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May 27, 1947. J. C. O'BRIEN 2,421,081

TESTED CHANNEL RADIO COMMUNICATING SYSTEM

Filed Sept. 6, 1944 3 Sheets-Sheet 1

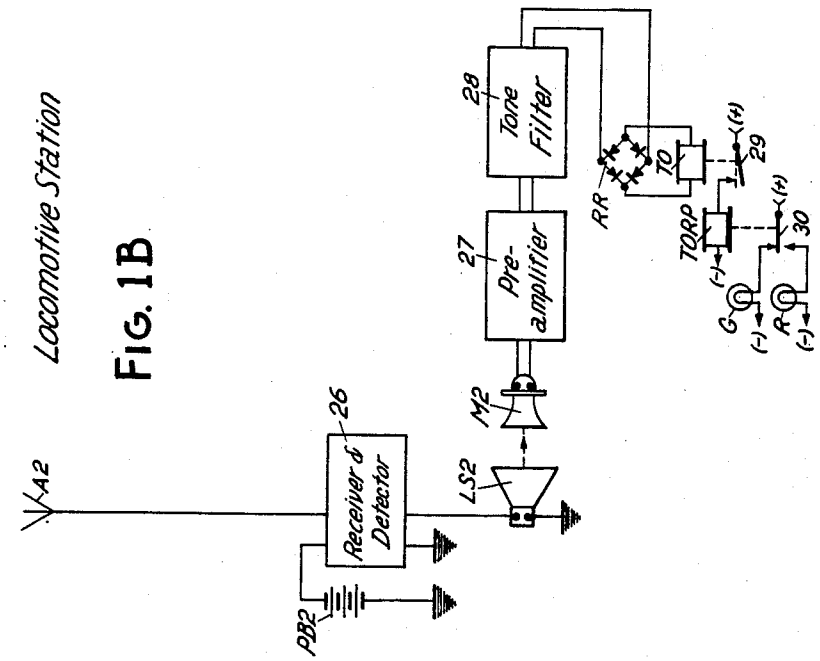


FIG. 1B

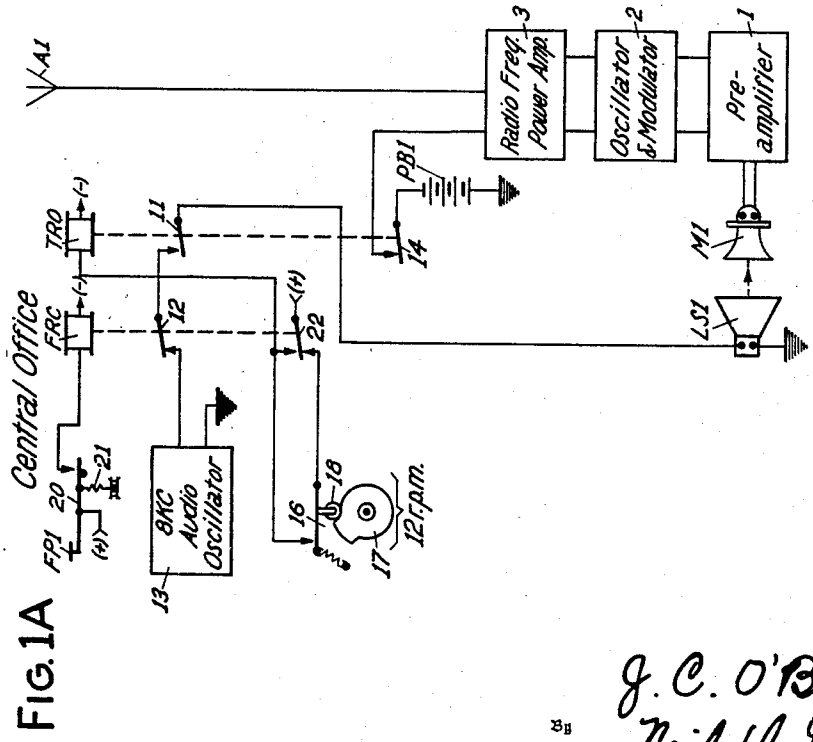


FIG. 1A

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TESTED CHANNEL RADIO COMMUNICATING SYSTEM

Filed Sept. 6, 1944 3 Sheets-Sheet 2

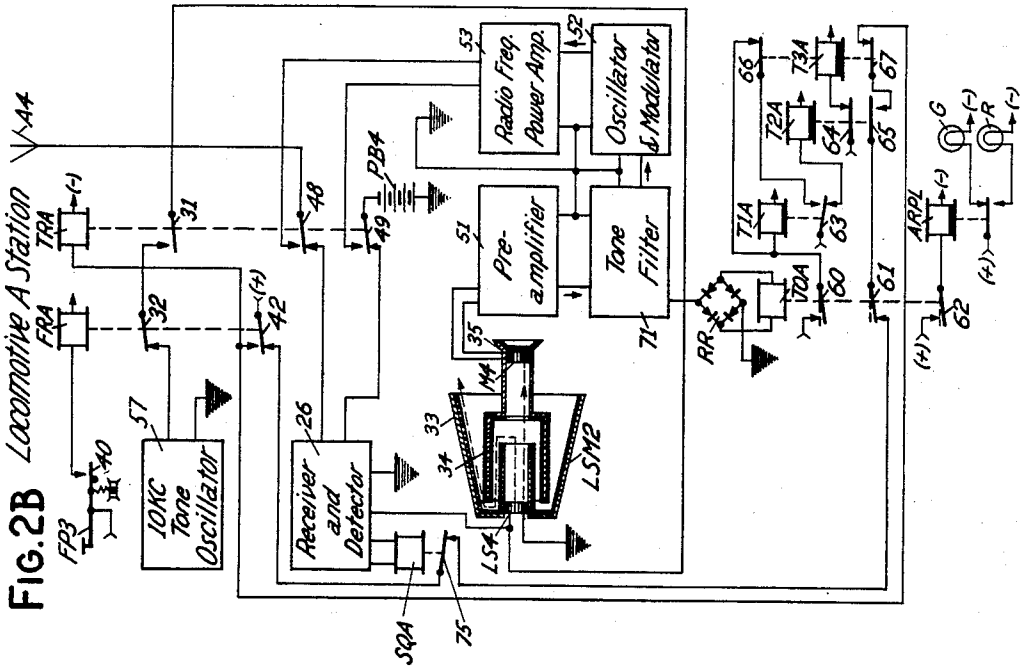


FIG. 2B

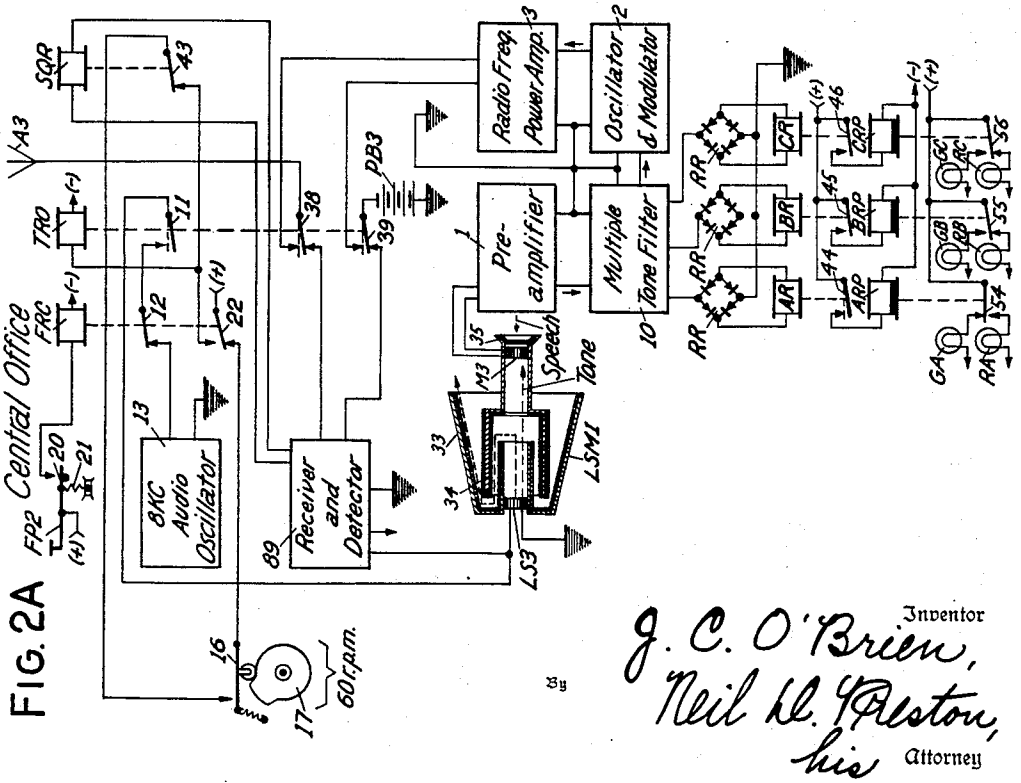


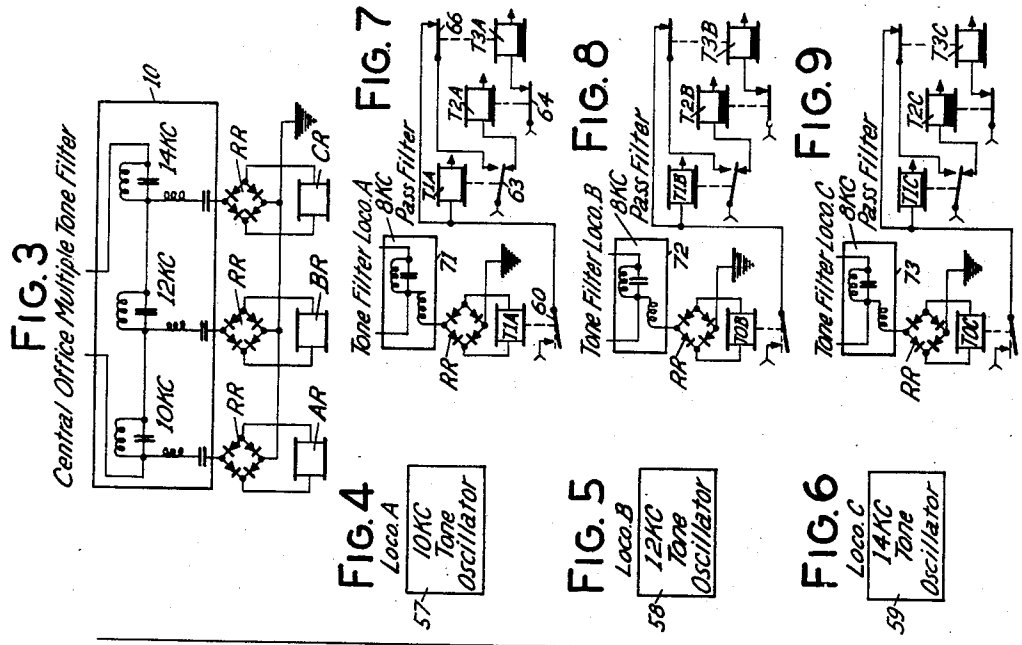
FIG. 2A

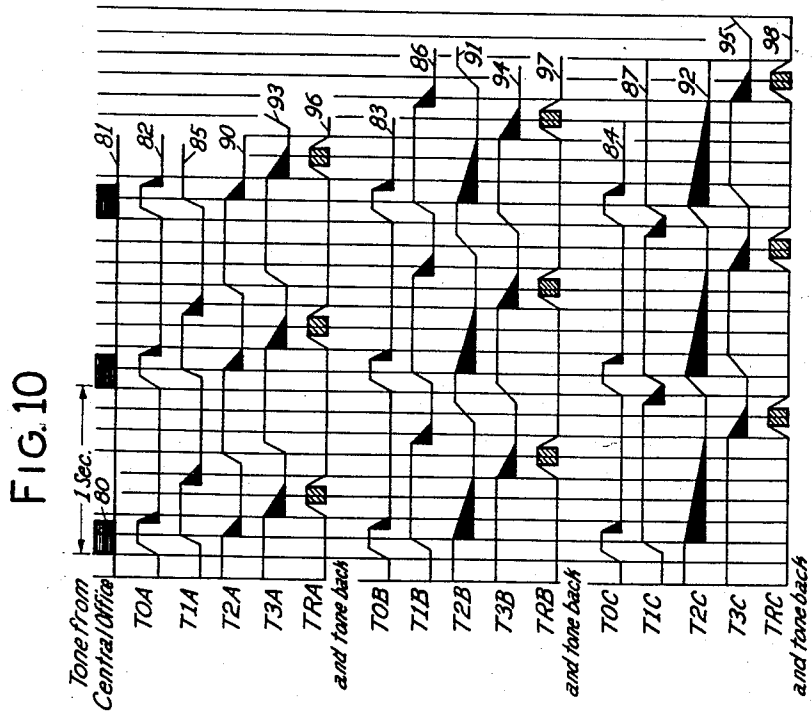
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TESTED CHANNEL RADIO COMMUNICATING SYSTEM

Filed Sept. 6, 1944 3 Sheets-Sheet 3





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Patented May 27, 1947

2,421,081

UNITED STATES PATENT OFFICE

2,421,081

TESTED CHANNEL RADIO COMMUNICATING SYSTEM

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Application September 6, 1944, Serial No. 552,833

20 Claims. (Cl. 250—6)

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This invention relates to radio communicating systems for communicating between a central station and one or more moving vehicles, and relates more particularly to means for checking whether the whole system is in proper working condition.

This invention is an improvement over the invention disclosed in the prior patent to Chappell, No. 2,280,420 and the prior patent to Chappell et al., No. 2,280,421. Although the systems of the two above mentioned patents include suitable checking means for checking the operativeness of a large portion of the apparatus involved, these former systems do not include means for completely checking the operativeness of the microphone at the central station and loud speaker on the moving vehicle, nor for checking the return communication channel from the moving vehicle to the central station.

In accordance with the present invention, it is proposed to provide suitable checking means for checking if the radio telephone system is in proper working order in both directions, which checking means involves the transmission of tone energy through both the microphone and the loud speaker in the first form of the invention and through a plurality of microphones and a plurality of loud speakers in the second form of the invention illustrated. By reason of the requirement that the checking energy not only pass through the circuits of the loud speaker and microphone but that it also check other operating properties of these instruments, it is proposed to convert the electric tone energy to acoustic wave motion and then back to electrical tone current by the diaphragms of the tone loud speaker and microphone.

