

June 7, 1949.

W. D. HAILES  
SINGLE CHANNEL RADIO COMMUNICATION SYSTEM  
AFFORDING BREAK-IN OPERATION

2,472,585

Filed April 4, 1945

2 Sheets-Sheet 1

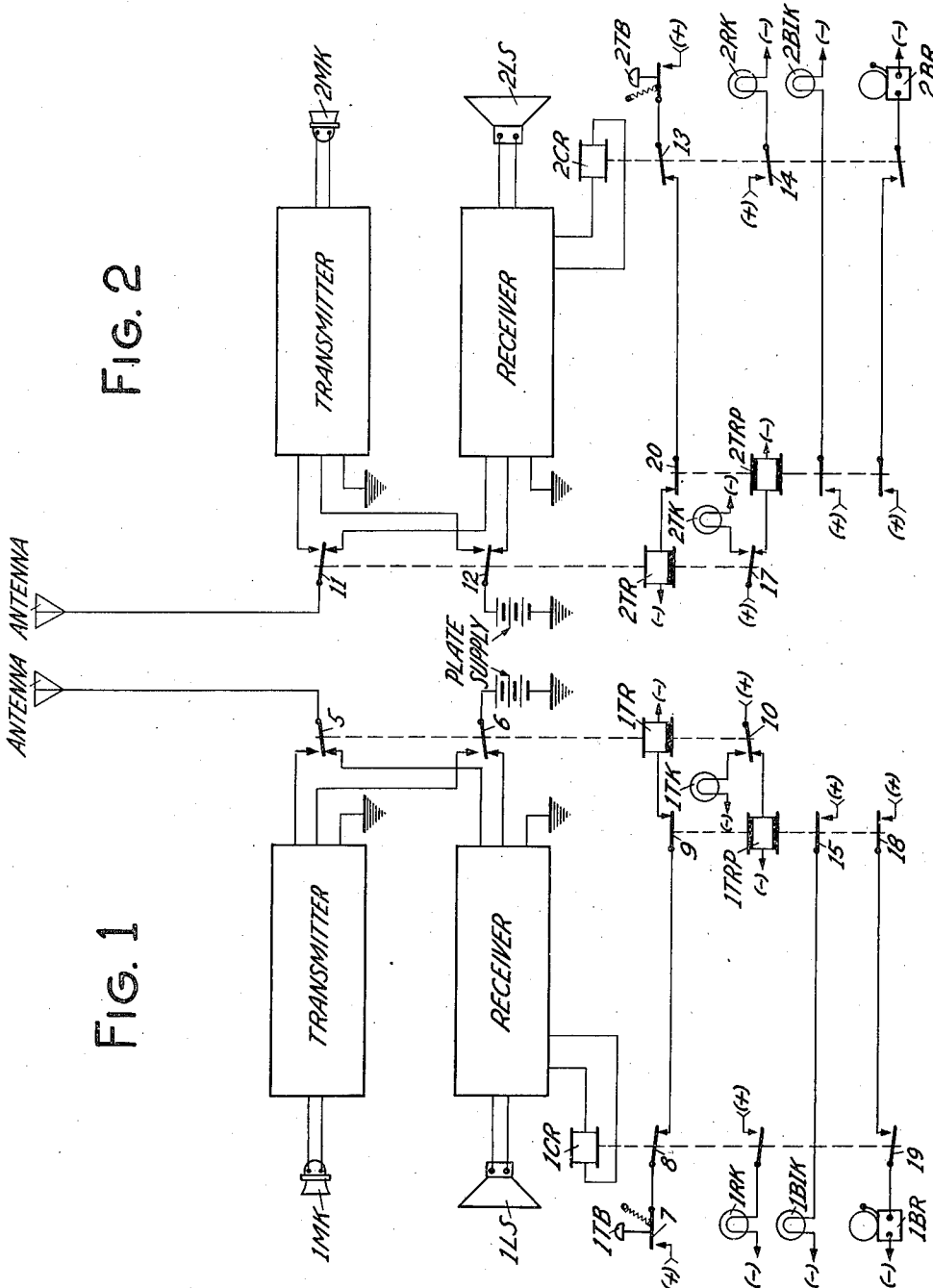


FIG. 1

FIG. 2

W. D. Hailes,  
Neil H. Preston,  
his Attorney

June 7, 1949.

