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Oct. 8, 1946. N. D. PRESTON 2,408,878

COMMUNICATION SYSTEM

Filed Feb. 28, 1945

FIG. 1

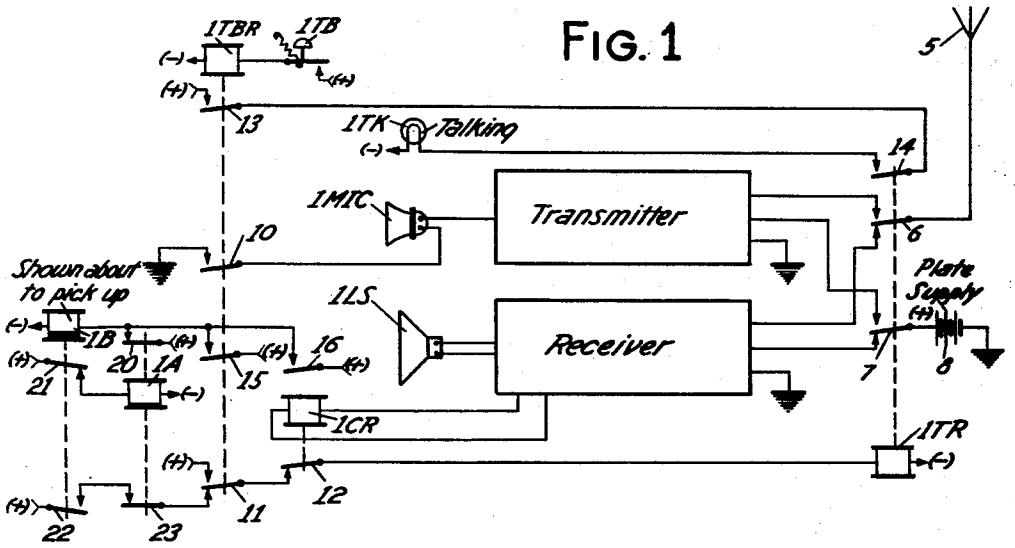


FIG. 2

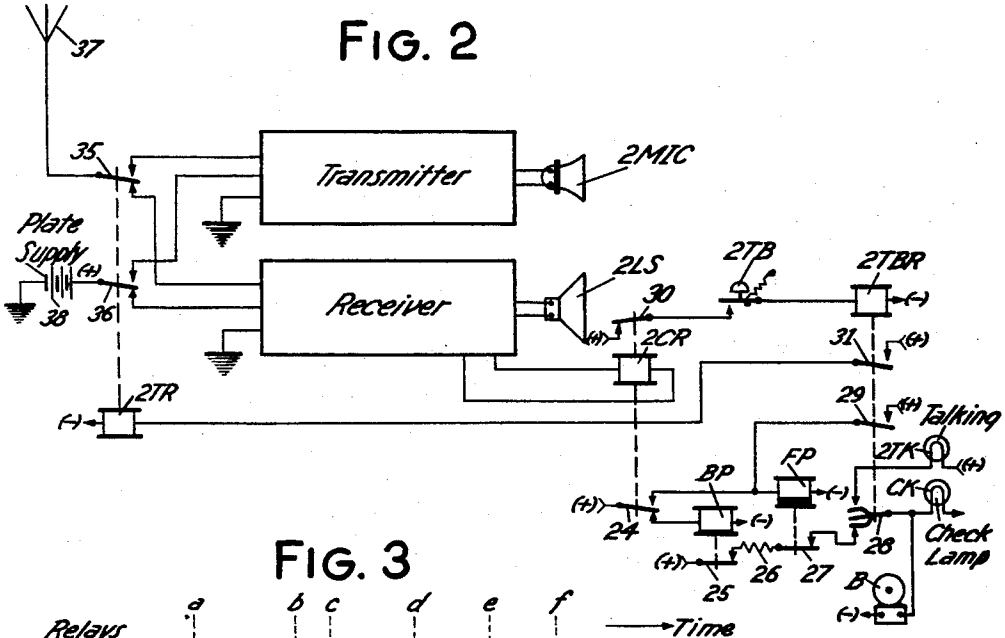
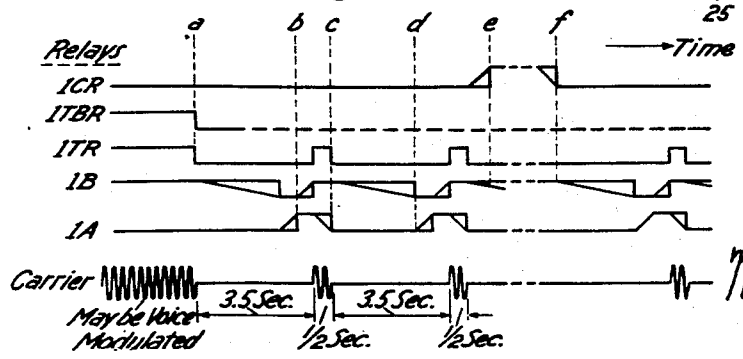


FIG. 3



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COMMUNICATION SYSTEM

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21 Claims. (Cl. 250—6)

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This invention relates to a system for checking the integrity of communication systems for transmitting intelligence, verbally or otherwise by modulation of a carrier frequency, so that an operator at a receiving station may determine if the communication system is in proper operating condition to bring to him a message, and may take the appropriate action in the event of failure of some part of the communication system.

In connection with communication systems used for regulating or governing the movement of traffic on railroads, airways and the like, where messages or instructions involving safety of operation are at times communicated to the operator of a movable vehicle, it is important, and in some cases essential for safety, that the locomotive engineer or operator of some other type of mobile unit should be assured that the communication system is in satisfactory operating condition to bring to him whenever necessary any message or instructions concerning the movement of his vehicle, so that in the event of some failure of some part of the communication system, he is promptly apprised of such fact and can govern his train or other mobile unit in the interests of safety as conditions may require. 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, and the engineer of such pusher engine is given instructions to move ahead, it is essential for safety that his locomotive engineer should be able to determine whenever any failure occurs in the communication system that will prevent him receiving instructions when to slow down or stop, so that in the case of such failure the engineer may bring the string of cars to a stop and avoid the confusion and hazards that might otherwise occur if an instruction to slow down or stop could not reach him on account of failure of the communication system. Similarly, when the locomotive engineer of a railroad train may receive messages over a communication system from the conductor or brakeman at the rear of his train, or from some operator along the wayside, and such messages may involve safety of train operation, it is important that the engineer should be able to determine if the communication system is in proper operating condition, so that he may take the appropriate action to safeguard his train as conditions may require, on the assumption that such failure of the communication may prevent him getting important information.

The type of communication system more particularly contemplated in accordance with this invention is one in which messages or instructions are communicated to power mobile units on railroads or the like, either verbally, by facsimile telegraph, or the like, by modulation of a carrier frequency in accordance with the voice message or other intelligence, and which involves either space radiation, as in the usual radio system, or induction into line wires, track rails, or like conductors along the path of movement of the mobile unit in the manner commonly referred to as a wired radio or a carrier current system. It is further contemplated that it will ordinarily be desirable to provide for two-way communication to and from the mobile unit or other vehicle and a distant primary or sending station on the same carrier frequency, and that the system for checking a carrier frequency communication system should be applicable to such a two-way system, as well as to a one-way system, even though in the interests of safety the checking feature may be limited to the communication with the operator of the mobile unit.

