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R. S. OHL

TELEPHONE SUBSTATION CIRCUITS

Filed June 24, 1926

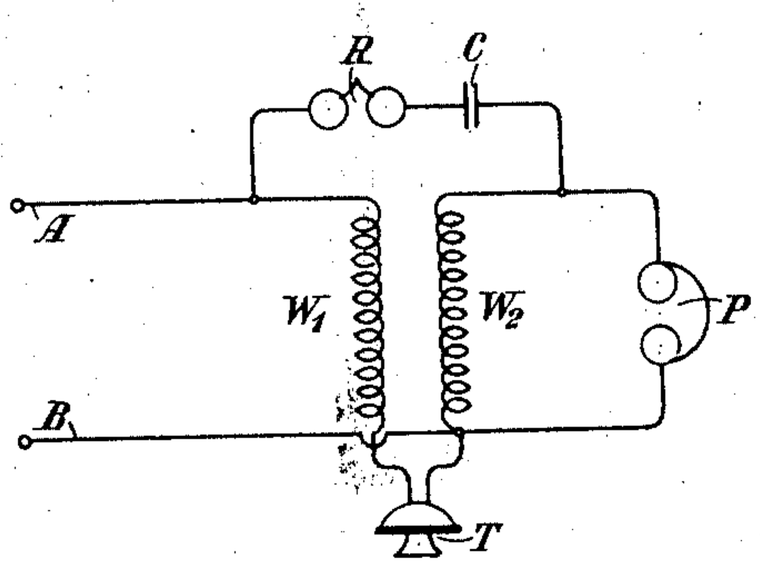

Fig. 1

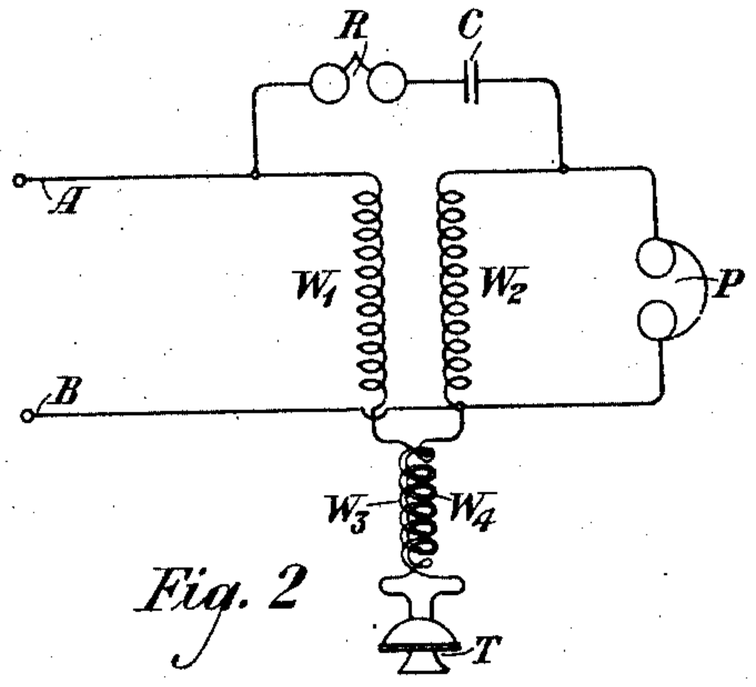

Fig. 2

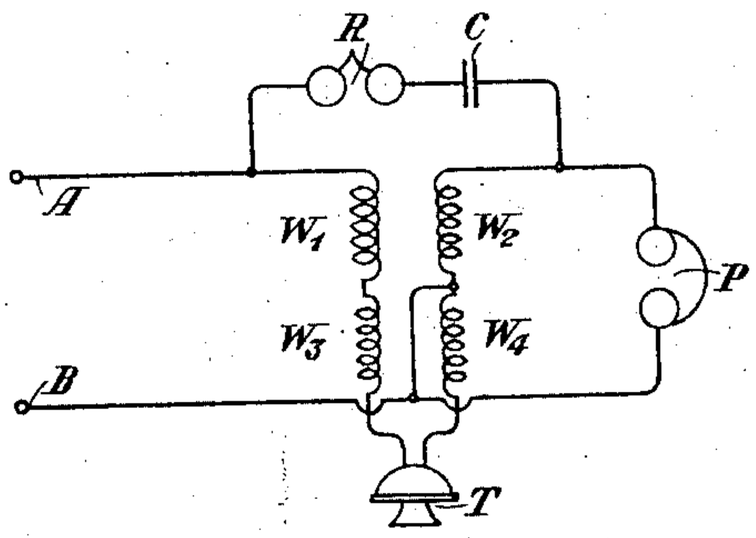

Fig. 3

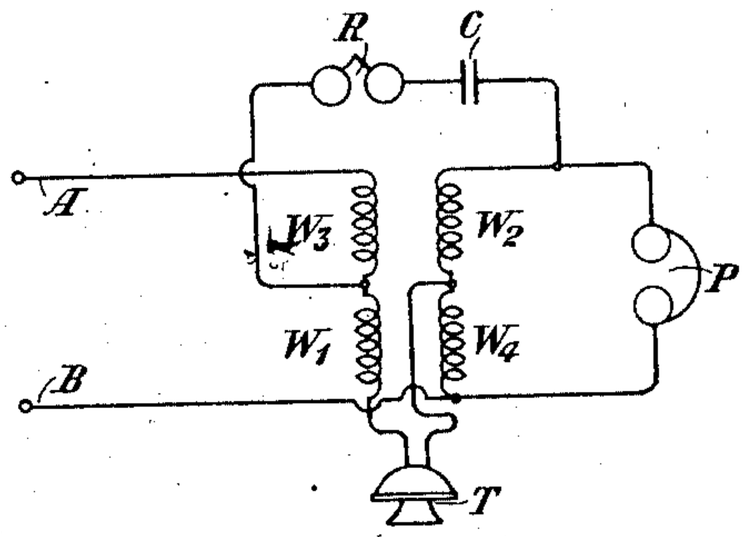

Fig. 4

INVENTOR
R. S. Ohl

BY

ATTORNEY

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UNITED STATES PATENT OFFICE.

RUSSELL S. OHL, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE SUBSTATION CIRCUITS.

Application filed June 24, 1926. Serial No. 118,349.

This invention relates to telephone substation circuits, and particularly to arrangements for eliminating the detrimental effects on telephone substation circuits caused by high frequency currents.

A subscriber's substation circuit may occasionally be so located that it is exposed to a strong high frequency electromagnetic field. Due to this exposure, high frequency currents may flow through various portions of the substation circuit. Such currents may result either from induced high frequency electromotive forces established around any mesh of the electrical network, or from capacity unbalances to ground in various portions of such electrical network. The flow of high frequency current through the microphone of the substation circuit may lead to interference between the high frequency field and the voice frequencies which normally operate the substation circuit. This interference is caused by the microphone acting as a detector by virtue of the rectifying properties of its carbon button. When these high frequency currents become modulated by speech originating at a radio transmitting station, the speech will often be heard at the telephone receiver of the substation circuit, the speech very often being sufficient in volume to impair the normal communicative qualities of the telephone system.

However, if the high frequency radio waves are initially unmodulated by speech, these high frequencies may nevertheless become modulated by speech transmitted over the telephone lines, when such speech impinges upon the diaphragm of the transmitter of the substation circuit. In this case the telephone conversation can be picked up by radio receivers which are tuned to receive the radio frequency waves, these radio frequency waves being re-radiated, modulated by the telephone conversation. Consequently those operating the radio receivers hear the telephone conversation.

