

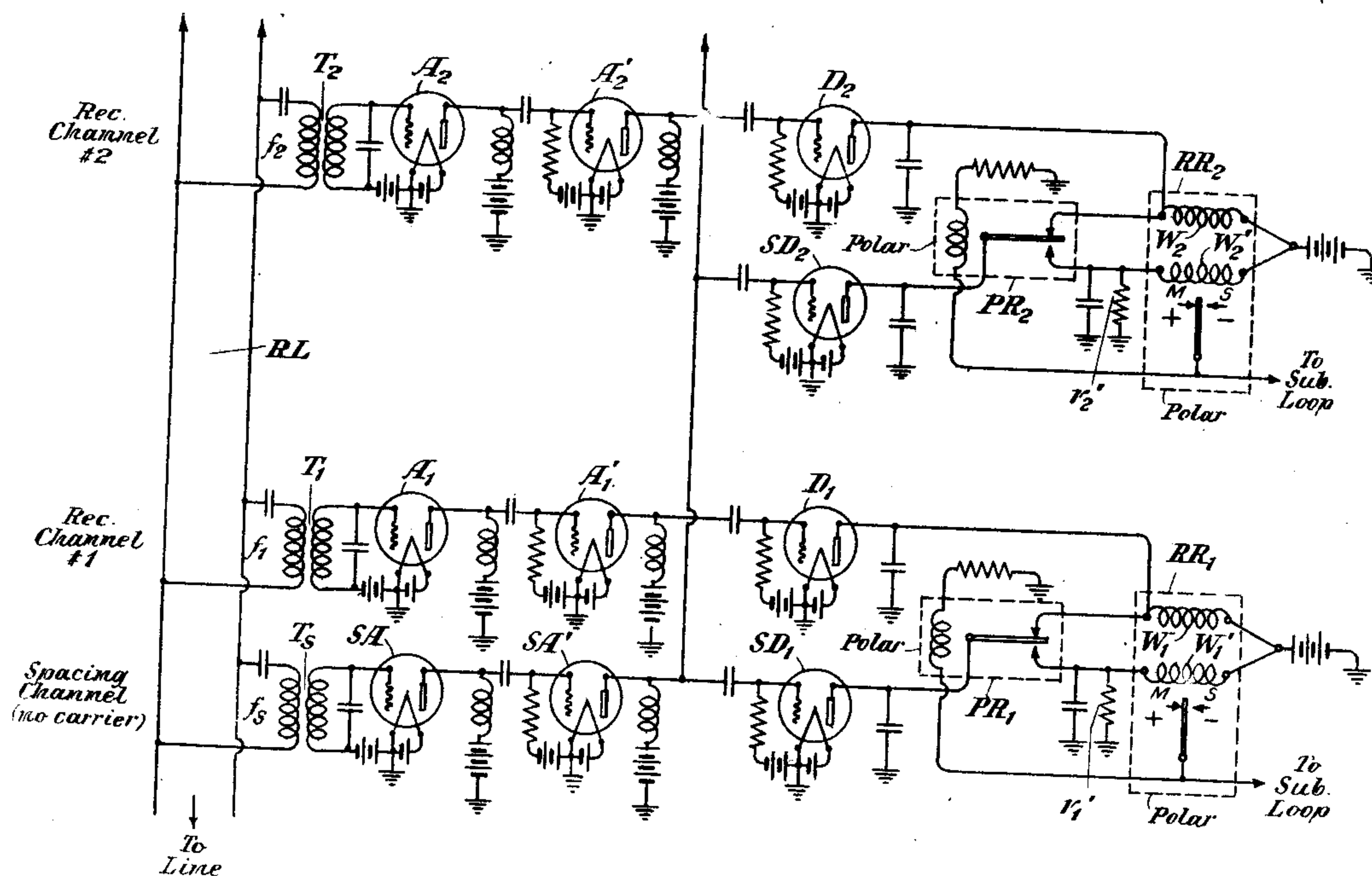
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D. E. BRANSON

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REDUCTION OF STATIC INTERFERENCE IN CARRIER SYSTEMS

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INVENTOR
D. E. Branson
BY *g. e. to k.*
ATTORNEY

UNITED STATES PATENT OFFICE

DAVID E. BRANSON, OF RIVER EDGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

REDUCTION OF STATIC INTERFERENCE IN CARRIER SYSTEMS

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This invention relates to wire and wireless carrier telegraph systems, and more particularly to arrangements for reducing the effect of lightning and other static interference upon such systems.

