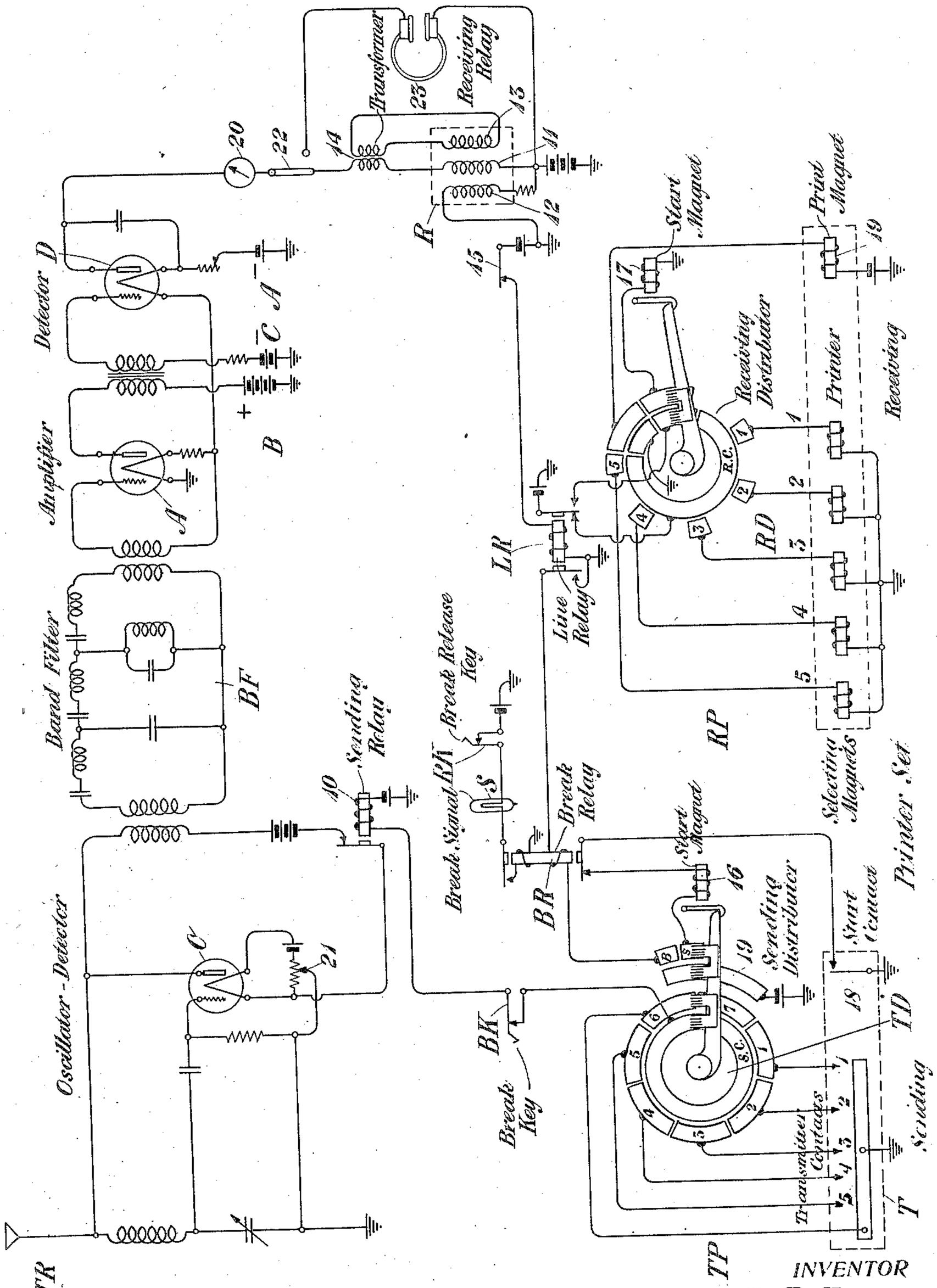
May 5, 1925. 1,536,130

D. B. PERRY

OPERATION OF PRINTING APPARATUS BY RADIO

Filed March 29, 1924



INVENTOR

D. B. Perry

BY

ATTORNEY

Patented May 5, 1925. 1,536,130

UNITED STATES PATENT OFFICE.

