April 22, 1924. 1,491,340

A. M. CURTIS

SYSTEM FOR SIGNALING

Filed Aug. 13, 1919

Fig. 1

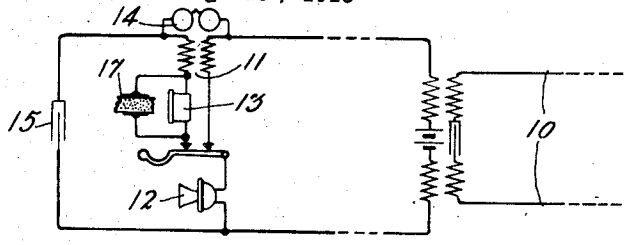


Fig. 2

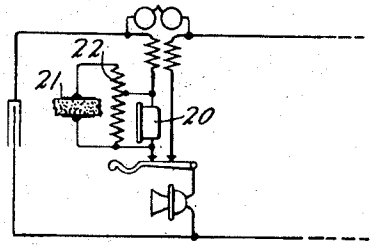


Fig. 3

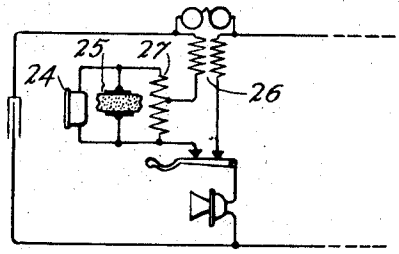


Fig. 4

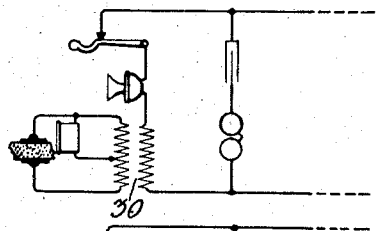


Fig. 5

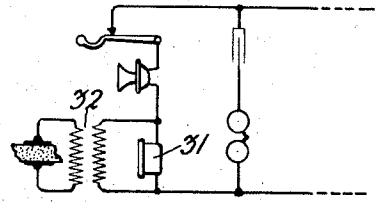
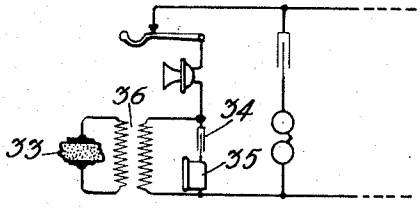


Fig. 6



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Patented Apr. 22, 1924. 1,491,340

UNITED STATES PATENT OFFICE.

AUSTEN M. CURTIS, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SYSTEM FOR SIGNALING.

Application filed August 13, 1919. Serial No. 317,262.

To all whom it may concern:

Be it known that I, AUSTEN M. CURTIS, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Systems for Signaling, of which the following is a full, clear, concise, and exact description.

This invention relates to circuit arrangements for signaling systems wherein the signals may be either transmitted from or received at the same station. In its more specific aspects, this invention is embodied in a subscriber's telephone station hereinafter termed a substation.

An object of this invention is to protect the receiving apparatus from interference by transmission energy originating at the same station.

The object of this invention is attained in its specific aspect by the association with the transmitting and the receiving apparatus of the substation of a device, the effective resistance of which depends upon the strength of the current or the voltage impressed thereon. Preferably, the resistance of this device should decrease with increase in applied voltage. If such a device of the preferred form is shunted around the receiving apparatus either conductively or through a transformer, it is evident that for relatively high voltages the resistance of the device may be such that it serves as a short-circuit for the receiving apparatus, while for relatively low voltages the resistance of the device may be sufficiently high with respect to the resistance of the receiving apparatus that practically all of the current passes through the receiver instead of the device. It is therefore apparent that if the signals coming in from the line to which the substation is connected are relatively weak compared to the strength of the signals originating at the substation circuit, the device may be so adjusted that it serves practically as a short-circuit for the locally generated currents while absorbing little or no energy of the weak signals coming in from the line. In the preferred form this device comprises a block or crystal of carborundum or some other similar substance such as a metallic sulphide, oxide, or silicide, that possesses the property that its resistance decreases very rapidly with increase of applied voltage.

Another distinct advantage arising from the use of such a device in shunt to the receiving apparatus is that practically none of the transmitted energy originating at the substation is absorbed by the receiving apparatus so that the transmission efficiency of the substation is considerably increased thereby. It has also been found that this negative resistance device serves to reduce the howling in a substation set to an intensity that is not objectionable, in case, as in a hand set, there is a tendency for the substation set to howl.

This invention will be better understood by reference to the following detail description taken in connection with the accompanying drawings, in which Fig. 1 shows the negative resistance device shunted directly across the terminals of the receiver by a subscriber's set; Fig. 2 shows the receiver shunted by the negative resistance device through an auto-transformer; Fig. 3 is a modification of Fig. 1; Fig. 4 shows the negative resistance device shunting a permanent magnet receiver; Fig. 5 shows the negative resistance device shunting an electromagnetic receiver; and Fig. 6 shows a negative resistance device shunting a permanent magnet receiver through a transformer.