In carrier telegraph systems, lightning interference may manifest itself either (1) as an undesired pulse during the spacing or no-current interval, in which case the interference appears as a false marking signal, or (2) an instantaneous overloading of repeaters or receiving vacuum tube apparatus by the relatively large energy of the interfering pulse, in which case the "crowding" of the vacuum tubes by the superposition of the interfering pulse upon the normal carrier current of the channel reduces the current which operates the receiving relay so that a false spacing signal may appear during a marking impulse.

In order to overcome this difficulty it has been proposed to provide in addition to the regular receiving channels of the carrier system, an auxiliary "bucking" channel in which no signals are ordinarily received, due to the fact that no carrier is transmitted corresponding to this channel. When a lightning discharge occurs the auxiliary channel picks up one of the component frequencies of the lightning discharge, which is rectified to produce a pulse corresponding to the disturbing signal pulse occurring in the normal channels of the system. This pulse is transmitted through auxiliary windings to each of the receiving relays in such a direction as to tend to hold the armature of the receiving relay upon either its marking or spacing contact, depending upon which contact it rested against at the time the disturbing impulse occurred.

As the direction of the effect of the correcting impulse is determined merely by the character of the received signal (marking or spacing) at the time the static disturbance occurs, and is independent of whether the static impulse tends to hold the armature against its contact or to shift it, it is evident that if the static impulse occurs just at the time the signal is changing from marking to spacing or vice versa, the impulse from

the auxiliary channel may tend to prolong the marking or spacing signal by holding the armature of the receiving relay against the contact upon which it then rests. In accordance with the present invention it is proposed to utilize auxiliary channels in such a manner as to produce effects upon any given receiving relay which are opposite in direction to those produced by the static disturbance.

In order to accomplish this result, an auxiliary spacing channel is provided, that is, a channel to which no carrier is transmitted from the distant station. Instead of connecting this channel to an auxiliary winding of each receiving relay and reversing the connections of such auxiliary winding when the signal changes from marking to spacing and vice versa, the spacing channel is arranged to be connected to the operating winding of the receiving relay during marking conditions, and its connection is shifted to the spacing winding during spacing conditions. Consequently, the current flow due to the static impulse in the spacing channel may be used to balance the current flow in the operating winding due to the static during the receipt of a spacing signal, and during the receipt of a marking signal the current flow in the spacing channel may be used to make up for the decrease in current through the operating winding due to the crowding effect of the static impulse.

The invention will now be more fully understood from the following description, when read in connection with the accompanying drawing, the figure of which is a circuit diagram illustrating a preferred embodiment of the invention.

Referring to the figure, the various currents of the multiplex carrier system are received in a circuit RL which may be connected to either a wire line or a radio antenna. To the circuit RL any desired number of signal receiving channels may be connected, although in the ordinary wire carrier telegraph practice ten such channels are usually provided. The apparatus for each channel is similar to that of all the other channels except that the selecting apparatus of each

channel is adjusted to select the particular frequency assigned to the particular channel.

In the present instance only two signal receiving channels are actually shown in the drawing, and of these a description of one, for example, channel No. 2, will suffice. This comprises a tuned selecting circuit T_2 associated with the circuit RL for selecting the carrier frequency f_2 assigned to the channel. Vacuum tube amplifiers A_2 and A'_2 are provided for amplifying the carrier frequencies. A rectifying vacuum tube D_2 is also provided for translating the carrier frequency into direct current signal impulses. The grid of the vacuum tube D_2 is so biased by means of a C battery that with no carrier current present no current will flow in the plate circuit. When carrier current is applied to the grid, however, the rectified one-way current flows in the plate circuit of the rectifier tube D_2 . The operating winding W_2 of the receiving relay RR_2 is included in the plate circuit of the rectifier. A biasing winding W'_2 is also provided, and by means of a suitable resistance r'_2 the current flowing through the biasing winding is made equal to about one-half the current supplied from the plate of the detector D_2 when the carrier is being received.

In the system as illustrated it is assumed that carrier current is transmitted during the marking interval and that no carrier current is transmitted during the spacing interval. Normally when no signaling is taking place the carrier current is continuously on the circuit so that a steady direct current flows through the winding W_2 to hold the armature of the receiving relay RR_2 upon its marking contact in spite of the normal biasing current through the winding W'_2 . Each time a spacing signal is transmitted by interrupting the carrier current the rectified current through the winding W_2 ceases and the armature is shifted to its spacing contact by the pull due to the biasing winding W'_2 .

