My invention relates to transmitting apparatus for railway train communication systems, and more particularly to transmitting apparatus for railway train communication systems which use the track rails as conductors of a transmitting circuit.

In a railway train communication system which uses the track rails in the transmitting circuit, the transmitting apparatus on a train is frequently conductively coupled to the transmitting circuit by a sending loop circuit which is interposed between the transmitting apparatus and two pairs of wheels of the train, such sending loop circuit including the wheel-to-rail contact and the length of rail between the two pairs of wheels. The current flowing in this sending loop circuit creates a voltage drop across such length of rail, and such voltage drop in turn causes communication current to flow in the rails in multiple and through the rail-to-ground impedance. In order to create a relatively large voltage drop across such rail length, the sending loop circuit is tuned for the communication current and is proportioned for an impedance that places a full load on the transmitting apparatus. When a train stops or is moving at a very low speed, there may be a very high resistance, amounting to practically an open circuit, for such sending loop circuit due to the rust and dirt between the wheels and the rails. That is to say, a high resistance wheel-to-rail contact may occur due to the surface condition of the rails.

A feature of my invention is the provision of train carried transmitting apparatus of the type here involved incorporating novel and improved means wherewith a relatively high temporary voltage is created to break down the resistance of a wheel-to-rail contact.

Still another feature of my invention is the provision of train carried transmitting apparatus incorporating novel means for conditioning an associated sending loop circuit so as to place the full normal output load on the transmitting apparatus independent of the usual path through the wheel-to-rail contacts and rails and to create a relatively high temporary voltage across the circuit conductors connected to the wheels.

Again, a feature of my invention is the provision of train carried transmitting apparatus incorporating an improved series-parallel tuned sending loop circuit for conductively coupling train carried transmitting apparatus to the track rails.

Other features and advantages embodying my invention will appear as the specification progresses.

The above features and advantages embodying my invention I attain by providing a low power factor inductance, a special load reactance and a special switching means, the switching means being operable to connect the low power factor inductance across the loop circuit conductors leading to the wheels at which contacts are made to the rails, and to connect the special load reactance to the transmitting apparatus. In this way a temporary circuit is formed by the special reactance and inductance and which circuit causes substantially the full load current to be supplied by the transmitting apparatus and a resultant relatively high voltage developed across the low power factor inductance. The inductance being connected across the conductors leading to the wheels, this high voltage is applied across the wheel-to-rail contact to break down the resistance of the wheel-to-rail contact. Ordinarily the breaking down of the resistance of the wheel-to-rail contact is effected almost immediately and hence a short period set up by the switching means is all that is required. The sending loop circuit may be series tuned or parallel tuned as has been used heretofore, but I have found that a series-parallel tuned circuit has special advantages.

I shall describe three forms of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 is a diagrammatic view showing one form of apparatus embodying my invention when used with train carried transmitting apparatus using a series tuned sending loop circuit. Fig. 2 is a diagrammatic view showing another form of apparatus embodying my invention when used with train carried transmitting apparatus using a parallel tuned sending loop circuit. Fig. 3 is a diagrammatic view showing train carried transmitting apparatus provided with a series-parallel tuned sending loop circuit and which apparatus also embodies my invention. In each of the different views like reference characters are used to designate similar parts.