W. D. HAILES  
SINGLE CHANNEL RADIO COMMUNICATION SYSTEM  
AFFORDING BREAK-IN OPERATION

2,472,585

Filed April 4, 1945

2 Sheets-Sheet 2

FIG. 4

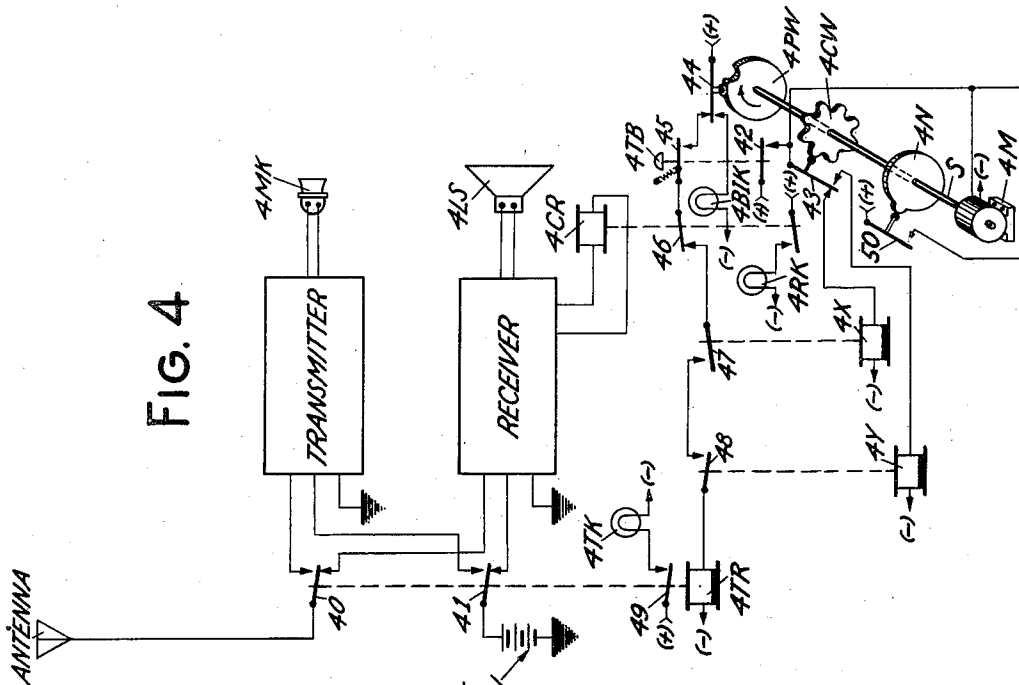
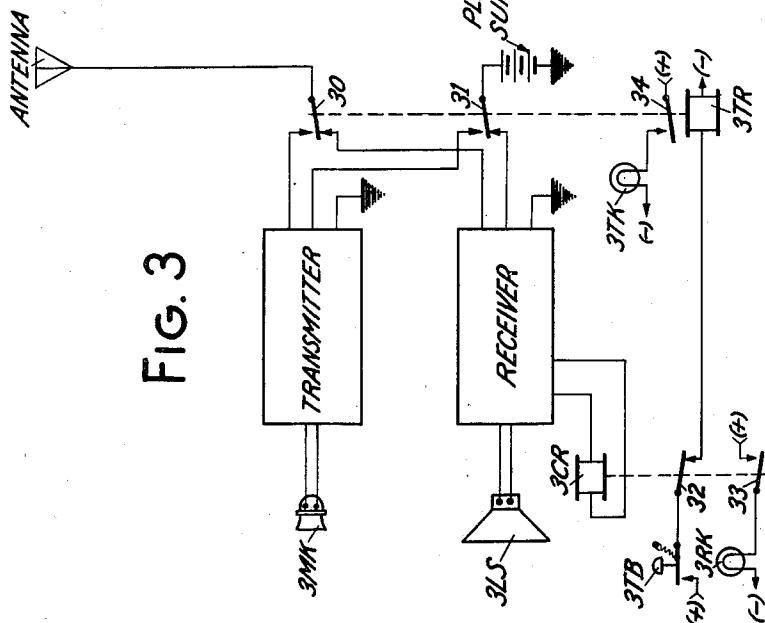


FIG. 3



W. D. Hailes, Inventor  
Neil W. Preston, Attorney

## UNITED STATES PATENT OFFICE

2,472,585

SINGLE CHANNEL RADIO COMMUNICATION  
SYSTEM AFFORDING BREAK-IN OPERA-  
TIONWilliam D. Hailes, Brighton, N. Y., assignor to  
General Railway Signal Company, Rochester,  
N. Y.

Application April 4, 1945, Serial No. 586,599

17 Claims. (Cl. 250—6)

1

This invention relates to communication systems for transmitting intelligence verbally or otherwise by modulation of a carrier frequency, and more particularly pertains to such a communication system adapted for use in connection with communication with and between mobile units.

The type of communication more particularly contemplated in accordance with this invention is one in which messages or instructions are communicated to mobile units on railroads or the like, by modulation of a carrier frequency in accordance with a voice message or other intelligence, which carrier frequency may be employed in connection with space radiation as in the usual radio system, or by induction into line wires, track rails, or like conductors along the path of movement of the mobile unit in a manner commonly referred to as a wired radio or carrier current system. It is further contemplated that it will ordinarily be desirable to provide for two-way communication between the mobile unit and another station located along the wayside over the same carrier frequency channel.

For example, when a radio-telephone system is employed for issuing instructions to a pusher engine moving cars over the hump in a classification yard on a railroad, it is essential for the safety of the locomotive that the way-side operator can instruct the engineer immediately as to any trouble or occasion that the train should be stopped; but in a two-way system of communication on the same channel, it is desirable to provide interlocking means which allows transmission from one station to lock out the other station until the first station has stopped its communication. This is because the first station cannot receive until it stops transmitting anyway, so that it is desirable to prevent the second station operator from falsely thinking that he has successfully transmitted his message. With such an organization, it is apparent that the way-side operator might have important instructions to transmit but would be withheld from doing it by reason of the monopolization of the communication channel by an operator on a pusher engine, or by reason of the fact that several engine stations might gain access to the channel successively in such a way as to prevent the transmission of the important instructions from the wayside.

The present invention is not only adapted to provide the characteristic features of the present invention in connection with communication between a mobile unit and a wayside station; but

2

the invention may also be applied to communication between two or more mobile units, or between one end of a mobile unit and the other end such as between the rear end of a train and its locomotive. In this last case, it may be desirable to provide that each station be allotted only a particular period of time for communication so that the stations may transmit alternately without either being superior to the other.

In view of these considerations, it is proposed to provide a communication system in which two-way communication is provided on the same frequency channel with an interlock to allow one station to transmit and hold out the other station for only a limited time and then give a similar opportunity for transmission from any other station. In other words, each station is given a limited time in which to transmit and then a turn to transmit is provided another station. In this way, communication of messages between any two stations must be effected alternately at spaced intervals if both stations are endeavoring to transmit at the same time. However, if only one station is endeavoring to transmit, it can do so as long as desired but such transmission will be periodically interrupted by short intervals or break-in periods during which another station can gain control of the carrier frequency channel if desired.