Another feature of the present invention contemplates the use of a single central station or office and a plurality of movable stations on movable vehicles together with means for distinctively indicating at the central office the operativeness of the radio telephone apparatus on each of a plurality of moving vehicles, in some cases the indication that a particular vehicle carried apparatus is not in working condition may be due to the fact that such apparatus has been moved to a point out of communicating range with the central office located apparatus.

It is also proposed in accordance with the present invention to indicate an out-of-order condition of that portion of the radio communicating apparatus for communicating from the central office to a particular vehicle on such vehicle including means for checking the microphone at

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said central office and the loud speaker on such vehicle.

Other objects, purposes and characteristic features of the present invention will be understood when this description is considered in the light of accompanying drawings, in which:

Figs. 1A and 1B illustrate central office and vehicle carried apparatus of a one-way radio telephone communicating system embodying the present invention;

Figs. 2A and 2B show respectively the central office located apparatus and the apparatus carried on locomotive A, of a plurality of locomotives, of a two-way radio communicating system embodying the present invention;

Fig. 3 shows the multiple tone filter also illustrated in Fig. 2A of the drawings;

Figs. 4, 5 and 6 show the tone oscillator for locomotives A, B and C respectively of the system shown partly in Figs. 2A and 2B of the drawings;

Figs. 7, 8 and 9 show the tone filters and associated apparatuses for locomotives A, B and C respectively of which the tone filter and associated relays for locomotive A are also shown in Fig. 2B of the drawings; and

Fig. 10 shows a timing chart for the relays for locomotives A, B and C receiving their energies from filters shown in Figs. 7, 8 and 9 which filter out tone current generated by the tone generator of Fig. 2A.