Referring to Fig. 1, the reference character CO designates a vehicle of a railway train, such as, for example, a caboose of a freight train. This vehicle CO has mounted thereon communication apparatus which ordinarily comprises transmitting apparatus and receiving apparatus. As here shown, the transmitting apparatus includes as essential elements a modulator MO, an oscillator
OS, a band pass filter BPF, a power amplifier PA and a sending loop circuit SL, together with proper sources of current and a switching means to be described hereinafter. The modulator, oscillator, filter and power amplifier of the transmitting apparatus may be of any one of several different constructions, and they are shown conventionally in Fig. 1 since their specific construction forms no part of my present invention. For example, these elements of the transmitting apparatus may be similar to those disclosed by Letters Patent of the United States No. 2,064,639, granted December 15, 1936, to Leland D. Whitelock et al. for Communication systems. It is sufficient for the present application to point out that voice frequencies produced in a microphone M and the carrier frequency current generated at oscillator OS are mixed at modulator MO to produce upper and lower side bands of the carrier. Band pass filter BPF is proportioned to pass a preselected one of the side bands to the power amplifier PA where such side band current is amplified in the plate circuits of two electron tubes 4 and 5. The plate circuits for tubes 4 and 5 include windings 6 and 7, respectively, of an output transformer T1. A source of current whose terminals are identified at E300 and N300 is connected to these plate circuits through a front contact 8 of a directional relay DR, and a winding of a relay RF, both of which relays will be referred to later. A condenser CB is preferably connected across the winding of relay RF. The communication apparatus mounted on caboose CO would ordinarily include receiving apparatus so to provide two way communication, but such receiving apparatus is omitted from the drawing since it forms no part of my invention and is not required for an understanding thereof. Normally, the directional relay DR is released, closing back contact 8 to connect the B300—N300 current source to the receiving apparatus and the receiving apparatus is normally conditioned for reception. With relay DR released to open front contact 8 the tubes 4 and 5 of the power amplifier PA are without plate voltage and the transmitting apparatus is normally inactive. When a push button PB1 is operated to close a contact 8 a simple circuit for energizing relay DR by current from a source whose terminals are designated E300 and N300 is completed and relay DR is picked up to switch the B300—N300 current source from the receiving apparatus to tubes 4 and 5 of the power amplifier and the transmitting apparatus is made active for supplying communication current, such current being delivered to a secondary winding 10 of output transformer T1 at a relatively high energy level. This transmitting apparatus is also operable to supply current of a preselected frequency within the preselected side band for calling and signaling purposes. Such calling current may be created by shifting the frequency of the oscillator OS a predetermined voice frequency and as here shown this is done by disconnecting a condenser 11 from the oscillating circuit of oscillator OS, oscillator OS being of the electron tube type. A calling relay DR1 is normally released to close back contact 12 and connect condenser 11 to the oscillating circuit of oscillator OS and the oscillator is conditioned to deliver a carrier frequency as preselected for telephone purposes. Operation of a push button PB2 completes at its contact 13 a simple circuit for energizing relays DR1 and DR in series. The picking up of relay DR1 to open back contact 12 disconnects condenser 11, and the oscillator OS is conditioned to deliver a carrier current of a frequency equal to the original frequency plus a preselcted voice frequency. Since relay DR is also picked up to apply plate voltage to the tubes of the power amplifier PA, the calling current is supplied to winding 10 of output transformer T1 at a relatively high energy level. By way of illustration, I shall assume that oscillator OS is normally conditioned to deliver a carrier current of 5700 cycles per second. The frequency of the range of 400 to 2000 cycles per second are used for modulation and the upper side band is selected by filter BPF. Thus with directional relay DR picked up and calling relay DR1 released, a carrier telephone current of the frequency range of 5700 to 8300 cycles is applied to the winding 10 of the output transformer. Furthermore, I shall assume that the carrier current is raised 1000 cycles to 6700 cycles per second when condenser 11 is disconnected, carrier current of 6700 cycles being the equivalent of the original carrier of 5700 cycles modulated by the voice frequency of 1000 cycles. Thus when both relays DR and DR1 are picked up a calling current of 6700 cycles per second is supplied to the winding 10 of output transformer T1.

The sending loop circuit SL connects winding 10 of transformer T1 to the two pairs of wheels 14 and 16 of caboose CO, only one wheel of each pair being shown in the drawing. This sending loop circuit can be traced from one terminal of winding 10 of transformer T1 through condenser 17 to the pair of wheels 14 of caboose CO, the contacts between wheels 14 and the track rails, track rails in multiple, contacts between the rails and wheels 15, conductor 18 and condenser CS to the other terminal of winding 10. Condenser CS is proportioned to series tune the circuit SL for the carrier telephone current, and preferably the circuit SL is tuned to resonance at some mid frequency of the carrier, telephone current, and which mid frequency may be that used for the calling current. Furthermore, condensers 16 and 12, as well as other parts of the circuit SL, are made of relatively large cross sections so that the resistance of the circuit is relatively low and its overall impedance is such as to place substantially full load on the transmitting apparatus.

According to my invention, circuit SL has associated therewith a low power factor inductance L, a load reactance LP, and relay RF. Inductance L is connected across conductors 16 and 12 over back contact 18 of relay RF, and load reactance LP is connected across winding 10 of transformer T1 over back contact 20 of relay RP. Inductance L may be, for example, an air core coil, and load reactance LP may be, for example, an iron core coil.