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Assuming a communication system of such a carrier frequency type for such use, the primary object of the present invention is to provide a checking indication on the mobile vehicle which is controlled reliably in a simple manner by the carrier frequency in such a way as to manifest promptly whenever the system is being used for communication purposes from a distant sending station, so that the operator of the vehicle may detect or determine if the communication system is operating properly by reason of the fact that he actually receives, or fails to receive, the message intended for him, this checking indication being also automatically rendered active in the event of failure of the system to transmit or receive a carrier frequency when not in use for communication purposes.

Generally speaking, and without attempting to define the exact nature and scope of the present invention, it is proposed to transmit continuously, under normal conditions and while the communication system is not in use for communication purposes, short pulses of carrier frequency without modulation at regularly spaced intervals, and to utilize such interrupted or coded carrier frequency to maintain a suitable indicating device, tending to assume an active condition and located on the vehicle, in an inactive condition, only so long as such intermittent carrier frequency pulses are being received. Such intermittent or coded character of the carrier frequency pulses is definitely distinctive from the

steady or sustained carrier frequency existing when the system is used for transmission of voice messages or the like by modulation of such carrier frequency; and consequently the indicating device on the vehicle assumes its active condition as soon as the communication system is put into use for transmission of messages to the operator of the vehicle, thereby enabling such operator to detect a failure of any part of the communication system by reason of the fact that he fails to receive a message when he should. The indicating device on the vehicle also automatically assumes its active condition in the event of some failure in the transmission or reception of the carrier frequency.

Considered more specifically in the terms of means preferably employed, it is proposed to provide in accordance with this invention suitable pulsing means at the primary or sending station for automatically rendering the transmitter at that station effectively at regular spaced intervals to send out relatively short pulses of unmodulated carrier frequency under normal conditions, and until the person at such sending station actuates a push-to-talk button or equivalent for the purpose of transmitting a message to a vehicle or secondary station and causes the transmitter to send out a steady carrier frequency to be modulated in accordance with the desired message, and also to provide suitable means on the vehicle responsive only to the intermittent pulses of carrier frequency for maintaining a checking indicator on the vehicle in its inactive condition.

Since the checking function is accomplished by the transmission of carrier pulses at intervals, the operator on the vehicle may break in between the checking pulses and establish communication on the same carrier frequency with the sending station, which includes suitable means in the form of a carrier frequency operated relay or the like for suppressing the impulsing operation of the transmitter at such sending station while a message is being received from the vehicle.

Also, since the checking indicator is rendered active by a steady or sustained carrier frequency, as distinctive from an intermittent or coded carrier frequency, the desired checking function may be carried out with respect to a plurality of vehicle and a plurality of primary or sending stations within range of each other by appropriately synchronizing the normal transmission of carrier pulses, so that the checking indicators of all vehicles are rendered active when any one of the primary or sending stations transmits a steady carrier in connection with the use of the system for communication purposes.

Other objects of the invention are to provide the desired checking feature with a minimum of apparatus and without the complication of tone generators, filters and the like; to render the checking indicator active or inactive promptly and at the proper time at the beginning and end of each period the system is used for communication purposes, so that the operation of the indicator may not be confusing or misleading; and to provide an audible signal in conjunction with a visual signal as a checking indicator, so as to afford an arrestive indication for the operator of the vehicle.

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

In describing the invention in detail, reference

will be made to the accompanying drawing, in which one specific embodiment of the invention has been illustrated in a simplified and diagrammatic manner, and in which—

Fig. 1 illustrates transmitting and receiving equipment and associated parts for a primary or sending station in a two-way communication system between such station and a receiving station, such as on a locomotive or other movable vehicle;

Fig. 2 illustrates the transmitting and receiving equipment on a vehicle or like secondary station in such a two-way communication system, together with the checking indicator and associated control means; and

Fig. 3 shows a graph or time chart illustrating for explanatory purposes the sequence and timing operation of certain relays for one specific organization of the system.

In order to simplify the illustration on the drawing and facilitate an explanation of the fundamental nature and character of the invention, various parts and circuits have been shown diagrammatically and in accordance with certain conventions. Arrows with associated symbols (+) and (—) are employed to indicate connections of the circuits for the various relays to the opposite terminals of a suitable source of current for the energization of such relays, assumed to be a direct current generator, battery, or the like, as for example, a 32-volt turbo generator for the locomotive equipment, and a storage battery for a primary or sending station in the caboose of a railroad train, or along the wayside. The various contact fingers of the relays are shown conventionally as being in a lowered 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 contact fingers belonging to a given relay being shown connected to its coil by dotted lines, and the stationary front and back contacts cooperating with the movable contact fingers of the relays being shown conventionally as arrows. These relays are of the usual type having their contact fingers biased downward by gravity or 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 space radiation type, employing either amplitude or frequency modulation and operating on a suitable carrier frequency allocated for the particular use, presumably in the megacycle band. Since the structure and operation of radio telephone transmitters and receivers of this type are well-known in the art, no attempt has been made to illustrate the oscillators, intermediate frequency amplifiers, power amplifiers, modulating and demodulating circuits, or other component elements, such parts and circuits being assumed to be of any suitable or conventional form and being represented by dotted rectangles designated "Transmitter" and "Receiver." Although the checking feature of this invention as shown is effective for communication one way to the movable vehicle, and may be employed in a one-way communication system, the particular embodiment of the invention illustrated relates to a two-way communication system, including a microphone and loud speaker at both the primary or sending station and the vehicle or secondary station.

Referring to Fig. 1 illustrating the equipment at the primary or sending station, the usual an-

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tenna 5 is normally connected to the receiver through a back contact 6 of a transmit relay 1TR, which also serves to connect through its back contact 7 a suitable source of plate voltage indicated as a battery 8 to the receiver. When the transmit relay 1TR is energized, the receiver is disconnected from the antenna 5 and the source of plate voltage 8, and the antenna 5 is connected to the transmitter through the front contact 6 of said transmit relay, and the source of plate voltage 8 is connected to the transmitter through the front contact 7 of said transmit relay.

In other words, while the transmit relay 1TR is deenergized, the receiver is effective to receive, and while this transmit relay 1TR is energized, the transmitter is rendered effective to send out a carrier frequency, the duration of this carrier frequency depending upon how long the transmit relay 1TR is kept energized. This particular arrangement illustrated for switching from the transmitter to the receiver, including the shift in plate supply energy, is merely typical of a suitable organization for this purpose, and may be accomplished in various other ways.

The receiver is provided with a relay 1CR, conveniently termed a carrier operated relay, which is suitably connected to the squelch circuit of the receiver, or otherwise controlled so as to be energized in response to the reception of carrier frequency with or without modulation. This carrier operated relay 1CR acts to perform certain lockout and synchronizing functions more conveniently considered later.

