

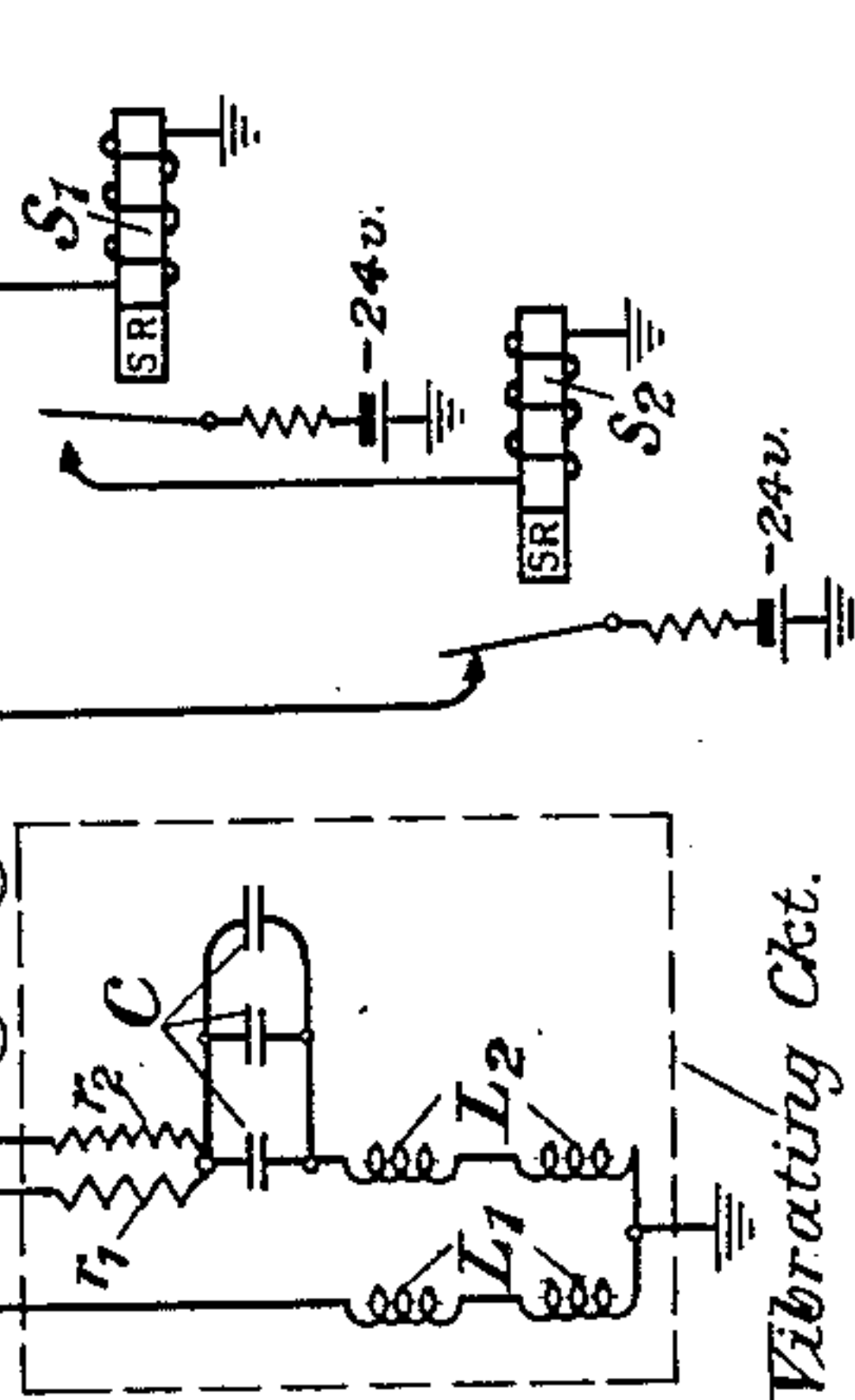
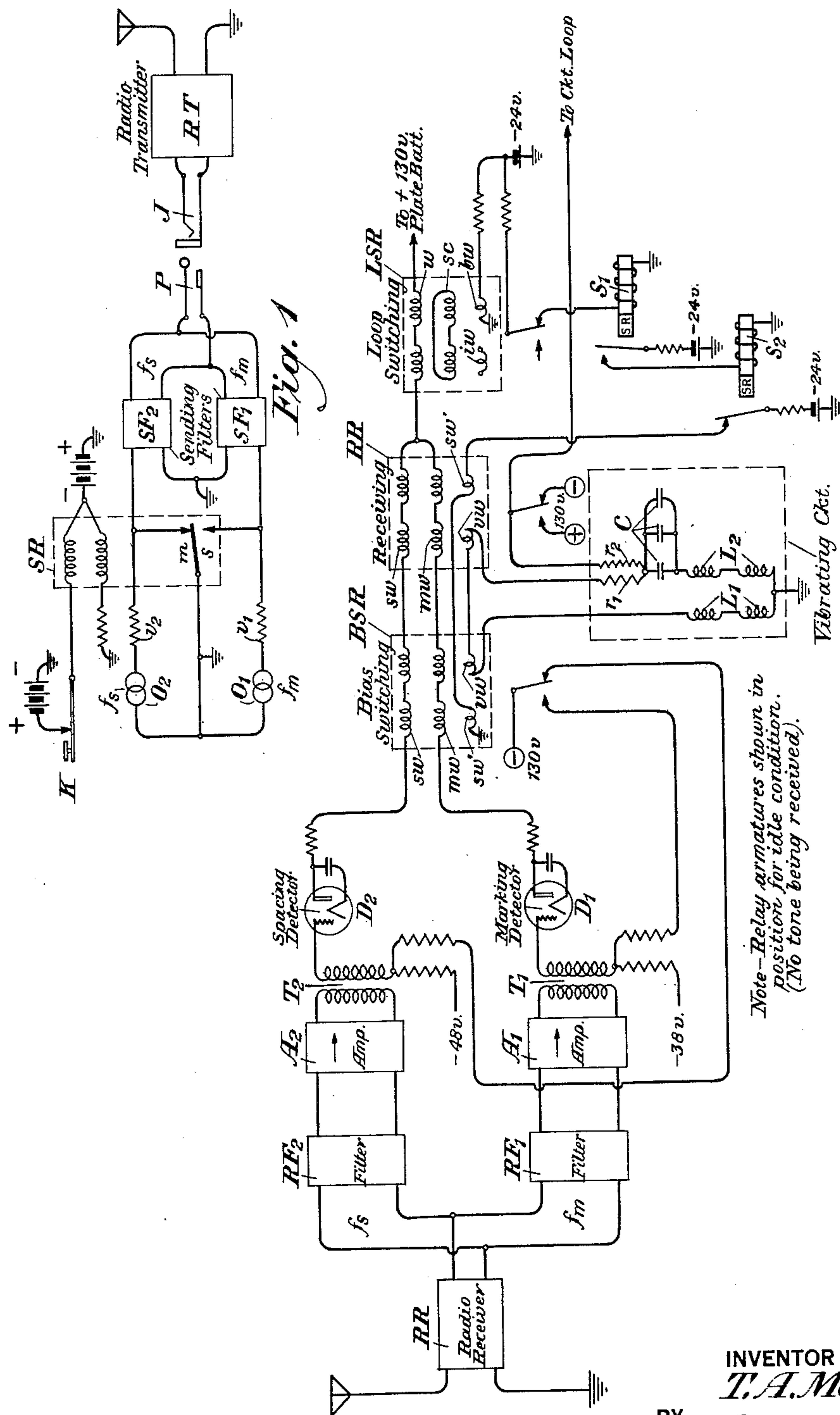
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REDUCTION OF INTERFERENCE