In describing the operation of the apparatus of Fig. 1, I shall assume that caboose CO is not moving and that the contact between at least one pair of the wheels and the track rails is of a relatively high resistance or normal condition on the surface of the rails. The normal procedure in initiating communication in a train communication system is for an operator to first transmit calling current to inform the operator at the associated remote station that telephone communication is desired, and to this end the operator at the caboose CO actuates push button PB2 to pick up both relays DR and DR1 to condition the transmitting apparatus for supplying the calling current. When plate volt-
age is applied to tubes 4 and 5 of the power amplifier, the relay RF is also energized, but relay RF is provided with a predetermined slow pick-up period, and hence there is an interval during which relay RF remains released, after relays DR and DRI are picked up. During this slow pick-up period of relay RF, there are two circuit paths across secondary winding 10, one path including condenser CS, back contact 15 of relay RP and inductance L, and the other path including load reactance LP and back contact 23 of relay RF. The temporary circuit formed by load reactance LP in multiple with condenser CS and inductance L in series is proportioned for parallel resonance at the frequency of the calling current, and thus the current flowing through condenser CS and inductance L is large as compared to the output current of transformer T1 with the result a high voltage is created across condenser CS and inductance L. This voltage created across inductance L is applied to conductors 18 and 19 and hence is available for breaking down the resistance of the assumed high resistance contact between wheels 14 and the rails. If the resistance of the wheel-to-rail contact is going to break down at all it will nearly always do so immediately and also when such resistance is once broken down it remains at its usual low value. Thus, the high voltage developed across inductance L during the slow pick-up period of relay RF is usually sufficient for breaking down any high resistance at a wheel-to-rail contact.

By way of example, a sending loop circuit of the type here involved may have a normal resistance of the order of 1.0 ohm and a power factor of about 0.1 without giving a circuit impedance of about 1.0 ohm. The transmitting apparatus may have a full load output of 100 watts, which work would make a normal load current of about 32 amperes for the sending loop circuit. The temporary circuit formed by inductance L and load reactance LP should consume 100 watts, the full load of the transmitting apparatus. Inductance L may have a power factor of about 0.2 percent, a practical value for an air core coil, and a resistance of about 0.02 ohm. Condenser CS may have a 1 percent power factor and a resistance of about 0.01 ohm. This gives a total resistance of 0.03 for the two devices L and CS in series. Considering that the power loss through inductance L and condenser CS to be 90 watts, the current flowing therethrough would be 55 amperes

\[(55 \times 55 \times 0.63 = 90)\]

For the transmitting apparatus to deliver its full load to the temporary circuit its output voltage and current should have their normal values. This requires that 45 reactive amperes for reactance LP be added to the 32 power amperes from output transformer T1 to give the above assumed 55 amperes through inductance L and condenser CS. The normal voltage of transformer T1 is about 22 volts, making the 65 volt-amperes in reactance LP about 144 (45\times3.2). If now reactance LP is provided with a power factor of 1 percent it will consume about 10 watts \((144\times0.01)\), making the total power consumed in the temporary circuit 100 watts, which is the full output of the transmitting apparatus.

Under these conditions inductance L would have a reactance of about 0.95 ohm giving a voltage across its terminals of about 52 volts \((0.95\times55)\), and which 52 volts are available for breaking down the resistance of the wheel-to-rail contact.

When only directional relay DR is picked up to initiate telephone communication, the telephone current creates no appreciable breakdown voltage during the pick-up period of relay RF. It is clear that in Fig. 1 a condenser may be used for the reactance LP in place of an inductor and the apparatus will operate in substantially the same manner as described above.

