced, which is of a frequent occurrence in long-wave transmissions, the transmission in counter-manipulation need not be made and the only methods relating to the elimination of parasites need be applied.

I claim:—

1. In radiotelegraphy, the method of eliminating deformation of signals due to parasites and fading, which consists in transmitting a message several times by the normal method of sending the signals as impulses separated by spaces, receiving the same, and making a corrected record thereof by removing all positive indications which appear on less than all of the received messages; transmitting the same message, in inverted form, several times, by transmitting the spaces between the signals as impulses, receiving the same, and making a corrected record of the message, in re-inverted form, by removing all indications which appear on less than all of the received messages, which would be blanks on the messages received in inverted form, or positive indications on the same messages if again inverted so that the signals will appear as positive indications; and making a final corrected record from the two corrected records thus made, by inserting in the final record all positive indications which appear on either of said two corrected records.

2. In radiotelegraphy, the method of eliminating the deformation of signals to be recorded, which consists in transmitting a message several times, first by the normal method of sending the signals as impulses, separated by spaces, on a long wave-length, and secondly, in inverted form, by transmitting the spaces between the signals as impulses, on a short wave-length; receiving and making a corrected record of the first series by removing all positive indications which appear on less than all of the received messages; receiving, and making a corrected record of the second series, in re-inverted form, so that the signals will appear as positive indications, by removing all indications which appear on less than all the received messages, which would be blanks on the messages received in inverted form, or positive indications on the same messages if re-inverted; and making a final corrected record from the two corrected records thus made, by inserting in the final record all positive indications which appear on either of said two corrected records.

3. In radiotelegraphy, the method of eliminating the deformation of signals to be recorded, which consists in transmitting a message several times, first by the normal method of sending the signals as impulses, separated by spaces, on one wave-length and secondly, in inverted form, by transmitting the spaces between the signals as impulses, on a different wave-length; receiving and making a corrected record of the first series by removing all positive indications which appear on less than all of the received messages; receiving, and making a corrected record of the second series in re-inverted form, so that the signals will appear as positive indications, by removing all indications which appear on less than all the received messages, which would be blanks on the messages received in inverted form, or positive indications on the same messages if re-inverted; and making a final corrected record from the two correct records, thus made, by inserting in the final record all positive indications which appear on either of said two corrected records.

4. In radiotelegraphy, the method of eliminating the deformation of signals to be recorded, which consists in transmitting a message several times by the normal method of sending the signals as impulses, separated by spaces, receiving said repeated message and making a corrected record thereof by removing all positive indications which appear on less than all of the received messages; trans-

mitting the same message, in inverted form, several times, by transmitting the spaces between the signals, as impulses, receiving, and re-inverting the same, so that the signals will appear as positive indications and making a corrected record of the message by removing all positive indications which appear on less than all of the received, re-inverted messages; and making a final corrected record from the two corrected records thus made by inserting in the final record all positive indications which appear on either of said two corrected records.

In testimony whereof I have hereunto affixed my signature.

MAURICE DE SAIVRE.