In some cases it may be desirable to render one station superior to another, so that it will not only be able to break into the communication channel, but may also be superior in the sense that it can continue its transmission as long as desired. Thus, it is proposed to provide a two-way communication system in which the automatic break-in feature is applied to only one of two stations leaving a main or primary station independent of an automatic break-in and allow it to continue to transmit as long as desired and withhold the automatic characteristics of the other station or stations.

Another feature of the present invention is that one or more stations may be provided with what is called a program sequencing device so that a station may transmit long messages or short messages with suitable intervals between the messages in accordance with a predetermined program or allotment of times for transmission and reception. In this way, it is believed that communication between a plurality of different stations can be most readily adapted to the practical problems of communication in connection with moving vehicles which at all times must be assured of reception of their instructions; be-

cause the stations may be provided with what may be termed automatic break-in facilities so that such stations cannot monopolize the communication channel to the exclusion of other stations. These break-in features may be organized to give any desired station a superiority with respect to the others or all stations may be given equal rank.

Other objects, purposes and characteristic features of the invention will be in part apparent and in part pointed out as the description of the embodiment of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which two specific forms of the present invention has been illustrated in a simplified and diagrammatic manner, and in which—

Figs. 1 and 2 represent two typical stations providing two-way communication on the same frequency channel with the automatic break-in features of the present invention applied thereto; and

Figs. 3 and 4 illustrate another form of automatic break-in features applied to a single station as typical of a plurality of stations and associated with the superior station of Fig. 3.

In order to simplify the illustrations in the drawings and facilitate the explanation of the fundamental characteristics of the invention, various parts and circuits have been shown diagrammatically in accordance with conventional symbols. Arrows with associated symbols (+) and (—) are employed to indicate connections of the circuits to the various relays to the opposite terminals of a suitable source of current for the energization of such relays, and the source of current may be of any suitable characteristic for the purpose intended. The various contact fingers of the relays are shown conventionally as being in a lower or inclined position when the coil or winding of the associated relay is deenergized, and in a raised or horizontal position when the relay is energized; the contacts belonging to any given relay are shown connected to its coil by dotted lines and these contacts may be either below or above the illustration of the relay winding. The front and back contacts operated by the different relays are shown conventionally as arrowheads, which contacts are ordinarily of the type which have their contacts biased downwardly by gravity or by spring action.

The specific embodiment of the invention chosen for the purpose of illustration and description comprises a radio telephone communication system of the usual and well-known type, employing either amplitude or frequency modulation and operating on a suitable carrier frequency allocated for the particular use; and in connection with the control of traffic it is contemplated that such frequency channel will be in the megacycle band. Since the structure and operation of radio telephone transmitters and receivers are well known in the art, no attempt has been made to illustrate the various component parts such as oscillators, intermediate frequency amplifiers, power amplifiers, modulating and demodulating circuits, emphasis and pre-emphasis organizations for frequency modulation or any such other components as may be required for the particular radio characteristics desired, it being assumed that any conventional form of circuit arrangement may be used and this has been represented by rectangles designated "Transmitter" and "Receiver" for each of the stations illustrated.

*Automatic break-in features for a plurality of*

stations.—With reference to Figs. 1 and 2, each figure represents a separate station which may be located on the wayside or at some locations on a mobile unit, and each station is provided with a suitable "Transmitter" and "Receiver." With more particular reference to Fig. 1 as typical, it will be seen that the "Receiver" of the station is normally connected to its associated antenna through back contact 5 of relay 1TR; but when the relay 1TR is picked up, it connects the antenna to the "Transmitter." Similarly back contact 6 of relay 1TR normally connects the plate supply (or "B" battery) to the "Receiver" to render it active for the reception of carrier frequency signals, but when the relay 1TR is picked up front contact 6 connects the plate supply to the "Transmitter." Both the "Transmitter" and "Receiver" are provided with their respective ground connections, and are assumed to be of any suitable type either of the amplitude or frequency modulation types, but adapted to receive and transmit the carrier frequencies suitably modulated. The receiver is provided with the usual loudspeaker 1LS; while the transmitter is provided with the usual microphone 1MK.

Associated with the "Receiver" is a carrier-responsive relay 1CR. This relay is normally deenergized even though the associated receiver is rendered active by reason of the connection of its plate supply, but whenever a carrier frequency signal of the proper frequency is received, the carrier-responsive relay 1CR is picked up irrespective of whether or not such carrier frequency signal is modulated with a voice message, or other form of intelligence. This carrier-responsive relay 1CR may be energized in any suitable way, one way may be as shown in the prior application of Knapp and O'Brien Ser. No. 565,206 filed November 27, 1944, now Patent No. 2,435,010, dated January 27, 1948.

The transmit relay 1TR has associated therewith a repeater relay 1TRP which is slow in picking up and considerably slower in its releasing characteristics. The transmit relay 1TR is preferably quick in picking up but somewhat slow in releasing. These pick-up and release characteristics will be considered more in detail herein-after.

The station of Fig. 1 includes a push-to-talk button 1TB and associated indicator lamps to indicate when the station is receiving, when a break-in period is to occur and when the operator may talk, which indicators are designated 1RK, 1BIK and 1TK respectively. A single stroke warning bell 1BR is provided to give a warning whenever the station is to receive a message during a break-in period and thus advise the operator that he may expect to receive a message rather than to prepare to continue his transmission at the end of the break-in period.