The equipment in Fig. 1 for the primary or sending station includes a push-to-talk spring return push button 1TB, or an equivalent foot switch or like device, which is arranged to energize a talking relay 1TBR by an obvious circuit readily traced on the drawing. The energization of this talking relay 1TBR closes a plurality of front contacts to perform various functions. The closure of the front contact 10 of the relay 1TBR connects the microphone 1MIC to ground, and renders it effective to modulate the carrier frequency being sent out by the transmitter, the microphone being normally disconnected so that it will not pick up extraneous sounds or noise and transmit these to the vehicle when pulses of carrier frequency are transmitted in connection with carrying out the checking function. In this connection, it has been assumed that the circuits of the radio transmitters and receivers will be grounded in accordance with the usual practice, and hence the circuit connections directly associated therewith are indicated as connected to ground, while the circuits for the relays and other parts of the system are shown as connected to (+) and (−) terminals of a suitable current source.

The closure of the front contact 11 of the relay 1TBR establishes an energizing circuit for the transmit relay 1TR which may be traced from (+), through front contact 11 of relay 1TBR, back contact 12 of carrier operated relay 1CR, relay 1TR, to (−). Since this energizing circuit just traced from the transmit relay 1TR includes the back contact 12 of the carrier operated relay 1CR, it can be seen that the actuation of the button 1TB and energization of the talking relay 1TBR is not effective to operate the transmit relay 1TR while a message is being received from the locomotive, thereby preventing accidental or careless manipulation of the push-to-talk button 1TB from curtailing or interrupting a message being received from the locomotive.

The energization of the talking relay 1TBR and the closure of its front contact 13, together with the energization of the transmit relay 1TR, establishes a circuit for lighting the "talking" lamp 1TK which may be traced from (+), through front contact 13 of relay 1TBR, front contact 14 of relay 1TR, lamp 1TK, to (−).

The energization of the talking relay 1TBR also closes a front contact 15, and similarly the energization of the carrier operated relay 1CR closes a front contact 16 to supply current over circuit connections readily traced on the drawing to energize a relay 1B of the pulsing means for synchronizing purposes later discussed.

The equipment shown in Fig. 1 for the primary or sending station also includes a pulsing means for intermittently energizing the transmit relay 1TR to send out regularly spaced pulses of carrier frequency; and in order that this pulsing means may be restored or reset to an initial condition and synchronized as necessary with other operations of the system, this pulsing means is preferably in the form of two slow acting relays 1A and 1B interconnected in such a way as to constitute a self-propelling interrupter or chopper for providing the desired duration and spacing of carrier frequency pulses. In the particular arrangement shown, the energization of one relay 1A energizes the other relay 1B, which upon its energization releases the first relay 1A, thereby in turn releasing the relay 1B, and so on, for a series of sequential energizations and deenergizations of these relays 1A and 1B.

The duration and spacing of the carrier frequency pulses employed for checking purposes in accordance with this invention may be varied as required, a sufficient duration of the carrier frequency pulse being required to produce the desired relay action, and the spacing between pulses being suitable to permit a break-in from the locomotive or other secondary station. For the purpose of explanation, it has been assumed that the duration of the carrier frequency pulses will be approximately one-half second, and the spacing or time interval between these impulses approximately 3.5 seconds.

Considering in more detail the operation and timing of the relays 1A and 1B constituting the pulsing means, these relays and circuits are illustrated in Fig. 1 in a transitory state where the energizing circuit for the relay 1B is closed through a front contact 20 of the other relay 1A, and the relay 1B is about to pick up or attract its armature and open its back contact 21 to break the energizing circuit readily traced on the drawing for the relay 1A, this condition being indicated at *b* in the time chart of Fig. 3. When relay 1B attracts its armature, it closes a front contact 22 to complete an energizing circuit for the transmit relay 1TR which may be traced from (+), through front contact 22 of relay 1B, front contact 23 of relay 1A, back contact 11 of relay 1TBR, back contact 12 of relay 1CR, and transmit relay 1TR to (−).

At the same time the relay 1B thus operates to energize the transmit relay 1TR, the back contact 21 of relay 1B is opened to deenergize relay 1A, which opens its front contact 23 after a short time corresponding with the duration of the carrier frequency pulse desired, say one-half second, thereby opening the circuit of the transmit relay 1TR to release this relay and terminate the carrier frequency pulse. With reference to the time

indicated in Fig. 3, it has been assumed that the transmit relay 1TR is very quick acting, in the order of .015 of a second, so that its operating time is negligible at the time scale indicated.

When the relay 1A releases to terminate the carrier frequency pulse, as indicated at *c* in the time chart of Fig. 3, its front contact **20** opens to break the energizing circuit for the relay 1B, which then starts to time. The relay 1B is made sufficiently slow releasing by use of copper slugs, rectifiers, or other well-known expedients, to maintain its armature in an attracted position for the desired spacing between the carrier frequency pulses, say 3.5 seconds. In this connection, it is evident that two or more relays operated sequentially in cascade may be used if desired to perform this timing function of the relay 1B. When the relay 1B ultimately releases, as indicated at *d* in Fig. 3, it opens at its front contact **22** the energizing circuit for the transmit relay 1TR at another point, and closes at its back contact **21** the energizing circuit for the relay 1A, which picks up again and starts the beginning of another similar cycle of operation by energizing the relay 1B. This cycle of energization and deenergization of the relays 1A and 1B is repeated over and over to provide the desired pulses of carrier frequency, the duration of such pulses being determined by the release time of the relay 1A, and the spacing between pulses by the release time of relay 1B.

Considering now the equipment shown in Fig. 2 for the locomotive or secondary station, this comprises a transmitter and a receiver, with associated microphone 2MIC and loud speaker 2LS, a transmit relay 2TR, and a carrier operated relay 2CR, substantially the same as in the equipment for the primary or sending station, the microphone 2MIC being directly connected to the transmitter which in this case is not effective unless the microphone is to be used. The transmit relay 2TR operates contact fingers **35** and **36** co-operating with front and back contacts to switch the antenna **37** from the receiver to the transmitter, and vice versa, and shift the connection from the battery **38** constituting a source of plate supply voltage from the transmitter to receiver accordingly.

The locomotive equipment includes a spring return push-to-talk button 2TB or equivalent which closes an energizing circuit for a talking relay 2TBR which may be traced from (+), through back contact **30** of the carrier operated relay 2CR, button 2TB, relay 2TBR, to (—). The energization of the talking relay 2TBR and closure of its front contact **31** establishes a circuit readily traced on the drawing for the energization of the transmit relay 2TR. It can be seen that the operation of the push-to-talk button 2TB is not effective to energize the relay 2TBR and in turn the transmit relay 2TR, while a carrier frequency is being received, so that accidental or careless manipulation of this button 2TB will not interrupt or curtail any voice message being received.

