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REDUCTION OF INTERFERENCE

Original Filed March 15, 1930

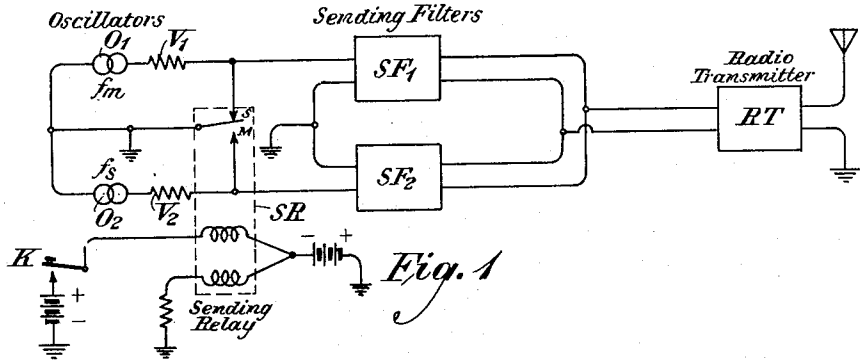


Fig. 1

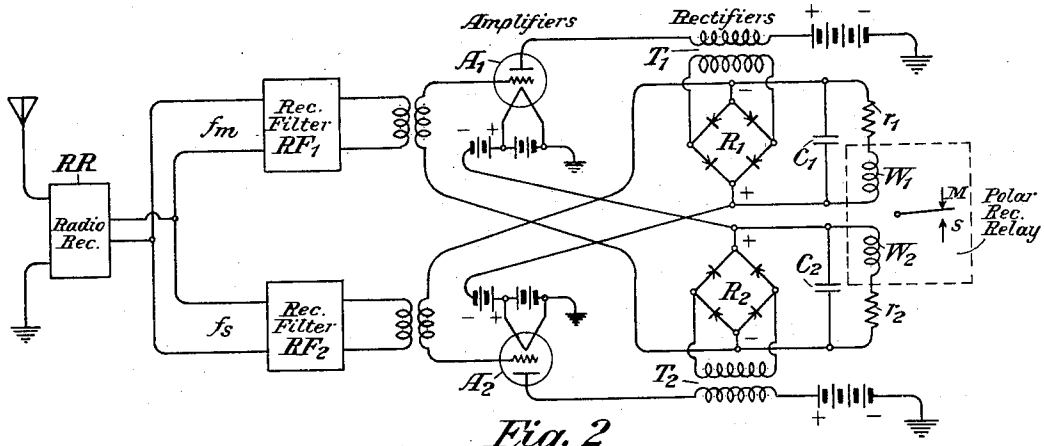


Fig. 2

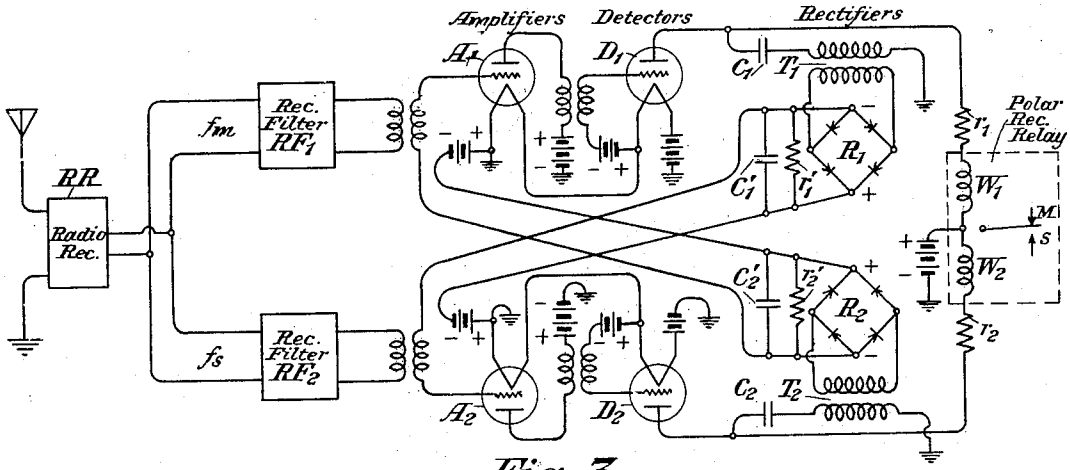


Fig. 3

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REDUCTION OF INTERFERENCE

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This invention relates to telegraph transmission systems and more particularly to means for reducing interference in such systems.