One-way system—Structure.—In Fig. 1A of the drawings has been illustrated central office apparatus comprising a radio transmitter including a preamplifier 1, a radio oscillator and modulator 2, a radio frequency power amplifier 3, an antenna A1, and a microphone M1, this apparatus including a plate battery PB1. Under certain conditions tone energy is applied to the microphone M1 through the medium of a loud speaker LS1. This loud speaker LS1 has at times tone current applied thereto through a circuit including a front contact 11 of a relay TRO and a back contact 12 of a relay FRC, this tone current being derived from an audio oscillator 13 which oscillates a tone current preferably of approximately 8 kilocycles per second. The transfer relay TRO is at times intermittently picked up through the medium of a motor driven interrupter contact 16 closed intermittently through the medium of the cam 17 acting on roller 18. The other relay FRC is a foot pedal controlled relay and is controlled through a circuit including the normally open contact 20 of a foot pedal FP1. This contact 20 is normally held open through the medium of a tension spring 21. At other times the trans-

fer relay TRO may be held continuously energized through the medium of a front contact 22 of the foot pedal relay FRC.

Referring now to the vehicle carried apparatus shown in Fig. 1B of the drawings this apparatus includes an antenna A2, a receiver 26, a loud speaker LS2, a microphone M2, used only for checking purposes, a preamplifier 27, a tone filter 28, a tone following relay TO, a slow dropping tone repeating relay TORP and indicating lamps G and R.

One-way system—Operation.—Under normal conditions, that is, when no speech transmission takes place, the foot pedal FP1 is in its biased open-contact position so that the relay FRC assumes its deenergized position. The coding cam 17 is continuously operated by a suitable motor (not shown). This cam 17 may for instance be operated at a speed of 12 R. P. M. so that the contact 16 is closed once for every 5 second interval. The transfer relay TRO is therefore picked up intermittently at 5 second intervals and during each picking up of this transfer relay TRO audio current generated by the audio oscillator 13 may flow through the back contact 12 of the relay FRC and the front contact 11 of the relay TRO to the loud speaker LS1. This tone current is preferably of a frequency of 8 kc. or 8000 cycles per second. Although this tone current is of a frequency that falls in the audio range it falls in the upper portion of this range and the tone resulting therefrom is a very high pitch tone. As shown by the dotted arrow this high pitch tone passes from the loud speaker LS1 to the microphone M1 where it is converted into current which is amplified by the preamplifier 1, it is then passed to the oscillator and modulator 2 where it is used to modulate carrier frequency generated in this oscillator and modulator 2, from whence the modulated carrier current, after being amplified by the radio frequency power amplifier 3, is applied to the antenna A1. It should be observed that radio power amplifier 3 has its plate battery normally disconnected which is, however, connected through front contact 14 of relay TRO when this relay is picked up.

A portion of the radio energy emitted by antenna A1 is picked up by the antenna A2 and received by the receiver and detector 26 from whence the audio current detected flows to the loud speaker LS2. The high pitched tone given off by this loud speaker LS2 and originally generated by the oscillator 13 may then flow to the microphone M2 where it is converted into tone current which is amplified by the preamplifier 27 from whence this current may flow through the tone filter 28 and rectifier to the tone impulse following relay TO. The tone impulse following relay TO includes a full-wave rectifier RR as shown. This is resorted to by reason of the relative high frequency tone current employed. Other tone following relays are provided with a similar rectifier RR.

This tone relay TO will, therefore, follow the impulses of the rate code created by the coding cam 17 and if this cam rotates at 12 R. P. M. the tone relay TO will pick up 12 times per minute. This tone relay TO through the medium of its front contact 29 applies current intermittently to the tone repeating relay TORP. This latter relay TORP is so slow dropping that it will be continuously maintained in an energized position so long as the contact 29 is intermittently closed at this coding rate of 12 R. P. M. Obviously other tone coding rates may be used, if

desired. This tone repeating relay TORP is provided with a contact 30 which during energized conditions of the relay supplies energy to a green or "safe" color lamp G whereas under deenergized conditions of this relay it applies current to the red or "danger" lamp R. It is thus seen that during normal operating conditions, namely, when the telephone system is not used for transmitting speech, the lamp G is continuously energized and the tone repeating relay TO is intermittently energized and follows the impulses of the transmitted tone. It is thus seen that the green lamp G cannot be lighted unless both the microphone M1 and the loud speaker LS2 are both in good working condition. Furthermore, the preamplifier 1, oscillator and modulator 2, radio frequency power amplifier 3, and receiver 26 must all be in good working condition to maintain this green lamp G energized. It should be understood that the green and red colors mentioned signify "clear"; "danger" and but, since in the present disclosure the lamps G and R are to signify "working condition" and "out-of-order condition" respectively other colors such as amber and blue may be used, if desired.

Let us now assume that the operator at the central office desires to communicate an order to the locomotive engineer on the locomotive, as for instance, an order which is to be carried out continuously until countermanded by the operator at the central office. In order to communicate such an order, or any other speech, the operator at the central office will depress the foot pedal FP1 resulting in the closure of its contact 20 and in the energization and picking up of the foot pedal relay FRC. The picking up of this relay FRC by opening its back contact 12 removes all tone energy from the communicating apparatus. Also, picking up of its contact 22 continuously applies current to the transfer relay TRO so that this relay TRO is continuously picked up. The operator at the central office may now speak into the microphone M1 and the voice message received by this microphone M1 is transmitted to the loud speaker LS2 on the locomotive for obvious reasons. The locomotive engineer will obviously follow the orders transmitted to him until cancelled or until the checking apparatus including the green lamp G and the red lamp R manifest that the communicating system is out of working condition. If the locomotive engineer observes the red lamp R lighted and the green lamp G extinguished he will immediately discontinue carrying out the standing order given to him by the operator at the central office. This is done because it must be assumed that the operator may want to rescind the order and since he cannot do so it must be considered rescinded.

The advantage in the check in the system illustrated in Figs. 1A and 1B is that it enables an order, which is to be carried out until countermanded, to be safely given, in that this order may be countermanded by the operator at the central office if he so desires at any time so long as the apparatus is in working condition and is automatically countermanded upon failure of the communicating system. That is, should the radio communicating apparatus get out of order an equivalent countermanding order is given to the locomotive engineer through the medium of his check lights G and R and the locomotive engineer will upon indication of failure of the system discontinue carrying out the order that was given to him. In practice this continuing order may consist of an order to continue to push cars over

a hump in a classification system of the hump yard type.

Two-way system—Structure.—In Fig. 2A of the drawings has been conveniently illustrated the central office apparatus of a two-way radio communicating system of which some of the elements employed have also been shown in Fig. 1A, and for this reason have been assigned like reference characters. In Figs. 1A and 1B of the drawings the loud speakers LS1 and LS2 have been shown in relationship to their associated microphone M1 or M2 so that the sounds emitted by the loud speaker may readily strike the diaphragm of the associated microphone. In Figs. 2A and 2B of the drawings, however, each microphone M and its associated loud speaker LS comprise part of a unitary loud-speaker-microphone structure LSM and this structure has been designated LSM1 in Fig. 2A and has been designated LSM2 in Fig. 2B. This loud-speaker-microphone structure LSM1 is of circular construction and a cross-section taken through its axis of rotation is shown in each of Figs. 2A and 2B of the drawings.

It will be observed (Fig. 2A) that the speaker LS3 is arranged co-axially with the microphone M3, these two units being connected by a straight circular tube so that high pitched tones, which are much more directional in their travel than lower tones, may flow freely from the speaker LS3 to the microphone M3. As shown by cross hatching the diverging bell 33 is internally lined with sound absorbing material, such as felt, as is also the inside and outside of a telescoping bell 34, which extends into the bell 33, so that the sound emitted by the speaker unit LS3 and spread by the bell 33 must make several turns through a high pitch sound absorbing path before it reaches the surrounding atmosphere. Since both sides of the path of travel of this sound are provided with sound absorbing material, which greatly absorbs high pitched tones and only slightly absorbs low pitched tones, the structure renders the high pitched tones barely audible to a nearby standing person.