This same effect has been experienced where the subscriber's loop was employed as the radio antenna system. When the telephone set was connected to a radio receiver, perhaps through a condenser, the subscriber's loop and the telephone set thus acting as a substitute for the usual receiving antenna system, high frequency currents set up in the subscriber's circuit passed through the microphone. When the receiver was removed from the switch hook to permit a telephone conversation to take place, speech passing through the telephone set was superimposed on the high frequency energy, whereupon it was demodulated at the radio receivers tuned to the high frequency energy, so that the audience at the radio receivers was again able to hear the telephone conversation.

Accordingly, it is one of the objects of this invention to eliminate the detrimental effects produced by electro-magnetic waves superimposed on a telephone substation circuit.

Another of the objects of this invention is to alter the well-known substation circuit so as to render it substantially free from the detrimental effects of high frequency currents, without causing any substantial change in the voice frequency transmission characteristics of the substation circuit.

And it is a further object of this invention to prevent the flow of high frequency currents in a substation circuit, or in a portion thereof, which circuit may be connected to a telephone line exposed to a high frequency electromagnetic field.

While the invention will be pointed out with particularity in the appended claims, the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing, in which Figure 1 shows one form of substation circuit, Fig. 2 shows an arrangement for substantially preventing the effects mentioned hereinabove, and Figs. 3 and 4 show particular ways in which the substation circuit may be modified so as to eliminate these effects.

Referring to Fig. 1 of the drawing, conductors A and B represent conductors connected to a telephone line which may be assumed to be connected to another substation circuit (not shown) through one or more central offices. A ringer R and a condenser C are in series relationship with each other at the substation. It will be understood, however, that the proper ringing current for operating the ringer R may be impressed upon conductors A and B at the central office. This ringing current path may then be traced over conductor A, the ringer R, the condenser C, the inductance W_2 and the

conductor B. A receiver P is associated with the substation circuit so that speech transmitted over the telephone conductors A and B originating at a distant substation circuit may be received by the receiver P. Speech may be transmitted over the conductors A and B to a distant substation circuit by means of the transmitter T. The local transmitting circuit includes the conductor A, the winding W_1, the transmitter T and the conductor B. The local receiving circuit includes the winding W_2 and the receiver P. Signals coming in over the conductors A and B are first impressed on the winding W_1. By virtue of the inductive relation existing between windings W_2 and W_1, these signals are heard at the receiver P.