DONALD B. PERRY, OF YONKERS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

OPERATION OF PRINTING APPARATUS BY RADIO.

Application filed March 29, 1924. Serial No. 702,877.

To all whom it may concern:

Be it known that I, DONALD B. PERRY, residing at Yonkers, in the county of Westchester and State of New York, have invented certain Improvements in Operation of Printing Apparatus by Radio, of which the following is a specification.

This invention relates to radio signaling and more particularly to the transmission of printing telegraph messages by means of radio.

Printer intercommunication by radio on the half-duplex basis presents certain difficulties, particularly in the matter of breaking by a receiving operator to obtain control of the circuit for sending. In ordinary radio telegraph service, except where special provision is made for duplex operation, it is necessary for a station that is receiving to wait until the sending operator stops and listens before it may send. This method, if applied to printer service, will result in unsatisfactory service and no break feature.

It is one of the purposes of the present invention to connect a combination radio transmitter and receiver to a printer circuit in such a manner as to permit of an instantaneous break. This result may be accomplished by arranging two intercommunicating stations so that normally each station will send out a different wave length. At the sending station the wave length transmitted will have impressed thereon code combinations set up by the transmitting apparatus of a printing telegraph set. At both the transmitting and receiving stations a beat frequency may be obtained corresponding to the difference between the two radiated wave lengths, and upon this beat frequency the code combinations will be superposed. At each station the beat frequency will be selected and the code combinations will be detected therefrom to operate the receiving printer.

In a system such as above outlined, the receiving station will be radiating a continuous wave. By merely interrupting the continuous wave emitted from the receiving station the receiving operator may break the circuit, for the beat frequency will no longer be present and consequently the code combination sent out from the transmitting station will not be impressed upon the final detector at either the transmitting or receiving station. The sending operator will no longer receive his own copy and the printer circuit may be arranged in a well known manner so that under these conditions a break relay will be operated to stop the transmitter and give an audible or visual signal.

Further details and object of the invention will be clear from the following description when read in connection with the accompanying drawing, the figure of which illustrates a preferred embodiment of the invention.

Referring to the drawing, TR designates a radio antenna with which is associated a circuit of the vacuum tube O, arranged to generate and transmit from the antenna oscillations of a wave length differing from those radiated from a distant station by a definite beat frequency. The circuit of the vacuum tube O is controlled by the sending relay 10, which is associated with the transmitting printer TP, the circuit being normally closed when the transmitter TP is not actuated. Code combinations set up by the transmitter TP cause the sending relay 10 to successively interrupt the plate circuit of the vacuum tube O to impress the code combinations upon the wave length transmitted.

The vacuum tube oscillator O also functions as a detector to detect the beat note due to interaction of the wave length radiated from a distant station and the wave length radiated from the station under consideration. When code combinations are impressed upon either one of the wave lengths the beat frequency detected by the vacuum tube O will be interrupted in accordance with the code combination. A band filter BF, of a well known type, is associated with the plate circuit of the vacuum tube O to select the beat note carrying the code combination and impress it upon a suitable vacuum tube amplifier A. A vacuum tube detector D, of a well known type, is associated with the output circuit of the amplifier and functions to detect from the beat note the code combination which is impressed upon one or the other of the radio frequencies, depending upon whether the station illustrated is transmitting or whether the distant station is transmitting.

A receiving relay R is provided, said receiving relay having three windings. One

of the windings 11 is included in the plate circuit of the detector D. The biasing winding 12 is connected in circuit with the source of plate current through a suitable resistance and is magnetically opposed to the operating winding 11. The third winding 13 is a so-called "kick" winding, which is inductively associated with the plate circuit of the detector D through a transformer 14, thereby producing more positive action of the relay. For the best operation of the relay, the current flow through the biasing winding 12 should be about one-half of the current flowing through the operating winding 11 when the beat note is being received. The tube is so adjusted by means of its C battery that when no beat note is impressed upon the detector D no current will flow through the winding 11 and the winding 12 will become effective to shift the armature 15 so that the circuit of the line relay LR is held open. When the beat note is impressed upon the detector D, however, sufficient plate current will flow through the winding 11 to shift the armature 15 in the opposite direction and close the circuit of the line relay LR.