The microphone M3 of the unit LSM1 may, if desired, be a microphone of the double diaphragm type, so that it can be actuated from either side or it may be a single diaphragm microphone which is so mounted in the loud speaker housing that sound striking it from either side will vibrate the same diaphragm. These microphones M3 and M4 are also provided with a flared-out bell 35 over the mouth of which is stretched absorbent material capable of absorbing high pitched tones or that high pitched tones coming from the loud speaker will to a large extent be prevented from reaching the outside atmosphere, and high-pitched sounds from extraneous sources, such as escaping steam, will not simulate a check signal at the microphone, but will be absorbed by the sound-absorbing material covering the microphone. The loud-speaker-microphone structure LSM1 therefore comprises a unit which if spoken into, as into the flared bell 35, will cause audio currents to be transmitted from the microphone end of the unit. If, on the other hand, audio current is caused to flow in the winding of the speaker unit LS3, those currents which produce ordinary audio tones will cause these tones to pass out and be spread by the flared bell 33 whereas the tones due to the transmitted tone current, which are of high pitch frequency and cause high pitched tones to be given off by the speaker unit LS3, travel in a straight line to the diaphragm of the microphone M3.

In addition to the relays shown in Fig. 1A of the drawings, Fig. 2A of the drawings shows a squelch relay SQR having a back contact 43 and the code following relays AR, BR and CR having front contacts 44, 45 and 46 respectively. These relays AR, BR and CR are repeated into slow acting repeater and decoding relays ARP, BRP and CRP. These latter relays are so slow dropping that code-following operation of their associated relays will result in continuous energization of these latter relays ARP, BRP or CRP. In other words, the relays AR, BR and CR are rectified tone following relays whereas the repeater relays ARP, BRP and CRP are rectified tone decoding relays. These rectified tone decoding relays ARP, BRP and CRP are provided with contacts 54, 55 and 56 respectively. It will be observed that the rectified tone following relays AR, BR and CR derive their respective energies from the multiple tone filter 10 and associated rectifiers. It may be pointed out that this tone filter 10 has also been shown in Fig. 3 of the drawings from which it is readily seen that the relay AR will pick up only if 10 kilocycle tone energy is received, the relay BR will pick up if only 12 kilocycle tone energy is received and the relay CR will pick up only if tone energy of 14 kc. is received. In other words, relays AR, BR and CR pick up individually only if a tone current of 10 kc., 12 kc. and 14 kc., respectively, is received.

As already pointed out the central office apparatus transmits tone current which is preferably of 8000 cycles per second frequency and it may now be pointed out that the tone energy transmitted by the tone oscillators 57, 58 and 59 (Figs. 4, 5 and 6) generate tone currents of 10,000 cycles per second, 12,000 cycles per second and 14,000 cycles per second, respectively. In other words, tone energy generated by tone oscillator 57 (Fig. 4) can pick up only the tone repeating relay AR (Fig. 3), the tone generator 58 (Fig. 5) can only generate tone current which will be passed by the multiple tone filter 10 to the tone relay BR whereas the tone current generated by tone oscillator 59 (Fig. 6) will be passed by the multiple tone filter 10 (Fig. 3) only to the tone following relay CR. Although the timing of the relays AR, BR and CR, that is, their pick-up time and drop-away time, may be exactly the same, and the repeater relays ARP, BRP and CRP are also preferably timed alike, these relays follow distinctive tones as determined by their respective filters.

Referring now to Figs. 7, 8 and 9 the tone following relays TOA, TOB and TOC are connected to receive rectified tone energy passed only by their associated tone filter 71, 72 or 73 respectively. Each of these tone filters is, however, constructed to pass current of 8000 cycles per second so that these tone filters 71, 72 and 73 are identical. The tone filter 71 and its associated tone following relay TOA, and timing relays T1A, T2A and T3A have also been illustrated in Fig. 2B of the drawings. It will be seen that the timing relays T1A, T2A and T3A are controlled by the tone following relay TOA. As already pointed out all of these tone filters 71, 72 and 73 and their associated rectified tone following relays TOA, TOB and TOC are identical, or at least may be, but their associated timing relays are not identical in that the timing relays T2A, T2B and T2C (Figs. 7, 8 and 9) have successively longer drop-away times. This is conventionally indicated by

different width shaded portions of the relay windings and is also shown in the timing chart shown in Fig. 10 of the drawings. It will be noted that in the timing chart the timing relay T2A (Fig. 10) drops in one increment of time, that timing relay T2B drops in three increments of time, and that timing relays T2C drops in five increments of time. In all other respects, the timing relays T2A, T2B and T2C are identical. Also, timing relays T1A, T1B and T1C are preferably identical, and timing relays T3A, T3B and T3C are preferably identical. The purpose of making the drop-away times of these relays T2A, T2B and T2C different is to cause the answer-back tone impulses that are returned to the central office from the locomotives A, B and C to be applied to their respective antennas in sequence so that the central office antenna will receive these tones one at a time in sequence and will receive all three between successive tone impulses transmitted from the central office. In other words, it is proposed to transmit a tone impulse from the office and to thereafter first transmit a tone impulse from locomotive A to the office, then transmit a tone impulse from locomotive B to the office, then transmit a tone impulse from locomotive C to the office and after a suitable interval, another check is obtained when a tone impulse is again transmitted from the office to each of the three locomotives simultaneously. This cycle of operation is then repeated.

Two-way system—Operation.—Under normal conditions of the apparatus illustrated in Figs. 2A and 2B the foot pedal FP2 is in its retracted contact-open position so that the transfer relay TRO is intermittently picked up through a circuit starting at the terminal (+) of a suitable source of current, back contact 22 of the relay FRC, intermittent contact 16 operated by the coding cam 17, back contact 43 of the squelch relay SQR, through the winding of this transfer relay TRO to the other terminal (—) of the same source. The cam 17 in the form of invention illustrated in Figs. 2A and 2B is preferably operated at a higher speed than is the corresponding cam shown in Fig. 1A. The cam 17 of Fig. 2A is preferably operated at about 60 R. P. M. or once every second. The transfer relay TRO is intermittently picked up at the rate of once per second and when in its picked-up condition not only through the medium of its front contact 38 connects the antenna A3 to the transmitting apparatus but also through the medium of its contact 39 applies plate battery from the source PB3 to the transmitting apparatus.

Furthermore, each time the transfer relay TRO picks up it applies tone current generated by the audio tone oscillator 13 to the speaker LS3 of the loud-speaker-microphone unit LSM1. This tone current is of rather high pitch and its oscillation of the diaphragm of the speaker LS3 causes sound wave motion to be radiated in a comparatively straight direction which in turn will strike the diaphragm of the microphone M3. Very little of this high pitched tone will be radiated into the surrounding space through the flared bell 33 because a large part of the sound is radiated in axial line of the unit, and since the bell 33 is lined by sound absorbing material as already pointed out hereinbefore the diffused high pitch sound is absorbed in this bell. This high pitched tone oscillates the diaphragm of the microphone M3 and in turn generates an audio current which is amplified by the preamplifier 1 after which it passes into the radio oscillator and modulator 2

from whence it is amplified by the radio frequency amplifier 3 and applied through front contact 38 of the transfer relay TRO to the antenna A3. A portion of the radiated energy radiated by antenna A3 is picked up by the antenna A4 (Fig. 2B) and this energy then flows to the receiver and detector 26 (Fig. 2B) from whence the detected tone current flows to the speaker unit LS4 of the loud-speaker-microphone unit LSM2. For reasons already pointed out a high pitched tone given off by this speaker LS4 causes vibration of the diaphragm of microphone M4 to generate tone current which is amplified by the preamplifier 51 on each of the three locomotives A, B and C (only one having been shown in detail) to cause the picking up of the tone relay TOA for locomotive A, tone relay TOB for locomotive B and tone relay TOC for locomotive C, (Figs. 7, 8, and 9).