In Fig. 2, a vehicle CO of a railway train is provided with communication apparatus including transmitting apparatus of a construction similar to that of Fig. 1 except a parallel condenser CP replaces series condenser CS and a series load reactance LS replaces parallel reactance LP. Also relay RF of Fig. 1 is replaced by a relay RF1 and the switching means is modified to condition circuit SL to develop a breakdown voltage whenever the transmitting apparatus is being conditioned for supplying a telephone current as well as when it is being conditioned for supplying a calling current. Looking at Fig. 2, operation of push button PBS for sending calling current completes a circuit for energizing relays RF1, DR and DRI in series, such circuit extending from terminal B through the windings of relays RF1, DR and DRI in series, and contact 13 of push button PBS to terminal C. Relay RF1 is provided with a slow pick-up period and consequently relay DR is picked up to connect the B300—N300 source to the tubes 4 and 5 of the power amplifier PA and relay DR is picked up to condition oscillator OS to supply the calling current prior to the picking up of relay RF1. With relay RF1 released, the low power factor inductance L is connected across conductors 16 and 13 over back contact 21 of relay RF1 and load reactance LS is connected across windings 19 in series with inductance L and condenser CP in parallel. The susceptance of inductance L is made slightly less than that of condenser CP and load reactance LS tunes out the resulting capacitance reactance of condenser CP and inductance L in parallel so that transformer T1 feeds the calling current into a temporary circuit having a resistance that places substantially full load on the transmitting apparatus. Hence a relatively high voltage is developed across inductance L in the manner described in connection with Fig. 1, and which voltage is available for breaking down the resistance of the wheel-to-rail contacts. At the end of the slow pick-up period of relay RF1, the relay picks up to disconnect inductance L at back contact 18 and to short circuit load reactance LS at front contact 22 and the sending loop circuit SL is then in its normal condition for transmission of the calling current. In the event push button PBI is operated to condition the transmitting apparatus for supplying carrier telephone current, a circuit is first formed from terminal B through windings of relays RF1, DR and DRI, back contact 23, and transfer contact 15 of a continuity transfer contact for relay RF1, and contact 9 of push button PBI to terminal C, and the three relays are energized in series with relays DR and DRI being picked up immediately and relay RF1 being picked up at the end of its slow pick-up period. Hence a calling current is first delivered to the temporary circuit to develop a high voltage across conductors 16 and 13 for breaking down the resistance of the wheel-to-rail contacts. With relay RF1 picked up, the relays RF1 and DR are
held energized over a circuit which passes from terminal B through the windings of relays RFI and DR, front contact 25 and transfer contact 24 of relay RF1 and contact 3 of push button PBI to terminal C. Relay DR is now deenergized and released, and oscillator OS conditioned to supply the original carrier current used for telephone purposes. With relay RF1 picked up, the circuit SL is switched to its normal condition as explained above. It is to be pointed out that inductor L' for the load resistance of Fig. 2 may be replaced by a condenser if desired.

In Fig. 3, a caboose CO is provided with transmitting apparatus similar to that of Fig. 1, except to include a series-parallel tuned sending loop circuit and a switching means that is modified to apply a high break-down voltage automatically whenever needed, instead of being applied only when one or the other of the push buttons PBI and PBO is operated to initiate either the sending of calling or telephone current. Such switching means includes a polar relay RP, a neutral relay RP2 and two rectifiers 26 and 27. Relay RP is preferably a two winding biased polar relay, contact members 30 and 31 of relay RP are biased to the right as viewed in Fig. 3, and the energization of winding 25 by current flowing in the direction indicated by the arrow placed on winding 25 energizes the relay to add the bias to position the polar contact members 30 and 31 to the right to engage respective normal polar contacts. Energization of winding 23 by current of the direction indicated by the arrow placed on winding 23 energizes the relay to position contact members 33 and 31 to the left to engage respective reverse polar contacts. Winding 23 is supplied with unidirectional current from a transformer T2 and rectifier 27, transformer T2 having a primary winding 33 in series with the sending circuit SL and a secondary winding 32 connected to the output terminals of rectifier 27 whose output terminals are connected across winding 23. Winding 33 is energized by energy taken from transformer T1 in parallel with circuit SL, winding 15 of transformer T1 being connected to the input terminals of rectifier 26 whose output terminals are connected to winding 23. Relay RP2 is energized over a simple circuit including reverse polar contact 32 of relay RP.

Circuit SL of Fig. 3 normally extends from top contact of winding 10 of transformer T1 through series condenser CS, back contact 35 of relay RP2, winding 33 of transformer T2, conductor 18, wheels 15, track rails, wheels 14, and conductor 16 to the lower terminal of winding 10. A condenser CP is connected across the circuit and the two condensers CS and CP serve to series-parallel tune the circuit for the communication current. Such a series-parallel tuned circuit SL supplies current to the rails of a value equal to that supplied by either of the series tuned circuits of Fig. 1 or the parallel tuned circuit of Fig. 2 for a given full load condition of the transmitting apparatus, gives a little higher voltage across the wheel-to-rail contact and permits a very much simpler construction for the output transformer T1 because its secondary current 19 can be relatively small.