The transmitting printer apparatus TP comprises the usual start-stop distributor TD, controlled by a start magnet 16, so that it will be released to complete one revolution each time the contacts of the transmitter T are actuated. The receiving printer apparatus RP also comprises a distributor RD of the start-stop type, which is released by a starting magnet 17 in response to the starting impulse preceding each code combination. The circuits of suitable selecting magnets 1 to 5 inclusive are controlled as the distributor rotates by means of the line relay LR. The transmitting and receiving printing apparatus are so arranged as to operate with a code combination consisting of seven impulses, an initial starting impulse, five impulses corresponding to the usual five impulses of the Baudot code, and a final stopping impulse.

A break relay BR is provided under the joint control of the line relay LR and a special break segment B of the transmitting distributor TD. Under normal conditions, the circuit of the break relay will be open at the left-hand contact of the line relay LR as the brush of the distributor TD passes over the break segment B. When the beat note is not present, as is the case when the break signal is transmitted by means of the break key BK of the other station, the circuit of the break relay BR will be closed by the line relay LR as the brush of the transmitting distributor TD passes over the break segment B. The break relay operates to light a lamp S and to hold open the circuit of the start magnet 16 to prevent further operation of the transmitting distributor.

Further details of the invention will now be clear from the description of the operation, which is as follows: When the transmitting printer TP is not actuated, the circuit of the sending relay 10 is closed over the break key BK, inner ring of the distributor TD, segment 6 of the outer ring of the distributor, and over the bus-bar of the transmitter T to ground. The sending relay 10 accordingly holds the plate circuit of the vacuum tube O closed so that oscillations are emitted by the antenna TR and radiated to the distant station. If the distant station is not signaling it will similarly transmit a different wave length to the station illustrated, this wave length being received by the antenna TR and impressed upon the vacuum tube O. The two wave lengths beat with each other to produce a beat frequency in the plate circuit which will be selected by the band filter BF, amplified by the amplifier A and impressed upon the detector D to cause a steady plate current to flow in the output circuit of the detector D and through the operating winding 11 of the receiving relay R. This causes the armature 15 of the receiving relay to hold the circuit of the line relay LR closed.

Let us now assume that signals are to be transmitted by the station illustrated. The transmitter contacts of the transmitter T will be actuated so that certain of the contacts 1 to 5 inclusive will make contact with the bus-bar, depending upon the code combination to be transmitted. At the same time, the start contact 18 will be closed to complete a circuit from ground, over the lower back contact of the break relay BR, through the winding of the start magnet 16, over the start segment S of the distributor TD, over the brush of the distributor and thence to battery over the segment 19. The start magnet trips the brush arm, which commences to rotate in a clockwise direction. As soon as the brush passes from segment 6 to segment 7 of the distributor TD, the circuit previously described from the sending relay 10 is interrupted and the start impulse is transmitted. This impulse opens the plate circuit of the vacuum tube O so that the beat note normally transmitted through the band filter BF is interrupted. The wave length normally radiated by the antenna TR is also interrupted so that at the distant station only the wave length normally radiated at the distant station will appear in the circuit of the oscillator at said distant station. Consequently, the beat note will not appear in the plate circuit of the oscillator at that station and will accordingly not be transmitted through the band filter corresponding to BF.

Returning to the station illustrated, the interruption of the beat note causes the plate current normally flowing in the output circuit of the detector D to be interrupted with the result that the biasing winding 12 shifts the armature 15 of the receiving relay R and opens the circuit of the line relay LR. A circuit is therefore completed from battery, over the back right-hand contact of relay LR, over a segment of the inner ring of the receiving distributor RD, over the brush arm of the distributor, and a segment of the outer ring of the distributor RD and through the winding of the start magnet 17 to ground. The start magnet accordingly trips the brush arm of the receiving distributor RD so that the brush arm begins to rotate in a clockwise direction. A similar action of the receiving apparatus takes place at the distant station.