Referring now to the timing chart the tone pulse just mentioned has been indicated at 80 on time line 81 in Fig. 10 of the drawings, and it will be seen that this tone impulse 80 is repeated at spaced time intervals as illustrated on line 81. It will be observed from time line 82 that relay TOA is picked up immediately after the beginning of tone pulse 80 (see line 82), as is also true of relay TOB (see line 83) and relay TOC (see line 84). From this timing chart it will be observed that the picking up of relays TOA, TOB and TOC results in the immediate picking up of relay T1A, T1B and T1C as indicated by lines 85, 86 and 87 in Fig. 10 of the drawings. That is, relays TOA, TOB and TOC pick up in synchronism and a little later relays T1A, T1B and T1C pick up in synchronism. It is also readily seen that as soon as the relays T1A, T1B and T1C assume their energized positions (lines 85, 86 and 87) which relays all pick up at the same time, the relays T2A, T2B and T2C (lines 90, 91 and 92) all start to drop at the same instant, but that relay T2A will drop in one increment of time, relay T2B will drop in three increments of time, and relay T2C will drop in five increments of time. By referring to Fig. 2B of the drawings it will be observed that the dropping of the relay T2A, causing closure of its back contact 65, closes a circuit for picking up the transfer relay TRA. In other words, it is readily seen that the transfer relays TRA, TRB and TRC for locomotives A, B and C are not picked up simultaneously but are picked up sequentially, it being assumed that all three of these locomotives are at this time in use and that they are all in receiving range of the central office radio antenna. The time during which these three transfer relays TRA, TRB and TRC are sequentially picked up is indicated in Fig. 10 of the drawings by the timing lines 96, 97 and 98 respectively. The crosshatched blocks on these lines 96, 97 and 98 indicate the answer-back or inverse code impulses in a similar way as crosshatched block 80 identifies the driven code tone pulse in line 81. It is readily seen from the timing chart for relays T3A, T3B and T3C (see lines 93, 94 and 95 of Fig. 10) that these tone pulses are cut off as soon as the associated third timing relay T3A, T3B or T3C drops to its deenergized position.

The timing chart shown in Fig. 10 is based upon the circuits illustrated in Figs. 2B, 7, 8 and 9 of the drawings, it being remembered that relays T2A, T2B and T2C have different drop-away time periods. Referring to Fig. 2B and referring to the upper part of the time chart in Fig. 10 it will be seen that the picking up of the tone repeating relay TOA by the closure of its contact 60 picks up

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the relay T1A (see lines 82 and 85, Fig. 10). The relay T1A upon picking up closes a stick circuit including its stick contact 63 and its own winding. Also, the picking up of the relay T1A, causing the opening of its back contact 63, deenergizes the relay T2A (see lines 85 and 90 of Fig. 10). Dropping of the relay T2A, causing the opening of its front contact 64, deenergizes the relay T3A (see lines 90 and 93 of Fig. 10) and also by the closing of its back contact 65 closes an energizing circuit for the transfer relay TRA (see lines 90 and 96 of Fig. 10. This circuit may be traced from the terminal (+) of a suitable source of current, through back contact 42 of relay FRA, back contact 75 of squelch relay SQA, back contact 61 of relay TOA, back contact 65 of relay T2A, front contact 67 of relay T3A to the winding of relay TRA, to the other terminal (—). The dropping of the relay T3A will terminate the tone pulse (see lines 93 and 96 of Fig. 10) this being accomplished by the opening of its front contact 67. The opening of front contact 66 of relay T3A deenergizes the relay T1A (see lines 93 and 85 of Fig. 10).

In the same manner as the relays TOA, T1A, T2A and T3A of Fig. 10 define timing characteristics for locomotive A as indicated by lines 81, 82, 85, 90, 93 and 96 of Fig. 10 corresponding relays (see Figs. 8 and 9) for locomotives B and C define corresponding time periods as indicated by lines 83, 86, 91, 94, 97 and 84, 87, 92, 95, 98 respectively in Fig. 10 of the drawings. Referring to Fig. 2B it will be observed that relay TOA also controls through its contact 62, a slow dropping repeater relay ARPL. This latter relay ARPL is sufficiently slow dropping, that is, will remain continuously energized during intermittent picking up of the tone relay TOA at approximately the rate of one pick-up and drop-away per second. Locomotives B and C are provided with similar relays BRP and CRP. It is thus seen that if all of the apparatus for transmitting information from the office to the three locomotives is in good condition the green lamp G on each of these locomotives A, B and C will be lighted and this checking function includes the operativeness of all of the microphones and all of the loud speaker units.

Let us now observe how the operator at the central office is made aware of whether or not the radio communicating apparatus for communicating to a locomotive and back from such locomotive to the central office is in working condition. As already pointed out the transfer relays TR on each of the locomotives A, B and C are operated sequentially once for each impulse transmitted from the central office and between successive impulses so transmitted. Referring to Fig. 2B the picking up of the transfer relay TRA by closing its front contacts 48 and 49 connects the transmitting apparatus to the antenna A4 and connects the plate battery PB4 to this transmitting apparatus. Also, closing of front contact 31 of this transfer relay TRA causes tone energy to flow from the tone oscillator 57 through back contact 32 of the foot switch repeating relay FRA, front contact 31 of transfer relay TRA, to the coil of the speaker unit LS4. This energization of the speaker unit LS4 causes energy of air vibration to be transmitted to the microphone M4 from whence tone current is amplified by preamplifier 51, which then passes to the oscillator and modulator unit 52 where carrier frequency is modulated to this tone current frequency after which the resulting modulated carrier frequency is amplified by the radio power amplifier 53 from whence carrier frequency energy is transmitted through front contact 48 of transfer relay TRA to the antenna A4. A portion of the transmitted radio energy is received by the antenna A3 at the central office and since the transfer relay TRO at the central office has now assumed its deenergized position the received radio current flows through the back contact 38 of this relay TRO to the receiver and detector 89. At this point the received radio energy is detected and amplified and the resultant tone current is applied to the speaker unit LS3. This tone energy being of relatively high pitch audio frequency causes a relatively high pitched tone to be set up in the housing of the loud-speaker-microphone unit LSM1 to in turn cause vibration in the diaphragm of microphone M3. As already pointed out hereinbefore very little of this high pitch energy is emitted to the outside of, and by, this loud-speaker-microphone unit LSM1 and therefore this tone is not audible to the ear of the operator at the central office. The resulting tone current created by the microphone M3 is then applied to and is amplified by the preamplifier 1 from whence the energy flows to the multiple tone filter 10. This filter 10 has also been shown in Fig. 3 of the drawings and the tone current just considered will cause energization and picking up of the tone repeated relay AR because it is of 10 kc. frequency. Intermittent picking up of the tone repeater relay AR causes the repeater relay ARP to be maintained in its energized position continuously resulting in the continuous closure of front contact 54 and in the continuous illumination of the lamp GA.

For reasons already pointed out this received tone impulse will normally be followed by tone impulses from locomotives B and C in that order before the next tone impulse is transmitted from the central office. These tone impulses from locomotives B and C will in turn cause intermittent picking up of relay BR and CR and continuous picking up of relays BRP and CRP as a result of which the green lamps GB and GC will also be continuously lighted. This operation is of course based on the assumption that the apparatus on all three of the locomotives is in good working condition and that all three of these locomotives are within radio transmitting range of the central office apparatus. During this operation of the checking apparatus the squelch relay SQR (Fig. 2A) is picked up during each pulse of checking energy that is transmitted from the locomotives to the central office. By this is meant that it is picked up once for each of the three locomotives if three locomotives are employed. Putting this in different language the squelch relay SQR is sufficiently quick to pick up so as to pick up once for each pulse of checking energy transmitted to the office and drop between such pulses. If desired, however, the squelch relay may be slow enough dropping to be unable to drop between such sequential checking impulses transmitted to the office so that it will pick up and drop at the same rate as the rate of intermittent closing of contact 16 (Fig. 2A).

Let us now assume that the operator at the central office (Fig. 2A) desires to communicate with the engineers on one of the locomotives A, B or C. Since no selection to speak to any one of these engineers individually has been provided he must speak to all of them and specifically mention the particular engineer for whom the message is intended. The operator at the central office will then depress his foot pedal FP2 resulting in permanent energization of the relay

FRC which by opening its back contact 12 removes all tone pulses from the central office transmitting apparatus and by the closing of its front contact 22 picks up the transfer relay TRO permanently. The antenna A3 is now permanently connected to the transmitting apparatus as is also the plate battery PB3. The operator in the central office may now speak into the small bell 35 of the loud-speaker-microphone unit LSM1 and this results in the application of speech modulation to the carrier frequency generated and transmitted by the transmitting apparatus 1—3 to the antenna A3. Since tone impulses are no longer received at each of the locomotives A, B and C (relay FRC up) the apparatus illustrated in Fig. 2B of the drawings will remain as illustrated in the drawing so that voice modulated carrier frequency received by antenna A4 may flow directly through back contact 48 of the transfer relay TRA (Fig. 2B) to the receiver and detector 26, from whence after being demodulated the voice currents may flow to the loud speaker portion LS4 of the loud-speaker-microphone unit LSM2. Since this voice energy flows readily out of the large flared bell 33 and into the surrounding atmosphere in spite of the high pitch sound absorbent material shown by heavy lines the engineer on locomotive A will clearly hear the voice of the operator at the central office. What has been said in regard to locomotive A is also true of locomotives B and C.