Both of the stations shown in Figs. 1 and 2 are similar, and the various devices have been given the same letter reference characters, with preceding numerals characteristic of its figure numbers; and in this connection it should be understood that there may be more than two stations associated in a group but for convenience in the description only the two stations shown will be taken into consideration.

Whenever the operator of the station in Fig. 1 desires to transmit a message, he actuates the push-to-talk button 1TB and thereby closes a circuit from (+) through back contact 7 of button 1TB, back contact 8 of relay 1CR, front contact 9 of relay 1TRP, windings of relay 1TR to (—).

5

This energization of the relay 1TR causes its contacts to immediately pick up and render the station in condition for transmission of a voice message.

It will be noted that the repeater relay 1TRP is normally energized through back contact 10 of the transmit relay 1TR, and is deenergized so that it will release after a time whenever the relay 1TR is picked up. As soon as the relay 1TR picks up, it closes front contact 10 and energizes the talk lamp 1TK. This advises the operator that the system is ready for transmission and that he may talk into the microphone 1MK to transmit his message.

The transmission of a message from the station of Fig. 1 is effected by the radiation of the modulated carrier frequency from the associated antenna, and is received by one or more associated stations such as shown in Fig. 2 for example. This is because the "Receiver" of Fig. 2 is normally rendered active by reason of the closed condition of back contacts 11 and 12 of its transmit relay 2TR. The reception of the carrier signal at the station of Fig. 2 results in the energization of its carrier-responsive relay 2CR which opens back contact 13 to prevent the energization of the transmit relay 2TR in the event that the operator at the station of Fig. 2 should actuate the push-to-talk button 2TB during the reception of such message. The closure of front contact 14 of relay 2CR causes the energization of the receiving lamp 2RK advising the operator at the station of Fig. 2 that a message is to be received.

It will be seen that as soon as the transmit relay 1TR of Fig. 1 is energized, the relay 1TRP begins its release period which may be of any desired length in accordance with what might be considered the average length of message transmission, and this may range from five to fifteen seconds or even as long as five minutes if the application of the invention to actual conditions should indicate such a time to be desirable. In this connection, it may be that special timing apparatus may be required in place of a simple slow-acting relay, such as indicated by 1TRP, in order to obtain the desired length of message transmission period for the relatively long times (see Fig. 4). In some circumstances, it may be desirable to provide a very short break-in period and accompanied by a similarly short message period with a complete message being broken up into parts and transmitted during successive message periods.

In any event, after a time (as selected in accordance with the particular application involved) the relay 1TRP releases and opens its front contact 9 effecting the deenergization of the relay 1TR. The closure of back contact 15 causes the illumination of the break-in warning lamp 1BIK advising the operator that the break-in period is about to take place, and a moment or two later the actual break-in occurs when the transmit relay 1TR drops away. The warning period may be considered as the duration of the release period of the transmit relay 1TR, and the length of this period may be suitably selected to allow completion of a word, or the like.

If the operator at the station of Fig. 2 desires to transmit a message in response to the message being received, he can actuate his push-to-talk button 2TB even during the reception of a message so that as soon as the break-in period occurs at the transmitting station, his station immediately effects the energization of the relay 2TR which in turn causes the radiation of a car-

6

rier signal to effect the picking up of the carrier-responsive relay 1CR. This opens back contact 8 to prevent the operator of the station at Fig. 1 from gaining control to again transmit until after the allotted time for the station of Fig. 2. The picking up of the carrier-responsive relay 1CR of course energizes the receiving indicator 1RK through front contact 16 advising the operator to prepare to receive. The fact that the transmit relay 2TR is effective at the station of Fig. 2 is indicated by the illumination of the talk lamp 2TK which is energized through front contact 17 of relay 2TR.

Since the relay 1TRP is deenergized to effect the break-in, its back contact 18 is closed when the carrier-responsive relay 1CR picks up in response to the reception of a carrier signal from the other station. This causes a single stroke warning by the bell 1BR that a message is to be received, and this occurs at the same instant that the receiving lamp 1RK is energized.

After a suitable interval of time, the release of the relay 2TRP occurs and opens front contact 20 to cause the break-in on the transmission from the station of Fig. 2, the same as described in connection with the station of Fig. 1. Thus, if the station of Fig. 1 still desires to transmit, then the push-to-talk button 1TB is being held down and the relay 1TRP is of course picked up shortly after the relay 1TR has released, so that the transmit relay 1TR can be energized during the break-in period provided upon the release of the relay 2TR which of course deenergizes the relay 1CR.

From the above description, it will be seen that the two stations are provided with alternate talk and receiving periods. The talk period of a station extends throughout the time that the relay 1TR for example is picked up i. e. as soon as it is picked up and until its contacts actually release; while its receiving period is determined by the length of the talk period measured at the particular station which is transmitting to it, as for example the station of Fig. 2.

If the station of Fig. 1 for example is transmitting and desires to transmit a prolonged message which will require more than one talk period, then it transmits until the end of one talk period which is when the relay 1TR releases; but the release of relay 1TR closes back contact 10 and energizes the relay 1TRP to again effect the energization of the relay 1TR if the push-to-talk button 1TB is still actuated. In other words, as the operator holds down the push-to-talk button 1TB, there is a succession of talk periods spaced by what may be termed break-in periods and these break-in periods are for the duration of the picking up of the relay 1TRP. This pick-up period may be relatively short such as in the order of one to five seconds for example, and if the period is not more than one or two seconds, the break-in will not be objectionable for the transmission of a prolonged message since these periods if properly spaced will be useful for the operator to take a breath, so to speak, so as to continue his message. However, one or two seconds will be adequate for a signal to be initiated from some other station, such as the station in Fig. 2, to effect a break-in upon the message being transmitted from the station of Fig. 1.