As the brush arm of the transmitting distributor TD continues to rotate, it passes over the segments 1 to 5 inclusive of the outer ring of the distributor and thereby transmits either open or closed circuit impulses to the sending relay 10, depending upon the selective position of the contacts of the transmitter T. As the brush arm passes over a grounded transmitting segment the relay 10 will close the plate circuit of the oscillator O so that the normal wave length of the station will be radiated and a beat note will appear in the plate circuit due to the interaction of the radiated wave length and the received wave length. A similar beat frequency will, of course, be produced in the plate circuit of the oscillator tube at the distant receiving station. At both stations the beat frequency will be passed through the filter BF, amplified by the amplifier A and impressed upon the detector D to produce a direct current component through the operating winding 11 of the receiving relay R. This causes the contact 15 to close the circuit of the line relay LR.

As the brush arm of the transmitting distributor TD passes over an ungrounded transmitting segment, the circuit of the sending relay 10 will be open and the ensuing circuit operation will be the same as that described in connection with the transmission of the starting impulse. In short, each time the sending relay 10 transmits a closed circuit impulse the receiving relay LR at the local station and the corresponding relay at the distant station receive a closed circuit impulse. Likewise, each time the sending relay 10 transmits an open circuit impulse the circuit of the line relay LR at the local station and the circuit of the similar relay at the distant station will be open.

As the brush arm of the receiving distributor RD rotates it passes over the successive segments 1 to 5 inclusive of its outer ring coincident with the receiving of an open or closed circuit impulse through the line relay LR. If a closed circuit impulse is received a circuit will be completed over the left-hand front contact of the line relay and over the corresponding segment in the outer ring of the receiving distributor RD to one of the selecting magnets 1 to 5 inclusive. If an open circuit impulse is received by the line relay the circuit of the corresponding selecting magnet will not be completed. A similar operation takes place at the receiving printer of the distant station.

As the brush arm of the transmitting distributor TD passes onto the sixth segment of the outer ring a closed circuit condition is established for the sending relay 10 and the final step impulse is transmitted. The line relay LR accordingly receives a closed circuit impulse, as does the similar line relay at the distant station. Consequently, as the brush arm of the receiving distributor RD returns to its initial position the circuit of the start magnet 17 will be held open at the right-hand contact of the line relay LR until the start impulse of the succeeding code combination is transmitted. The brush arm accordingly is brought to rest by coaction with the latch of the start magnet. Just before the brush arm passes to its initial position it closes a circuit from the grounded segment of the inner ring of the receiving distributor and over the corresponding segment in the outer ring, through the print magnet 19, which causes a character to be printed, determined by the combination of selecting magnets actuated during the selecting operation, as is well understood in the art. The operation of the receiving printer at the distant receiving station will be similar to that just described.

Let us now assume that the operator at the distant receiving station desires to break in. The distant operator will then open the key corresponding to BK at that station, thereby holding open the circuit of the sending relay corresponding to 10 at that station. This will continuously interrupt the plate circuit of the oscillator corresponding to O at the distant receiving station, with the result that the wave length normally radiated from the distant station will no longer be received in the circuit of the oscillator O at the station illustrated. The beat note will therefore no longer be transmitted through the band filter BF and no closed circuit impulses will pass through the operating winding 11 of the receiving relay R. Consequently, the armature 15 of the receiving relay R will hold open the circuit of the line relay LR as long as the break key BK is held open at the distant receiving station. As the brush arm of the transmitting distributor TD passes over the sixth segment

of the outer ring of the distributor and returns to its normal position the closed circuit impulse transmitted to the sending relay 10 will be ineffective to transmit a closed circuit impulse to the line relay LR by reason of the absence of the beat note. As a consequence, a circuit will be completed from ground, over the left-hand back contact of the line relay LR, through the lower winding of the break relay BR, over the break segment B, brush and segment 19 of the distributor TD to battery. A momentary circuit is thus closed through the lower winding of the break relay as the brush arm passes over the break segment B so that the break relay BR is energized. A circuit is completed by the break relay through its locking winding over its upper front contact in series with the break signal S. At its lower armature the break relay BR holds open the circuit of the start magnet 16 and when the brush arm 19 comes to rest the brush arm can no longer be released in response to the closing of the start contact 18 as the sender T is further operated.

Upon observing the signal lamp S the operator at the station illustrated (which, as described, was sending) will open the release key RK, thereby unlocking the break relay BR. The operator also ceases to transmit by means of the transmitter T as soon as the break signal is observed, and as the circuit is now in its normal position the operator at the distant station may begin to transmit signals in the opposite direction. The transmission of signals from the distant station after the breaking operation will be obvious without further description as the circuit at the distant station is identical in all respects with that illustrated.