When push button PBO of Fig. 3 is operated to close contact 13 to energize relays DR4 and DR4 in series and condition the transmitting apparatus for supplying calling current, the energization of winding 28 by current supplied from winding 10 of transformer T1 through rectifier 26 is insufficient to overcome the energization of winding 29 by the current supplied from transformer T3 through rectifier 27 if no high resistance wheel-to-rail contact exists. Relay RP4 is thus held at its normal right-hand position with the result that circuit SL is retained in its normal condition for supplying the calling current to the rails. Assuming that a high resistance wheel-to-rail contact develops at either wheel 14 or 15, energization of winding 29 is decreased and is overcome by the energization of winding 28, and relay RP4 is operated to its left-hand position to close reverse polar contact 32 and cause relay RP3 to be picked up. The picking up of relay RP3 to open back contact 35 and close front contact 36 removes the short circuit from load reactance LS and connects low power factor inductance L across conductors 16 and 18, winding 33 of transformer T2 being in the connection to conductor 16. Inductance L and reactance LS have such values that the temporary circuit they form with condensers CS and CP places a full load condition on the transmitting apparatus and develops a high voltage across inductance L in substantially the same manner as shown in Fig. 1, and this high voltage is applied to conductors 16 and 18 for breaking down the resistance of the wheel-to-rail contact. When such high resistance breaks down current again flows in winding 33 of transformer T2 and winding 28 is reenergized causing relay RP3 to be operated to its normal right-hand position with the result that the sending loop circuit SL is switched to its normal condition.

In the event push button PBI is operated to energize relay DR4 and condition the transmitting apparatus to supply carrier telephone current, this carrier telephone current is supplied to the sending loop circuit SL in its normal condition. It is to be pointed out that relay DR6 of Fig. 3 is energized by a circuit which passes from terminal B through winding of relay DR4, normal polar contact 31 of relay RP4 and contact 9 of push button PBI to terminal C. Assuming that during the transmission of telephone current a high wheel-to-rail contact develops, then relay RP4 is operated to its left-hand position to pick up relay RP2 and switch the sending circuit SL to the temporary circuit condition including inductance L and load reactance LS. Also a circuit is now formed from transformer T1 through windings of relays DR4 and DR4 in series, reverse polar contact 31—32 of relay RP4, and contact 9 of push button PBI to terminal C, and both relays DR4 and DR4 are energized so that the transmitting apparatus is condition to supply calling current with the result that a high voltage is developed across inductance L for breaking down the resistance of the wheel-to-rail contact. When the high resistance of the wheel-to-rail contact breaks down, then relay RP4 is restored to its normal position deenergizing relay RP2 and reestablishing the normal condition of circuit SL. Also, relay DR4 is now deenergized and released so that the oscillator delivers the original carrier current used for telephone purposes. It is to be seen therefore that the apparatus of Fig. 3 acts and operates for the circuit SL to a condition for developing a high break-down voltage and conditions the transmitting apparatus for supplying calling current whenever a high wheel-to-rail contact occurs. Although I have herein shown and described only three forms of transmitting apparatus for railway train communication systems embodying
my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a train carried transmitting apparatus for a railway train communication system using a sending loop circuit interposed between the transmitting apparatus and two spaced wheels of the train to supply communication current to the rails, the combination comprising, an inductance, a load reactance, and switching means operable at times to connect said inductance and load reactance to said sending loop circuit to develop a voltage for breaking down the resistance of a wheel-to-rail contact of said sending circuit.

2. In a train carried transmitting apparatus for a railway train communication system using a sending loop circuit interposed between the transmitting apparatus and two spaced wheels of the train to supply communication current to the rails, the combination comprising, a low power factor inductance, a load reactance, a relay, circuit means including a contact of said relay to connect said inductance and load reactance to said sending loop circuit to develop a voltage to break down the resistance of a wheel-to-rail contact of said sending circuit, and means to control said relay.

3. In a train carried transmitting apparatus for a railway train communication system using a sending loop circuit interposed between the transmitting apparatus and two spaced pairs of wheels of the train to supply communication current to the rails, the combination comprising, condenser means connected to the sending loop circuit to tune the circuit to resonance at a given frequency, an inductance, a load reactance, circuit means including a contact to electrically associate said inductance and load reactance with said condenser means to develop a high voltage in said sending loop circuit to break down the resistance of the wheel-to-rail contact at either of said spaced pairs of wheels when current of said given frequency is supplied by the transmitting apparatus, and means to control the contact of said circuit means and to condition the transmitting apparatus to supply current of said given frequency.