In a communication system employing stations as disclosed in Figs. 1 and 2, there are various combinations in which such stations may be used. For example, it may be that two stations such as shown in Figs. 1 and 2 are located on the

front and rear ends of a train, or one station may be located along the wayside and another station located on the train. Irrespective of the particular location of such two stations, it will be apparent that each station may break in upon the transmission from the other station so that each may transmit alternately with such periods of transmission not exceeding a predetermined time. In such a case, both stations may be said to have the same rank.

On the other hand, there may be a larger number of stations involved, and in such a case no one station can transmit longer than the period measured by its break-in apparatus; and any one of the other stations of the communication system may break-in upon the station then transmitting at the next break-in period.

A further organization of a communication system may involve one or more stations as shown in Fig. 1 for example with another station such as shown in Fig. 3 where no automatic break-in apparatus is employed. The elimination of the automatic break-in apparatus causes the station of Fig. 3 to act as a superior station, that is, it can initiate transmission of a carrier signal during a break-in period, and once its carrier signal is effective to pick up the carrier-responsive relays at the other stations, it can continue transmission so long as the operator depresses the transmit button 3TB. As shown, the station of Fig. 3 includes a back contact 32 of the carrier-responsive relay 3CR, so that the carrier signal can be initiated from this station of Fig. 3 only during a break-in period when another station is transmitting, it of course being understood that if no station is transmitting this station of Fig. 3 can transmit at any time. However, it can be seen that once this station initiates transmission that it will continue until the button 3TB is released. In some cases, it may be desirable to omit the back contact 32 and permit the station of Fig. 3 to initiate transmission at any time instead of waiting for a break-in period. In brief, one combination of stations contemplated by the present invention may be considered as including stations 1, 2 and 3 used in combination with the station of Fig. 3 acting as the superior communication station.

With more specific reference to Fig. 3, the "Receiver" is normally rendered active by reason of back contacts 30 and 31 of the transmit relay 3TR, but when the push-to-talk button 3TB is operated, the transmit relay 3TR is energized through back contact 32 of the carrier-responsive relay 3CR so that the "Transmitter" is then rendered effective for control by the usual microphone 3MK. The "Receiver" is provided with the usual loudspeaker 3LS. Whenever the carrier-responsive relay 3CR, which is responsive to the reception of a carrier signal by its associated receiver irrespective of the presence or absence of modulations, is picked up, it closes front contact 33 to cause the energization of the receiving lamp 3RK. Also, when the transmit relay 3TR is picked up and closes front contact 34, the talk lamp 3TK is energized.

As mentioned above in connection with Figs. 1 and 2, it may be desirable to provide longer message periods than can be conveniently measured by a single slow-acting relay or several slow-acting relays in cascade, and in such cases a motor-driven timing organization may be used. As typical of such an organization, Fig. 4 has been shown representing a station as having what may be termed a program wheel which is motor-

driven to provide the automatic break-in periods at definite time-spaced periods. It is to be understood that this modified form of Fig. 4 may be used in place of stations such as shown in Figs. 1 and 2, and that such a station as shown in Fig. 4 may be used with another like station; with a plurality of like stations; with a superior station as shown in Fig. 3; or with a plurality of like stations and a superior station as shown in Fig. 3. These various combinations of station arrangements are of course dependent upon the particular situation with which the present invention is to be used.

With reference to Fig. 4, the "Receiver" is normally active by reason of the closed condition of back contacts 40 and 41; but the "Transmitter" is rendered active whenever the transmit relay 4TR is picked up. The "Receiver" is provided with the usual loudspeaker 4LS; while the "Transmitter" is provided with the usual microphone 4MK. This station is provided with a push-to-talk button 4TB, a carrier-responsive relay 4CR, which is responsive to the reception of a carrier signal irrespective of the presence or absence of modulations, a transmit lamp 4TK, a receiving lamp 4RK, and a program sequencing organization.

The program sequencing organization includes a motor 4M of any suitable type which is set into operation whenever the push-to-talk button 4TB is actuated and back contact 42 is closed. When the motor 4M operates, it actuates either directly or through suitable gearing, a control wheel 4CW which is notched and has an associated contact 43 which is intermittently operated to its opposite positions as the control wheel 4CW is rotated by the motor 4M. The contact 42 as well as supplying energy to the motor, supplies energy to the contact 43 which in one position energizes the slow-release relay 4X and in its other position energizes the slow-release relay 4Y. When the control wheel 4CW is being rotated by the motor 4M, the application of intermittent pulses to these relays 4X and 4Y by the operation of the contact 43, causes these relays 4X and 4Y to be picked up and to maintain their contacts closed even though they are only intermittently energized. When wheel 4CW is not in operation, contact 43 remains in one position or the other.

The operation of the program organization by the motor 4M causes the program wheel 4PW to be operated. This is a cam having the desired shape to cause the desired operation of the contact 44. Assuming that the push-to-talk button 4TB has been operated, then the beginning of the rotation of the program organization has the result of the energization of the motor 4M, causes the picking up of the relays 4X and 4Y so that energy can flow from (+) through contact 44 in its raised position, operated contact 45 of the button 4TB, back contact 46 of relay 4CR, front contact 47 of relay 4X, front contact 48 of relay 4Y, windings of relay 4TR, to (-). This energizes the transmit relay 4TR and renders the transmitter active. This is indicated because the closure of front contact 49 energizes the talk lamp 4TK advising the operator that he may transmit his message through the microphone 4MK. As the program organization operates, the program wheel 4PW operates to a position in which a break-in period is to occur and the contact 44 assumes a lower position and energizes the indicator lamp 4BIK advising the operator of the station at Fig. 4 that a break-in period is to occur which will exist as soon as the relay 4TR re-

leases and will be indicated by the extinguishing of the talk lamp 4TK. In other words, the warning period is measured by the release period of the relay 4TR.