Considering now the checking indicator and its control means on the locomotive or other secondary station, in the specific arrangement illustrated in Fig. 2, the carrier operated relay 2CR is responsive to a carrier frequency with or without modulation, and is energized momentarily by a pulse of carrier frequency, and steadily during reception of a carrier frequency in connection with transmission of a voice message. This carrier operated relay 2CR controls the operation of

suitable decoding means which is responsive only to carrier frequency pulses of limited duration repeated at regular intervals of less than a predetermined time. The type of decoding means illustrated comprises front and back repeater relays FP and BP, respectively, which are energized by circuits which are readily traced on the drawing by the closure of front and back contacts co-operating with a contact finger **24** of the carrier operated relay 2CR. These relays FP and BP, indicated conventionally as slow acting, are preferably constructed or arranged to pick up or attract their armatures relatively quickly, and are made slow to release by the use of rectifiers, copper slugs or the like. The back contact repeater relay BP, energized while the carrier operated relay 2CR is deenergized and its back contact **24** is closed, is made to have a release time to span the duration of the carrier frequency pulses, with a suitable margin; and a front contact repeater relay FP, energized when the carrier operated relay 2CR is picked up, is made to have a longer release time to span over the spacing or "off" period between successive carrier frequency pulses, with a suitable margin.

The checking indicator, governed by the relays FP and BP, may take any desired form of indicating device suitable for arresting the attention of the operator of the movable vehicle. In the preferred arrangement illustrated, this checking indicator comprises a visual signal in the form of a conventional incandescent lamp CK disposed in a suitable casing for illuminating a color screen of the desired color such as green, or otherwise displaying the desired visual indication; and an associated audible signal in the form of a single-stroke electrical bell B operating to give an arrestive sound momentarily upon deenergization. While the check lamp CK and the bell B are shown as energized in multiple from the same control circuits, they may be connected in series if desired.

When both of the relays BP and FP are energized as shown, an energizing circuit for the check lamp CK and bell B is established and may be traced from (+), through front contact **25** of relay BP, a resistor **26**, front contact **27** of relay FP, back contact **28** of the talking relay 2TBR, and thence through the lamp CK and the bell B in multiple, to (—).

While the operator of the vehicle is communicating with the primary or sending station, and the talking relay 2TBR of Fig. 2 is energized, the check lamp CK and bell B in multiple are maintained energized in series with a "talking" lamp 2TK through a front contact **28** of the relay 2TBR, make-before-break contacts as shown diagrammatically being employed for the relay 2TBR, so that the shift between one energizing circuit for the lamp CK and bell B through the contacts **25** and **27** of the relays BP and FP to the other energizing circuit through the lamp 2TK is made without interruption, which otherwise might cause the check lamp CK to blink and the bell B sound. The energization of the talking relay 2TBR in Fig. 2 and closure of its front contact **29** establishes an auxiliary circuit readily traced on the drawing for maintaining the relay FP energized, for reasons more conveniently explained in discussing the operation.

Operation.—Under normal conditions, when the communication system under consideration is not in use for communicating to or from the primary or sending station of Fig. 1, the pulsing means comprising relays 1A and 1B are operating

continuously to intermittently energize the transmit relay 1TR and send out at regular intervals short pulses of carrier frequency. These pulses of carrier frequency intermittently energize the carrier operated relay 2CR of the vehicle carried equipment in Fig. 2; and each time this relay 2CR is energized by a carrier frequency pulse, the closure of its front contact 24 supplies energy to the relay FP to restore it in effect to an initial timing condition ready for a new period of timing when the relay 2CR releases. Similarly, each time the carrier operated relay 2CR releases, closure of its back contact 24 supplies energy to the relay BP to restore it to its initial timing condition. It can be seen that, so long as the duration and spacing of the carrier pulses fall within the timing limits of the relays BP and FP, both of these relays will be maintained energized, and the check lamp CK is lighted and the bell B is maintained energized.

Assume that the person at the primary or sending station desires to communicate some information or instructions to the locomotive engineer, or operator of some other mobile unit, which may involve the safety of the continued operation of such train or mobile unit, and which must be communicated to the engineer or operator in the interests of safety. Under these conditions, when the person at the primary or sending station actuates the push-to-talk button 1TB, the transmit relay 1TR is kept energized by closure of the front contact 11 of relay 1TBR to cause the transmitter to send out a steady carrier frequency, and the microphone 1MIC is rendered effective by closure of front contact 10 of relay 1TBR to modulate this carrier frequency in accordance with the desired instructions. The lighting of the "talking" lamp 1TK indicates that the actuation of the button 1TB has been effective and the message may be given.

This operation may occur at any time during the cycling of the relays 1A and 1B; and if such use of the system for communication purposes is initiated during the "off" period or spacing between the carrier frequency pulses of say 3.5 seconds, as is most likely to happen, as soon as the carrier operated relay 2CR on the locomotive of Fig. 2 is held up by the sustained carrier longer than the release time of relay BP of about one-half second, this relay BP opens its front contact 25 and breaks the energizing circuit for the check lamp CK and the bell B, thereby extinguishing the check lamp CK, and causing the bell B to sound in the manner characteristic of single stroke bells when arranged to sound when deenergized. If it should happen that the operator at the primary station starts to use the system for communication purposes just during the time the relays 1A and 1B are acting to apply a carrier frequency pulse, then the relay BP will release much quicker.

In any event, regardless of just when the push-to-talk button 1TB of Fig. 1 happens to be actuated, the check lamp CK is extinguished and the bell B sounded in less than a second which is much shorter than the time the push-to-talk button 1TB would be held down for the shortest message. In other words, even though a short message is to be communicated, the checking indicator is rendered inactive to warn the operator of a vehicle that a message should be received. Such prompt response of the checking indicator is also desirable, where as shown an audible signal is associated with the visual signal, so that

the audible signal will not interfere with any message received from the loud speaker.

In this way, in accordance with the checking system of this invention, the locomotive engineer or other operator of the movable vehicle is promptly advised by visual and audible signals that system is about to be used for communication of a message to him. If this message is heard, then it is obvious that all parts of the communication system are in proper operating condition, including the microphone, loud speaker, and the modulating or other elements of the system. If, however, the engineer hears no message immediately after the giving of the visual and audible checking signal, he may properly assume that the system is out of order in some respect, and should taken action accordingly.

The particular action to be taken on the part of a locomotive engineer when he realizes the communication system is out of order is dependent upon the existing operating conditions, and the rules and regulations prescribed for such a case. For example, if the communication system is being used for directing the movements of a pusher engine which is pushing a string of cars up and over the hump in a classification yard for railroads, and if the engineer is pushing the string of cars in accordance with the last instructions given, a failure of the communication system under such conditions would ordinarily require the engineer of the pusher engine to stop at once, because the system may have failed just at the time he should receive instructions to slow down or stop, and continued movement under such circumstances might well be disastrous. In the applications of a communication system between the head end and the rear end of the train, where the checking function is preferably employed for communication from the conductor or brakeman at the rear end of a train to the engineer at the front end, if the locomotive engineer fails to hear a message when warned by the checking indicator, he may properly assume that the conductor or brakeman at the rear end may have some important information for him with regard to a hot box, dragging equipment, some special stop to be made, or the like. Under such circumstances, the engineer may look back for some hand signal from the rear end, or discover for himself that something is wrong with his train; but in absence of some assurance that the message failing to reach him was not vital, or that the communication system has failed in some way without any attempt to communicate with him, the engineer should stop, find out what matter of safety, if any, is involved, or take such other action as may be permitted under the established rules. In case a communication system is employed for communication from a dispatcher or other operator along the wayside with a locomotive engineer, and the checking feature of this invention is employed to check the integrity of such communication to the engineer, then a failure of the system as manifested by the checking feature may call for somewhat different action on the part of the engineer, dependent to a large extent upon the conditions under which he is then operating his train. For instance, if the movement of the train is safeguarded by an automatic block signal system, it may be sufficient for the engineer to slow down and proceed with extra caution in watching out for a derailment, landslide, or other track condition which the operator may have been trying to tell him about, and actually not stop until he

reaches the nearest telephone to communicate with the wayside operator. Other applications of a communication system may call for different procedures; but this invention enables the operator of a movable vehicle likely to receive important instructions or information to determine promptly when the system is not in proper operating condition, and act accordingly.