4. In a train carried transmitting apparatus for a railway train communication system using a sending loop circuit interposed between the transmitting apparatus and two spaced pairs of wheels of the train to supply communication current to the rails, the combination comprising, reactance means connected to said sending loop circuit to tune the circuit to resonance at a preselected frequency, an inductance, a load reactance, and slow acting switching means operable to simultaneously and temporarily connect said inductance and load reactance to said sending loop circuit and to condition the transmitting apparatus to supply current of said preselected frequency for developing a high voltage across the wheel-to-rail contacts of said sending loop circuit to break down the resistance of such wheel-to-rail contacts.

5. In a train carried transmitting apparatus for a railway train communication system, the combination comprising, a sending loop circuit including a winding coupled to the transmitting apparatus and two conductors connected one to each of two spaced pairs of wheels of the train to cause communication current supplied by the transmitting apparatus to flow through the rails between such spaced wheels, an inductance, a load reactance, and switching means including circuit controlling contacts to connect said inductance and load reactance to said conductors to form across said winding a temporary circuit independent of said wheels and rails to create a voltage across said conductors for breaking down the resistance of a wheel-to-rail contact.

6. In a train carried transmitting apparatus for a railway train communication system, the combination comprising, a sending loop circuit interposed between the transmitting apparatus and two spaced pairs of wheels of the train to include a given length of the rails in such loop circuit, capacitance means interposed in the sending loop circuit to tune the circuit to resonance at a given frequency, said sending loop circuit formed to provide a circuit impedance that places a full load on said transmitting apparatus, reactance means, and switching means and at times connecting said reactance means to said sending loop circuit to restore said full load condition and simultaneously develop a high voltage when there is a high resistance wheel-to-rail contact in said sending circuit.

7. In a train carried transmitting apparatus for a railway train communication system, the combination comprising, a sending loop circuit including a winding coupled to the transmitting apparatus and conductors connected to spaced pairs of wheels of the train to cause communication current supplied by the transmitting apparatus to flow through the rails between such spaced pairs of wheels, said loop circuit tuned and formed for an impedance which places a substantially full load on the transmitting apparatus, an inductance, a load reactance, switching means including circuit controlling contacts to connect said inductance and load reactance to said winding to form a temporary circuit in multiple with the path of the loop circuit through said wheels and track rails and which temporary circuit has a tuning and impedance substantially equal to that of said loop circuit to develop a voltage across the loop circuit path through the wheels and rails forming a voltage for breaking down the resistance at a wheel-to-rail contact of the loop circuit, and means to control said switching means.

8. In a train carried transmitting apparatus for a railway train communication system, the combination comprising, two conductors to connect the output terminals of the transmitting apparatus to two spaced pairs of wheels of the train to form a sending loop circuit including a given length of track rails, condenser means connected to said conductors to tune said sending loop circuit, an inductance, a reactance, a relay, circuit means including contacts of said relay to connect said inductance and reactance to said conductor means to form across the output terminals of the transmitting apparatus a temporary circuit having an impedance and tuning substantially equal to those of said loop circuit for applying a high voltage across said conductors of said loop circuit when current of said given frequency is supplied by the transmitting apparatus and manually operable means to control said relay and to condition the transmitting apparatus to supply current of said given frequency.

9. In a train carried transmitting apparatus for a railway train communication systems, the combination comprising, a sending loop circuit including a winding coupled to the transmitting apparatus and two conductors connected one to each of two spaced pairs of wheels of the train...
to cause communication current to flow through the rails between said spaced wheels, a condenser connected to said loop circuit to tune said loop circuit to resonance at a given frequency, an inductance, a reac-tance, a relay, circuit means including a contact of said relay to connect said inductance and reac-tance to said winding to form a temporary circuit, having an impedance substantially equal to that of said loop circuit to receive current from the transmitting apparatus to create across said conductors a high voltage for breaking down the wheel-to-rail contact re-sistance of the sending loop circuit, and means to control said relay and to condition said transmitting apparatus to supply current of said given frequency.