Filed Oct. 8, 1931



Note—Relay armatures shown in position for idle condition. (No tone being received).

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REDUCTION OF INTERFERENCE

Application filed October 8, 1931. Serial No. 567,726.

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

5 In the transmission of telegraph signals, and more particularly of printing telegraph signals, it has been found desirable to transmit the signals by means of tones of two different frequencies instead of interrupting a
10 tone of a single frequency. One of the tones transmitted corresponds to a marking signal, and the other to a spacing signal. At the receiving station the two tones are separated into two paths, one for marking and the other
15 for spacing. The tones 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 tones is received, and against the other
20 contact when the other tone is received. Such a system has the advantage that fairly large variations in transmission equivalent will have substantially no effect upon the bias of the received signals, since the effect upon the
25 marking and spacing tones will be substantially the same.

In practical operation it has been found, however, that the two tone system has one
30 disadvantage as compared with the interrupted single tone system in that it is more susceptible to high noise levels. Apparently when tone is received in the single tone system the effect of static is to reduce the plate current in the detector of the receiving channel.
35 In the case of the two tone system not only does this effect appear to be present in the receiving channel which is active at the moment, but in addition the static may produce a false impulse in the idle receiving channel
40 in which no tone is being received. If these two effects are cumulative the possibility of a false signal due to static, is increased.

45 In the United States patent to Joseph Herman No. 1,795,393, issued March 10, 1931, an arrangement is disclosed for overcoming this difficulty by arranging the two receiving channels so that when one channel is actively receiving a tone some of the energy of the received tone will be rectified and used to bias
50 a tube in the other channel, thus tending to

block the idle channel against interference. The arrangement of the Herman patent, however, has the disadvantage that the bias applied to the tube of the idle channel is always
55 a function of the amplitude of the received tone, and consequently, when the tone is received at a low transmission level the bias applied to the tube of the idle channel may be insufficient to block the channel and completely prevent any effect of static in the idle chan-
60 nel.

In accordance with the present invention it is proposed to overcome this difficulty by utilizing the rectified tone to control the operation of a relay which relay will in turn
65 control the disabling of the idle channel. While the receiving relay might be used for this purpose, inasmuch as the receiving relay is usually only provided with a single tongue, it is more feasible to provide an additional relay similar to the receiving relay
70 for controlling the disabling operation. Various methods may be employed for enabling the relay to disable the idle channel, such as opening or short-circuiting the channel,
75 but as herein disclosed, the relay is used to apply biasing potential from a local source to a tube in the idle channel in order to disable the channel.

Another feature of the invention resides
80 in the employment of a vibrating circuit for use in connection with the receiving relay and bias switching relay. The vibrating circuit is so arranged that upon the cessation of tone in the active channel the armatures
85 of the relays are shifted instantly by the action of the vibrating circuit, and the relays do not depend for their operation upon the reception of tone in the other channel. In fact, since the idle channel is completely
90 disabled until the relay armatures are shifted, the system would be locked up unless a vibrating circuit were provided.

The invention will now be more fully understood from the following description
95 when read in connection with the accompanying drawing, Figure 1 of which shows the transmitting circuit, and Fig. 2 of which shows the received circuit of a system embodying the invention.
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The system shown in the drawing and herein described, involves the application of the invention to a system for transmitting telegraph signals, and particularly for the operation of printing telegraphs by radio. 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 tone 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 a tone 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 tone 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 a tone of frequency f_m is transmitted from the oscillator O_1 , through the resistance v_1 , and thence through the sending filter SF_1 to the radio transmitter RT. The tone so transmitted corresponds to a marking signal. With this arrangement, when the key K is operated to send telegraph signals, tone 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 the two frequencies transmitted. By means of a plug P and a jack J the telegraph transmitter may be connected to, or disconnected from, the radio transmitter RT at will, so that the radio transmitter may be used for other purposes such as the transmission of radio telephony when desired.