It is of course understood that during this speech transmission from the central office to the locomotives no tone impulses will be received on these locomotives and the three tone following relays TOA, TOB and TOC will all remain deenergized long enough to drop their associated repeater relays ARPL, BRPL and CRPL respectively, so that the green check lights G on all three locomotives and the green check lights GA, GB and GC in the central office will be extinguished and their associated red lights R, RA, RB and RC will be illuminated. This illumination of the red indicator lamps and extinguishment of the green indicating lamps will be disregarded by the engineers of the three locomotives so long as speech is being received over the radio telephone communicating system. It is only when a green indicating lamp is extinguished without the immediate reception of speech that these engineers will interpret the radio telephone communication apparatus as being out of order.

Let us now assume that the apparatus is again in its normal tone pulse transmitting condition and that the engineer on locomotive A wishes to talk to the operator in the central office. In order to do so he will depress his foot pedal FP3 which results in the picking up of the foot pedal repeating relay FRA. The picking up of this repeating relay FRA by opening of contact 32 prevents any tone energy being transmitted from locomotive A. The reason for this is that closing of its front contact 42 results in the permanent picking up of the transfer relay TRA which by closing its front contacts 48 and 49 will cause continuous generation of carrier frequency and continuous connection of the transmitter 51—53 to the antenna A4. This locomotive A can therefore not transmit tone energy back to the central office as can the apparatus on locomotives B and C but it can transmit carrier frequency energy continuously. This continuous transmission of carrier frequency energy from locomotive A to the central office will result in the picking up of the squelch relay SQR (Fig. 2A). This squelch relay SQR will remain in its energized condition so long as the apparatus on locomotive A transmits carrier frequency as the result of which its open back contact 43 prevents further picking up of relay TRO and the transmission of either tone modulated or non-modulated carrier frequency. With this relay TRO permanently deenergized the antenna A3 is permanently connected to the receiver and detector 89. In other words, the engineer on any one of the locomotives A, B or C may at any time stop the transmission of tone impulses from the central office to all of the locomotives A, B and C and since the checking impulses transmitted by these locomotives to the central office are merely answer-back or reverse impulses they too will be discontinued. Furthermore, such engineer on locomotive A may by holding the transfer relay TRO at the central office permanently deenergized cause the central office antenna A3 to be permanently connected to the central office receiver. The engineer on locomotive A may now freely talk to the central office operator and this voice communication will also be heard by the engineers on locomotives B and C. This is true because all sets transmit and respond to the same carrier frequency in the preferred form of the invention. It should be understood, however, that distinctive carrier frequencies could be used but little is gained by such departure from the specific disclosure. The engineers on locomotives B or C, however, cannot speak to the engineer on locomotive A nor to the operator at the central office unless they first depress their own foot pedal.

As already pointed out the cam 17 may operate at any suitable speed, speeds of twelve and sixty revolutions per minute having been mentioned. In this connection, the speed of operation of the cam should be fast enough so that if an operator depresses his foot pedal, momentarily talks, and then releases his foot pedal, the apparatus at the receiving end will have been conditioned to receive the speech information and will have received it. For instance, the relay FRA (Fig. 2B) must be down to allow the reception of speech on locomotive A and this relay is controlled by time delay relays. The relay TRO should therefore drop fast enough so that the operator at the central office need not delay his talking too long. This time will be shortened as the speed of the cam 17 is increased. It should be understood that the expression loud speaker is not to be specifically construed in this application and that this expression is to mean any audible receiving means.

Two-way telephone communicating apparatus has thus been disclosed in which checking apparatus is provided which, during the absence of speech transmission of the apparatus, operates continuously to light indicating lamps which indicate operativeness of the apparatus so long as particular indicating lamps are energized, these checking impulses originating at the central office and being transmitted to each of the locomotives in the field. Each of the locomotives in the field will in sequential time order transmit answer-back or inverse checking impulses to the central office which checking impulses are received sequentially and produce individual indications of operativeness and within-range distance of these locomotives. It should be understood that these inverse tone pulses need not be transmitted in sequence as described in that they may be applied simultaneously but in this case

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more selective filtering apparatus must be employed in the multiple tone filter 10. Also, separate carrier frequencies for transmission of information from locomotive to central office may be used if desired. The apparatus is further such that the operator at the central office may at any time discontinue the transmission of driven checking impulses to enable him to transmit speech to the various locomotives. Also, the engineers on these various locomotives may break in between two successive impulses transmitted from the central office and by such breaking into the checking function may stop the transmission of checking impulses from the central office in order to enable such engineer to transmit speech to the central office.

The applicant has thus shown and described several embodiments of the present invention and has pointed out how this invention may be applied to a situation where there is one stationary central office and where there are three locomotives. It should, however, be understood that a large number of locomotives may be employed, if desired, and that the apparatus may be used for transmitting other information separate from speech information such, for instance, as traffic condition information, it being understood that in this case the lighting of the red check light will be construed to be a manifestation of danger traffic conditions.

Having thus shown and described only two embodiments of the present invention it should be understood that these particular embodiments have been selected to facilitate description of the underlying principles of the invention rather than the specific form the invention is to take or its scope, and that the unitary loud speaker and microphone units LSM1 and LSM2 of Figs. 2A and 2B may be replaced by individual units such as shown in Figs. 1A and 1B, which are arranged in communicating relationship to each other, and that, if desired, the combined units LSM1 and LSM2 of Figs. 2A and 2B may be used in the systems illustrated in Figs. 1A and 1B, also that various other changes, modifications and additions may be made to adapt the invention to the particular problems encountered in practicing the same, all within the spirit and scope of the present invention, so long as these changes come within the scope of the following claims.

What I claim as new is:

1. In a radio telephone system for transmitting from a central station to a movable vehicle voice messages concerning how the vehicle shall be manipulated; a radio transmitter for transmitting carrier frequency, a microphone including a diaphragm, a tone generator for generating vibrations to vibrate the diaphragm of said microphone, switching means operable by the operator at said central station and normally rendering said tone generator effective to vibrate said diaphragm and to in turn modulate said carrier frequency to such tone and operable to render said tone generator ineffective and to allow voice communication through said microphone and said transmitter; and a receiving station on a vehicle including a radio receiver, a loud speaker controlled by said receiver and emitting such speech and such tone, and visual signal means including a microphone effective only if tone energy is emitted by said loud speaker; whereby a person on the vehicle may detect from the failure to receive either such tone as indicated by said visual signal means or a voice message from the loud speaker that the system may be out of order.

2. In a radio telephone system for transmitting from a central station to a movable vehicle voice messages concerning how the vehicle shall be manipulated; a radio transmitter for transmitting carrier frequency, a combined microphone and loud speaker unit constructed so that sound of a predetermined tone is efficiently transmitted from the loud speaker portion to the microphone portion thereof, a tone generator for generating electric energy of a frequency corresponding to said predetermined tone, switching means operable by the operator at said central station and normally connecting said tone generator to the loud speaker portion of said unit to in turn actuate the microphone portion and modulate said carrier frequency to such tone and operable to render said tone generator ineffective so as to render said microphone free for speech transmission; and a receiving station on a vehicle including a radio receiver, another combined microphone and loud speaker unit of which the loud speaker portion is controlled by said receiver and emits such speech and such tone, and visual signal means including said another combined microphone and loud speaker unit and effective only if tone energy is emitted by the loud speaker portion and received by the microphone portion of said unit; whereby a person on the vehicle may detect from the failure to receive either such tone as indicated by said visual signal means or a voice message from the loud speaker that the system may be out of order.