To aid in properly tuning the variable condenser in the circuit of the antenna TR, an ammeter 20 is shown connected in circuit with the operating winding of the receiving relay R. A change in the adjustment of the tuning condenser will vary the frequency of the beat note, assuming that the distant station is emitting a constant frequency. The maximum ammeter reading will indicate the beat note best transmitted through the band filter and the optimum setting of the variable condenser.

The system may be expanded to give intercommunication between more than two stations. In this case, each station will normally have assigned to it a "stand-by" wave length which it emits when not signaling. The stand-by wave length for each station will, of course, be different. When any particular station desires to signal another station the operator will adjust the antenna capacity to tune the output of the oscillator O to a frequency near that emitted by the desired station, thereby producing a beat note, which will be passed through the filter BF. The amplitude of the wave radiated should be reduced while tuning in in order to prevent interference in case the desired station is in communication with some other station. For this purpose, the grid connection of the oscillator may be varied, by means of the adjustable resistance 21, to increase the negative potential in the grid until the amplitude of the oscillations radiated is so small as not to cause interference with the distant station. The operator, while tuning, will throw the switch 22 to substitute a telephone receiver 23 for the receiving relay R. This is done for the reason that the operator will determine whether or not the desired station is signaling by receiving the signals transmitted from the distant intercommunicating stations and these signals will be so weak, because of the reduced amplitude of the frequency emitted by the station which is tuning in, that they will not operate the receiving relay. They may be readily heard in the receiver 23, however, so that the operator will know that the desired station is busy.

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 radio signaling system, a plurality of intercommunicating stations, each station emitting waves of a different frequency, means at each station for producing a beat frequency from the two waves, means at each station for superposing telegraph signals on the wave emitted by that station whereby similar signals are superposed upon the beat frequency produced at each station, means whereby the wave which is emitted from the station which is receiving may be interrupted when the receiving operator desires to break in, thereby causing the beat frequency to cease, and means at the station which is sending responsive to the interruption of the beat frequency to operate a break signal at said station.

2. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means at each station to produce a beat frequency between the wave emitted and the wave received, means at each station to vary the wave emitted from that station in accordance with signal impulses, thereby producing a corresponding variation in the beat frequency produced at each station, means to detect signals from the beat frequency at each station, and means at the station which is receiving signals for interrupting the wave emitted from that station when it is desired to break in, thereby interrupting the beat frequency at each sta-

tion, and means at the station which is sending responsive to the interruption of the beat frequency to actuate a signal to indicate the break.

3. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means at each station to produce a beat frequency by the interaction of the wave emitted with the wave received, an automatic signal transmitter at each station, means controlled by said automatic signal transmitter to impress corresponding signal variations upon the wave emitted from that station, thereby producing similar signal variations upon the beat frequency at each station, means to detect the transmitted signals produced by the automatic signal transmitter from the beat frequency at each station, means at the station which is receiving for interrupting the wave emitted therefrom when it is desired to break, thereby interrupting the beat frequency at both stations, and means responsive to the interruption of the beat frequency at the sending station to stop said automatic signal transmitter.

4. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means at each station to produce a beat frequency by the interaction of the wave emitted with the wave received, an automatic signal transmitter at each station, means controlled by said automatic signal transmitter to impress corresponding signal variations upon the wave emitted from that station, thereby producing similar signal variations upon the beat frequency at each station, means to detect the transmitted signals produced by the automatic signal transmitter from the beat frequency at each station, means at the station which is receiving for interrupting the wave emitted therefrom when it is desired to break, thereby interrupting the beat frequency at both stations, and means responsive to the interruption of the beat frequency at the sending station to stop said automatic signal transmitter and actuate a signal to indicate the break.

5. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means to produce a beat frequency at each station by the interaction of the wave emitted with the wave received thereat, a printing telegraph transmitter at each station, means controlled by said transmitter at a station which is signaling for impressing code impulses upon the wave emitted from that station, thereby causing similar code impulses to be superposed upon the beat frequencies produced at both stations, means to detect said code impulses from the beat frequency at each station, a receiving printer at each station responsive to the detected code impulses to print a character corresponding to each code combination, means at the station which is receiving for interrupting the wave emitted from that station when it is desired to transmit a break signal, thereby interrupting the beat frequency at both stations, and means responsive to the interruption of the beat frequency at the station which is sending to stop said printing telegraph transmitter.

6. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means to produce a beat frequency at each station by the interaction of the wave emitted with the wave received thereat, a printing telegraph transmitter at each station, means controlled by said transmitter at a station which is signaling for impressing code impulses upon the wave emitted from that station, thereby causing similar code impulses to be superposed upon the beat frequency produced at each station, means to detect said code impulses from the beat frequency at each station, a receiving printer at each station responsive to the detected code impulses to print a character corresponding to each code combination, means at the station which is receiving for interrupting the wave emitted from that station when it is desired to transmit a break signal, thereby interrupting the beat frequency at both stations, and means responsive to the interruption of the beat frequency at the station which is sending to stop said printing telegraph transmitter and actuate a signal to indicate the break.

7. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means at each station to produce a beat frequency by the interaction of the wave emitted from that station with the wave being received thereat, a printing telegraph transmitter at each station for setting up code combinations, a distributor associated with each transmitter for successively impressing the impulses of the code combination upon the wave emitted from the corresponding station, thereby causing similar code combinations to be impressed upon the beat frequency produced at both stations, means at each station for detecting from the beat frequency the code combinations impressed thereon, a receiving printer at each station, a distributor associated with each receiving printer for impressing upon the elements of the printer the impulses of the detected code combination, means at the station which is receiving signals for interrupting the wave emitted therefrom when it is desired to transmit a break signal, thereby interrupting the beat frequency at both stations, and means responsive to the interrup-

tion of the beat frequency at the station which is sending to stop the distributor associated with the transmitter thereat.

8. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave having a different frequency, means at each station to produce a beat frequency by the interaction of the wave emitted from that station with the wave being received thereat, a printing telegraph transmitter at each station for setting up code combinations, a distributor associated with each transmitter for successively impressing the impulses of the code combination upon the wave emitted from the corresponding station, thereby causing similar code combinations to be impressed upon the beat frequency produced at each station, means at each station for detecting from the beat frequency the code combination upon the wave emitted from the corresponding station, thereby causing similar code combinations to be impressed upon the beat frequency produced at both stations, means at each station for detecting from the beat frequency the code combinations impressed thereon, a receiving printer at each station, a distributor associated with each receiving printer for impressing upon the elements of the printer the impulses of the detected code combination, means at the station which is receiving signals for interrupting the wave emitted therefrom when it is desired to transmit a break signal, thereby interrupting the beat frequency at each station, and means responsive to the interruption of the beat frequency at the station which is sending to stop the distributor associated with the transmitter thereat and to actuate a special signal to indicate the break.

9. In a radio signaling system, a plurality of intercommunicating stations, each station emitting a wave having a different frequency, means to produce a beat frequency at each station by the interaction of the wave emitted with the wave received thereat, a printing telegraph transmitter at each station, means controlled at said transmitter at the station which is signaling for impressing code impulses upon the wave emitted from that station, thereby causing similar code impulses to be superposed on the beat frequencies produced at both stations, means to detect said code impulses from the beat frequency at each station, a receiving printer at each station responsive to the detected code impulses to print a character corresponding to each code combination, means at the station which is receiving for interrupting the wave emitted from that station when it is desired to transmit a break signal, thereby interrupting the beat frequency at both stations so that the receiving printer at the transmitting station will not record the signals transmitted.

10. In a radio signaling system, a plurality of intercommunicating stations, each emitting a wave of a different frequency, means at each station to produce a beat frequency between the wave emitted and the wave received, means at each station to vary the wave emitted from that station in accordance with said signaling impulses, thereby producing a corresponding variation in the beat frequency produced at each station, means to select the beat frequency at each station, means to detect signals from the beat frequency at each station, and means at the station which is receiving signals for interrupting the wave emitted from that station when it is desired to break in, thereby interrupting the beat frequency at each station and preventing further operation of the detecting means.

In testimony whereof, I have signed my name to this specification this 26th day of March, 1924.

DONALD B. PERRY.