If another station such as the superior station of Fig. 3 desires to transmit a message, it does so in the usual way by the actuation of the push-to-talk button 3TB which transmits a carrier frequency signal that is received by the station of Fig. 4 energizing the carrier-responsive relay 4CR. Such energization of the carrier-responsive relay 4CR prevents the transmission from the station of Fig. 4 even though the operator maintains the button 4TB actuated. So long as the carrier-responsive relay 4CR is maintained picked up by reason of the reception from the superior station of Fig. 3, the station of Fig. 4 cannot transmit, but the cessation of a message from the station of Fig. 3 will permit the station of Fig. 4 to again transmit.

Whenever the operator actuates the button 4TB and initiates operation of the motor 4M, the normalizing cam 4N moves out of its normal position and allows the back contact 50 to be closed. Thus, it can be seen that the motor 4M receives energy to cause at least one complete revolution of the program wheel 4PW for each operation of button 4TB; and, when its normal position has been reached, the contact 50 will be re-opened and the motor 4M will cease its operation. In other words, if the operator merely transmits a short message, the release of the button 4TB will allow the transmit relay 4TR to release and render the transmitter inactive, but the motor 4M continues operation and restores the program wheel 4PW to its normal position in readiness for another operation. In this way, the transmission or message period upon each initiation of the program wheel is assured of being the desired length or duration.

In the event that no other station has a message to transmit and thus does not break in upon the station of Fig. 4 during a break-in period, the operator of the station of Fig. 4 may continue to transmit messages in successive message periods. To do this, he merely maintains the push-to-talk button 4TB actuated and thus continues to keep the transmitter effective except during the break-in periods provided when the program wheel 4PW opens front contact 44 and allows the transmit relay 4TR to release.

It should be noted that the depression in the program wheel 4PW includes a sufficient amount of its periphery so that the front contact 44 will be opened long enough to allow the release of the relay 4TR for a break-in period. No effort has been made to show specific relationships between the speed of the motor 4M and the speed of the cam wheels 4PW, 4CW and 4M, it being understood that the relative speeds of operation can be suitably chosen in accordance with the time periods to be measured. If different time measuring is to be used at different times the gear ratio between the motor 4M and the shaft S driving the cam wheels can be suitably varied or changed.

It will be noted that the relays 4X and 4Y are not both energized unless the program wheels are actually operating by the motor 4M, that is, should the motor 4M fail to operate due to a broken circuit or the like, the program organization might stop in a particular position and energize either the relay 4X or the relay 4Y (assuming button 4TB to be depressed), but when thus stopped it could not energize both of these relays.

Thus, these relays provide a check that the program wheel organization is operative whenever button 4TB is actuated.

It will be noted that whenever the motor M is driving the shaft S, and back contact 50 is closed, it applies energy not only to the motor 4M but also to the heel of contact 43 so that the relays 4X and 4Y are intermittently energized so long as the timing organization is in operation even though the button 4TB is not actuated. This provides that front contacts 47 and 48 will be closed under such circumstances so that should the push button 4TB be immediately re-operated, the immediate energization of relay 4TR would take place and the operator could immediately transmit. It is, of course, understood that under such circumstances, the operator must be ready for a break-in period to be indicated by the lamp 4BIK at any time, since under such circumstances the program wheel 4PW has not started from its initial position. However, it is thought that once an operator becomes accustomed to the use of a system organized in accordance with the present invention, he will be prepared to stop his message immediately upon the indication of a break-in period, and to continue it as soon as the break-in period is over assuming of course that some other station has not taken control of the communication channel.

Having thus shown a communication system with several forms of automatic break-in means, it is desired to be understood that these forms are selected merely to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and, it is to be further understood that various modifications, adaptations and alterations may be applied to the specific forms shown to meet the particular requirements of practice without in any manner departing from the spirit or scope of the present invention except as limited by the appended claims.

What I claim is:

1. In a communication system for transmitting messages by the modulation of a carrier frequency, a station having a receiver and a transmitter both being capable of operating on the same carrier frequency, circuit means at said station for normally rendering the associated receiver effective to receive carrier signals, but acting in response to manual control to render said transmitter active and said receiver inactive, and means set into operation by manual control of said circuit means for automatically acting to intermittently render said transmitter momentarily inactive at spaced intervals regardless of the continued manual control of said circuit means.
2. In a communication system for transmitting messages by the modulation of a carrier frequency between a plurality of stations each having a receiver and a transmitter, means at each station normally rendering the receiver active and the transmitter inactive, manually operable means at each station acting when operated to render the associated receiver inactive and the transmitter active, means at each station for intermittently rendering its associated manually operable means ineffective in spite of its operated condition to thereby intermittently render said receiver momentarily active independently of said manually operable means, and means at each station controlled by the associated receiver in response to the reception of a carrier signal for

11

rendering said manually operable means ineffective so long as such carrier signal is received, whereby any transmitting station can be interrupted by another station in case it has a more important message to transmit.

3. In a communication system for transmitting messages by the modulation of a carrier frequency between a plurality of stations, each having a receiver and a transmitter, relay means normally acting to render said receiver active for the reception of carrier signals, circuit means being manually controllable to energize said relay means to render said transmitter active and said receiver inactive, and a program device set into operation simultaneously with the energization of said relay means and operating to intermittently open said circuit means to render said transmitter ineffective and said receiver active regardless of the manual control of said circuit means.