In accordance with the present invention telegraph signals are transmitted by applying currents of two different frequencies instead of by interrupting a current of a single frequency. One of the frequencies transmitted corresponds to a marking signal and the other to a spacing signal. At the receiving station two paths are provided, one for receiving the marking frequency and the other for receiving the spacing frequency. The currents in the two paths are then caused to actuate separate windings of a polar receiving relay so that the relay armature operates against one contact when one of the currents is received and against the other contact when the other current is received. The current flowing in either path is also utilized to disable the other path, with the result that when current of one frequency is being received, an interfering current having a frequency such that it may be received in the other path will not cause false operation. The system also has the advantage that fairly large variations in transmission equivalents will have practically no effect upon the bias of the received signals since the effect upon the marking and spacing currents will be substantially the same.

The invention will now be more fully understood from the following description when read in connection with the accompanying drawing in which Figure 1 is a circuit diagram showing the apparatus at a sending station; Fig. 2 is a circuit diagram showing the apparatus at a receiving station; and Fig. 3 is a circuit diagram showing a modified form of the receiving apparatus.

Referring to Fig. 1, the operation of the sending key K controls the sending relay SR whose contact in turn determines the transmission of a frequency from either of two oscillators O_1 or O_2. When the armature of the sending relay SR rests upon its spacing contact s, the output of the oscillator O_1 is short-circuited and current of frequency f_s is transmitted from the oscillator O_2 through the resistance v_2 and thence through the sending filter SF_2 to the radio transmitter RT. The current thus transmitted corresponds to a spacing signal. When the armature of the relay SR rests upon its marking contact m, the output of the oscillator O_2 is short-circuited and the frequency f_m is transmitted through the resistance v_1 and through the sending filter SF_1 to the radio transmitter RT. The current so transmitted corresponds to a marking signal. With this arrangement, when the key K is operated to send telegraph signals, current of one of the two frequencies will be on the circuit at all times and the discrimination at the receiver between marking and spacing signals will depend upon the selection between two frequencies transmitted.

One form of receiving arrangement which may be employed is shown in Fig. 2. Here a radio receiver RR picks up the received ether waves and translates them into marking and spacing frequencies f_m and f_s corresponding to the marking and spacing frequencies sent out under the control of the key K at the transmitter. Two receiving paths are provided, one for receiving the marking frequency, and the other for receiving the spacing frequency. When the marking frequency f_m is received it passes through a receiving filter RF_1 to an amplifier A_1 the output of which is coupled through a transformer T_1 to a rectifying arrangement R_1. The rectifying arrangement R_1 consists of four rectifying elements of any known type connected in a bridge circuit, as shown, so that when alternating current flows in the secondary of the transformer T_1 the half waves of either direction which are applied to two of the terminals of the bridge produce a one-way potential always in the same direction across the other two terminals of the bridge. The result is that a rectified current will flow through the resistance r_1 and through the winding W_1 of the polar receiving relay, thereby causing the armature to be held against the marking contact m. Similarly, if a spacing frequency f_s is being received this frequency will be selected through the receiving filter RF_2 and applied

to the amplifier A_2. The output of the amplifier is coupled through a transformer T_2 to a rectifying arrangement R_2 similar to that already described. Consequently, when the received alternating current flows in the output circuit of the amplifier A_2, a one-way potential is applied across the upper and lower terminals of the rectifying arrangement R_2 with the result that a one-way current flows through the winding W_2 of the polar receiving relay and through the resistance r_2. This current causes the armature of the receiving relay to be moved to its spacing contact.

With the receiving arrangement so far described, it will be evident that under normal conditions one or the other of the two frequencies f_m and f_s will be received at all times and only one of said frequencies will be received at any given instant. Consequently, if the marking frequency is being received the receiving polar relay will have its armature shifted to its marking contact and the receiving apparatus in the spacing path will have no effect to shift the armature in the opposite direction. Likewise, if the spacing frequency is received, the receiving apparatus in the marking path will be without effect upon the receiving armature which will be moved and held against the spacing contact. If under these conditions the transmission equivalent of the circuit should change, both the marking and spacing frequencies would be subjected to substantially the same change in transmission with the result that the bias of the receiver as between marking and spacing would not be materially altered.