3. In a radio telephone system for transmitting from a central station to a movable vehicle voice messages concerning how the vehicle shall be manipulated; a radio transmitter for transmitting carrier frequency, a combined microphone and loud speaker unit constructed so that sound of a predetermined tone is efficiently transmitted from the loud speaker portion to the microphone portion and including sound absorbent material for preventing the vibrations of such tone being emitted to the surrounding atmosphere, a tone generator for generating electric energy of a frequency corresponding to said predetermined tone, switching means operable by the operator at said central station and normally connecting said tone generator to the loud speaker portion of said unit and to in turn actuate the associated microphone portion and modulate said carrier frequency to such tone and operable to render said tone generator ineffective so as to render said microphone free for speech transmission; and a receiving station on a vehicle including a radio receiver, another combined microphone and loud speaker unit of which the loud speaker portion is controlled by said receiver and emits such speech and such tone, and visual signal means including said another combined microphone and loud speaker unit and effective only if tone energy is emitted by the loud speaker portion and received by the microphone portion of said unit; whereby a person on the vehicle may detect from the failure to receive either such tone as indicated by said visual signal means or a voice message from the loud speaker that the system may be out of order.

4. In a radio telephone system for transmitting from a central station to a movable vehicle and from such movable vehicle to said central station voice messages concerning how the vehicle shall be and is being manipulated; a radio transmitter for transmitting carrier frequency, a radio receiver for receiving radio energy of the same carrier frequency and a combined microphone-loud-

speaker unit constructed so that sound of a predetermined tone is efficiently transmitted from the loud speaker portion to the microphone portion thereof and including sound absorbent material for preventing the vibrations of such tone being emitted to the surrounding atmosphere at each the central station and on the movable vehicle; each loud speaker portion being connected to the associated receiver and each microphone portion being connected to the associated transmittter; an interrupter at said central station; a tone generator for generating electric energy of a frequency corresponding to said tone at said central station; switching means at said central station operable by the operator at such station and normally connecting said tone generator through the medium of said interrupter to the loud speaker portion of the unit at such central station and to in turn actuate the associated microphone and modulate said carrier frequency to such tone and operable to render said tone generator ineffective so as to render the microphone portion of the unit at said central station free for speech transmission; a tone generator on said vehicle for generating a similar tone; relay means on said vehicle responsive to intermittent tone impulses one response for each impulse; means on said vehicle controlled by said relay means for connecting said vehicle carried tone generator to the loud speaker portion of the unit on said vehicle between the impulses of tone modulated carrier frequency transmitted from said central station to said vehicle; and indicating means at said central office responsive to impulses of tone modulated carrier frequency transmitted from said vehicle to said central station; whereby the operator at said central station in response to an indication by said indicating means is informed that the entire radio telephone system including both the microphone portion and the loud speaker portion of both of the combined microphone-loud-speaker units is in working condition.

5. In a radio telephone system for transmitting from a central station to a movable vehicle and from such movable vehicle to said central station voice messages concerning how the vehicle shall be and is being manipulated; a radio transmitter for transmitting carrier frequency, a radio receiver for receiving radio energy of the same carrier frequency and a combined microphone-loud-speaker unit constructed so that sound of a predetermined tone is efficiently transmitted from the loud speaker portion to the microphone portion thereof and including sound absorbent material for preventing the vibrations of such tone being emitted to the surrounding atmosphere at each the central station and on the movable vehicle; each loud speaker portion being connected to the associated receiver and each microphone portion being connected to the associated transmitter; an interrupter at said central station; a tone generator for generating electric energy of a frequency corresponding to said tone at said central station; switching means at said central station operable by the operator at such station and normally connecting said tone generator through the medium of said interrupter to the loud speaker portion of the unit at such central station and to in turn actuate the associated microphone and modulate said carrier frequency to such tone and operable to render said tone generator ineffective so as to render the microphone portion of the unit at said central station free for speech transmission; a tone generator on said vehicle for generating a similar tone; relay means on said vehicle responsive to intermittent tone impulses one response for each impulse; means on said vehicle controlled by said relay means for connecting said vehicle carried tone generator to the loud speaker portion of the unit on said vehicle between the impulses of tone modulated carrier frequency transmitted from said central station to said vehicle; vehicle carried indicating means responsive to tone impulses transmitted from said office to said vehicle; and office located indicating means at said central office responsive to impulses of tone modulated carrier frequency transmitted from said vehicle to said central station; whereby the operator of said vehicle in response to an indication by said vehicle carried means is informed that the portion of the radio telephone system for transmitting information from said office to said vehicle including both microphone-loud-speaker units is in working condition, and whereby the operator at said central station in response to an indication by said office located indicating means is informed that the entire radio telephone system including both the microphone portion and the loud speaker portion of both of the combined microphone-loud-speaker units is in working condition.

6. In a radio telephone system for transmitting from a central station to a movable vehicle and from such movable vehicle to said central station voice messages concerning how the vehicle shall be and is being manipulated; a radio transmitter for transmitting carrier frequency, a radio receiver for receiving energy of the same carrier frequency, a microphone, and a loud speaker at each the central station and on the movable vehicle; said microphone and loud speaker being positioned so that sound from said loud speaker can actuate the diaphragm of said microphone, the loud speaker being connected to the associated receiver and the microphone being connected to the associated transmitter; a tone generator at said central station for generating electric energy of a predetermined frequency; a circuit interrupter at said central station; switching means at said central station operable by the operator at such station and normally connecting said tone generator through said interrupter to the associated loud speaker at such central station to in turn actuate said microphone and modulate said carrier frequency to such tone and operable to render said tone generator ineffective so as to render the microphone free for speech transmission; a tone generator on said vehicle for generating a similar tone; means on said vehicle for connecting said tone generator to the loud speaker on said vehicle between the impulses of tone modulated carrier frequency transmitted from said central station to said vehicle; and means at said central office responsive to impulses of tone modulated carrier frequency transmitted from said vehicle to said central station; whereby the operator at said central station in response to an indication by said indicating means is informed that the entire radio telephone system including both the microphone and the loud speaker both on the vehicle and at said central station are in working condition.

7. In a radio telephone system for transmitting from a central station to any one of a plurality of movable vehicles and from such movable vehicles to said central station voice messages concerning how the vehicles shall be and are being manipulated; a radio transmitter for transmitting carrier frequency, a radio receiver for re-

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ceiving energy of the same carrier frequency, a microphone, and a loud speaker at each the central station and on each of the movable vehicles; said microphone and loud speaker being positioned so that sound from said loud speaker can actuate the diaphragm of said microphone, the loud speaker being connected to the associated receiver and the microphone being connected to the associated transmitter; a tone generator at said central station for generating electric energy of a predetermined frequency; a circuit interrupter at said central station; switching means at said central station operable by the operator at such station and normally connecting said tone generator through said interrupter to the associated loud speaker at such central station to in turn actuate said microphone and modulate said carrier frequency to such tone and operable to render said tone generator ineffective so as to render the microphone free for speech transmission; a tone generator on each of said vehicles for generating a similar but distinctive tone; means on each vehicle for connecting its tone generator to the loud speaker on such vehicle between the impulses of tone modulated carrier frequency transmitted from said central station to said vehicle; and means at said central office distinctively responsive to distinctive impulses of tone modulated carrier frequency transmitted from said vehicles to said central station; whereby the operator at said central station in response to indications by said indicating means is informed that the entire radio telephone system including both the microphone and the loud speaker both on each of the vehicles and at said central station are in working condition.

8. In a checked two-way radio communicating system, a first radio communicating system for transmitting information from one location to another location, a second radio communicating system for transmitting information from said another location to said one location, each of said radio communicating systems including a microphone and a speaker, and means at each of said locations for manifesting when any of said microphones or speakers are out of order.

9. In a checked two-way radio communicating system, a first radio communicating system for transmitting information from one location to another, a second radio communicating system for transmitting information from said another to said one location, each of said radio communicating systems including a microphone and a speaker, and means at said one location for manifesting when either of said communicating systems including their microphone and speaker is out of order.