Referring to Fig. 1, connected to the line 10 is a subscriber's set comprising a transformer 11, transmitter 12, receiver 13, ringer 14 and condenser 15. Shunted directly around the terminals of the receiver 13 is a negative resistance device 17 which may consist of a block or crystal of carborundum, the resistance of which decreases enormously with increase in applied voltage. The receiver 13 should preferably be so chosen that its impedance is such that the resistance of negative resistance device 17 for the locally generated signals is so low that the device serves practically as a short-circuit for the receiver. With such an arrangement signaling currents generated by transmitter 12 will not pass through the receiver 13 to any appreciable degree but will be short-circuited through the negative resistance 17. The negative resistance 17 therefore serves to make the subscriber's set anti-side-tone for the locally generated signals. However, the incoming signals from line 10 which will be impressed by transformer 11 on the receiver 13 will be so weak, compared to the signals generated by transmitter 12, that the effective resistance of device 17 will be many

times higher than its value for the strong locally generated signals, so that practically none of the energy received from line 10 will be absorbed by negative resistance 17. Since the negative resistance 17 serves as a substantial short-circuit for the receiver 13 while locally generated signals are being sent out to line 10, practically none of the transmission energy is absorbed by the receiver 13, thereby making the set much more efficient than subscriber's set of the usual type, wherein a large percentage of the outgoing energy is absorbed in the receiver.

In case the resistance of the carborundum for the locally generated signals is of such a value compared to the impedance of the receiver of a set that it permits a part of the transmitted energy to pass through the receiver when connected as shown in Fig. 1, the impedance of the negative resistance device for the locally generated signals may be lowered to the desired value by shunting the negative resistance device around the receiver through a transformer.

In Fig. 2 the receiver 20 is shunted by negative resistance device 21 through an autotransformer 22, the low side of which is connected to the receiver. This transformer serves to step down the effective resistance of the carborundum 21 to such a value for the locally generated signals that the carborundum serves as a short-circuit for the receiver during the transmission of energy to the outgoing line. For the weak incoming signals, however, the carborundum still has an effective resistance so high as to prevent any of the incoming energy from being absorbed therein.

Fig. 3 shows an arrangement that may be employed in case it is desired to use a receiver that has a high impedance compared to the transmitter of the set. As shown in this figure, the high impedance receiver 24 and the negative resistance device 25 are shown to be connected with the secondary of transformer 26 through an auto transformer 27, the high side of which is connected to the receiver. The operation of this circuit is similar to that above described. The negative resistance device 25 serves to short-circuit the receiver 24 during the transmission of energy to the outgoing line, while absorbing practically none of the energy received from the line.

Fig. 4 shows an arrangement which may be employed in connection with a permanent magnet receiver. In this arrangement all of the secondary winding of the transformer 30 of the subscriber's set is in shunt to the negative resistance device, while only a part of the secondary is in shunt to the receiver.

Fig. 5 illustrates an arrangement that may be employed in connection with an electromagnetic receiver and a transmitter of comparatively low resistance. The negative resistance in this arrangement is shown shunted around the receiver 31 by transformer 32.

Fig. 6 shows an arrangement in which a comparatively low resistance transmitter is employed and where the receiver is of the permanent magnet type. The negative resistance 33 is connected in shunt to condenser 34 and receiver 35 by means of a transformer 36.

Reference is made to my Patent No. 1,325,889, granted December 23, 1919, which relates broadly to the use of a negative resistance device in shunt to a telephone receiver.

It is to be understood that this invention is not limited to the circuit arrangements above described but that they may be variously modified without departing anywise from the spirit of this invention as defined by the appended claims.

What is claimed is:

1. An electric circuit comprising means for receiving signals, means associated therewith for transmitting signals, and a device having a variable coefficient of resistance so connected in circuit with said receiving means that an increase in the amplitude of transmitted signals produces less than a proportionate increase in the current in said receiving means.

2. An electric circuit comprising means for receiving signals, means associated therewith for transmitting signals, and a device having a negative coefficient of resistance in shunt to said receiving means for reducing side tone therein.

3. An electric circuit comprising means for receiving signals, means associated therewith for transmitting signals, and a block of carborundum in shunt to said receiving means for reducing side tone therein.

4. A telephone substation circuit comprising a transmitter, a receiver, and a device in circuit with said receiver having an impedance which is varied in response to an increase in transmitted currents to reduce the relative amount of current in said receiver.

5. A telephone substation circuit comprising a transmitter, a receiver, and a device having a negative coefficient of resistance in shunt to said receiver for reducing side tone therein.

6. A telephone substation circuit comprising a transmitter, a receiver, and a block of carborundum in shunt to said receiver for reducing side tone therein.

In witness whereof, I hereunto subscribe my name this 8th day of August A. D., 1919.

AUSTEN M. CURTIS.