The conditions just described might be varied, however, if static or other disturbing currents were received. Suppose, for example, that the marking frequency f_m is being received and at the same time a static discharge should occur which would result in a frequency corresponding to f_s being applied to the filter RF_2. This would result in a flow of current through the winding W_2 of the receiving relay at the same time that the desired signal is actuating the winding W_1. This might result in causing a false spacing signal by shifting the armature to the spacing contact. Similarly, during the receipt of a spacing frequency f_s a static discharge might cause a component corresponding to f_m to enter the receiving filter RF_1. This would result in an unwanted current flowing through the winding W_1 of the polar receiving relay at the same time that the desired spacing current flows through the winding W_2.

In order to prevent such false action, a connection extends from the upper and lower terminals of the rectifying arrangement R_1 to the grid circuit of the amplifier A_2 of the opposite path so that when a rectified potential is produced across said terminals said rectified potential will be in such a direction as to cause the grid of the amplifier A_2 to be so negative that no current can flow in its output circuit even when an alternating current component corresponding to static is superimposed upon the grid. In other words, the rectified current from the rectifying arrangement R_1 is utilized to paralyze the amplifier A_2 and thereby to render the spacing path inoperative during the presence of the wanted marking signal. The receiving relay, therefore, cannot shift its armature from marking to spacing until the marking frequency ceases. Similarly, a connection is made between the upper and lower terminals of the rectifier arrangement R_2 in the spacing path to the grid of the amplifier A_1 in the marking path so that when a desired spacing frequency is received rectified potential will be applied to the grid of the amplifier A_1 to paralyze said amplifier and prevent a static component corresponding to the marking frequency from being transmitted to the output circuit of the amplifier. Accordingly, the receiving relay cannot shift its armature from spacing to marking until the wanted spacing current ceases.

By means of the arrangement above described, while either the marking or spacing path is receiving its desired frequency, the other path is disabled so that an interfering frequency corresponding to the other path will be without effect until the path having control of the receiving relay no longer receives its frequency. In passing it may be noted that the rectified potentials supplied by the rectifier arrangements R_1 and R_2 may be smoothed out by the provision of condensers C_1 and C_2 bridged across the output terminals of the rectifiers, or by means of inductances connected in series in the output circuit, or by means of a combination of inductances and condensers.

A modified receiving arrangement is shown in Fig. 3. Here the output circuits of the amplifiers A_1 and A_2 of the marking and spacing paths, respectively, are connected to detectors D_1 and D_2 whose output circuits supply detected currents to operate the marking and spacing windings W_1 and W_2, respectively, of the polar receiving relay. In order that when either the marking or spacing frequency is being received the other channel may be disabled to prevent false operation due to interference, the alternating current component appearing in the output circuit of each detector, which is normally by-passed through condensers such as C_1 and C_2, respectively, is caused to flow through the primary windings of the transformer T_1 in the case of the marking path, and the transformer T_2 in the case of the spacing path. Rectifying arrangements R_1 and R_2 are associated with the secondaries of these transformers in the manner described in connec-

tion with Fig. 1, and the rectified potential from these rectifiers is applied to the grid circuits of the amplifiers of the opposite paths. The result is that when the marking frequency is being received, for example, the rectifier R_1 will rectify a frequency corresponding to the marking signal appearing in the output circuit of the detector D_1 and paralyze the amplifier A_2 to prevent an interfering current in the winding W_2 of the receiving relay. Similarly, when the marking frequency is being received, the rectifier R_2 will cause the amplifier A_1 in the marking path to be paralyzed and prevent false operation of the receiving relay due to current flowing through the winding W_1. Condensers C'_1 and C'_2 are bridged across the output circuits of the rectifiers R_1 and R_2 to smooth out the rectified potentials, and resistances r'_1 and r'_2 are provided for discharging the capacities.