4. In a communication system for transmitting messages by the modulation of a carrier frequency, a plurality of stations each having a receiver and a transmitter, a carrier-responsive relay at each station associated with the receiver at that station and responsive to the reception of a carrier frequency irrespective of its modulations, a transmitter relay at each station normally rendering its receiver effective to receive a carrier signal but acting when energized to render its associated transmitter effective to transmit a carrier signal, manually operable means at each station for energizing its associated transmitter relay only when the associated carrier-responsive relay is inactive, and control apparatus rendered effective by the manual actuation of said manually operable means for automatically deenergizing said transmitting relay after a time interval independently of the operated condition of said manually operable means, said control apparatus being automatically restored by the deenergization of said transmitter relay, whereby transmission from each station while the manually operable means is actuated is intermittently interrupted to permit some other station to break in.

5. In a communication system for transmitting and receiving messages by the modulation of a carrier frequency, a station having a receiver and a transmitter, a transmit relay at the station normally deenergized and acting to render the associated receiver active for the reception of carrier signals and the associated transmitter inactive but effective when energized for rendering said receiver inactive and said transmitter active, said transmit relay having slow-release characteristics, a normally energized timing device deenergized upon each energization of said transmit relay and effective a predetermined time thereafter to open a timing contact, a carrier-responsive relay associated with said receiver and energized upon the reception of a carrier signal independently of its modulation, a manually operable contact, an energizing circuit for said transmit relay including said timing contact, a back contact of said carrier responsive relay and said manually operable contact, an indicator lamp energized whenever said transmit relay is energized to indicate when said transmitter is rendered active for the transmission of a message, and another indicator energized whenever said timing device has measured said predetermined time to thereby warn the operator that the transmitter will be rendered ineffective

12

after a short period measured by the release of said slow-release transmit relay.

6. In a communication system for transmitting and receiving messages by the modulation of a carrier frequency, a station having a receiver and a transmitter, a transmit relay at the station normally deenergized and acting to render the associated receiver active for the reception of carrier signals and the associated transmitter inactive but effective when energized for rendering said receiver inactive and said transmitter active, a normally energized timing device deenergized upon each energization of said transmit relay and effective a predetermined time thereafter to open a timing contact, a carrier-responsive relay associated with said receiver and energized upon the reception of a carrier signal independently of its modulation, a manually operable contact, and an energizing circuit for said transmit relay including said timing contact, a back contact of said carrier responsive relay and said manually operable contact.

7. In a communication system for transmitting messages in both directions between different stations by the modulation of the same carrier frequency and each of said stations having a receiver and a transmitter, a transmit relay at each station normally rendering the associated receiver active for the reception of carrier signals and said transmitter inactive but acting when energized to render said receiver inactive and said transmitter active, a timing device set into operation each time said transmit relay is energized and having a timing contact opened after a predetermined time, a carrier-responsive relay associated with said receiver and energized whenever a carrier signal is received, a manually operable self-restoring push button, and a control circuit for said transmit relay including said timing contact, a back contact of said carrier responsive relay and a contact closed upon actuation of said push button.

8. In a communication system for transmitting messages in both directions between two stations by the modulation of the same carrier frequency, each station having a receiver and a transmitter, automatic break-in means at one station but not at the other station rendered effective by manual control for communication to the other station to cause that one station to be temporarily conditioned for receiving at spaced time intervals each long enough for transmission of a short message, a carrier-responsive relay at said one station which acts if energized upon the reception of a carrier signal to prevent the associated transmitter from being manually rendered active, and means at the other station normally rendering its associated receiver active but capable of at times manually rendering its transmitter active provided no message is being received from said other station, whereby said other station is superior to said one station because said other station can at intervals break in upon transmission from said one station but said one station cannot break in upon transmission from said other station.

9. In a communication system for transmitting messages in both directions between two stations by the modulation of the same carrier frequency each station having a receiver and a transmitter, means at each station normally rendering said receiver active and said transmitter inactive, manually operable means at each station for at times rendering the associated transmitter active for the transmission of voice mes-

sages, automatic break-in means at each station effective to momentarily render the associated transmitter inactive at recurring intervals during transmission from that station regardless of the operated condition of its associated manually operable means, and means at each station including a carrier-responsive relay associated with the receiver at that station for preventing the rendering active of the associated transmitter by its associated manually operable means whenever said receiver is receiving a carrier signal, whereby each station may interrupt the transmission from the other station during the break-in interval in the carrier signal of such other station, and whereby said stations are caused to transmit alternately in opposite directions if both stations are continuously conditioned to transmit.

10. In a communication system for transmitting messages by the modulation of a carrier frequency in both directions between different stations each of which has a receiver and a transmitter, a transmit relay acting while deenergized to render the associated receiver active and the associated transmitter inactive but effective when energized to render the associated receiver inactive and the associated transmitter active, a manually operable push-button of the self-restoring type, a motor driven timing device having a contact intermittently opened at spaced time intervals when said device is set into operation, a circuit for setting said timing device into operation whenever said push button is actuated, check contact means closed only while said timing device is in operation, and a control circuit for said transmit relay including said contact of said timing device, a contact closed when said push button is operated, and said check contact means, whereby said transmit relay can render said transmitter effective with brief intervals of rendering said receiver effective as measured by said timing device while said push button is actuated only if said timing device is in operation.

11. In a communication system for transmitting messages by the modulation of a carrier frequency in both directions between different stations each of which has a receiver and a transmitter, a transmit relay acting while deenergized to render the associated receiver active and the associated transmitter inactive but effective when energized to render the associated receiver inactive and the associated transmitter active, a manually operable push button, a motor driven timing device having a contact intermittently opened at spaced time intervals when set into operation, a circuit for setting said timing device into operation whenever said push button is actuated, and a control circuit for said transmit relay including said contact of said timing device and a contact closed when said push button is operated, whereby said transmit relay renders said transmitter effective except during spaced brief intervals of rendering said receiver effective as measured by said timing device while said push button is actuated.