The effect of a lightning or other static interference upon the system so far described is as follows: If at the time the lightning discharge occurs a spacing signal is being transmitted so that normally no carrier would be present, the selecting device T_2 of the channel will pick up one of the component frequencies of the lightning discharge which corresponds to the frequency of the channel so that this frequency will be amplified and impressed upon the rectifier D_2 to produce a short pulse of direct current, tending to shift the armature of the receiving relay RR_2 from its spacing contact to its marking contact, thereby causing a false signal. If the lightning discharge should occur during the transmission of a marking signal, the effect will depend upon the magnitude of the energy of the static discharge at the frequency corresponding to the channel. If this energy is not so large as to overload the tubes of the system

it merely tends to produce a larger rectified current in the plate circuit of the rectifier D_2 so that the effect upon the winding W_2 is to increase the pull tending to hold the armature upon its marking contact. If, however, the energy of the static discharge is very large, so as to overload the various tubes of the system, thereby producing "crowding" of the normal carrier currents of the channels, the carrier current for each channel is reduced in amplitude to make room, as it were, for the excess energy of the lightning discharge. This reduction in the carrier frequency of the particular channel now under consideration may result in a decreased current in the plate circuit of the rectifier D_2 so that the winding W_2 is no longer able to hold the armature against the pull of the biasing winding. This causes a false spacing signal.

In order to correct for these false signals an auxiliary spacing channel is provided comprising a selective circuit T_s selective of a frequency different from the various signaling channels. The spacing channel also includes amplifiers SA and SA' similar in all respects to the amplifiers A_2 and A'_2 described in connection with receiving channel No. 2. The spacing channel has associated therewith a plurality of detectors, such as SD_1 , SD_2 , etc., one detector corresponding to each signal receiving channel. No carrier current is transmitted from the distant transmitting station to the spacing channel so that normally no current flows in the plate circuits of the detectors, such as SD_2 , due to the fact that their grid circuits are biased by C batteries, as described in connection with detector D_2 . When, however, a static disturbance occurs on the line circuit, the selective device T_s of the spacing channel selects a component of the static disturbance whose frequency corresponds to that of the spacing channel, and thereby causes a current to flow in the plate circuit of each of the detectors, such as SD_2 .

The connection of the plate circuit of the detector SD_2 is controlled by a polar relay PR_2 which in turn is controlled by the armature of the receiving relay RR_2 . When a marking signal is being received the armature of the relay RR_2 is on its marking contact and the armature of the polar relay PR is on its upper contact, thereby connecting the plate circuit of the rectifier SD_2 to the operating winding W_2 . When, however, a spacing signal is received and the armature of the receiving relay RR_2 is shifted to its spacing contact, the armature of the polar relay PR_2 shifts to its lower contact and connects the plate circuit of the detector SD_2 to the biasing winding W'_2 . The connections for the plate circuits of the detector, such as SD_1 , are similar to the connections just described for the detector SD_2 .

As has already been stated, the effect of a

static disturbance upon a particular channel depends upon whether that channel is receiving a marking signal or a spacing signal. If receiving channel No. 2 is receiving a marking signal and a static disturbance occurs when the transmission circuit is in such condition that the tubes are overloaded, the plate current of the detector D_2 will be decreased due to the corresponding decrease in the carrier frequency for channel No. 2. If this decrease in plate current is sufficient so that the current flowing through the winding W_2 is less than the biasing current through the winding W'_2 , a false spacing signal would occur. This is prevented, however, by the fact that the spacing channel selects a component from the static disturbance which corresponds to the frequency assigned to the spacing channel. This causes a flow of current in the plate of the detector SD_2 (whose plate current is normally zero) and this plate current flowing over the upper contact of the polar relay PR_2 , passes through the operating winding W_2 and tends to compensate for the decrease of current in said winding, due to the crowding effect of the static discharge.

If, at the time the static discharge occurred the transmission circuit was in such condition that the tubes were not overloaded, the effect of the static discharge upon the receiving channel No. 2 would be to increase the plate current of the detector D_2 due to the static component selected by the selective circuit T_2 . This would cause an increase in the current through the operating winding, and the effect of the static impulse on the spacing channel would be to cause a further increase in the operating current, due to the current in the plate circuit of the detector SD_2 . This, however, would not cause a false operation except in so far as the receiving relay might, upon the cessation of the marking signal, continue to hold its armature upon its marking contact, due to the prolonging of the static discharge after the marking signal ceased.