10. In a radio telephone system of the type described, the combination with a central station and a movable vehicle; a transmitter, a receiver, an antenna, a microphone, a loud speaker and a transfer relay to connect either the receiver or the transmitter to the antenna at each said central station and on said vehicle; each loud speaker being so located with respect to its associated microphone that sounds from said loud speaker can actuate the microphone; means at said central station for intermittently operating the office transfer relay to intermittently apply a tone frequency current to the loud speaker which by actuating the microphone modulates the carrier frequency applied to the office antenna each time this antenna is connected to the associated transmitter during intermittent operation of said transfer relay; means on said vehicle responsive to said tone modulated carrier frequency to actuate the vehicle carried transfer relay to apply a tone frequency current to the vehicle carried loud speaker which by actuating the associated microphone modulates the carrier frequency applied to the vehicle carried antenna during each intermittent picking up of the vehicle carried transfer relay and between the impulses of tone modulated carrier frequency transmitted by said central office; and visual indicating means at said central office responsive to the reception of tone modulated carrier frequency; whereby the operator at said central station in response to an indication by said visual indicating means is informed that the entire radio telephone system including both microphones and both loud speakers is in working condition.

11. In a radio telephone system of the type described, the combination with a central station and a movable vehicle; a transmitter, a receiver, an antenna, a microphone, a loud speaker and a transfer relay to connect either the receiver or the transmitter to the antenna at each said central station and on said vehicle; each loud speaker being so located with respect to its associated microphone that sounds from said loud speaker can actuate the microphone; means at said central station for intermittently operating the office transfer relay to intermittently apply a tone frequency current to the loud speaker which by actuating the microphone modulates the carrier frequency applied to the office antenna each time this antenna is connected to the associated transmitter during intermittent operation of said transfer relay; means on said vehicle responsive to said tone modulated carrier frequency to actuate the vehicle carried transfer relay to apply a tone frequency current to the vehicle carried loud speaker which by actuating the associated microphone modulates the carrier frequency applied to the vehicle carried antenna during each intermittent picking up of the vehicle carried transfer relay and between the impulses of tone modulated carrier frequency transmitted by said central office; means for each transfer relay manually operable to pick up and hold such transfer relay energized to permit speech transmission from that location; and visual indicating means at said central office responsive to the reception of tone modulated carrier frequency; whereby the operator at said central station in response to an indication by said visual indicating means is informed that the entire radio telephone system including both microphones and both loud speakers is in working condition.

12. In a radio telephone system of the type described, the combination with a central station and a movable vehicle; a transmitter, a receiver, an antenna, a microphone, a loud speaker and a transfer relay to connect either the receiver or the transmitter to the antenna at each said central station and on said vehicle; each loud speaker being so located with respect to its associated microphone that sounds from said loud speaker can actuate the microphone; means at said central station for intermittently operating the office transfer relay to intermittently apply a tone frequency current to the loud speaker which by actuating the microphone modulates the carrier frequency applied to the office antenna each time this antenna is connected to the associated transmitter during intermittent operation of said transfer relay; means on said vehicle responsive to said tone modulated carrier frequency to actuate the vehicle carried transfer

relay to apply a tone frequency current to the vehicle carried loud speaker which by actuating the associated microphone modulates the carrier frequency applied to the vehicle carried antenna during each intermittent picking up of the vehicle carried transfer relay and between the impulses of tone modulated carried frequency transmitted by said central office; and visual indicating means at said central office and on said vehicle responsive to the reception of tone modulated carrier frequency; whereby the operator at said central station in response to an indication by the office visual indicating means is informed that the entire radio telephone system including both microphones and both loud speakers is in working condition and the operator on said vehicle in response to an indication by the vehicle carried visual indicating means is informed that the portion of the system for transmitting information from the office to such vehicle is in working condition.

13. In a two-way radio telephone communicating system; the combination with radio telephone transmitting and radio telephone receiving apparatus at one station, of radio telephone transmitting and radio telephone receiving apparatus at another station, both apparatuses employing the same carrier frequency and each including a microphone and a loud speaker; manually operable means at each station which if actuated determines that that station is the transmitting station; and means effective so long as both of said apparatuses are not in use to check the operativeness of said system including both microphones and both loud speakers.

14. In a two-way radio telephone communicating system; the combination with radio telephone transmitting and radio telephone receiving apparatus at one station, of radio telephone transmitting and radio telephone receiving apparatus at another station, both apparatuses employing the same carrier frequency and each including a microphone-loud-speaker unit constructed so that all sounds emitted by the loud speaker vibrate the diaphragm of the associated microphone; manually operable means at each station which if actuated determines that that station is the transmitting station; and means effective so long as both of said apparatuses are not in use to check the operativeness of said system including the operativeness of both microphones and both loud speakers.

15. In a two-way radio telephone communicating system; the combination with radio telephone transmitting and radio telephone receiving apparatus at a central station, of a plurality of radio telephone transmitting and radio telephone receiving apparatuses one at each of a plurality of other stations, all apparatuses employing the same carrier frequency and each including a microphone and a loud speaker; manually operable means at each station which if actuated determines that that station is the transmitting station; and means effective so long as all of said apparatuses are not in use for checking the operativeness of said system including all microphones and all loud speakers.

16. In a two-way radio telephone communicating system; the combination with radio telephone transmitting and radio telephone receiving apparatus at a central station, of a plurality of radio telephone transmitting and radio telephone receiving apparatuses one at each of a plurality of other stations, all apparatuses employing the same carrier frequency and each including a microphone and a loud speaker; manually operable means at each station which if actuated determines that that station is the transmitting station; and indicating means at said central station effective so long as all of said apparatuses are not in use for checking individually the operativeness of said apparatuses including the microphone and the loud speaker of each apparatus.

17. In a two-way radio communicating system, a first radio communicating system for transmitting voice from one location to another and including a squelch relay for preventing such communication, a second radio communicating system for transmitting voice from said another to said one location also including a squelch relay for preventing such communication, each of said radio communicating systems including a microphone and a speaker, means for energizing a squelch relay at a station when such station receives radio energy, and means at said one location for checking the operativeness of said two-way communicating system.

18. In a radio communication system, a radio transmitter for transmitting a radio carrier frequency when rendered effective, a microphone for governing the modulation of said carrier frequency when activated, coding means acting to intermittently render said radio transmitter effective to transmit pulses of carrier frequency, a tone generator for activating said microphone during each of said carrier pulses, manually operable means for rendering said radio transmitter steadily effective and preventing the activation of said microphone by said tone generator whereby a voice message spoken into said microphone effects the modulation of said carrier frequency, a radio receiver at another station including a loud speaker, and indication means at said other station responsive to the intermittent emitting of said tone from said loud-speaker to give a distinctive indication, whereby the absence of both said distinctive indication or a voice message advises an operator that the communication system has failed.

19. In a radio communication system, a radio transmitter for transmitting a radio carrier frequency, a microphone for governing the modulation of said carrier frequency, coding means including a tone generator for intermittently activating said microphone to effect the transmission of check tone carrier pulses, manually operable means for rendering said coding means ineffective and said radio transmitter effective for the transmission of a voice message by speaking into said microphone, a radio receiver at another station including a loud speaker, and indication means at said another station governed by the intermittent reception of said check tone as emitted by said loud speaker for giving a distinctive indication during the absence of such intermittent reception of the check tone pulses, whereby said distinctive indication advises an operator that a voice message should be received and in the event of a failure to receive such a voice message the operator is advised that the system has failed.

20. In a two-way radio telephone system operating on a carrier frequency between a primary station and a secondary station, a transmitter and receiver at each station adapted to operate on the same carrier frequency channel, said receivers being normally active and their respective transmitters inactive, keying means at the primary station for intermittently rendering its associated receiver inactive and its transmitter

active to transmit a check-tone modulated carrier signal, a tone-responsive relay at each station operated by its associated receiver only upon the reception of a check-tone modulated carrier signal, circuit means at the secondary station controlled by the tone-responsive relay at that station each time it is operated for momentarily rendering its associated receiver inactive and its transmitter active to transmit a momentary answer-back check-tone modulated carrier signal, indication means at each station rendered active by the intermittent operation of its associated tone-responsive relay, manually operable means at each station effective to render the associated receiver inactive and render the associated transmitter active for the transmission of voice-modu-

lated carrier signals, and means at the primary station rendering said keying means ineffective both when that station is manually rendered active to transmit a voice-modulated carrier signal and when that station is receiving a voice-modulated carrier signal.

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