10. In train carried transmitting apparatus for supplying either a carrier telephone current or a calling current having a preselected frequency of the telephone current, the combination comprising: a sending loop circuit including a winding coupled to the transmitting apparatus and two conductors connected one to each of two spaced pairs of wheels of the train to cause current from the transmitting apparatus to flow in the rails between such spaced pairs of wheels, an inductance, a load reac-tance, switching means including circuit controlling contacts to connect said inductance and load reac-tance to said winding to form a temporary circuit in multiple with the wheels and rails of the sending loop circuit and said temporary circuit tuned to resonance at the frequency of the calling current to develop a voltage across said conductors for breaking down the resistance to a wheel-to-rail contact of the sending loop circuit, and manually operable means to control said switching means and to condition the transmitting apparatus to supply calling current.

11. In train carried transmitting apparatus for supplying either a carrier telephone current or a calling current having a preselected frequency of the telephone current, the combination comprising: a sending loop circuit including a winding coupled to the transmitting apparatus and two conductors connected one to each of two spaced pairs of wheels of the train, a condenser interposed in one of said conductors to series tune the loop circuit for said telephone current, an inductance, a load reac-tance, a slow pick-up relay provided with a back contact to connect said load reac-tance across said conductors and to connect said load reac-tance across said winding to form with said condenser a temporary circuit series-parallel tuned to resonance at said preselected frequency, and manually operable means to condition the transmitting apparatus to supply calling current and to energize said relay to develop by said temporary circuit during the slow pick-up period of said relay a voltage across said conductors to break down the resistance of the wheel-to-rail contact at said wheels.

12. In train carried transmitting apparatus for supplying either a carrier telephone current or a calling current having a preselected frequency of the telephone current, the combination comprising: a sending loop circuit including a winding coupled to the transmitting apparatus and two conductors connected one to each of two spaced pairs of wheels of the train, a condenser connected across said conductors to parallel tune the loop circuit to low impedance for said telephone current, an inductance, a reac-tance element interposed in one of said conductors, a slow pick-up relay provided with a back contact to connect said inductance across said conductors and a front contact to short circuit said reaction ele-ment to form with said condenser a special circuit across said winding, said special circuit of low impedance and tuned to resonance at said preselected frequency to develop a voltage across said inductance for breaking down the resistance of a wheel-to-rail contact at said spaced wheels, and manually operable means to simultaneously condition the transmitting apparatus to supply calling current and to energize said slow pick-up relay.

13. In train carried transmitting apparatus for supplying a carrier telephone current, the combination comprising, a sending loop circuit including two conductors connected one between one output terminal of the transmitting apparatus and a first pair of wheels of the train and the other conductor connected between the other output terminal of the transmitting apparatus and a second pair of wheels of the train, a first reac-tance element interposed in series in said one conductor, and a second reac-tance element con-nected across said two conductors to cooperate with said first reac-tance element to series-parallel tune said sending loop circuit for said carrier telephone current.

14. In train carried transmitting apparatus for supplying a carrier telephone current, the combination comprising, a winding coupled to said transmitting apparatus to receive such telephone current, two conductors connected one between one terminal of said winding and a first pair of wheels of the train and the other between the other terminal of said winding and a second pair of wheels of the train to form a sending loop circuit completed through the rails between said first and second pairs of wheels, a first condenser interposed in said one conductor, and a second condenser connected across said two conductors to cooperate with said first condenser to series-parallel tune said sending loop circuit to low impedance for said telephone current.

15. In train carried transmitting apparatus for supplying either a carrier telephone current or a calling current having a preselected frequency of such telephone current, the combination comprising, a picking-up transformer having a first winding connected to said transmitting apparatus to receive said telephone and calling currents, a second transformer; a sending loop circuit including a second winding of said first transformer, a first winding of said second transformer, two conduc-tors connected one to each of the two spaced pairs of the wheels of the train and the rails between said spaced pairs of wheels; an inductance, a load reac-tance, a relay jointly energized by energy re-ceived from the second winding of said first transformer and from a second winding of said second transformer, circuit means controlled by said relay to connect said inductance and said load reac-tance to said sending loop circuit to develop a voltage for breaking down the resistance of a wheel-to-rail contact of either one of said pairs of wheels when said calling current is supplied by the transmitting apparatus, and other circuit means controlled by said relay to condition the transmitting apparatus to supply said calling cur-rent.