If the static disturbance should occur while channel No. 2 is receiving a spacing signal, the polar relay PR_2 will have shifted the connection of the plate circuit of the detector SD_2 from the operating winding W_2 to the biasing winding W'_2 . If, now, a static impulse should occur, the effect upon the spacing channel would be to cause a plate current to flow from the detector D_2 through the operating winding W_2 of the receiving relay, which might cause a false marking signal. The effect of the static discharge upon the spacing channel, however, is such as to cause a corresponding plate current to flow in the detector SD_2 , thereby correspondingly increasing the current through the biasing winding W'_2 . This increase in biasing current compensates for and neutralizes the dis-

turbing current through the operating winding so that no false signal occurs. If, while the static impulse continues, the spacing signal should terminate and the marking signal begin, the plate current of the detector D_2 would increase, due to the marking signal, and cause the receiving relay to shift its armature to its marking contact without any tendency of the relay to hold over the spacing signal due to the continuance of the static disturbance.

The operation of other channels, such as channel No. 1, will be similar in all respects to that of channel No. 2 and therefore need not be described.

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 carrier system, a receiving channel comprising means to select an alternating carrier current; means to detect therefrom signaling impulses, and a receiving relay having an operating winding responsive to said impulses to shift the armature in one direction, and a biasing winding to shift the armature in the opposite direction; an auxiliary channel comprising means selective of interfering components differing in frequency from the receiving channel, and means to connect said auxiliary channel to one of said relay windings during the receipt of marking signals, and to the other relay winding during the receipt of spacing signals.

2. In a carrier system, a receiving channel comprising means to select an alternating carrier current, means to detect therefrom signaling impulses, and a receiving relay having an operating winding responsive to said impulses to shift the armature in one direction, and a biasing winding to shift the armature in the opposite direction; an auxiliary channel comprising means selective of interfering components differing in frequency from the receiving channel, and means to connect said auxiliary channel to said operating winding during the receipt of marking signals, and to said biasing winding during the receipt of spacing signals.

3. In a carrier system, a transmission circuit; a receiving channel associated therewith and comprising means to select an alternating carrier current from said transmission circuit, means to detect signaling impulses from said carrier current, and a receiving relay having an operating winding responsive to said impulses to shift the armature in one direction, and a biasing winding to shift the armature in the opposite direction; an auxiliary channel to which no carrier frequency is transmitted over said transmission circuit; said auxiliary channel including means selec-

tive of interfering components differing in frequency from the receiving channel; and means to connect said auxiliary channel to one of said relay windings during the receipt of marking signals, and to the other relay winding during the receipt of spacing signals.

4. In a carrier system, a transmission circuit; a receiving channel associated therewith and comprising means to select an alternating carrier current from said transmission circuit, means to detect signaling impulses from said carrier current, and a receiving relay having an operating winding responsive to said impulses to shift the armature in one direction, and a biasing winding to shift the armature in the opposite direction; an auxiliary channel to which no carrier frequency is transmitted over said transmission circuit; said auxiliary channel including means selective of interfering components differing in frequency from the receiving channel; and means to connect said auxiliary channel to said operating winding during the receipt of marking signals, and to said biasing winding during the receipt of spacing signals.

5. In a carrier system, a transmission circuit, a receiving channel associated therewith and comprising means to select an alternating carrier current from said transmission circuit, means to detect signaling impulses from said carrier current, and a receiving relay having an operating winding responsive to said impulses to shift the armature in one direction, and a biasing winding to shift the armature in the opposite direction; an auxiliary channel to which no carrier frequency is transmitted over said transmission circuit; said auxiliary channel including means selective of interfering components differing in frequency from the receiving channel; a detector associated with said auxiliary channel; and means to connect said detector to one of said relay windings during the receipt of marking signals, and to the other relay winding during the receipt of spacing signals.

6. In a carrier system, a transmission circuit; a receiving channel associated therewith and comprising means to select an alternating carrier current from said transmission circuit, means to detect signaling impulses from said carrier current, and a receiving relay having an operating winding responsive to said impulses to shift the armature in one direction, and a biasing winding to shift the armature in the opposite direction; an auxiliary channel to which no carrier frequency is transmitted over said transmission circuit; said auxiliary channel including means selective of interfering components differing in frequency from the receiving channel; a detector associated with said auxiliary channel; and means to connect said detector to said operating winding during the receipt of marking signals, and to

said biasing winding during the receipt of spacing signals.

In testimony whereof, I have signed my name to this specification this 14th day of November, 1928.

DAVID E. BRANSON.

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