12. In a communication system for transmitting messages by the modulation of a carrier frequency, a station having a receiver and a transmitter both being adapted to operate on the same carrier frequency channel, control means at said station for normally rendering the associated receiver effective for the reception of carrier signals, but capable of rendering the associated receiver ineffective to receive carrier signals and the associated transmitter effective to transmit

a carrier signal when such transmit control means is manually actuated, and timing means initiated by the manual actuation of said control means for allowing it to be effective to cause the transmission of a carrier signal by said transmitter for only a limited time following the manual actuation of said control means, whereby the carrier frequency signal channel cannot be monopolized by this station.

13. In a communication system for the transmission of messages by the modulation of the carrier frequency of an assigned frequency channel, two stations each having a receiver and a transmitter, control means at each station for normally rendering its receiver effective to receive carrier signals but manually operable to render said transmitter effective to transmit a carrier signal and at the same time render said receiver ineffective, means at each station responsive to the reception of a carrier signal by its receiver for rendering the associated control means unresponsive to manual actuation so long as a carrier signal is being received, and timing means at each station initiated by the manual actuation of said control means at that station for allowing such control means to be effective for only a limited time, whereby the control means is ineffective to cause transmission at a station which is receiving a carrier signal but whereby the station then transmitting can prevent such receiving station from being rendered effective to transmit for only a limited time.

14. In a communication system for transmitting messages by the modulation of a carrier frequency, a station having a receiver and a transmitter, means at said station for normally rendering the associated receiver effective to receive carrier signals, said control means acting when manually actuated to render the associated transmitter effective and the associated receiver ineffective, means at said station responsive to the reception of a carrier signal by its receiver for rendering the associated control means incapable of being manually actuated so long as such carrier signal persists, timing means initiated by the manual actuation of said control means for rendering said control means unresponsive to manual control at spaced intervals to render said receiver effective during such intervals, and an indicator controlled by said carrier responsive means to indicate when said control means is unresponsive to manual actuation.

15. In a communication system for transmitting messages by the modulation of a carrier frequency, a station having a receiver and a transmitter, control means at said station for normally rendering the associated receiver effective to receive carrier signals but acting when manually actuated to render said receiver ineffective and the associated transmitter effective for the transmission of a carrier signal that may be modulated with a message, timing means for periodically interrupting the transmission from said station for predetermined short intervals by acting upon said control means, said timing means also acting to render said receiver effective during such intervals, means at said station responsive to the reception of a carrier signal by its associated receiver for rendering said control means unresponsive to manual actuation so long as such carrier signal continues to be received, and an indicator means controlled by said timing means to give an advance warning of an interruption in the transmission with respect to each of said short intervals.

15

16. In a communication system for transmitting messages by the modulation of a carrier frequency of an assigned frequency channel, a station having a receiver and a transmitter, control means at said station normally acting to render the associated receiver effective to receive carrier signals, manually operable means for acting upon said control means to cause the associated receiver to be rendered ineffective to receive carrier signals and to cause said associated transmitter to be rendered effective to transmit a carrier signal that may be modulated for the transmission of a message, means at said station responsive to the reception of a carrier signal by said receiver for preventing said manually operable means from acting upon said control means so long as a carrier signal is being received irrespective of whether such signal is modulated or not, timing means initiated each time said transmitter is rendered effective to transmit a carrier signal for measuring a predetermined limited time in which said transmitter may be rendered effective by said control means, indication means for indicating whenever said control means renders said transmitter effective for the transmission of a carrier signal that may be modulated, another indicator for indicating whenever said carrier responsive means is effective, and a third indicator controlled by said timing means so as to be rendered effective to give an indication shortly before the elapse of said predetermined limited time.

17. In a communication system for transmitting messages by the modulation of a carrier frequency, two stations each having a receiver and a transmitter, a transmit relay at each station normally rendering its associated receiver effective to receive carrier signals but acting when energized to render its associated transmitter effective to transmit carrier signals and its asso-

16

ciated receiver ineffective, a carrier responsive relay at each station responsive to the reception of a carrier frequency by said receiver at that station regardless of any modulation of such carrier frequency, a timing means at each station, said timing means at a station being set into operation each time said transmit relay at that station is energized for repeatedly measuring a predetermined long time followed by a predetermined short time, and energizing circuit means at each station for said transmit relay at that station, said circuit means including a manually actuatable contact, a contact opened when said carrier responsive relay is actuated, and a contact opened by said timing means for said predetermined short time at spaced intervals of said predetermined long time, whereby transmission from either station is temporarily interrupted at spaced intervals, whereby either station can effectively break in upon the transmission of the other during any one of said short intervals as measured at such other station, and whereby said two stations are caused to alternately transmit when said manually actuatable contacts are steadily closed at both stations.

WILLIAM D. HAILES.

## REFERENCES CITED

The following references are of record in the file of this patent:

## UNITED STATES PATENTS

| Number     | Name             | Date           |
|------------|------------------|----------------|
| Re. 12,073 | Shoemaker        | Jan. 13, 1903  |
| 1,945,082  | Sandeman et al.  | Jan. 30, 1934  |
| 2,064,639  | Whitelock et al. | Dec. 15, 1936  |
| 2,115,914  | MacKay           | May 3, 1938    |
| 2,199,179  | Koch             | Apr. 30, 1940  |
| 2,407,846  | O'Brien          | Sept. 17, 1946 |