Resuming consideration of the case where the operator at the primary or sending station is communicating with the operator of a vehicle, the energization of the relay 1TBR in Fig. 1 and closure of its front contact 15 maintains relay 1B energized and relay 1A deenergized, so that when such communication terminates, and the relay 1TBR releases to close its back contact 11 and prepare the circuit for providing spaced pulses of carrier frequency, the relays 1A and 1B are in a condition corresponding with the "off" period or blank interval as indicated at *a* in the time chart of Fig. 3, and the next pulse carrier frequency is not transmitted until after say 3.5 seconds. This assures that the carrier operated relay 2CR in Fig. 2 will definitely drop at the end of the message transmission, and properly energize the repeater relay BP, rather than be prematurely energized by a pulse of carrier frequency quickly following the termination of speech transmission if the pulsing means had continued its cycling operation and should happen to be in condition to give such pulse at the critical time. This is an optional refinement that may be omitted if desired.

During the transmission of the message, the carrier operated relay 2CR on the vehicle in Fig. 2 is energized and maintains the front contact repeater relay FP energized. Consequently, as soon as the carrier frequency ceases upon termination of the message, and the carrier operated relay 2CR releases, the relay BP quickly picks up to establish again the energizing circuit for the check lamp CK and bell B. In other words, immediately after the voice message ceases, the check light CK is lighted. In this connection, it is desirable that the check light CK be lighted at all times except when the system is being used for communication with the vehicle, so that the operator of the vehicle acquires the habit of expecting to hear a voice message any time the check lamp CK is extinguished, and will quickly subconsciously recognize a different condition.

If, under normal conditions, there should be some failure in the pulsing means provided by the relays 1A and 1B, or in the transmission or reception of these carrier pulses, the carrier operated relay 2CR of the vehicle fails to pick up, the relay FP is no longer intermittently energized, and after a relatively short time of some four seconds, the armature of this relay FP assumes its retracted position, opening its front contact 27 and breaking the energizing circuit for the check lamp CK and bell B, thereby extinguishing the lamp and causing the bell to sound. In other words, if there should be some failure in the instrumentalities involved in the transmission or reception of the carrier frequency, the indicating means is rendered active the same as when the system is used for communication purposes; and the checking means checks the normal operating condition of certain parts of the system while it is not being used for communication purposes, as well as all parts of the system, including the microphone, loud speaker, etc., whenever the system is put into use for communication purposes. In this connection,

it is apparent that if the failure is such as to prevent the transmission or reception of a carrier frequency to be modulated, then no message can be communicated; and it is important that the operator of the vehicle be apprised of this fact. If the fault should be in the carrier operated relay 2CR, so that it does not pick up as it should, then there is no assurance that the checking indicator will be properly operated at the time some message is being sent, and thus provide the desired check upon the integrity of the entire system to communicate the desired message. If it should be the pulsing means that is out of order, then there is no intermittent transmission of carrier frequency pulses to check the operability of the carrier operated relay 2CR and assure that it will act to render the checking indicator active when the system is used for communication of a message.

In short, the proper operating condition of the parts involved in the control of the checking indicating means is likewise fully checked, so that it is assured that the desired checking function will be performed whenever called upon by use of the system for communication purposes.

Whenever the checking indicator is rendered active and no message is actually received, the operator on the vehicle may try to call the other sending or primary station, assuming a two-way communication system, and determine by actual trial if the failure manifested by the checking indicator is in the pulsing means, or some other part of the system which does not in fact prevent the communication of messages, at least for the time being. In this way, the operator of the vehicle may sometimes avoid stopping or taking such other action as would be required with respect to the vehicle if the communication facilities had actually failed. If it should happen that the check lamp CK burns out this fact would be indicated by failure of the bell B to sound when the check lamp burns out, and may be also verified by failure of the lamp 2TK to properly light when the push-to-talk button 2TB is actuated and relay 2TBR is energized. In short, there are ways in which the operator of the vehicle can determine to some extent the nature of the failure causing an operation of the checking indicator without an accompanying message, and will be able to avoid any uncertainties and delays that might otherwise occur.

Considering now a case where a two-way communication system is employed, and the operator on the vehicle desires to break in and communicate with the primary or sending station, the actuation of the push-to-talk button 2TB in Fig. 2 will pick up the talking relay 2TBR at once, if this action is taken during the blank interval between pulses of carrier frequency, or as soon as a carrier frequency pulse ceases, if such action should happen to coincide with such a pulse. The energization of the talking relay 2TBR energizes the transmit relay 2TR to disconnect the receiver and render the transmitter effective to send out a carrier frequency, which picks up the carrier operated relay 1CR at the primary station in Fig. 1, thereby locking out or suppressing any further energization of the transmit relay 1TR by operation of the pulsing means, so as not to mutilate or chop the voice message being received. The energization of the relay 1CR not only opens at its back contact 12 the energizing circuit for the transmit relay 1TR, but also closes its front contact 16 to hold up the relay 1B, as indicated at *e* in Fig. 3.

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The energization of the transmit relay 2TBR on a vehicle in Fig. 2 also closes its front contact 29 to maintain energized the repeater relay FP, and with the carrier operated relay 2CR deenergized, the repeater relay BP is also energized, so that the normal energizing circuit for the checking lamp CK and bell B is prepared through the front contacts 25 and 27 of these relays BP and FB in readiness for reclosure at the end of the transmission upon the release of relay 2TBR and closure of back contact 28.

It is preferable to keep the check lamp CK lighted while the operator in the vehicle is using the system, for reasons above indicated; and in the arrangement shown, this is done by connecting a "talking" lamp 2TK through a front contact 28 of the relay 2TBR in series with the check lamp CK. The lighting of the talking lamp 2TK along with the check lamp CK indicates the conversation may be started. The resistance 26 is preferably used to provide the same resistance in the different circuits for the energization of the check lamp CK and bell B. This is merely one specific arrangement suitable for this purpose, and various other expedients might be employed to maintain the check lamp CK lighted, and also provide a suitable indication that the break-in is effective.

When the communication from the vehicle ceases, and the relay 2TBR drops, the lamp 2TK is extinguished, but the lamp CK and the bell B are maintained energized by the normal circuit through the front contacts 25 and 27 of the relays BP and FP, the contact 28 of the relay 2TBR being preferably made make-before-break to avoid circuit interruption. Upon termination of the message from the vehicle, the carrier operated relay 1CR at the primary station in Fig. 1 releases, as indicated at *f* in Fig. 3, and the normal transmission of carrier frequency pulses will be reinstated.