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 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 the receiving filter RF_1 to an amplifier A_1 , the output of which is coupled through a transformer T_1 to a marking detector D_1 which rectifies the received tone so that it may be used to operate a receiving or other relay. 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 spacing detector D_2 similar to the marking detector D_1 .

Three polar type relays of identical construction are associated with the receiving channels. One of these polar relays is the

receiving relay RR which includes a spacing winding sw connected in the plate circuit of the spacing detector, and a marking winding mw connected in circuit with the plate of the marking detector. Two additional windings are also provided, the winding vw being operated by the vibrating circuit to be described later, and the winding sw' serving to hold the armature of the relay in marking position under the control of the loop switching relay LSR when no tone is present, as will be more fully described later.

The second of the three polar relays is the bias switching relay BSR which is identical in construction with the receiving relay RR, and has its windings connected in the same manner as the receiving winding, the spacing winding sw being connected to the plate of the spacing detector, and winding mw being connected to the plate of the marking detector.

The third relay LSR which will be herein referred to as the loop switching relay, is also identical in construction with the two relays just described, but its windings are connected in the circuit in a different manner so that it operates somewhat differently. The winding w of this relay (which corresponds to the winding sw of the receiving relay RR) is connected at one terminal to the junction point of the plate circuits of the spacing and marking detectors, the other terminal of the winding being connected to the plate battery so that the plate current is supplied through the winding w . This winding is therefore energized whenever tone is being received in either receiving channel. The second main winding sc of the relay LSR (which corresponds to the winding mw of the receiving relay RR) is short-circuited and is used as a slightly sluggish winding to make the relay of false operation of its armature in case there should be a short no current interval during the change from marking to spacing. The small winding bw (which corresponds to the winding sw' of the receiving relay RR) is connected through the resistance to a 24 volt battery so that it operates as a biasing winding to hold the armature of the relay on its right hand contact at such times as no current is flowing through the operating winding w . The other small winding iw (which corresponds to the winding vw of the receiving relay RR) is idle, and is not used.

When the telegraph transmitter of Fig. 1 is not connected to the radio transmitter RT no tone will be received in either of the receiving channels. In this idle condition of the circuit the armatures of the three polar relays will rest upon their right hand contacts as shown. The armature of the receiving relay RR controls the connection of positive or negative battery to the loop circuit, and also connects positive or negative battery

to the vibrating circuit which includes the coils L_1 and L_2 , the condensers C , and the resistances r_1 and r_2 . The armature of the bias switching relay BSR controls the connection of negative 130 volt battery to the grids of the spacing detector and the marking detector, respectively. The connection of this biasing potential to either detector biases its grid so far negative that no reception can take place. The armature of the relay LSR controls through slow release relays S_1 and S_2 the circuit of the auxiliary windings sw' of the receiving relay RR and the bias switching relay BSR, so that when no tone is being received in either channel the armatures of said relays will be held against their right hand contacts. This is necessary because when the telegraph transmitter is disconnected from the radio transmitter RT at the sending station, neither marking nor spacing tone will be received. The windings sw' come into play at this time to maintain the loop and the biasing circuits in marking condition.

The operation is as follows: Assuming that the plug P is not connected to the jack J at the transmitter, and hence, no tones are received at the receiver, no plate current will flow in either detector D_1 or D_2 , for normally both tubes are biased so that no current flows in the absence of received tone on the grid. Consequently, no current will flow in the winding sw of the loop switching relay LSR. The current flowing from the 24 volt battery, through bias winding bw of relay LSR, therefore holds the armature against its right hand contact to energize the slow release relay S_1 . Relay S_1 in turn holds open the circuit of the slow release relay S_2 . The armature of the latter therefor closes a circuit over its back contact through the windings sw' of the relays RR and BSR, in series. As no current is flowing through either the spacing or marking windings of these relays, the current through the sw' windings causes the armatures to be maintained against their right hand contacts. The armature of the relay RR therefore applies negative current to the loop circuit, thereby simulating the condition which exists when a marking signal is received. The armature of the relay BSR, on the other hand, connects negative bias battery to the grid of the spacing detector D_2 to disable it. The channel including the marking detector is, however, in condition to receive a marking tone.