The circuits above described are illustrated in connection with radio transmission from the sending station to the receiving station and for this reason a radio transmitter RT and a radio receiver RR have been symbolically indicated. It will be understood, however, that the invention is not limited to radio transmission but may be employed for carrier transmission over wire lines by connecting the transmitting station and the receiving station by any known type of carrier transmission circuit.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, and means controlled by a current flowing in either path for disabling the other path.

2. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, means controlled by a current flowing in either path for disabling the other path, and a receiving relay having separate windings controlled by the currents flowing in the two paths.

3. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a rectifier arrangement associated with each path for producing rectified potentials in response to the currents flowing in the respective paths, and means whereby the rectified potentials produced by either rectifying arrangement will cause disablement of the opposite path.

4. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a rectifier arrangement associated with each path for producing rectified potentials in response to the currents flowing in the respective paths, means whereby the rectified potentials produced by either rectifying arrangement will cause disablement of the opposite path, and a receiving relay having separate windings controlled by currents flowing in the two paths.

5. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, an amplifier in each path, and means controlled by currents received in either path for disabling the amplifier in the opposite path.

6. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, an amplifier in each path, means controlled by currents received in either path for disabling the amplifier in the opposite path, and a receiving relay having separate windings controlled by currents flowing in the two paths.

7. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, an amplifier in each path, a rectifying arrangement associated with each path for producing rectified potentials in response to currents flowing in the paths, and means whereby rectified potential supplied by each rectifying arrangement disables the amplifier of the opposite path.

8. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing fre-

quency into the other path, an amplifier in each path, a rectifying arrangement associated with each path for producing rectified potentials in response to currents flowing in the paths, means whereby rectified potential supplied by each rectifying arrangement disables the amplifier of the opposite path, and a receiving relay having separate windings controlled by the currents flowing in the two paths.

9. In a transmission system having means for transmititng one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, an amplifier in each path, a rectifying arrangement associated with each path comprising four rectifiers connected in a bridge having two of its terminals so associated with the path that in response to alternating currents flowing in the path a rectified potential will be produced at the opposite terminals of the bridge, and means controlled by the rectified potential supplied by each rectifying arrangement for disabling the amplifier of the opposite path.

10. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver comprising two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, an amplifier in each path, a rectifying arrangement associated with each path comprising four rectifiers connected in a bridge having two of its terminals so associated with the path that in response to alternating currents flowing in the path a rectified potential will be produced at the opposite terminals of the bridge, means controlled by the rectified potential supplied by each rectifying arrangement for disabling the amplifier of the opposite path, and a receiving relay having separate windings controlled by the currents flowing in the two paths.

11. In a transmission system having means for transmitting one frequency for one signaling condition and another frequency for another signaling condition, a receiver comprising two paths, means for selecting the one frequency into one path, means for selecting the other frequency into the other path, a rectifier arrangement associated with each path for producing rectified potentials in response to the currents flowing in the respective paths, and means whereby the rectified potential produced by either rectifying arrangement will cause disablement of the opposite path.

12. In a transmission system having means for transmitting one frequency for one signaling condition and another frequency for another signaling condition, a receiver comprising two paths, means for selecting the one frequency into one path, means for selecting the other frequency into the other path, an amplifier in each path, and means controlled by currents received in either path for disabling the amplifier in the opposite path.

13. In a transmission system having means for transmitting one frequency for one signaling condition and another frequency for another signaling condition, a receiver comprising two paths, means for selecting the one frequency into one path, means for selecting the other frequency into the other path, an amplifier in each path, a rectifying arrangement associated with each path for producing rectified potentials in response to currents flowing in the paths, and means whereby rectified potentials supplied by each rectifying arrangement disables the amplifier of the opposite path.

14. In a transmission system having means for transmitting one frequency for one signaling condition and another frequency for another signaling condition, a receiver comprising two paths, means for selecting the one frequency into one path, means for selecting the other frequency into the other path, an amplifier in each path, a rectifying arrangement associated with each path comprising four rectifiers connected in a bridge having two of its terminals so associated with the path that in response to alternating currents flowing in the path a rectified potential will be produced at the opposite terminals of the bridge, and means controlled by the rectified potential supplied by each rectifying arrangement for disabling the amplifier of the opposite path.

In testimony whereof, have signed my name to this specification this 14th day of March 1930.

JOSEPH HERMAN.