One application of a communication system of the character under consideration is for communication between the front end and the rear end of trains; and it can be readily appreciated that the transmitters on two or more trains may at times be within range of each other as different trains come close together or pass each other. It is desirable, for reasons previously indicated, to provide the checking feature of this invention for communication from the conductor or brakeman at the rear end of the train with the engineer at the front end, who is the one capable of slowing down or stopping the train as may be required. In other words, it is contemplated that the primary or sending station of Fig. 1 in such an application will be provided in the caboose or rear car of the train. If there are a number of such primary stations within range of each other, each applying at spaced intervals carrier frequency pulses in accordance with the timing of their own respective pulsing means, it can be seen that there might well be an overlapping of carrier frequency pulses from different equipments to a degree to simulate the effect of a sustained carrier, thereby causing a premature or improper operation of the checking indicators on locomotives within this range.

In order to obviate this difficulty, where a plurality of primary or sending stations are involved, the pulsing means comprising the relays 1A and 1B is organized to be reset or restored to an initial timing position, so as to bring about in effect a synchronization of carrier frequency pulses sent out from a plurality of primary stations within range of each other. Referring to Fig. 1, the energization of the carrier operated relay 1CR in response to a carrier frequency from any other station closes a front contact 16 which energizes the relay 1B timing the spacing between carrier frequency pulses. Considering the case where two primary stations, such as shown in Fig. 1, come within range of each other, the station which first sends out a carrier frequency pulse causes energization of the carrier operated relay 1CR at the other station, and in effect resets the timing relay 1B to an initial condition to start off a timing operation synchronously with the first station at the time the relay 1CR releases. After this first pulse, the next pulse of carrier frequency will be sent out from the two primary stations at the same time, if their pulsing means are operating to provide the same spacing between pulses; and the same will be true for subsequent pulses. If, however, the operating times of the relays 1A and 1B of the pulsing means for the respective primary stations should differ to some degree, due to variations in the operating characteristics of these relays, differences in operating voltages, or the like, then the primary station acting to provide the shortest spacing between the carrier frequency pulses will send out its pulse first, and this will energize the carrier operating relay 1CR at each of the other primary station or stations, thereby energizing the relay 1B at such station or stations to restore that relay to its initial timing condition and maintain the associated relay 1A deenergized, so that such other station or stations will not by itself send out a carrier frequency pulse.

In other words, under the conditions under consideration, the carrier frequency pulses will be sent out together in synchronism from a plurality of primary stations within range of each other, or else the rate of pulsing will be dictated by the station providing the shortest "off" interval or spacing between pulses. Similarly, if two primary stations differ in the strength and range of their carrier frequency pulses or in the sensitivity or response of their carrier operated relays 1CR, one or the other of these stations will set the pace, so to speak, in transmission of carrier frequency pulses, so that there will be no overlapping of pulses from different stations to cause improper operation of the checking indicators on the vehicles within their range.

The indicating means on the various locomotives or secondary stations within range of the plurality of primary sending stations under consideration will respond to carrier frequency pulses coming from any primary station. In this connection, it should be understood that the relays BP and FP for decoding the carrier frequency pulses are arranged to have a suitable margin in their timing operation so as to follow pulses from any primary station within the variations in the timing operation of the pulsing means for such stations.

Thus, the checking function of this invention may be readily carried out for a number of trains moving into and out of range of each other, all operating on the same carrier frequency and able to communicate with each other, without the complication of distinctive tone frequencies or codes for the different trains. Whenever one of the primary or sending stations on a train starts to send a message, the checking indicator will be operated on each locomotive within range; but this message also will be heard by the engineer on

each locomotive as an indication that the communication system is operating properly.

Under these special conditions under consideration, it should perhaps be explained that if the primary station on a given train should for some reason become unable to send out any steady carrier frequency for communication of a message, such defective condition will not necessarily be manifested by the indicating means in the associated locomotive, because such indicating means may be maintained inactive by spaced carrier frequency pulses received from the primary station on some other train within range; but this applies to only one of the several kinds of failure that may occur in a communication system, and will be manifested as soon as the train with such a defective primary station gets out of range of the primary stations on other trains. In this connection, it is contemplated that the transmitters for front and rear communication on a train will have a limited range for pulsing control; and also, if desired, well known expedients for directional transmission or reception may be employed to limit the effective range of pulsing control. The limitations of the checking means of this invention in this respect under these special conditions are outweighed by the simplicity of the checking means employed, and the facility with which various trains can communicate with each other on the same carrier frequency, or receive on the same carrier frequency messages perhaps affecting all trains from a wayside station.

A communication system provided with the checking feature of this invention, while particularly useful for train communication on railroads, airways and the like, where messages dealing with safety of operation of mobile units are involved, may be employed in various ways for other purposes as desired, with the assurance that failures in the communicating system will be promptly manifested by the checking means.

The particular embodiments of the invention illustrated and described are merely typical or representative of the various forms which a communication system embodying the checking system of this invention may take; and it should be understood that this invention is in no way limited to the particular construction, arrangement and organization of parts and circuits herein illustrated and described, but is susceptible to various adaptations, modifications and additions, without departing from the invention.

What I claim is:

1. In a system for communicating instructions from a primary station to a secondary station by modulation of a carrier frequency, transmitting equipment at one primary station including a transmitter for generating a carrier frequency and modulating means for modulating that carrier frequency in accordance with the intelligence to be communicated to another secondary station, impulsing means at said primary station normally acting to render said transmitter active for a short time at regular spaced intervals to provide spaced pulses of carrier frequency without modulation, manually operable means at said primary station operable by an operator when he desires to communicate instructions to the secondary station for controlling said transmitter to provide a steady carrier frequency and at the same time rendering said modulating means effective to modulate said carrier frequency, receiving means at the secondary station including relay means energized in response to said carrier frequency with or without modulation, indicating means at said secondary station, and means effective only if said relay means is intermittently energized and deenergized in response to the transmission of spaced carrier frequency pulses for maintaining said indicating means inactive, whereby said indicating means is rendered active by the transmission of a sustained carrier frequency as soon as the operator at the primary station starts to communicate with the secondary station, and whereby said indicating means is automatically rendered active in the event of failure in the transmission or reception of said carrier frequency.

2. A system for checking the integrity of communication systems operating by the modulation of a carrier frequency comprising, transmitting means at one location including means for generating the carrier frequency and modulating means for modulating said carrier frequency for transmission of intelligence, impulsing means normally acting while said transmitting means is not in use for communication of intelligence for controlling said transmitting means to send out at regular intervals short pulses of unmodulated carrier frequency, manually operable means for controlling said transmitter to provide for the transmission of a steady carrier frequency and at the same time rendering said modulating means effective, a receiving means at another location responsive to the carrier frequency and the modulation thereof created by said transmitting means, indicating means associated with said receiving means and tending to assume an active condition, and means associated with said receiving means and responsive only to the reception of spaced carrier pulses for maintaining said indicating means in its inactive condition, whereby said indicating means is rendered active whenever a steady carrier frequency is transmitted for communication purposes or no carrier frequency is transmitted or received.