When the conductors of the telephone line are exposed to a high frequency electromagnetic field, high frequency currents may flow in the telephone line, these currents passing over the conductors A and B. These high frequency currents then pass through the winding W_1 and the transmitter T. As the high frequency energy passes through the transmitter T, it becomes rectified by virtue of the rectifying properties of the carbon button of the transmitter T. The rectified current is impressed upon the winding W_1, whereupon it is received at the receiver P because of the mutually inductive effect between windings W_2 and W_1.

This invention is directed to provide arrangements for substantially suppressing high frequency energy so that this high frequency energy is not detected at the substation circuit, and so that the effect thereof is substantially negligible at the receiver P of the substation circuit. This high frequency energy may be suppressed in a number of ways, one of which involves the introduction of suitable inductances in the leads connected to the transmitter T, these inductances being of magnitudes sufficient to substantially supress the high frequency current which would otherwise flow through the transmitter T. The transmitter itself is a low empedance device and offers practically no resistance to the flow of this high frequency current. These inductances, however, greatly increase the impedance in series with the transmitter T so that no appreciable high frequency current can pass therethrough. Moreover, these inductances are, preferably, of low distributed capacity, for a high distributed capacity would normally decrease the impedance in series with the carbon button of the transmitter T.

In Fig. 2 there are shown two windings W_3 and W_4, each of suitable inductance, connected between the windings W_1 and W_2 respectively, and the terminals of the transmitter T. The winding W_3 is in series with the winding W_1, and the winding W_4 is in series with the winding W_2. Moreover, these inductances may be located a considerable distance from the box, or other container, in which the windings W_1 and W_2 are housed.

Fig. 3 shows the windings W_3 and W_4 connected in a manner similar to that shown in Fig. 2; yet in this arrangement, the windings W_3 and W_4 are intended to be included along with windings W_1 and W_2 in the normal substation circuit. The box which houses windings W_1 and W_2 also houses windings W_3 and W_4.

In Fig. 4 there is a slight modification of the arrangement shown in Fig. 3. In this figure, the ringing circuit includes the conductor A, the winding W_3, the ringer R, the condenser C, windings W_2 and W_4 and conductor B. The transmitting circuit includes the conductor A, the winding W_3, the winding W_1, the transmitter T, the winding W_4 and the conductor B. The receiving circuit includes the windings W_2 and W_4 and the receiver P.

While the invention has been shown in certain particular embodiments for the purpose of illustration, it is to be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. A system for eliminating the effect of high frequency currents induced in a telephone substation circuit, comprising means within said telephone substation circuit and in series with its transmitter for substantially suppressing these high frequency currents by reactances of predetermined magnitude.

2. In a telephone substation circuit comprising a transmitter, a receiver and a ringer, the combination of reactance means in series with the transmitter so as to prevent its action as a rectifier of high frequency currents flowing in the substation circuit.

3. In a telephone substation circuit comprising a transmitter, a receiver and a ringer, the combination of a telephone line, and means including choke coils in series with said transmitter to prevent its action as a rectifier of high frequency currents flowing in said telephone line.

4. In a telephone substation circuit comprising a transmitter, a receiver and a ringer, the combination of means in series with said transmitter interposing high impedance to radio frequencies for substantially suppressing induced modulated and unmodulated radio frequency energy from said substation circuit.

5. In a telephone substation circuit comprising a transmitter, a receiver and a ringer, the combination of a telephone line, and inductance means in series with said transmitter for substantially preventing the re-

ception of a conversation taking place over said telephone line through any high frequency transmission system exposed to said telephone line.

6. In a telephone substation circuit, the combination of a telephone line, two mutually reactive inductances, a condenser and a ringer in series relationship with said telephone line, a transmitter connected to said telephone line through one of said inductances, a receiver connected to said telephone line through the other of said inductances, and choking means also serially connected to said transmitter for substantially preventing the modulation of high frequency currents by the normal currents transmitted over said telephone line.

7. In a telephone substation circuit, the combinatin of a telephone line, two mutually reactive inductances, a condenser and a ringer in series relationship with said telephone line, a transmitter connected to said telephone line through one of said inductances, a receiver connected to said telephone line through the other of said inductances, and additional reactance means in series with said transmitter to prevent its action as a rectifier of radio frequency currents superimposed on said telephone line.

8. In a telephone substation circuit, the combination of a telephone line, two mutually reactive inductances, a condenser and a ringer in series relationship with said telephone line, a transmitter connected to said telephone line through one of said inductances, a receiver connected to said telephone line through the other of said inductances, and radio frequency chokes also in series with said transmitter for substantially preventing induced radio frequency energy from flowing therethrough.

9. In a telephone substation circuit, the combination of a telephone line, two mutually reactive inductances, a condenser and a ringer in series relationship with said telephone line, a transmitter connected to said telephone line through one of said inductances, a receiver connected to said telephone line through the other of said inductances, and choking means also in series with said transmitter and having a definite inductive value for substantially preventing the transmission of a conversation over said telephone line through any high frequency transmitting array exposed to said telephone line.

In testimony whereof, I have signed my name to this specification this 23rd day of June, 1926.

RUSSELL S. OHL.