If now, the telegraph transmitter should be connected to the radio transmitter RT by inserting the plug P in the jack J, and the operator leaves the sending key K in its closed or marking condition, the armature of the sending relay SR will rest upon its marking contact m and a marking tone f_m will be transmitted. The radio receiver RR will respond to reproduce at the receiving station a mark-

ing tone f_m which is transmitted to the marking detector D_1 .

A rectified plate current now flows in the plate circuit of the marking detector D_1 through the mw windings of the bias switching relay BSR and the receiving relay RR, and also through the winding w of the loop switching relay LSR. The current through the mw windings of relays BSR and RR is in such direction as to tend to hold their armatures against their right contacts. The current through the operating winding w of the relay LSR energizes said winding to overcome the pull of the biasing winding bw , and the armature of the relay is shifted to its idle left hand contact, thereby opening the circuit of the slow release relay S_1 . Slow release relay S_1 in turn closes the circuit of slow release relay S_2 which then opens the circuit of the windings sw' of the receiving relay RR and the bias switching relay BSR. The slow release relays S_1 and S_2 are so timed that they will not cause the opening or closing of the circuit of the windings sw' until the armature of the loop switching relay LSR has remained continuously on one of its contacts for a time of the order of a third or a half second. Consequently, during the rapid transmission of successive marking and spacing signals in sending a telegraph message, the circuit of the windings sw' of the receiving and bias switching relays will remain continuously open.

Upon the opening of the circuit of the windings sw' of relays BSR and RR, the mw windings of said relays are effective to maintain the armatures of said relays upon their right hand contacts, so long as the marking tone continues, thereby maintaining positive marking battery upon the loop and maintaining biasing battery upon the spacing detector D_2 . The biasing battery applied to the loop circuit over the right hand contact of the receiving relay RR also energizes the vibrating circuit to charge the condensers C , in series with the inductance L_2 and also causing current to flow through resistances r_2 and r_1 , through the vibrating windings vw of the relays RR and BSR, and thence through the inductance L_1 to ground. The current thus flowing through the vibrating windings and the relays RR and BSR, tends to shift their armatures away from the back contacts upon which they are resting, but the armatures are still held against said contacts, however, by the greater pull due to the rectified space current flowing through the marking windings mw .

If now, the operator at the sending station opens the key K to send spacing signals, the sending relay SR shifts its armature to the spacing contact s in Fig. 1, thereby short-circuiting the oscillator O_1 and causing a marking tone of frequency f_s to be sent out from the oscillator O_2 . At the receiving station the radio receiver RR reproduces a

spacing tone corresponding to f_s which is transmitted through the filter RF_2 , and amplifier A_2 , to the spacing detector D_2 . This tone is without effect upon the spacing detector D_2 until the 130 volt biasing potential applied to the grid of the tube over the right hand contact of the bias switching relay BSR is removed. As soon, however, as the oscillator O_1 is short-circuited at the sending station, in the manner described, the marking tone f_m ceases at the receiving station, and space current no longer flows from the marking detector through the marking windings mw of the bias switching relay BSR and the receiving relay RR. This enables the vibrating windings vw to come into play and shift the armatures of said relays to their left hand contacts as soon as the marking tone ceases.