3. A system for checking the integrity of radio telephone systems for communicating oral messages to moving vehicles concerning their movement comprising, a radio transmitter at a primary station for creating a carrier frequency, a microphone for modulating said carrier frequency in accordance with the desired verbal message, impulsing means normally acting while the system is not in use for transmission of voice messages to render said transmitter effective to send out at regularly spaced intervals short pulses of unmodulated carrier frequency, means manually operable by an operator for controlling said transmitter independently of said impulsing means to provide a sustained carrier frequency and for rendering at the same time the microphone effective to modulate said carrier frequency, receiving means at a secondary station including relay means energized by the reception of a carrier frequency either modulated or unmodulated, visual and audible indicating means at the secondary station tending to assume its active condition and maintained inactive by the energization of a control circuit, and means for maintaining said control circuit for said indicating means energized only if said carrier operated relay means is intermittently operated at regularly spaced intervals, whereby said indicating means is automatically rendered active upon failure in the transmission or reception of the carrier frequency or when a sustained carrier frequency is transmitted in connection with the transmission of a voice message.

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4. In a communication system for transmitting voice messages from a primary station to a secondary station with a check upon the reliability of the reception of such messages, a transmitting equipment at the primary station including means for generating a carrier frequency, a microphone and a code pulsing device; means at the primary station normally acting to render said code pulsing device effective to cause the intermittent transmission of pulses of unmodulated carrier frequency but effective when manually actuated to cause the steady transmission of said carrier frequency and at the same time render said microphone operable to modulate such carrier; receiving equipment at the secondary station including a loudspeaker and a carrier-responsive relay controlled by the reception of a carrier signal irrespective of the presence or absence of voice modulations; an indicator; and means requiring the intermittent operation of said carrier-responsive relay at predetermined spaced intervals for maintaining said indicator in a normal condition to give a distinctive indication, whereby said indicator normally gives a distinctive indication but ceases to give such indication when a steady carrier frequency with a voice message is transmitted and thereby enable an operator at the secondary station to detect a failure in communication if no voice message is received during the absence of said distinctive indication.

5. In a two-way communication system for transmitting voice messages between a primary station and a secondary station with a check upon the reliability of reception at the secondary station, transmitting and receiving equipments at the primary station, said transmitting equipment including means for generating a carrier frequency, a mircophone and a code pulsing device, said receiving equipment including a receiver, a loudspeaker and a carrier-responsive relay controlled by the reception of a carrier frequency signal irrespective of the presence or absence of voice modulations, means at the primary station normally acting to render said pulsing device effective to cause the transmission of unmodulated carrier frequency pulses at regular intervals, but rendered ineffective whenever the carrier-responsive relay of the associated receiving equipment responds to a carrier frequency signal from the secondary station, said means also being manually controllable to cause the steady transmission of said carrier frequency and at the same time render said microphone operable to modulate said carrier and rendering the associated receiver incapable of responding to local transmission, transmitting and receiving equipments at the secondary station, said transmitting equipment at the secondary station including means for generating a carrier frequency and a microphone, said receiving equipment at the secondary station including a receiver, loud speaker and a carrier-responsive relay controlled by the reception of a carrier signal irrespective of the presence or absence of voice modulations, means manually controllable for rendering said receiving equipment inactive and said transmitting equipment active providing said carrier-responsive relay is not responding to a carrier signal, an indicator at said secondary station, and means requiring the intermittent operation of said carrier-responsive relay at said regular intervals to cause said indicator to give a distinctive indication, whereby said indicator normally gives a distinctive indication but ceases to give such indication when a steady carrier frequency with a voice message is transmitted and thereby enable an operator at the secondary station to detect a failure in communication if no voice message is received during the absence of said distinctive indication, and whereby the operator at the secondary station can break-in to transmit between successive pulses of carrier frequency.

6. In a system for checking communication systems operating by modulation of a carrier frequency to communicate instructions to moving vehicles, a transmitter and a receiver on a vehicle and a transmitter and a receiver at a primary station permitting two-way communication on the same carrier frequency between said stations, means at the primary station normally acting while the associated transmitter is not being used for communication purposes or the associated receiver is not receiving a communication from the vehicle for rendering said transmitter effective to send out spaced pulses of carrier frequency without modulation, the spacing of said pulses of carrier frequency from the primary station permitting the operator of the vehicle to break-in and communicate with said primary station, a checking indicator on the vehicle, and means governed by the receiver on the vehicle for maintaining said indicator inactive in response to such spaced pulses of carrier frequency and for automatically rendering said indicator active whenever a steady carrier frequency is received in connection with the transmission of a message from the primary station.

7. In a system for checking the integrity of communication by modulation of a carrier frequency from a primary station to another secondary station, transmitting means at the primary station normally acting while the system is not in use for communication purposes to send out at regular spaced intervals short pulses of carrier frequency without modulation, said transmitting means acting when conditioned for communication of intelligence to the secondary station to send out a sustained carrier frequency modulated in accordance with such intelligence, receiving means at the secondary station including a carrier operated relay energized in response to a carrier frequency with or without modulation, indicating means at said secondary station tending to assume an active indicating condition, and decoding means including slow-release relays governed by said carrier relay for maintaining said indicating means inactive only while said carrier operated relay is intermittently energized by spaced pulses of carrier frequencies.

8. In a system for checking the integrity of a communication system for transmitting from a primary station messages to a secondary station on a movable vehicle by modulation of a carrier frequency, transmitting means at the primary station normally acting when the system is not in use for communication purposes to send out code pulses of unmodulated carrier frequency, receiving means on the vehicle including a carrier operated relay energized in response to carrier frequency with or without modulation and a checking indicator, and code responsive means on the vehicle governed by said carrier operated relay for maintaining said checking indicator inactive only so long as code carrier frequency pulses are being received, whereby said checking indicator is automatically rendered active whenever a steady carrier frequency is transmitted for purposes of communication or whenever there is a

failure in the transmission or reception of any carrier frequency.

9. In a system for checking the integrity of a communication system operating by modulation of a carrier frequency for communicating from a primary station to a movable vehicle messages concerning its movement, transmitting means at the primary station for sending out at regular intervals short pulses of unmodulated carrier frequency when the system is not in use for communication purposes and for sending out a steady modulated carrier frequency during periods of communication with the vehicle, receiving means on the vehicle including a carrier operated relay energized in response to a carrier frequency with or without modulation, a checking indicator on the vehicle, and means including slow-release relays respectively energized as said carrier operated relay is energized and deenergized for maintaining said indicator inactive only so long as said slow-release relays are maintained energized by the intermittent operation of said carrier operated relay.

10. In a system of the character described for checking the integrity of a communication system for transmitting messages from a primary station to a moving vehicle, indicating means on the vehicle tending to assume its active condition, receiving means on the vehicle including a carrier operated relay energized in response to reception of a carrier frequency with or without modulation, and means governed by said carrier operated relay for maintaining said indicating means inactive only if said relay is intermittently operated by the reception of pulses of carrier frequency at predetermined spaced intervals, whereby reception of a steady carrier frequency in connection with the transmission of a message to the vehicle automatically renders said indicating means active and enables the operator on the vehicle to detect if the system is in proper operating condition.