Positive spacing battery is now connected to the loop circuit by the armature of the receiving relay RR, and the negative biasing battery is shifted by means of the bias switching relay BSR from the grid of the spacing detector to the grid of the marking detector, thereby disabling the latter and permitting the former to transmit. The received spacing tone is now rectified by the spacing detector and space current flows through the sw windings of the bias switching relay BSR and the receiving relay RR, and also through the operating winding w of the loop switching relay LSR. The plate current through the sw windings tends to hold the armatures of the bias switching relay BSR and the receiving relay RR against their left hand or spacing contacts to which they had been previously shifted by the vibrating windings. The vibrating circuit is now charged, however, by positive current over the left hand contact of the receiving relay RR and this current causes the vibrating windings vw to tend to shift the armatures back to their right hand or marking contacts. This action is, however, prevented by the plate current through the sw windings. Should there be a momentary interruption of current through the winding mw of the loop switching relay LSR between the time that the marking tone ceased and the spacing tone began to be transmitted to the plate circuit of the detector D_2 the short-circuited winding sc of the relay LSR will prevent any fluttering of the armature of said relay, which would still be held against its left hand or open contact.

If, in turn, the spacing tone is interrupted and the marking tone is again transmitted, the current through the spacing windings will be interrupted and the current in the vibrating circuit causes the vibrating windings to shift the armatures of the relays BSR and RR back again to their marking contacts.

It will be noted that the vibrating circuit

is connected to the vibrating windings vw of both the bias switching relay BSR and the receiving relay RR, and that it is the current in the vibrating circuit which furnishes the motive power to shift the armatures of said relays from one contact to the other upon the cessation of the tone previously received. As the incoming tone changes from marking to spacing, or vice versa, the plate current in both detectors will be zero, during which interval the vibrating circuit controls the operation of shifting the armatures of the receiving and bias switching relays. As the armatures of these relays are moved to the opposite contact, the bias on the idle detector grid is returned to normal and a high bias is applied to the other detector. The tone in the former idle channel then takes control of the receiving and bias switching relay armatures to hold them on the opposite contacts against further action of the vibrating circuit until the tones are again changed. The actual shifting of the armatures is, however, caused by the vibrating windings. The frequency of the vibrating circuit should be adjusted so that it is only slightly higher than the frequency at which the marking and spacing signals succeed each other. If it is adjusted too high, the relay armatures may be moved from their contacts before the incoming tone has built up sufficient rectified current in the detector to take control of the relay.

It will be obvious that the general principles herein disclosed may be embodied in many 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 including two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, and means responsive to the frequency received in either path for exercising a control over the other path, and means rendering said control circuit independent of change in the amplitude of the received current.

2. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver including two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a vacuum tube in each path, and means responsive to the frequency received in either path for applying a biasing potential to the tube in the other path, and means to render said biasing potential independent of changes in the amplitude of the received current.

3. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver including two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a relay responsive to the current received in either path, and means controlled by said relay for fully blocking either path when current is being received in the other path.

4. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver including two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a polar relay having a winding in each path responsive to the current received in that path, said relay having an armature which rests upon one contact to completely disable one of said paths when a current is being received in the other path, and means operating upon the cessation of said current to shift the armature to another contact to render the disabled path operable to receive its current and to disable the previously operable path.

5. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver including two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a relay responsive to the current received in either path, means controlled by said relay for fully blocking either path when current is being received in the other path, a receiving relay responsive to the current received in one path to produce a marking condition and responsive to the current received in the other path to produce a spacing condition, and a third relay operating in response to continued cessation of the received current in both paths to maintain the circuit in one of said conditions.

6. In a transmission system having means for transmitting one frequency for marking and another frequency for spacing signals, a receiver including two paths, means for selecting the marking frequency into one path, means for selecting the spacing frequency into the other path, a polar relay having a winding in each path responsive to the current received in that path, said relay having an armature which rests upon one contact to completely disable one of said paths when a current is being received in the other path, means operating upon the cessation of said current to shift the armature to another contact to render the disabled path operable to receive its current and to disable the previously operable path, a local circuit, a second polar relay having a winding in each path and responsive to the current

received in one path to produce a marking condition in said local circuit and responsive to the current received in the other path to produce a spacing condition in said local circuit, and a third relay having a winding in both paths and operating in response to the continued cessation of the received current in both paths to maintain one of said conditions in said local circuit.

In testimony whereof, I have signed my name to this specification this 6th day of October, 1931.

THOMAS A. McCANN.

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