11. In a system of the character described for checking the integrity of a communication system acting by modulation of the carrier frequency for communication of messages to a movable vehicle, receiving means on the vehicle and including a carrier operated relay energized in response to a carrier frequency with or without modulation, two slow-acting relays respectively energized by said carrier operated relay as it is energized and deenergized, a check lamp, and a lighting circuit for said lamp governed by both of said relays and maintained closed to light said lamp only if said carrier operated relay is operated intermittently, whereby said check lamp is extinguished upon reception of a steady carrier frequency in connection with the communication of a message or by failure to receive any carrier frequency.

12. In a system for checking the integrity of a communication system between one or more primary stations and secondary stations, transmitting means associated with each primary station including a self-propelled pulsing means normally operating while said transmitting means is not in use for communication purposes to send out short pulses of carrier frequency at regular intervals, means associated with said pulsing means for each primary station for synchronizing its operation in accordance with carrier frequency pulses that may be received from another primary station, and receiving means at each secondary station including a checking indicator automatically rendered active in response to the reception of a sustained carrier frequency with or without modulation.

13. In a system for checking the integrity of a communciation system operating by carrier frequency from one end to the other end of any one of a plurality of trains, transmitting means associated with said one end of each train including automatic pulsing means normally operating while said transmitting means is not in use for communication purposes to send out short pulses of carrier frequency at intervals measured by the operating characteristics of said pulsing means, receiving means at said other end of each train including a checking indicator maintained inactive only in response to spaced pulses of carrier frequency, receiving means at said one end of each train including relay means responsive to the reception of a carrier frequency pulse from some other train, and means at said one station of each train governed by the associated relay means for synchronizing the operation of the associated pulsing means to conform with the carrier frequency pulse that may be received from some other train.

14. In a checking system of the character described involving transmission of spaced carrier frequency pulses from one or more primary stations coming within range, transmitting means for each primary station including pulsing means for sending out pulses of carrier frequency at intervals while said transmitting means is not in use for communication purposes, said pulsing means including a timing device restorable by energization of a control circuit to an initial timing condition, and receiving means for each primary station including a relay energized in response to the reception of a carrier frequency pulse from some other primary station for energizing said control circuit to restore said timing device to its initial timing condition.

15. In a system for checking the integrity of communication systems operating by modulation of a carrier frequency, transmitting equipment at a primary station normally acting while the system is not in use for communication purposes to send out spaced pulses of carrier frequencies, means for automatically discontinuing transmission of such pulses of carrier frequency whenever said transmitting equipment is used for communication purposes, receiving means at a secondary station including relay means responsive to pulses of carrier frequency, and a checking indicator at said secondary station including a lamp and an audible signal governed by said relay means and rendered active by extinguishing said lamp and temporarily sounding said audible signal whenever said pulses of carrier frequency are discontinued, whereby a visual and audible warning is given at the secondary station whenever said primary station is used for communication purposes, thereby enabling a person at the secondary station to detect if the communication system is operating properly.

16. In a checking system of the character described for communication systems operating by carrier frequency, receiving equipment at a secondary station comprising a carrier operated relay energized in response to the reception of a carrier frequency with or without modulation, two slow-acting relays respectively energized as said carrier operated relay is energized and deenergized, an indicating lamp and an audible signal, and a controlling circuit for lighting said signal and maintaining said audible signal inactive governed by both said slow acting relays,

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said control circuit being broken to extinguish said lamp and momentarily sound said audible signal whenever either of said slow acting relays is deenergized, whereby a visual and audible signal is given whenever the transmission of carrier frequency pulses to cause intermittent operation of the carrier operated relay and energization of both of said slow acting relays is changed to either a steady carrier in connection with the transmission of a message or there is a failure in the transmission or reception of any carrier frequency.

17. In a checking system of the character described for communication systems operated by a carrier frequency, a transmitter and a receiver at a primary station, pulsing means including a slow-acting relay and automatically operating while the system is not in use for communication purposes to intermittently render said transmitter effective to send out pulses of carrier frequency at intervals measured by the release time of said slow-acting relay, a carrier operated relay associated with said receiver and responsive to the reception of carrier frequency pulses from some other station, and means governed by said carrier operated relay for restoring said slow-acting relay to its initial timing condition in response to the reception of a carrier pulse from some other primary station.

18. In a checking system of the character described, transmitting means at a primary station normally acting when the system is not in use for communication purposes to send out spaced pulses of carrier frequency, receiving means at a secondary station including relay means responsive to said carrier frequency and a slow acting relay having a release time a little longer than the interval between said pulses, a checking indicator rendered active by the release of said slow acting relay, a transmitter at said secondary station for providing two-way communication, a talking circuit controller for rendering said transmitter active and said receiving means inactive, and means for maintaining said slow acting relay energized while said talking circuit controller is in its actuated condition, whereby said slow acting relay is maintained in its initial timing condition during operation of said talking circuit controller for communication and thus maintains said checking indicator inactive temporarily after termination of said communication.

19. In a checking system of the character described for communication systems of the carrier frequency type, a transmitter and a receiver at a station, a check lamp governed by said receiver and automatically rendered active whenever spaced pulses of carrier frequency are not being received, an auxiliary talking indicator, and manually operable means for rendering said transmitter active and said receiver inactive, said manually operable means when actuated acting to maintain said checking lamp lighted and to render said talking indicator active.

20. In a system for checking the integrity of communications from a primary station to a secondary station in a two-way communication system, transmitting means at the primary station normally acting only while the system is not in use for communication of a message to a secondary station for sending out spaced pulses of carrier frequency, receiving means at said secondary station including a check lamp, means for closing a lighting circuit for said check lamp only if pulses of carrier frequency are being received at said secondary station, a transmitter at said secondary station for two-way communication, talking means for rendering said transmitter active and said receiving means inactive and at the same time maintaining said indicating means active, whereby the indicating lamp is maintained lighted unless said primary station is sending out a steady carrier frequency in connection with the transmission of a message.

21. In a communication system for transmitting a voice message in both directions between a primary station and a secondary station with a check upon the reliability of reception at the secondary station, a transmitting and receiving equipment at the secondary station including a carrier-responsive relay actuated in response to the reception of a carrier frequency independently of the presence or absence of modulations on said carrier, said receiving equipment being normally effective and adapted to receive coded carrier frequency pulses at regular intervals, a check indicator, means requiring the operation of said carrier-responsive relay at said regular intervals to cause said indicator to give a distinctive indication but effective whenever said carrier-responsive relay remains in either position to cause a different indication, manually controllable means for rendering said receiver ineffective and said transmitter effective to transmit voice modulated signals, said means also acting to maintain said distinctive indication independent of the carrier-responsive relay and for a limited time after the receiver is again rendered active, whereby said distinctive indication is extinguished when a steady carrier frequency is received or when no carrier signal is received but is maintained at other times, to thereby advise an operator of a failure in communication if no voice message is received whenever there is an absence of said distinctive indication.

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